WebSphere® Application Server, Version 5.1.1

Security

Note
Before using this information, be sure to read the general information under "Notices" on page 497.

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Chapter 1. Welcome to Security

IBM WebSphere Application Server Version 5 provides security infrastructure and mechanisms to protect sensitive J2EE resources and administrative resources and to address enterprise end-to-end security requirements on authentication, resource access control, data integrity, confidentiality, privacy, and secure interoperability. IBM WebSphere Application Server security is based on industry standards. Version 5 has an open architecture that processes secure connectivity and interoperability with Enterprise Information Systems including:

- DB2
- CICS
- MQ Series
- Lotus Domino
- IBM Directory

WebSphere Application Server also supports other security providers including:

- IBM Tivoli Access Manager (Policy Director)
- WebSEAL secure proxy server

Based on industry standards

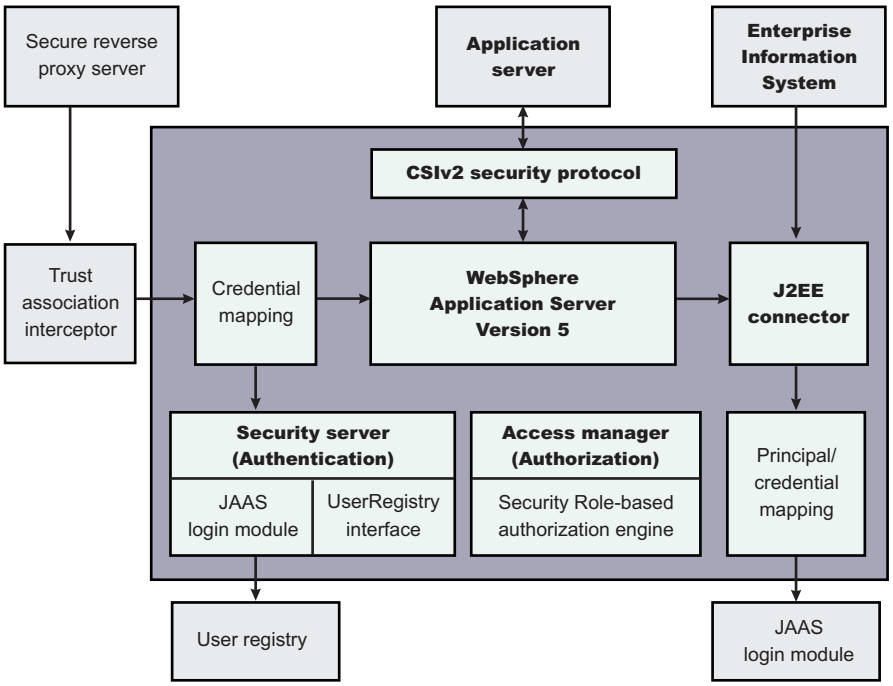
The product provides a unified, policy-based, and permission-based model for securing Web resources and enterprise JavaBeans according to J2EE specifications. Specifically Version 5 complies with J2EE specification Version 1.3 and has passed the J2EE Compatibility Test Suite. Product security is a layered architecture built on top of an operating system platform, a Java virtual machine (JVM), and Java 2 security. This security model employs a rich set of security technology including the:

- Java 2 security model, which provides policy-based, fine-grained, and permission-based access control to system resources.
- Common Secure Interoperability Version 2 (CSIv2) security protocol, in addition to the Secure Authentication Services (SAS) security protocol. Both protocols are supported by prior product releases. CSIv2 is an integral part of the J2EE 1.3 Specification and is essential for interoperability among application servers from different vendors and with enterprise CORBA services.
- Java Authentication and Authorization Service (JAAS) programming model for Java applications, servlets, and enterprise beans.
- J2EE Connector architecture for plugging in resource adapters that support access to Enterprise Information Systems.

The standard security model and interface supported include Java Secure Socket Extension (JSSE) and Java Cryptographic Extension (JCE) provider for secure socket communication, message encryption, and data encryption.

Open architecture paradigm

An application server plays an integral part in the multiple-tier enterprise computing framework. IBM WebSphere Application Server adopts the open architecture paradigm and provides many plug-in points to integrate with enterprise software components. Plug-in points are based on standard J2EE specifications wherever applicable.



The light blue shaded background indicates the boundary between the product and other business application components.

The product provides Simple WebSphere Authentication Mechanism (SWAM) and Lightweight Third Party Authentication (LTPA) mechanisms. Exactly one may be configured to be the active authentication mechanism for the security domain of the product. Exactly one user registry implementation may be configured to be the active user registry of the product security domain. The product provides the following user registry implementations: UNIX, Windows, and AS/400 LocalOS and LDAP. It also provides file-based and Java database connectivity (JDBC)-based user registry reference implementations. It supports a flexible combination of authentication mechanisms and user registries. SWAM is simple to configure and is useful for a single application server environment. LTPA generates a security token for authenticated users, which can propagate to downstream servers and is suitable for a distributed environment with multiple application servers. It is possible to use SWAM in a distributed environment if identity assertion is enabled. Note that identity assertion feature is available only on the CSIv2 security protocol.

The LTPA authentication mechanism is designed for distributed security. Downstream servers can validate the security token. It also supports setting up a trust association relationship with reverse secure proxy servers and single signon (SSO), which will be discussed later. Besides the combination of LTPA and LDAP or Custom user registry interface, Version 5 supports LTPA with a LocalOS user registry interface. The new configuration is particularly useful for a single node with multiple application servers. It can function in a distributed environment if the local OS user registry implementation is a centralized user registry (such as Windows Domain Controller) or can be maintained in a consistent state on multiple nodes.

The product supports the J2EE Connector architecture and offers container-managed authentication. It provides a default J2C principal and credential mapping module that maps any authenticated user credential to a

password credential for the specified Enterprise Information Systems (EIS) security domain. The mapping module is a special JAAS login module designed according to the Java 2 Connector and JAAS specifications. Other mapping login modules can be plugged in.

Note: WebSphere Application Server Version 5.1 does not support Windows NT.

Backward compatibility

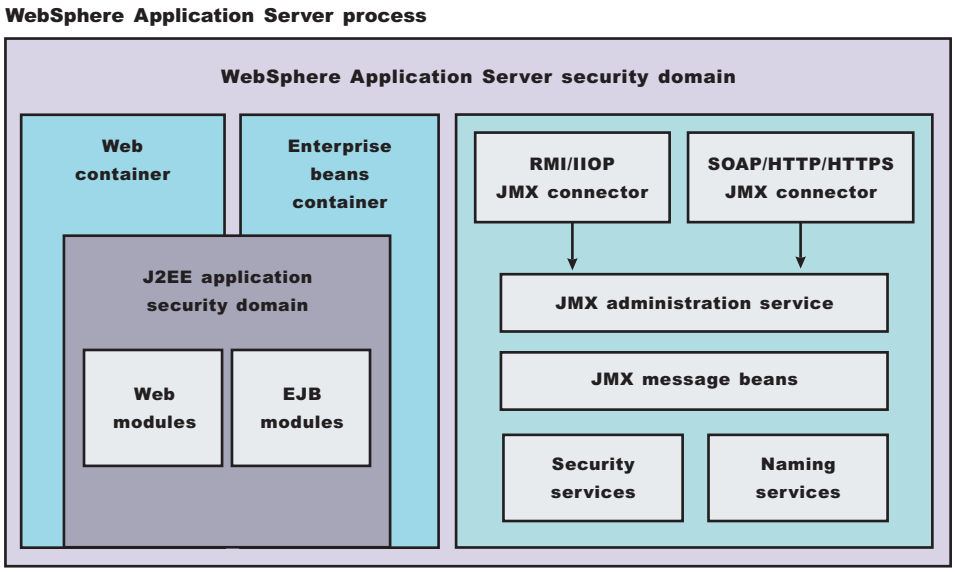
While adding new security functions and moving towards new industry standards, this version maintains backward compatibility with the 4.0.x and 3.5.x releases. Applications created in the Version 4.x development environment can deploy in Version 5. When Java 2 Security is enforced in Version 5, give special consideration to Version 4.0.x applications because Version 4.0 applications might not be Java 2 security compliant. Refer to the Security migration section for steps to port Version 4.0.x to Version 5. See also the Security section of New in this release.

Security for J2EE resources is provided by Web containers and EJB containers

Each container provides two kinds of security: *declarative security* and *programmatic security*. In declarative security, the security structure of an application, including data integrity and confidentiality, authentication requirements, security roles, and access control, is expressed in a form external to the application. In particular the deployment descriptor is the primary vehicle for declarative security in the J2EE platform. The product maintains a J2EE security policy, including information derived from the deployment descriptor and specified by deployers and administrators in a set of XML descriptor files. At run time, the container uses the security policy defined in the XML descriptor files to enforce data constraints and access control. When declarative security alone is not sufficient to express the security model of an application, the application code can use programmatic security to make access decisions. The API for programmatic security consists of two methods of the EJB EJBContext interface (`isCallerInRole`, `getCallerPrincipal`) and two methods of the servlet HttpServletrequest interface (`isUserInRole`, `getUserPrincipal`).

From a security perspective, every application server process consists of a Web container, an EJB container, and the administrative subsystem. There are many other components that constitute a server process, which are not discussed here. Remote interfaces to the administrative subsystem, including the Administrative Service interface through JMX connectors, the user registry interface, and the naming interface are protected by extended security role-based access control.

Java 2 security:The product supports the Java 2 security model. All the system code, including the administrative subsystem, the Web container, and the EJB container code, are running in the product security domain. The system code, shown in the WebSphere Application Server security domain box in the following diagram, is granted AllPermission and can access all system resources. Application code running in the application security domain, which by default is granted with permissions according to J2EE specifications, only can access a restricted set of system resources. The product run-time classes are protected by the product class loader and are kept invisible to application code.



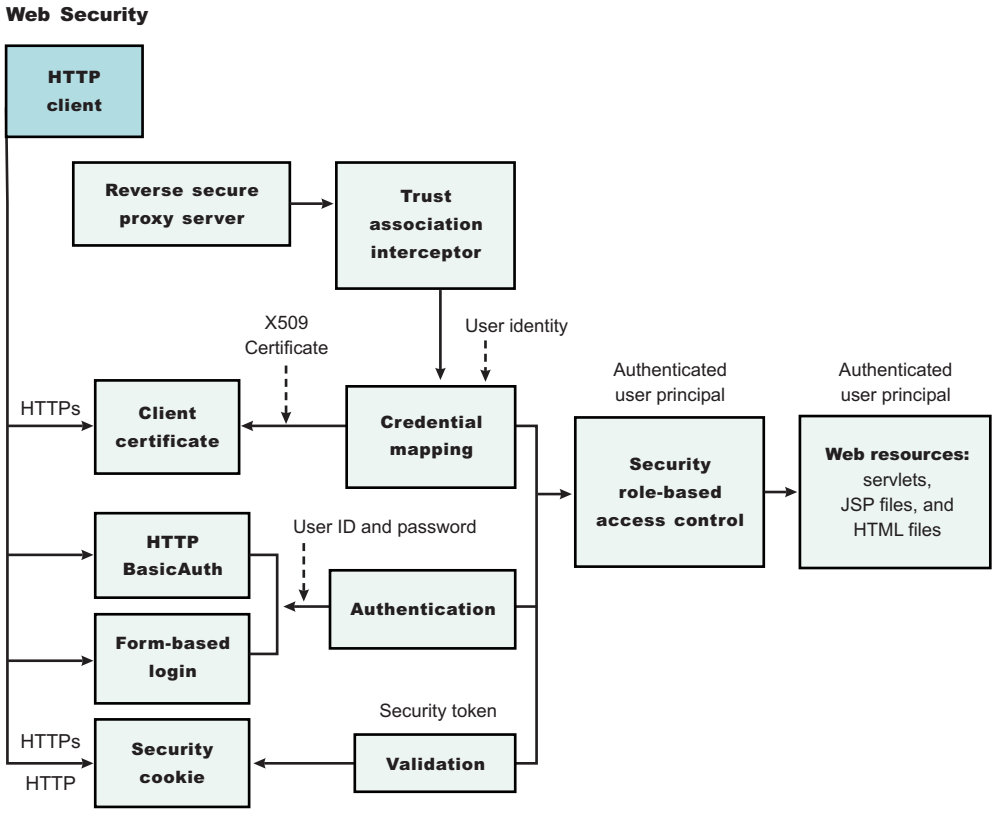
Security services consist of an authentication mechanism, a user registry, and an access control manager. All of the application server processes, by default, share a common security configuration, which is defined in a cell-level security XML document. The security configuration determines whether product security is enforced, whether Java 2 security is enforced, the authentication mechanism and user registry configuration, security protocol configurations, JAAS login configurations, and Secure Sockets Layer configurations. Applications can have their own unique security requirements. Each application server process can create a per server security configuration to address its own security requirement. Not all security configurations can be modified at the application server level. That can be modified at application server level include whether application security should be enforced, whether Java 2 security should be enforced, and security protocol configurations. The administrative subsystem security configuration is always determined by the cell level security document. The Web container and EJB container security configuration are determined by the optional per server level security document, which has precedence over the cell-level security document.

Security configuration, both at the cell level and at the application server level, are managed either by the Web-based administrative console application or by the WSADMIN scripting application.

Web security

When a security policy is specified for a Web resource and IBM WebSphere Application Server security is enforced, the Web container performs access control when the resource is requested by a Web client. The Web container challenges the Web client for authentication data if none is present according to the specified authentication method, ensure the data constraints are met, and determine whether the authenticated user has the required security role. The product supports the following login methods: HTTP basic authentication, Hypertext Transfer Protocol with Secure Sockets Layer (HTTPS) client authentication, and form-based Login. Mapping a client certificate to a product security credential uses the UserRegistry implementation to perform the mapping. The LDAP UserRegistry supports the mapping function while LocalOS UserRegistry does not.

When the LTPA authentication mechanism is configured and single signon (SSO) is enabled, an authenticated client is issued a security cookie, which can represent the user within the specified security domain. It is recommended that you use Secure Sockets Layer (SSL) to protect the security cookie from being intercepted and replayed. When a trust association is configured, the product can map an authenticated user identity to security credentials based on the trust relationship established with the secure reverse proxy server.



The Web security collaborator enforces role-based access control by using an access manager implementation. An access manager makes authorization decisions based on the security policy derived from the deployment descriptor. An authenticated user principal can access the requested Servlet or JSP file if it has one of the required security roles. Servlets and JSP files can use the HttpServletRequest methods: isUserInRole and getUserPrincipal. As an example, the administrative console uses the isUserInRole method to determine the proper set of administrative functionality to expose to a user principal.

EJB security

When security is enabled, the EJB container enforces access control on EJB method invocation. The authentication takes place regardless of whether a method permission is defined for the specific EJB method.

A Java application client can provide the authentication data in several ways. Using the `sas.client.props` file, a Java client can specify whether to use a user ID and password to authenticate or to use an SSL client certificate to authenticate. The client certificate is stored in the key file or in the hardware cryptographic card, as defined in a `sas.client.props` file. The user ID and password can be optionally

defined in the sas.client.props file. At run time, the Java client can either perform a programmatic login or perform a *lazy authentication*. In lazy authentication when the Java client is accessing a protected enterprise bean for the first time the security run time tries to obtain the required authentication data. Depending on the configuration setting in sas.client.props file the security runtime either looks up the authentication data from this file or prompts the user. Alternatively, a Java client can use programmatic login. The product supports the JAAS programming model and the JAAS login (LoginContext) is the recommended way of programmatic login. The login_helper request_login helper function is deprecated in Version 5. Java clients programmed to the login_helper APT can run in this version.

The EJB security collaborator enforces role-based access control by using an access manager implementation.

An access manager makes authorization decisions based on the security policy derived from the deployment descriptor. An authenticated user principal can access the requested EJB method if it has one of the required security roles. EJB code can use the EJBContext methods isCallerInRole and getCallerPrincipal. EJB code also can use the JAAS programming model to perform JAAS login and WSSubject doAs and doAsPrivileged methods. The code in the doAs and doAsPrivileged PrivilegedAction block executes under the Subject identity. Otherwise, the EJB method executes under either the RunAs identity or the caller identity, depending on the RunAs configuration. The J2EE RunAs specification is at the enterprise bean level. When RunAs identity is specified, it applies to all bean methods. The method level IBM RunAs extension introduced in Version 4.0 is still supported in this version.

The EJB security collaborator enforces role-based access control by using an access manager implementation. An access manager makes authorization decisions based on the security policy derived from the deployment descriptor. An authenticated user principal can access the requested EJB method if it has one of the required security roles. EJB code can use the EJBContext methods isCallerInRole and getCallerPrincipal. EJB code also can use the JAAS programming model to perform JAAS login and WSSubject doAs and doAsPrivileged methods. The code in the doAs and doAsPrivileged PrivilegedAction block executes under the Subject identity. Otherwise, the EJB method executes under either the RunAs identity or the caller identity, depending on the RunAs configuration.

Federal Information Processing Standards-approved

Federal Information Processing Standards (FIPS) are standards and guidelines issued by the National Institute of Standards and Technology (NIST) for federal computer systems. FIPS are developed when there are compelling federal government requirements for standards, such as for security and interoperability, but acceptable industry standards or solutions do not exist.

WebSphere Application Server integrates cryptographic modules including Java Secure Socket Extension (JSSE) and Java Cryptography Extension (JCE), which have undergone FIPS 140-2 certification. Throughout the documentation and the product, the IBM JSSE and JCE modules that have undergone FIPS certification are referred to as IBMJSSEFIPS and IBMJCEFIPS, which distinguishes the FIPS modules from the IBM JSSE and IBM JCE modules.

The IBMJSSEFIPS module supports the FIPS-approved TLS cipher suites including:
- SHA

- DES
- TripleDES

The IBMJSSEFIPS module supports the following algorithms:
- RSA public key algorithm
- ANSI X9.31
- IBM Random Number Generator (Patent pending)

The IBMJCEFIPS module supports the following symmetric cipher suites:
- AES (FIPS 197)
- DES and TripleDES (FIPS 46-3)
- SHA1 Message Digest algorithm (FIPS 180-1)

The IBMJCEFIPS module supports the following algorithms:
- Digital Signature DSA and RSA algorithms (FIPS 186-2)
- ANSI X 9.31 (FIPS 186-2)
- IBM Random Number Generator

The IBMJSSEFIPS and IBMJCEFIPS cryptographic modules only contain the algorithms that are approved by FIPS, which form a proper subset of those in the IBM JSSE and IBM JCE modules.

Chapter 2. Securing applications and their environments

WebSphere Application Server supports the J2EE model for creating, assembling, securing, and deploying applications. This article provides a high-level description of what is involved in securing resources in a J2EE environment. Applications are often created, assembled and deployed in different phases and by different teams.

Consult the J2EE specifications for complete details.

1. Plan to secure your applications and environment. For more information, see "Planning to secure your environment" on page 10. Complete this step before you install the WebSphere Application Server.
2. Consider pre-installation and post-installation requirements. For more information, see "Implementing security considerations" on page 22. For example, during this step, you learn how to protect security configurations after you install the product.
3. Migrate your existing security systems. For more information, see "Migrating security configurations from previous releases" on page 26.
4. Develop secured applications. For more information, see "Developing secured applications" on page 38.
5. Assemble secured applications. For more information, see "Assembling secured applications" on page 110.

   Development tools, such as the Deployment Tool for Enterprise JavaBeans (EJBDeploy) and the Assembling applications with the Assembly Toolkit are used to assemble J2EE modules and to set the attributes in the deployment descriptors.

   Most of the steps in assembling J2EE applications involve deployment descriptors; deployment descriptors play a central role in application security in a J2EE environment.

   Application assemblers combine J2EE modules, resolve references between them, and create from them a single deployment unit, typically an Enterprise Archive (EAR) file. Component providers and application assemblers can be represented by the same person but do not have to be.
6. Deploy secured applications. For more information, see "Deploying secured applications" on page 122.

   Deployer link entities refer to in an enterprise application to the run time environment. The deployer:

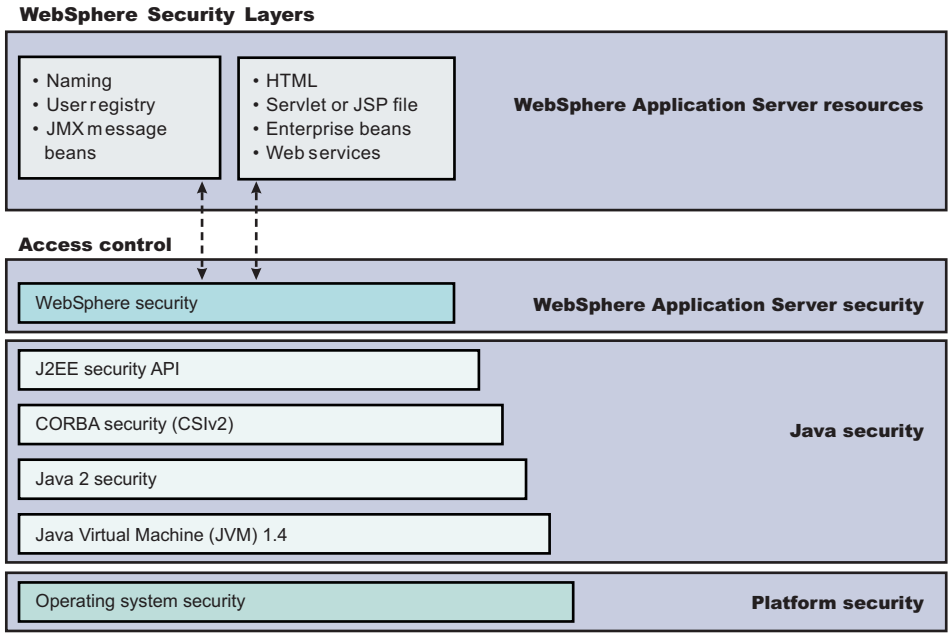
   - Maps actual users and groups to application roles
   - Installs the enterprise application into the environment
   - Makes the final adjustments needed to run the application
7. Test secured applications. For more information, see "Testing security" on page 135.
8. Manage security configurations. For more information, see "Managing security" on page 136.
9. Improve performance by tuning security configurations. For more information, see "Tuning security configurations" on page 479.
10. Troubleshoot security configurations. For more information, see "Troubleshooting security configurations" on page 479.

Your applications and production environment are secured.

See “Security: Resources for learning” on page 495 for more information on the WebSphere Application Server security architecture.

Planning to secure your environment

There are several communication links from a browser on the Internet, through web servers and product servers, to the enterprise data at the back end. This section examines some typical configuration and common security practices. WebSphere Application Server security is built on a layered security architecture as showed below. This section also examines the security protection offered by each security layer and common security practice for good quality of protection in end-to-end security. The following figure illustrates the building blocks that comprise the operating environment of WebSphere Security:



- **Operating System Security** -

  The security infrastructure of the underlying operating system provides certain security services to the WebSphere Security Application. This includes the file system security support to secure sensitive files in WebSphere product installation. The WebSphere system administrator can configure the product to obtain authentication information directly from the operating system user registry, for example the Windows system Security Access Manager (SAM).
- **Network Security** - The Network Security layers provide transport level authentication and message integrity and encryption. Communication between separate WebSphere Application Servers can be configured to use Secure Socket Layer (SSL) and HTTPS. Additionally IP Security and Virtual Private Network (VPN) might be used for added message protection.
- **JVM 1.3.1** - The JVM security model provides a layer of security above the operating system layer.
- **Java 2 Security** - The Java 2 Security model offers fine grained access control to system resources including file system, system property, socket connection, threading, class loading, and so on. Application code must explicitly grant the required permission to access a protected resource.
- **J2EE Security** - The security collaborator enforces J2EE based security policies and supports J2EE security APIs.

- **WebSphere Security** - WebSphere Application Server security enforces security policies and services in a unified manner on access to Web resources, enterprise beans, and JMX administrative resources. It consists of WebSphere Application Server security technologies and features to support the needs of a secure enterprise environment.
- **CORBA Security** - Any calls made among secure ORBs are invoked over the Common Security Interoperability Version 2 security protocol that sets up the security context and the necessary quality of protection. After the session is established, the call is passed up to the enterprise bean layer. WebSphere Application Server continues to support the Secure Authentication Service (SAS) security protocol which was used in prior releases of WebSphere Application Server and other IBM products for backward compatibility.

The following picture shows a typical multiple-tier business computing environment. Shown in the picture is a WebSphere Application Server Network Deployment (ND) installation. Note that there is a Node Agent instance on every computer node which is omitted in the picture. Each product application server consists of a web container, an EJB container, and the administrative subsystem. The WebSphere Application Server Deployment Manager contains only WebSphere administrative code and the administrative console application. The administrative console is a special J2EE Web Application that provides the GUI interface for performing administrative functions. WebSphere Application Server configuration data is stored in XML descriptor files. Those XML configuration files should be protected by operating system security. Passwords and other sensitive configuration data can be modified using the administrative console.

Hence, the administrative console Web application has a setup data constraint that requires the administrative console servlets and JSP files to be accessed only through an SSL connection when global security is enabled.

After installation, the administrative console HTTPS port is configured to use **DummyServerKeyFile.jks** and **DummyServerTrustFile.jks** with the default self signed certificate. Using the Dummy key and trust file certificate is not safe and you should generate your own certificate to replace dummy ones immediately. It is more secure if you first enable global security and complete other configuration tasks after global security is enforced.

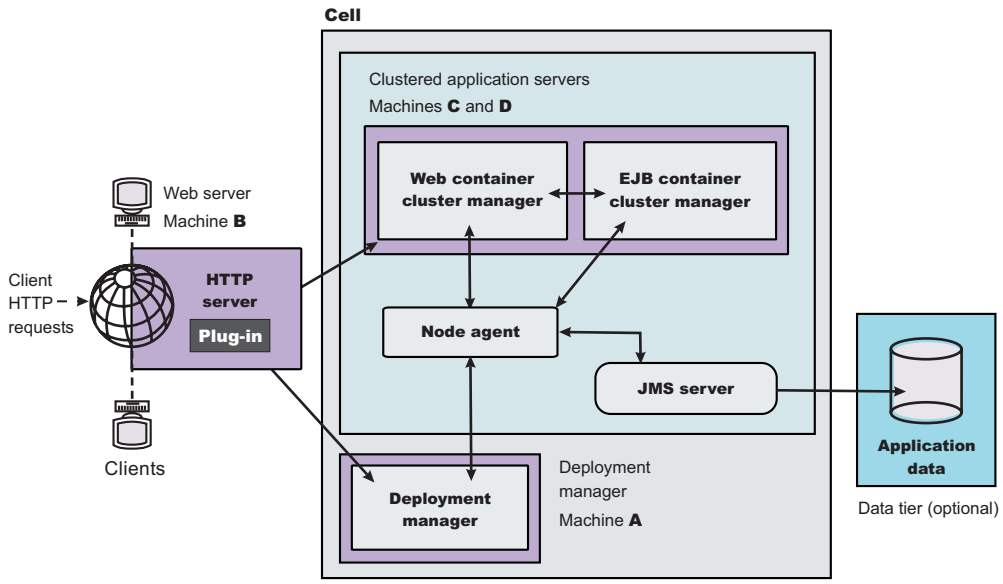


Figure 1. Multiple-tier business computing environment.

WebSphere Application Server servers interact with each other through CSIv2 and SAS security protocols as well and HTTP and or HTTPS protocols. Those protocols can be configured to use SSL when WebSphere Application Server global security is enabled. The WebSphere Application Server administrative subsystem in every server uses SOAP JMX connectors and or RMI/IIOP JMX connectors to pass administrative commands and configuration data. When global security is disabled, the SOAP JMX connector uses HTTP protocol and the RMI/IIOP connector uses TCP/IP protocol. When global security is enabled, the SOAP JMX connector always uses HTTPS protocol. When global security is enabled, the RMI/IIOP JMX connector may be configured to either use SSL or to use TCP/IP. Again it is recommended to enable global security and enable SSL to protect the sensitive configuration data.

Note: Global security and administrative security configuration is at the cell level.

While global security is enabled, application security at each individual application server may be disabled by disabling the **per server level security enable** flag. Disabling application server security does not affect the administrative subsystem in that application server which is controlled only by the global security configuration. Both administrative subsystem and application code in an application server share the optional per server security protocol configuration.

Security for J2EE resources is provided by Web container and EJB container. Each container provides two kind of security: declarative security and programmatic security.

In declarative security, an application security structure includes data integrity and confidentiality, authentication requirements, security roles, and access control. Access control is expressed in a form external to the application. In particular the deployment descriptor is the primary vehicle for declarative security in the J2EE platform. The WebSphere Application Server maintains J2EE security policy including information derived from the deployment descriptor and specified by

deployers and administrators in a set of XML descriptor files. At run time, the container uses the security policy defined in the XML descriptor files to enforce data constraints and access control.

When declarative security alone is not sufficient to express the security model of an application, "Programmatic login" on page 54 can be used by application code to make access decisions. When global security is enabled and application server security is not disabled at the server level, J2EE applications security will be enforced. When the security policy is specified for a web resource, the web container performs access control when the resource is requested by a web client. The web container would challenge the web client for authentication data if none is present according to the specified authentication method, ensure the data constraints are met, and determine whether the authenticated user has the required security role. The web security collaborator enforces role-based access control by using an access manager implementation. An access manager makes authorization decision based on security policy derived from the deployment descriptor. An authenticated user principal is allowed to access the requested Servlet or JSP file if it has one of the required security roles. Servlets and JSP pages may use the `HttpServletRequest` methods `isUserInRole` and `getUserPrincipal`. When global security is enabled and application server security is not disabled, EJB container will enforce access control on EJB method invocation. The authentication would take place regardless of whether method permission was defined for the specific EJB method. The EJB security collaborator enforces role-based access control by using an access manager implementation. An access manager makes authorization decisions based on security policy derived from the deployment descriptor. An authenticated user principal is allowed to access the requested EJB method if it has one of the required security roles. EJB code may use the `EJBContext` methods `isCallerInRole` and `getCallerPrincipal`. The J2EE role based access control should be used to protect valuable business data from being accessed by unauthorized users from both the Internet and the Intranet.

For enabling J2EE application security, please refer to "Securing Web applications using the Assembly Toolkit" on page 114 and "Securing enterprise bean applications using the Assembly Toolkit" on page 111.

WebSphere Application Server extends the security, role-based access control to administrative resources including the JMX system management subsystem, user registries, and JNDI name space. WebSphere administrative subsystem defines four administrative security roles:

- **Monitor role**, which can view configuration information and status but not anything more
- **Operator role**, which is a monitor that can trigger run time state changes, such as start an application server or stop an application, but cannot change configuration
- **Configurator role**, which is a monitor that can modify configuration information but cannot change run-time state
- **Administrator role**, which is an operator as well as a configurator

A user with the configurator role can perform most administrative work including installing new applications and application servers. There are certain configuration tasks a configurator does not have sufficient authority to do when global security is enabled, including modifying WebSphere Application Server server identity and password, LTPA password and keys, and assigning users to administrative security roles. Those sensitive configuration tasks require the administrative role because the server id is mapped to the administrator role.

WebSphere Application Server administrative security is enforced when global security is enabled. It is recommended that WebSphere Application Server global security be enabled to protect administrative subsystem integrity. Application server security can be selectively disabled if there is no sensitive information to protect. For securing administrative security, refer to “Assigning users to administrator roles” on page 150 and “Assigning users to naming roles” on page 154 WebSphere Application Server uses Java 2 Security Model to create a secure environment to run application code. Java 2 Security provides a fine, grained and policy based access control to protect system resources such as files, system properties, opening socket connections, loading libraries, and so on. J2EE Version 1.3 Specification defines typical set of Java 2 Security permissions that Web and EJB components should expect to have, which is shown in the table below.

Table 1. J2EE Security Permissions set for Web components

Security Permission	Target	Action
java.lang.RuntimePermission	loadLibrary	
java.lang.RuntimePermission	queuePrintJob	
java.net.SocketPermission	*	connect
java.io.FilePermission	*	read, write
java.util.PropertyPermission	*	read

Table 2. J2EE Security Permissions set for EJB components

Security Permission	Target	Action
java.lang.RuntimePermission	queuePrintJob	
java.net.SocketPermission	*	connect
java.util.PropertyPermission	*	read

WebSphere Application Server Java 2 Security implementation was based on J2EE Version 1.3 Specification. The Specification granted Web components read and write file access permission to any file in the file system, which may be too broad. WebSphere Application Server default policy gives Web components read and write permission to the sub directory and the sub tree where the Web module was installed. The default Java 2 Security policy for all Java virtual machines and WebSphere Application Server server processes are contained in the following policy files:

${java.home}/jre/lib/security/java.policy
Used as the default policy for the Java Virtual Machine (JVM).

${user.install.root}/properties/server.policy
Used as the default policy for all product server processes

To simplify policy management, WebSphere Application Server policy is based on resource type rather than code base (location). Default policy for WebSphere Application Server subsystem that considered as an extension of WebSphere Application Server run time, which is referred to as *SPI*, for library shared by multiple applications, and for J2EE applications, are:

${was.install.root}/config/cells/<cellname>/nodes/<nodename>/spi.policy
Used for embedded resources defined in the `resources.xml` file, such as the Java Messaging Service (JMS), JavaMail and JDBC drivers.

${was.install.root}/config/cells/<cellname>/nodes/<nodename>/library.policy
Used by the shared library defined by WebSphere Application Server administrative console.

${was.install.root}/config/cells/<cellname>/nodes/<nodename>/app.policy
Used as the default policy for J2EE applications.

In general, applications should not require more permissions to run than those recommended by the J2EE Specification in order to be portable among various application servers. But some applications may require more permissions. WebSphere Application Server allows a per application policy file, `was.policy`, to be packaged together with each application from granting extra permissions to that application. Note that granting extra permissions to an application should be handled with great care because of the potential of compromising system integrity.

WebSphere Application Server uses a permission filtering policy file to alert users when an application requires permissions that are on the filter list during application installation and cause the offended application installation to fail. For example, the `java.lang.RuntimePermission` *`exitVM`* permission should not be given to an application so that application code is not allowed to terminate the WebSphere Application Server. The filtering policy is defined by the `filterMask` in `${was.install.root}/config/cells/<cellname>/filter.policy`. Moreover, WebSphere Application Server also performs run time permission filtering based on the run time filtering policy to ensure no application code has been granted any permission that is considered harmful to system integrity. Applying Java 2 Security model to application server is new.

WebSphere Application Server Version 4 supported Java 2 Security but only enforced three permissions checking against `exitVM`, create and set the Security Manager. Other permission checking is disabled by default.

Hence many applications developed for prior releases of WebSphere Application Server might not be Java 2 Security ready. To migrate those applications to WebSphere Application Server Version 5 quickly, you might temporarily give those applications `java.security.AllPermission` in the `was.policy` file. It is recommended to test or make those applications Java 2 Security ready, for example, identity what extra permissions, if any, are required and to just grant those permissions to a particular application. Not granting applications `AllPermission` can certainly reduce the risk of compromising system integrity. For more information on migrating applications to WebSphere Application Server Version 5, refer to "Migrating Java 2 security policy" on page 476.

WebSphere Application Server run time uses Java 2 Security to protect sensitive run-time functions and hence it is always a good idea to enforce Java 2 Security. Applications that are granted with `AllPermission` not only have access to sensitive system resources but also WebSphere Application Server run-time resources and can potential cause damage to both. In cases where an application can be trusted to be safe, WebSphere Application Server allows Java 2 Security to be disabled on a per application server basis. In other words, you can enforce Java 2 Security by default in security center and disable the per application server Java 2 Security flag to disable it at the particular application server.

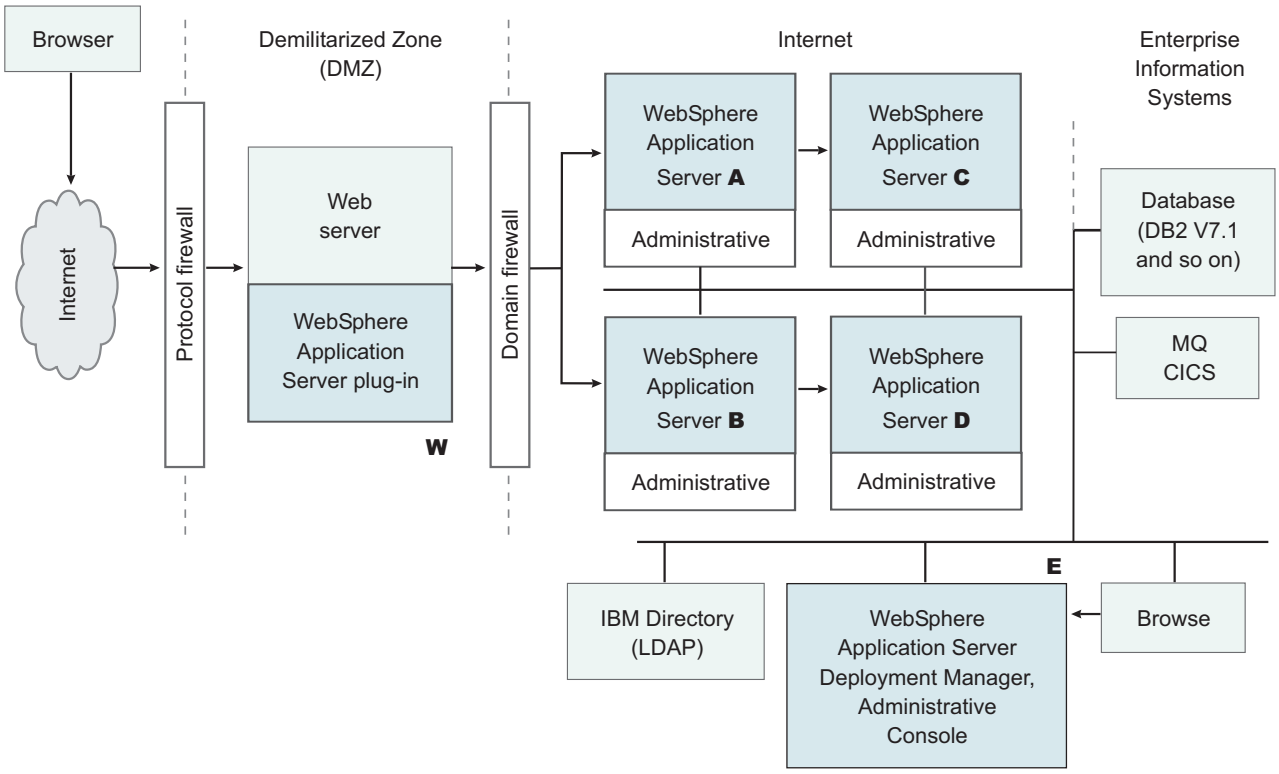
The global security enable flag and Java 2 Security enable flag along with other sensitive configuration data are stored in a set of XML configuration files. Both role based access control and Java 2 Security permission based access control are

employed to protect the integrity of the configuration data. We will use configuration data protection as an example to illustrate how system integrity is maintained.

- When Java 2 Security is enforced, application code cannot access the WebSphere Application Server run-time classes that manages the configuration data unless it has been granted the required WebSphere Application Server run-time permissions.
- When Java 2 Security is enforced, application code cannot access the WebSphere Application Server configuration XML files unless it has been granted the required file read and write permissions.
- The JMX administrative subsystem provides SOAP over HTTP or HTTPS and RMI/IIOP remote interface to allow application programs to extract and to modify configuration files and data. When global security is enabled, an application program can modify WebSphere Application Server configuration provided that the application program has presented valid authentication data and that the security identity has the required security roles.
- If a user is allowed to disable Java 2 Security, then that user can modify the WebSphere Application Server configuration including the WebSphere Application Server security identity and authentication data along with other sensitive data. Hence, only users with the administrator security role are allowed to disable Java 2 Security.
- Because WebSphere Application Server security identity is given the administrator role, only users with the administrator role are allowed to disable global security, to change server ID and password, and to map users and groups to administrative roles, and so on.

Other WebSphere Application Server run time resources are protected by similar mechanism as described previously. Hence it is very important to enable WebSphere Application Server global security and to enforce Java 2 Security. J2EE Specification defines four authentication method for Web components. WebSphere Application Server supports HTTP Basic Authentication, Form Based Authentication, and HTTPS Client Certificate Authentication. When using client certificate login, it is more convenient for the browser client if the web resources have integral or confidential data constraint. If a browser uses HTTP to access the web resource, the web container will automatically redirect it to the HTTPS port. The CSIv2 security protocol also supports client certificate authentication. SSL client authentication can also be used to setup secure communication among selected set of servers based on trust relationship.

If you start from the WebSphere Application Server plug-in at the Web server, SSL mutual authentication can be configured between it and the WebSphere Application Server HTTPS server. When using a self- signed certificate, one can restrict the WebSphere Application Server plug-in to communicate with only the selected two WebSphere Application Server servers as shown in the following picture. Suppose you want to restrict the HTTPS server in WebSphere Application Server **A** and in WebSphere Application Server **B** to accept secure socket connections only from the WebSphere Application Server plug-in **W**. You can generate three self-signed certificate using the IKEYMAN tool and certificate management utility. For example, use certificate **W** and trust certificate **A** and **B**. The HTTPS server of WebSphere Application Server **A** is configured to use certificate **A** and to trust certificate **W**. The HTTPS server of WebSphere Application Server **B** is configured to use certificate **B** and to trust certificate **W**.



The trust relationship depicted in the previous picture is shown in the following table.

Server	Key	Trust
WebSphere Application Server plug-in	W	A, B
WebSphere Application Server A	A	W
WebSphere Application Server B	B	W

In a Network Deployment installation, the WebSphere Application Server Deployment Manager is a central point of administration. System management commands are sent from the Deployment Manager to each individual application server. When global security is enabled, all WebSphere Application Server servers can be configured to require SSL and mutual authentication. Suppose you want to further restrict that WebSphere Application Server **A** so that it can only communicate with WebSphere Application Server **C** and WebSphere Application Server **B** can only communicate with WebSphere Application Server **D**. Note, as mentioned previously, all WebSphere Application Server application servers must be able to communicate with WebSphere Application Server Deployment Manager **E**. Hence, when using self-signed certificates, You might configure the CSIv2 and SOAP/HTTPS Key and trust relationship as shown in the following table.

Server	Key	Trust
WebSphere Application Server Server A	A	C, E

Server	Key	Trust
WebSphere Application Server Server B	B	D, E
WebSphere Application Server Server C	C	A, E
WebSphere Application Server Server D	D	B, E
WebSphere Application Server Deployment Manager E	E	A, B, C, D

When WebSphere Application Server is configured to use an LDAP user registry, SSL with mutual authentication also can be configured between every application server and the LDAP server with self-signed certificate so that no password will be passed in clear text from WebSphere Application Server to the LDAP server. In this example, the node agent processes were not discussed. Each node agent needs to communicate with application servers on the same node and with the Deployment Manager. Node agents also need to communicate with LDAP servers when they are configured to use LDAP user registry. It is reasonable to let the Deployment manager and the node agents use the same certificate. Suppose application server **A** and **C** are on the same computer node. The Node agent on that node needs to have certificates **A** and **C** in its trust file.

WebSphere Application Server does not provide a user registry configuration or management utility. In addition, it does not dictate the user registry password policy. It is recommended that you use the password policy recommended by your user registry, including the password length and expiration period.

1. Determine which versions of WebSphere Application Server you are using.
2. Review the WebSphere Application Server security architecture.
3. Review each of the following topics as also defined in Related reference.
   - "Authentication protocol for EJB security" on page 343
     - "Supported IBM protocols: Secure Authentication Service and Common Secure Interoperability Version 2" on page 353
     - "Common Secure Interoperability Version 2 features" on page 348
     - "Identity assertion" on page 348
   - "Authentication mechanisms" on page 155
     - "Simple WebSphere authentication mechanism" on page 156
     - "Lightweight Third Party Authentication settings" on page 160
     - "Trust Associations" on page 162
     - "Single Signon" on page 171
   - "User registries" on page 187
     - "Local operating system user registries" on page 189
     - "Lightweight Directory Access Protocol" on page 196
   - "Custom user registries" on page 212
   - "Java 2 security" on page 441
     - "Java 2 security policy files" on page 452
   - "Java Authentication and Authorization Service" on page 240
     - "Programmatic login" on page 54
   - "Java 2 Connector security" on page 257
   - "AccessControlException" on page 446
     - "Role-based authorization" on page 116
     - "Administrative console and naming service authorization" on page 147
   - "Secure Sockets Layer" on page 384

- "Authenticity" on page 387
- "Confidentiality" on page 387
- "Integrity" on page 390

Security considerations when adding a Base Application Server node to Network Deployment

At some point, you might decide to centralize the configuration of your stand-alone base application servers by adding them into a Network Deployment cell. If your base application server is currently configured with security, there are some issues to be considered. The major issue when adding a node to the cell is whether the user registries between the base application server and the Deployment Manager are the same. When adding a node to the cell, you automatically inherit both the user registry and the authentication mechanism of the cell.

For distributed security, all servers in the cell must use the same user registry and authentication mechanism. In order to recover from a user registry change, you will need to modify your applications so that the user and group to role mappings are correct for the new user registry. To do this, see the article on "Assigning users and groups to roles" on page 123.

Another major issue is the SSL public-key infrastructure. Prior to performing `addNode` with the Deployment Manager, verify that `addNode` can communicate as an SSL client with the Deployment Manager. This requires that the addNode truststore (configured in `sas.client.props`) contains the signer certificate of the Deployment Manager personal certificate as found in the keystore (specified in the administrative console).

See the article, "Managing digital certificates" on page 418.

The following are other issues to consider when running the `addNode` command with security:

1. When attempting to run system management commands such as `addNode`, you need to explicitly specify administrative credentials to perform the operation. The `addNode` command accepts `-username` and `-password` parameters to specify the userid and password, respectively. The user ID and password, which are specified should be an administrative user, for example, a user that is a member of the console users with **Operator** or **Admistrator** privileges or the admistrative user ID configured in the User Registry. An example for `addNode`, `addNode CELL_HOST 8879 -includeapps -username user -password pass`. `-includeapps` is optional, but this option attempts to include the server applications into the Deployment Manager. The `addNode` command might fail if the user registries used by the WebSphere Application Server and the Deployment Manager are not the same. To correct this problem, either make the user registries the same or turn off security. If you change the user registries, remember to verify that the users to roles and groups to roles mappings are correct. See addNode command for more information on the addNode syntax.
2. Adding a secured remote node through the administrative console is not supported. You can either disable security on the remote node before performing the operation or perform the operation from the command line using the addNode script.
3. Before running the `addNode` command, you must verify that the truststore files on the nodes can communicate with the keystore files from the Deployment

Manager and vice versa. When using the default `DummyServerKeyFile` and `DummyServerTrustFile`, you should not see this problem as these are already able to communicate. However, never use these dummy files in a production environment or anytime sensitive data is being transmitted.

4. After running addNode, the application server is in a new SSL domain. It might contain SSL configurations that point to keystore and truststore files that are not prepared to interoperate with other servers in the same domain. Consider which servers will be intercommunicating and ensure that the servers are trusted within your truststore files.

Proper understanding of the security interactions between distributed servers greatly reduces problems encountered with secure communications. Security adds complexity because additional function needs to be managed. For security to function, it needs thorough consideration during the planning of your infrastructure. This document helps to reduce the problems that could occur due to inherent security interactions.

When you have security problems related to the WebSphere Application Server Network Deployment environment, check the "Troubleshooting security configurations" on page 479 section to see if you can get information about the problem. When trace is needed to solve a problem, because servers are distributed, quite often it is required to gather trace on all servers simultaneously while recreating the problem. This trace can be enabled dynamically or statically, depending on the type problem occurring.

Creating login key files

1. Create a login key file. The authenticating user IDs, passwords, and target realms for each different z/OS target are specified in the login key file, which is an ASCII file. When the security authentication service processes the login key file, the passwords in the file are encoded.
2. Add information to the login key file in the following format:

   Realm_name User_ID Password
3. Make sure that the data conforms to the following rules:
   - One realm name
   - One user ID, and one password defined in each entry
   - One entry per line
   - No blank lines between entries
   - Comments on separate lines only
   - Begin any comment with a pound sign (#):

     Example:

     ```
     # Sample key file
     #
     # First target realm
     #
     TargetRealm serverID serverPassword
     #
     # Second target realm
     #
     TargetRealm2 serverID2 serverPassword2
     #
     # End of key file
     ```

A sample file named `wsserver.key` also contains these instructions. After installation, you can locate this sample file in the *install_root*`/properties` directory. You can use or modify the sample file as needed for testing.

Note: You can place the login key file anywhere on a host machine running the application server. However, it is recommended that you place the login key file under a securable file system.

After creating the login key files, read the article entitled, "Preparing truststore files."

Preparing truststore files

Secure Sockets Layer (SSL) protocol protects the communication between WebSphere Application Server and WebSphere Application Server for z/OS application servers. To complete the SSL connection, establish a valid truststore file for the WebSphere Application Server. A truststore file is a key database file that contains the public keys (See "Creating login key files" on page 20 for information about how to create a new keystore file.)

1. Extract the public key of the z/OS server by using the key management tool from WebSphere Application Server z/OS. For details, see Configuring the server for request decryption: choosing the decryption method.
2. With the key management utility (iKeyman) from WebSphere Application Server, add the public key from the WebSphere Application Server for z/OS server as a signer certificate into the requesting WebSphere Application Server truststore file. For details, see the related information about how to "Importing signer certificates" on page 427.

The WebSphere Application Server truststore file is now ready to use for SSL connections with the WebSphere Application Server for z/OS servers.

See "Configuring the application server for interoperability" for interoperability.

Configuring the application server for interoperability

After the truststore file is ready, complete the following steps to configure the WebSphere Application Server.

1. Configure the enterprise beans that access WebSphere Application Server for z/OS. Before deploying the enterprise beans, configure the RunAs Identity. Because the Security Authentication Service (SAS) only supports WebSphere Application Servers to interoperate with WebSphere Application Server for z/OS, set the RunAs Identity to `System Identity`.
2. Enable security.
3. Enable outbound SAS authentication protocol.
4. Specify the truststore file in an Secure Sockets Layer (SSL) configuration alias and configure the WebSphere Application Server with that alias.
5. Set the **Request timeout** and **Locate request timeout** values to zero for the Object Request Broker (ORB) service. When the WebSphere Application Server z/OS application server first starts, no server region is available for processing work. It is therefore recommended that you set these two properties to zero to prevent potential timeouts.
6. Specify a security property named com.ibm.CORBA.keyFileName for the absolute path of the login key file created earlier.

7. Restart the WebSphere Application Server.

Implementing security considerations

Complete the following tasks to implement security before, during, and after installing WebSphere Application Server.

1. "Securing your environment before installation." This step describes how to install WebSphere Application Server with the proper authority.
2. Install the WebSphere Application Server. This step describes how to install WebSphere Application Server. During installation you are prompted to "Migrating security configurations from previous releases" on page 26.
3. "Securing your environment after installation" on page 23 This step provides information on how to protect password information after you install WebSphere Application Server.

Securing your environment before installation

The following instructions explain how to perform a product installation with proper authority on UNIX platforms, Linux platforms, Solaris operating environments, and Windows platforms.

UNIX platforms

On UNIX platforms, log on as **root** and verify that the umask value is **022**.

To verify that the umask value is **022**, execute the **umask** command.

To set up the umask value as **022**, execute the **umask 022** command.

Linux platforms and Solaris operating environments

On Linux platforms or Solaris operating environments, make sure that the `/etc` directory contains a shadow password file. The shadow password file is named shadow and is in the `/etc` directory. If the shadow password file does not exist, an error occurs after enabling global security and configuring the user registry as local operating system.

To create the shadow file, run the pwconv command (with no parameters). This command creates an `/etc/shadow` file from the `/etc/passwd` file. After creating the shadow file, you can configure local operating system security.

Windows platforms

On Windows platforms, the logon user must be a member of the administrator group with the rights of **Act as part of the operating system** and **Log on as a service**.

To add the rights to a user on a Windows 2000 platform:

1. Click **Start** > **Programs** > **Administrative Tools** > **Local Security Policy** (for domain configuration, select **Domain Security Policies**, instead).
2. From the Local Security Settings Panel, click **Local Policies** > **User Rights Assignment** and add the following rights to the user ID:
   - Act as part of the operating system
   - Log on as a service

Securing your environment after installation

WebSphere Application Server depends on several configuration files created during installation. These files contain password information and need protection. Although the files are protected to a limited degree during installation, this basic level of protection is probably not sufficient for your site. Verify that these files are protected in compliance with the policies of your site.

The files in the *install_root*\config and *install_root*\ properties, except for those in the following list, need protection. For example, give permission to the user who logs onto the system for WebSphere Application Server primary administrative tasks. Other users or groups, such as WebSphere Application Server console users and console groups, who perform partial WebSphere Application Server administrative tasks, like configuring, starting servers and stopping servers, need permissions as well. The files in the *install_root*\properties directory that should not be protected are:

- TraceSettings.properties
- client.policy
- client_types.xml
- implfactory.properties
- sas.client.props
- sas.stdclient.properties
- sas.tools.properties
- soap.client.props
- wsadmin.properties
- wsjaas_client.conf

1. Secure files on a Windows system:
   a. Open the browser for a view of the files and directories on the machine.
   b. Locate and right-click the file or the directory to protect.
   c. Click **Properties**.
   d. Click the **Security** tab.
   e. Remove the Everyone entry and any other user or group that should not have access to the file.
   f. Add the users who should be allowed to access the files with the proper permission.
2. Secure files on UNIX systems. This procedure applies only to the ordinary UNIX file system. If your site uses access-control lists, secure the files by using that mechanism. Any site-specific requirements can affect the desired owner, group and corresponding privileges. For example, on AIX,
   a. Go to the *install_root* directory and change the ownership of the directory configuration and properties to the user who logs onto the system for WebSphere Application Server primary administrative tasks. Execute the following command: chown -R *logon_name directory_name*

      Where:

      - *login_name* is a specified user or group.
      - *directory_name* is the name of the directory that contains the files.

      It is recommended that you assign ownership of the files containing password information to the user who runs the application server. If more than one user runs the application server, provide permission to the group in which the users are assigned in the user registry.
   b. Set up the permission by executing the following command: chmod -R 770 *directory_name*.

c. Go to the *install_root*\properties directory and set the following file permission to **everybody** by executing the following command: `chmod 777 file_names`. where *file_names* are the following files:
   - TraceSettings.properties
   - client.policy
   - client_types.xml
   - implfactory.properties
   - sas.client.props
   - sas.stdclient.properties
   - sas.tools.properties
   - soap.client.props
   - wsadmin.properties
   - wsjaas_client.conf

d. Create a group for WebSphere Application Server and put the users who perform full or partial WebSphere Application Server administrative tasks in that group.

e. Restrict access to the /var/mqm directories and log files needed for WebSphere embedded messaging or WebSphere MQ as the JMS provider. Give write access only to the user ID mqm or members of the mqm user group. For detailed information, see Securing messaging directories and log files.

After securing your environment, only the users given permission can access the files. Failure to adequately secure these files can lead to a breach of security in your WebSphere Application Server applications.

If there are any failures caused by file accessing permissions, check the permission settings.

Protecting plain text passwords

The WebSphere Application Server has several plain text passwords. These passwords are not encrypted, but are encoded. The following is a list of files with encoded passwords:

File name	Additional information
security.xml	The following fields contain encoded passwords: • **LTPA password** • **JAAS Auth Data** • **User Registry server password** • **LDAP User Registry bind password** • **Key file password** • **Trust file password** • **Crypto token device password**
sas.client.props	
war/WEB-INF/ibm_web_bnd.xml	Specify passwords for the default basic authentication for the ″resource-ref″ bindings within all descriptors (except in the Java crytography architecture)

File name	Additional information
ejb jar/META-INF/ibm_ejbjar_bnd.xml	Specify passwords for the default basic authentication for the ″resource-ref″ bindings within all descriptors (except in the Java crytography architecture)
client jar/META-INF/ibm-appclient_bnd.xml	Specify passwords for the default basic authentication for the ″resource-ref″ bindings within all descriptors (except in the Java crytography architecture)
ear/META-INF/ibm_application_bnd.xml	Specify passwords for the default basic authentication for the ″run as″ bindings within all descriptors
server.xml	The following fields contain encoded passwords: • **key file password** • **trust file password** • **crypto token device password** • **auth target password** • **Session persistence password** • **DRS Client data replication password** (not available in WebSphere Application Server, Version 5
resource.xml (for cells, servers, and nodes)	The following fields contain encoded passwords: • **WAS40Datasource password** • **mailTransport password** • **mailStore password** • **MQQueue queue mgr password**
ws-security.xml	
ibm-webservices-bnd.xmi	
ibm-webservicesclient-bnd.xmi	
/properties/soap.client.props	
/properties/sas.tools.properties	
/properties/sas.stdclient.properties	
wsserver.key	

To re-encode a password in one of the previous files, complete the following steps:

1. Access the file using a text editor and type over the encoded password in plain text. The new password is shown in plain text and must be encoded.
2. Use the PropFilePasswordEncoder.bat or PropFilePasswordEncode.sh file in the *install_dir*/bin/ directory to re-encode the password.

   If you are re-encoding SAS properties files, type PropFilePasswordEncoder *file_name* -sas and the PropFilePasswordEncoder file encodes the known SAS properties.

If you are encoding files that are not SAS properties files, type `PropFilePasswordEncoder file_name password_properties_list`

file_name is the name of the z/SAS properties file. *password_properties_list* is the name of the properties to encode within the file.

Use the `PropFilePasswordEncoder` utility to encode WebSphere Application Server password files only. The utility cannot encode passwords contained in XML files or other files that contain open and close tags.

If you reopen the affected file or files, the passwords do not display in plain text. Instead, the passwords appear encoded. WebSphere Application Server does not provide a utility for decoding the passwords.

PropFilePasswordEncoder command reference

Purpose

The **PropFilePasswordEncoder** command encodes passwords located in plain text property files. This command encodes both Secure Authentication Server (SAS) property files and non-SAS property files. After you have encoded the passwords, note that a decoding command does not exist. To encode passwords, you must run this command from the *install_dir*`/bin` directory of a WebSphere Application Server installation.

Syntax

The command syntax is as follows:

```
PropFilePasswordEncoder file_name
```

Parameters

The following option is available for the PropFilePasswordEncoder command:

-sas
Encodes SAS property files.

The following examples demonstrate the correct syntax.

```
PropFilePasswordEncoder file_name password_properties_list
PropFilePasswordEncoder file_name -SAS
```

Migrating security configurations from previous releases

This article addresses the need to migration your security configurations from a previous release of IBM WebSphere Application Server to WebSphere Application Server, Version 5. Complete the following steps to migrate your security configurations:

- Before migrating your configurations, verify that the administrative server of the previous release is running.
- If security is enabled in the previous release, obtain the server ID and password of the previous release. This information is needed to log onto the administrative server of the previous release during migration.
- You can optionally disable security in the previous release before migrating the installation. There is no logon required during the installation.

1. Start the Installation Wizard by running the **install** command.

2. On the Installation Wizard panel, click **Specify previous version information > Migrate your applications and configuration from the previous version**. Complete the fields for **Install location** and **Configuration file** with corresponding information.
3. Follow the instructions provided in the Installation Wizard to complete the installation.

The security configuration of previous WebSphere Application Server releases and its applications are migrated to the new installation of WebSphere Application Server Version 5.

This task is for migrating an installation.

After migration is complete, re-enable your security configurations with security disabled in the migrated version. You must re-enable your security configurations even if the previous version had security enabled.

If custom user registry is used in the previous version, the migration process does not migrate the class files used by the custom user registry in the <*previous_install_root*>\classes directory. Therefore, after migration, copy your custom user registry implementation classes to the <*install_root*>\classes directory.

If you upgrade from WebSphere Application Server, Version 4.0.x to WebSphere Application Server, Version 5 or later, data associated with Version 4.0.x trust associations is not automatically migrated to Version 5 or later. To migrate trust associations, see "Migrating trust association interceptors" on page 30.

Migrating custom user registries

Before you perform this task, it is assumed that you already have a custom user registry implemented and working in WebSphere Application Server Version 4. The custom registry in WebSphere Application Server Version 4 is based on the CustomRegistry interface. For WebSphere Application Server Version 5, the interface is called the UserRegistry interface. The WebSphere Application Server Version 4-based custom registry works without any changes to the implementation in WebSphere Application Server Version 5 except when the implementation is using data sources to connect to a database during initialization. If the previous implementation is using a data source to access a database, change the implementation to use JDBC connections to connect to the database. The WebSphere Application Server Version 4 version of the CustomRegistry interface is deprecated in WebSphere Application Server Version 5. So, moving your implementation to the WebSphere Application Server Version 5-based interface is expected.

In WebSphere Application Server Version 5, in addition to the UserRegistry interface, the custom user registry requires the Result object to handle user and group information. This file is already provided in the package and you are expected to use it for the getUsers, getGroups and the getUsersForGroup methods.

In WebSphere Application Server Version 4, it might have been possible to use other WebSphere Application Server components (for example, datasources) to initialize the custom registry. This is no longer possible in WebSphere Application Server Version 5, because other components like the containers are initialized after security and are not available during the registry initialization. In WebSphere

Application Server Version 5, a custom registry implementation is a pure custom implementation, independent of other WebSphere Application Server components.

In WebSphere Application Server Version 4, if you had display names for users the EJB method getCallerPrincipal( ) and the servlet methods getUserPrincipal( ) and getRemoteUser( ) returned the display names. This behavior has changed in WebSphere Application Server Version 5. By default, these methods now return the security name instead of the display name. However, if you need the display names to return, set the WAS_UseDisplayName property to **true**. See the getUserDisplayName method description or the Javadoc, for more information.

If the migration tool was used to migrate the WebSphere Application Server Version 4 configuration to WebSphere Application Server Version 5, be aware that this migration does not involve any changes to your existing code. Since the WebSphere Application Server Version 4 custom registry works in WebSphere Application Server Version 5 without any changes to the implementation (except when using data sources) you can use the Version 4-based custom registry after the migration without modifying the code. Consider that the migration tool might not copy your implementation files from Version 4 to Version 5. You might have to copy them to the class path in the Version 5 setup (preferably to the `classes` subdirectoy, just like in Version 4). If you are using the WebSphere Application Server Network Deployment version, copy the files to the cell and to each of the nodes class paths.

In Version 5, a case insensitive authorization can occur when using the custom registry. This authorization is new in Version 5 and in effect only on the authorization check. This function is useful in cases where your custom registry returns inconsistent (in terms of case) results for user and group unique IDs.

Note: Setting this flag does not have any effect on the user names or passwords. Only the unique IDs returned from the registry are changed to lower-case before comparing them with the information in the authorization table, which is also converted to lowercase during run time.

Before proceeding, look at the new UserRegistry interface. See "Developing custom user registries" on page 94 for a description of each of these methods in detail and the changes from Version 4.

The following steps go through in detail all the changes required to move your WebSphere Application Server Version 4 custom user registry to the Version 5 custom user registry. The steps are very simple and involve minimal code changes. The sample implementation file is used as an example when describing some of the steps.

1. Change your implementation to `UserRegistry` instead of `CustomRegistry`. Change:

   ```
   public class FileRegistrySample implements CustomRegistry
   ```
   to
   ```
   public class FileRegistrySample implements UserRegistry
   ```
2. Throw the java.rmi.RemoteException in the constructors public FileRegistrySample() throws java.rmi.RemoteException
3. Change the mapCertificate method to take a certificate chain instead of a single certificate. Change

```
public String mapCertificate(X509Certificate cert)
to
public String mapCertificate(X509Certificate[]cert)
```

Having a certificate chain gives you the flexibility to act on the chain instead of one certificate. If you are only interested in the first certificate just take the first certificate in the chain before processing. In Version 5, the mapCertificate method is called to map the user in a certificate to a valid user in the registry, when certificates are used for authentication by the Web or the Java clients (transport layer certificates, Identity Assertion certificates). In Version 4, this was only called by Web clients since the Common Secure Interoperability Version 2 (CSIv2) protocol was not supported.

4. Remove the getUsers() method.
5. Change the signature of the getUsers(String) method to return a Result object and accept an additional parameter (int). Change:

   ```
   public List getUsers(String pattern)
   to
   public Result getUsers(String pattern, int limit)
   ```

   In your implementation, construct the Result object from the list of the users obtained from the registry (whose number is limited to the value of the limit parameter) and call the setHasMore() method on the Result object if the total number of users in the registry exceeds the limit value.
6. Change the signature of the getUsersForGroup(String) method to return a Result object and accept an additional parameter (int) and throw a new exception called NotImplementedException. Change the following:

   ```
   public List getUsersForGroup(String groupName)
            throws CustomRegistryException,
                   EntryNotFoundException {
   ```

   to

   ```
   public Result getUsersForGroup(String groupSecurityName, int limit)
            throws NotImplementedException,
                   EntryNotFoundException,
                   CustomRegistryException {
   ```

   In Version 5, this method is not called directly by the WebSphere Application Server Security component. However, other components of the WebSphere Application Server like the process choreographer use this method when staff assignments are modeled using groups. Since this already is implemented in WebSphere Application Server Version 4, it is recommended that you change the implementation similar to the `getUsers` method as explained in step 5.
7. Remove the getUniqueUserIds(String) method.
8. Remove the getGroups() method.
9. Change the signature of the getGroups(String) method to return a Result object and accept an additional parameter (int). change the following:

   ```
   public List getGroups(String pattern)
   ```

   to

```
public Result getGroups(String pattern, int limit)
```

In your implementation, construct the Result object from the list of the groups obtained from the registry (whose number is limited to the value of the limit parameter) and call the setHasMore() method on the Result object if the total number of groups in the registry exceeds the limit value.

10. Add the `createCredential` method. This method is not called at this time, so return as `null`.

```
public com.ibm.websphere.security.cred.WSCredential
   createCredential(String userSecurityName)
         throws CustomRegistryException,
                NotImplementedException,
                EntryNotFoundException {
         return null;
   }
```

The first and second lines of the previous code example normally appear on one line. However, it extended beyond the width of the page.

11. To build the Version 5 implementation make sure you have the `sas.jar` and `wssec.jar` in your class path.

```
%install_root%\java\bin\javac -classpath %WAS_HOME%\lib\wssec.jar;
%WAS_HOME%\lib\sas.jar FileRegistrySample.java
```

Type the previous lines as one continuous line.

To build the Version 4 custom registry in Version 5.0.2, only the `sas.jar` file is required.

12. Copy the implementation classes to the product class path. The *%install_root%*`/lib/ext` directory is the preferred location. If you are using the Network Deployment product, make sure that you copy these files to the cell and all the nodes. Without the files in each of the node class paths the nodes and the application servers in those nodes cannot start when security is on.
13. Use the administrative console to set up the custom registry. Follow the instructions in the “Configuring custom user registries” on page 214 article to set up the custom registry including the IgnoreCase flag. Make sure that you add the `WAS_UseDisplayName` properties, if required.

Migrates a Version 4 custom registry to the Version 5 custom registry.

This step is required to migrate a custom registry from WebSphere Application Server Version 4 to WebSphere Application Server Version 5.

If you are enabling security, make sure you complete the remaining steps. Once completed, save the configuration and restart all the servers. Try accessing some J2EE resources to verify that the custom registry migration was successful.

Migrating trust association interceptors

The following topics are addressed in this document:

- Changes to the product-provided trust association interceptors
- Migrating product-provided trust association interceptors
- Changes to the custom trust association interceptors
- Migrating custom trust association interceptors

Changes to the product-provided trust association interceptors

For the product provided implementation for the WebSeal server a new optional property com.ibm.websphere.security.webseal.ignoreProxy has been added. If this property is set to true or yes, the implementation does not check for the proxy host names and the proxy ports to match any of the host names and ports listed in the com.ibm.websphere.security.webseal.hostnames and the com.ibm.websphere.security.webseal.ports property respectively. For example, if the VIA header contains the following information:

HTTP/1.1 Fred (Proxy), 1.1 Sam (Apache/1.1),
HTP/1.1 webseal1:7002, 1.1 webseal2:7001

Note: The previous VIA header information was split onto two lines due to the width of the printed page.

and the com.ibm.websphere.security.webseal.ignoreProxy is set to true or yes, the host name Fred is not be used when matching the host names. By default, this property is not set, which implies that any proxy host names and ports expected in the VIA header should be listed in the host names and the ports properties to satisfy the isTargetInterceptor method.

Migrating product-provided trust association interceptors

The properties located in the webseal.properties and trustedserver.properties files are not migrated from previous versions of the WebSphere Application Server. You must migrate the appropriate properties to WebSphere Application Server, Version 5 using the trust association panels in the administrative console. For more information, see Configuring trust association interceptors.

Changes to the custom trust association interceptors

If the custom interceptor extends, com.ibm.websphere.security.WebSphereBaseTrustAssociationInterceptor, then implement the following new method to initialize the interceptor:

```
public int init (java.util.Properties props);
```

WebSphere Application Server checks the return status before using the Trust Association implementation. Zero (0) is the default value for indicating the the interceptor was successfully initialized.

However, if a previous implementation of the trust association interceptor returns a different error status you can either change your implementation to match the expectations or make one of the following changes:

Method 1:

Add the com.ibm.websphere.security.trustassociation.initStatus property in the trust association interceptor custom properties. Set the property to the value that indicates that the interceptor is successfully initialized. All of the other possible values imply failure. In case of failure, the corresponding trust association interceptor is not used.

Method 2:

Add the com.ibm.websphere.security.trustassociation.ignoreInitStatus property in the trust association interceptor custom properties. Set the value of this property to **true**, which tells WebSphere Application Server to ignore the status of this method. If you add this property to the custom

properties, WebSphere Application Server does not check the return status, which is similar to previous versions of WebSphere Application Server.

The `public int init (java.util.Properties props);` method replaces the `public int init (String propsFile)` method.

The init(Properties) method accepts a java.util.Properties object which contains the set of properties required to initialize the interceptor. All the properties set for an interceptor (by using the Custom Properties link for that interceptor or using scripting) will be sent to this method. The interceptor can then use these properties to initialize itself. For example, in the product provided implementation for the WebSEAL server, this method reads the hosts and ports so that a request coming in can be verified to come from trusted hosts and ports. A return value of 0 implies that the interceptor initialization is successful. Any other value implies that the initialization was not successful and the interceptor will not be used.

All the properties set for an interceptor (by using the **Custom Properties** link in the administrative console for that interceptor or using scripting) is sent to this method. The interceptor can then use these properties to initialize itself. For example, in the product-provided implementation for the WebSEAL server, this method reads the hosts and ports so that an incoming request can be verified to come from trusted hosts and ports. A return value of **0** implies that the interceptor initialization is successful. Any other value implies that the initialization was not successful and the interceptor is ignored.

Note: The `init(String)` method still works if you want to use it instead of implementing the init(Properties) method. The only requirement is that the file name containing the custom trust association properties should now be entered using the **Custom Properties** link of the interceptor in the administrative console or by using scripts. You can enter the property using *either* of the following methods. The first method is used for backward compatibility with previous versions of WebSphere Application Server.

Method 1:

The same property names used in the previous release are used to obtain the file name. The file name is obtained by concatenating the `.config` to the `com.ibm.websphere.security.trustassociation.types` property value. If the file name is called `myTAI.properties` and is located in the `C:/WebSphere/AppServer/properties` directory, set the following properties:

- `com.ibm.websphere.security.trustassociation.types = myTAItype`
- `com.ibm.websphere.security.trustassociation.myTAItype.config = C:/WebSphere/AppServer/properties/myTAI.properties`

Method 2:

You can set the `com.ibm.websphere.security.trustassociation.initPropsFile` property in the trust association custom properties to the location of the file. For example, set the following property:

```
com.ibm.websphere.security.trustassociation.initPropsFile=
C:/WebSphere/AppServer/properties/myTAI.properties
```

The previous line of code was split into two lines due to the width of the screen. Type as one continuous line.

However, it is highly recommened that your implementation be changed to implement the init(Properties) method instead of relying on init (String propsfile) method.

Migrating custom trust association interceptors

The trust associations from previous versions of WebSphere Application Server are not migrated to version 5. Users can manually migrate these trust asociations using the following steps:

1. Recompile the implementation file, if necessary.

   For more information, refer to the ″Changes to the custom trust association interceptors″ section previously discussed in this document.

   To recompile the implementation file, type the following:

   ```
   %WAS_HOME%/java/bin/javac -classpath %WAS_HOME%/lib/wssec.jar;
   %WAS_HOME%/lib/j2ee.jar <your implementation file>.java
   ```

   Note: The previous line of code was broken into two lines due to the width of the page. Type the code as one continuous line.
2. Copy the custom trust association interceptor class files to a location in your product class path. It is suggested that you copy these class files into the `%WAS_HOME%/lib/ext` directory.
3. Start the WebSphere Application Server
4. Enable security to use the trust association interceptor. *The properties located in your custom trust association properties file and in the `trustedserver.properties` file are not migrated from previous versions of WebSphere Application Server to version 5. You must migrate the appropriate properties to WebSphere Application Server, version 5 using the trust association panels in the GUI.* For more information, see Configuring trust association interceptors.

Migrating Common Object Request Broker Architecture programmatic login to Java Authentication and Authorization Service

WebSphere Application Server Version 5 fully supports the Java Authentication and Authorization Service (JAAS) as programmatic login APIs. See Configuring Java Authentication and Authorization Service and Developing with JAAS to log in programmatically, for more details on JAAS support.

This document outlines the deprecated Common Object Request Broker Architecture (CORBA) programmatic login APIs and the alternatives provided by JAAS. The following are the deprecated CORBA programmatic login APIs:

- `${user.install.root}/installedApps/sampleApp.ear/default_app.war/WEB-INF/classes/LoginHelper.java`.

  The `sampleApp` is not included in Version 5.
- `${user.install.root}/installedApps/sampleApp.ear/default_app.war/WEB-INF/classes/ServerSideAuthenticator.java`.

  The `sampleApp` is not included in Version 5.
- **com.ibm.IExtendedSecurity._LoginHelper**.

  This API is included with the product, but is deprecated.
- **org.omg.SecurityLevel2.Credentials**. This API is included with the product, but not recommended to use.

The alternative APIs provided in WebSphere Application Server Version 5 are a combination of standard JAAS APIs and a product implementation of standard JAAS interfaces.

5.1.1 The following information is only a summary; refer to the JAAS documentation for your platform located at `http://www.ibm.com/developerworks/java/jdk/security/` and the product Javadoc (`${was.install.root}/web/apidocs/index.html`) for details.

- Programmatic login APIs:
  - javax.security.auth.login.LoginContext
  - javax.security.auth.callback.CallbackHandler interface: The WebSphere Application Server product provides the following implementation of the javax.security.auth.callback.CallbackHandler interface:
    - **com.ibm.websphere.security.auth.callback.WSCallbackHandlerImpl**: A non-prompt CallbackHandler, application pushes basic authentication data (user ID, password, and security realm) or token data to product LoginModules. This API is recommended for server-side login.
    - **com.ibm.websphere.security.auth.callback.WSGUICallbackHandlerImpl**: A GUI login prompt CallbackHandler to gather basic authentication data (user ID, password, and security realm). This API is recommended for client-side login.

      Note: If this API is used on the server side, the server is blocked for input.
    - **com.ibm.websphere.security.auth.callback.WSStdinCallbackHandlerImpl**: A stdin login prompt CallbackHandler to gather basic authentication data (user ID, password, and security realm). This API is recommended for client-side login.

      Note: If this API is used on the server side, the server is blocked for input.
  - javax.security.auth.callback.Callback interface:
    - **javax.security.auth.callback.NameCallback**: Provided by JAAS to pass the user name to the LoginModules interface.
    - **javax.security.auth.callback.PasswordCallback**: Provided by JAAS to pass the password to the LoginModules interface.
    - **com.ibm.websphere.security.auth.callback.WSCredTokenCallbackImpl**: Provided by the product to perform a token-based login. With this API, an application can pass a token-byte array to the LoginModules interface.
  - **javax.security.auth.spi.LoginModule interface**: WebSphere Application Server provides LoginModules implementation for client and server-side login. Refer to Configuring Java Authentication and Authorization Service for details.
- javax.security.Subject:
  - **com.ibm.websphere.security.auth.WSSubject**: An extension provided by the product to invoke remote J2EE resources using the credentials in the javax.security.Subject
  - **com.ibm.websphere.security.cred.WSCredential**: After a successful JAAS login with the WebSphere Application Server LoginModules intefaces, a `com.ibm.websphere.security.cred.WSCredential` credentials is created and stored in the Subject.
  - **com.ibm.websphere.security.auth.WSPrincipal**: An authenticated principal, that is created and stored in a Subject that is authenticated by the WebSphere LoginModules interface.

1. Use the following as an example of how to perform programmatic login using the CORBA-based programmatic login APIs: The CORBA-based programmatic login APIs are replaced by JAAS login.

```
public class TestClient {
...
private void performLogin() {
// Get the ID and password of the user.
String userid = customGetUserid();
String password = customGetPassword();

// Create a new security context to hold authentication data.
LoginHelper loginHelper = new LoginHelper();
try {
// Provide the ID and password of the user for authentication.
org.omg.SecurityLevel2.Credentials credentials =
loginHelper.login(userid, password);

// Use the new credentials for all future invocations.
loginHelper.setInvocationCredentials(credentials);
// Retrieve the name of the user from the credentials
// so we can tell the user that login succeeded.

String username = loginHelper.getUserName(credentials);
System.out.println("Security context set for user: "+username);
} catch (org.omg.SecurityLevel2.LoginFailed e) {
// Handle the LoginFailed exception.
}
}
...
}
```

2. Use the following example to migrate the CORBA-based programmatic login APIs to the JAAS programmatic login APIs. The following example assumes that the application code is granted for the required Java 2 security permissions. See Configuring Java Authentication and Authorization Service, Configuring Java 2 security and JAAS documentation located in the ${was.install.root}/web/docs/jaas/JaasDocs.zip file for details.

```
public class TestClient {
...
private void performLogin() {
// Create a new JAAS LoginContext.
javax.security.auth.login.LoginContext lc = null;

try {
// Use GUI prompt to gather the BasicAuth data.
lc = new javax.security.auth.login.LoginContext("WSLogin",
new com.ibm.websphere.security.auth.callback.WSGUICallbackHandlerImpl());

// create a LoginContext and specify a CallbackHandler implementation
// CallbackHandler implementation determine how authentication data is collected
// in this case, the authentication date is collected by GUI login prompt
//   and pass to the authentication mechanism implemented by the LoginModule.
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: failed to instantiate a LoginContext and the exception: "
+ e.getMessage());
e.printStackTrace();

// may be javax.security.auth.AuthPermission "createLoginContext" is not granted
//   to the application, or the JAAS Login Configuration is not defined.
```

```
}

if (lc != null)
try {
lc.login();  // perform login
javax.security.auth.Subject s = lc.getSubject();
// get the authenticated subject

// Invoke a J2EE resources using the authenticated subject
com.ibm.websphere.security.auth.WSSubject.doAs(s,
new java.security.PrivilegedAction() {
public Object run() {
try {
bankAccount.deposit(100.00);  // where bankAccount is an protected EJB
} catch (Exception e) {
System.out.println("ERROR: error while accessing EJB resource, exception: "
+ e.getMessage());
e.printStackTrace();
}
return null;
}
}
);

// Retrieve the name of the principal from the Subject
// so we can tell the user that login succeeded,
// should only be one WSPrincipal.
java.util.Set ps =
s.getPrincipals(com.ibm.websphere.security.auth.WSPrincipal.class);
java.util.Iterator it = ps.iterator();
while (it.hasNext()) {
com.ibm.websphere.security.auth.WSPrincipal p =
(com.ibm.websphere.security.auth.WSPrincipal) it.next();
System.out.println("Principal: " + p.getName());
}
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: login failed with exception: " + e.getMessage());
e.printStackTrace();

// login failed, might want to provide relogin logic
}
}
...
}
```

Migrating CORBA-based programmatic login application to JAAS-based applications.

Migrating from the CustomLoginServlet class to servlet filters

The CustomLoginServlet class is deprecated in Version 5. Those applications using the CustomLoginServlet class to perform authentication now need to use form-based login. Using the form-based login mechanism, you can control the look and feel of the login screen. In form-based login, a login page is specified that displays when retrieving the user ID and password information. You also can specify an error page that displays when authentication fails.

If login and error pages are not enough to implement the CustomLoginServlet class, use servlet filters. Servlet filters can dynamically intercept requests and responses to transform or use the information contained in the requests or responses. One or more servlet filters attach to a servlet or a group of servlets. Servlet filters also can attach to JSP files and HTML pages. All the attached servlet filters are called before invoking the servlet.

Both form-based login and servlet filters are supported by any Servlet 2.3 specification-compliant Web container. A form login servlet performs the authentication and servlet filters can perform additional authentication,auditing, or logging tasks.

To perform pre-login and post-login actions using servlet filters, configure these servlet filters for either form login page or for `/j_security_check` URL. The `j_security_check` is posted by the form login page with the `j_username` parameter, containing the user name and the `j_password` parameter containing the password. A servlet filter can use user name and password information to perform more authentication or meet other special needs.

1. Develop a form login page and error page for the application, as described in "Developing form login pages" on page 46.
2. Configure the form login page and the error page for the application as described in "Securing Web applications using the Assembly Toolkit" on page 114.
3. Develop servlet filters if additional processing is required before and after form login authentication. Refer to "Developing servlet filters for form login processing" on page 41 for details.
4. Configure the servlet filters developed in the previous step for either the form login page URL or for the `/j_security_check` URL. Use an assembly tool or development tools like WebSphere Application Development Studio to configure filters. After configuring the servlet filters, the `web-xml` file contains two stanzas. The first stanza contains the servlet filter configuration, the servlet filter, and its implementation class. The second stanza contains the filter mapping section and a mapping of the servlet filter to the URL. In this case, the servlet filter maps to /j_security_check.

```
<filter id="Filter_1">
   <filter-name>LoginFilter</filter-name>
   <filter-class>LoginFilter</filter-class>
   <description>Performs pre-login and post-login operation</description>
   <init-param>
    <param-name>ParamName</param-name>
   <param-value>ParamValue</param-value>
  <init-param>
 </filet>

 <filter-mapping>
  <filter-name>LoginFilter</filter-name>
  <url-pattern>/j_security_check</url-pattern>
  </filter-mapping>
```

This migration results in an application that uses form-based login and servlet filters without the use of the CustomLoginServlet class.

The use of form-based login and servlet filters by the new application are used to replace the CustomLoginServlet class. Servlet filters also are used to perform additional authentication, auditing and logging.

Developing secured applications

IBM WebSphere Application Server provides security components that provide or collaborate with other services to provide authentication, authorization, delegation, and data protection. WebSphere Application Server also supports the security features described in the Java 2 Enterprise Edition (J2EE) specification. An application goes through three stages before it is ready to run:

- Development
- Assembly
- Deployment

Most of the security for an application is configured during the assembly stage. The security configured during the assembly stage is called *declarative security* because the security is *declared* or *defined* in the deployment descriptors. The declarative security is enforced by the security run time. For some applications, declarative security is not sufficient to express the security model of the application. For these applications, you can use *programmatic security*.

1. Develop secure Web applications. For more information, see "Developing with programmatic security APIs for Web applications."
2. Develop servlet filters for form login processing. For more information, see "Developing servlet filters for form login processing" on page 41.
3. Develop form login pages. For more information, see "Developing form login pages" on page 46.
4. Develop enterprise bean component applications. For more information, see "Developing with programmatic APIs for EJB applications" on page 50.
5. Develop with Java Authentication and Authorization Service to log in programmatically. For more information, see "Developing programmatic logins with the Java Authentication and Authorization Service" on page 62.
6. Develop your own Java 2 security mapping module. For more information, see "Configuring application logins for Java Authentication and Authorization Service" on page 243.
7. Develop custom user registries. For more information, see "Developing custom user registries" on page 94.
8. 5.1.1 Develop a custom interceptor for trust associations. For more information, see 5.1.1 "Trust association interceptor support for Subject creation" on page 108

Developing with programmatic security APIs for Web applications

Programmatic security is used by security-aware applications when declarative security alone is not sufficient to express the security model of the application. Programmatic security consists of the following methods of the HttpServletRequest interface:

getRemoteUser()

Returns the user name the client used for authentication. Returns **null** if no user is authenticated.

isUserInRole
(String role name): Returns **true** if the remote user is granted the specified security role. If the remote user is not granted the specified role, or if no user is authenticated, it returns **false**.

getUserPrincipal()
Returns the java.security.Principal object containing the remote user name. If no user is authenticated, it returns **null**.

When the `isUserInRole()` method is used, declare a security-role-ref element in the deployment descriptor with a `role-name` subelement containing the role name passed to this method. Since actual roles are created during the assembly stage of the application, you can use a logical role as the role name and provide enough hints to the assembler in the description of the security-role-ref element to link that role to the actual role. During assembly, the assembler creates a role-link subelement to link the role name to the actual role. Creation of a security-role-ref element is possible if development tools such as WebSphere Studio Application Developer is used. You also can create the security-role-ref element during assembly stage using the assembly tool.

1. Add the required security methods in the servlet code.
2. Create a security-role-ref element with the **role-name** field. If a security-role-ref element is not created during development, make sure it is created during the assembly stage.

A programmatically secured servlet application.

This step is required to secure an application programmatically. This action is particularly useful is when a Web application wants to access external resources and wants to control the access to external resources using its own authorization table (external-resource to remote-user mapping). In this case, use the `getUserPrincipal()` or `getRemoteUser()` methods to get the remote user and then it can consult its own authorization table to perform authorization. The remote user information also can help retrieve the corresponding user information from an external source such as a database or from an enterprise bean. You can use the isUserInRole() method in a similar way.

After development, a security-role-ref element can be created:

```
<security-role-ref>
<description>Provide hints to assembler for linking this role
name to an actual role here<\description>
<role-name>Mgr<\role-name>
</security-role-ref>
```

During assembly, the assembler creates a role-link element:

```
<security-role-ref>
<description>Hints provided by developer to map the role
name to the role-link</description>
<role-name>Mgr</role-name>
<role-link>Manager</role-link>
</security-role-ref>
```

You can add programmatic servlet security methods inside any servlet doGet(), doPost(), doPut(), doDelete() service methods. The following example depicts using a programmatic security API:

```
public void doGet(HttpServletRequest request,
HttpServletResponse response) {

   ....

   // to get remote user using getUserPrincipal()
   java.security.Principal principal = request.getUserPrincipal();
   String remoteUser = principal.getName();

   // to get remote user using getRemoteUser()
   remoteUser = request.getRemoteUser();

   // to check if remote user is granted Mgr role
   boolean isMgr = request.isUserInRole("Mgr");

   // use the above information in any way as needed by
   // the application
   ....

}
```

After developing an application, use the Assembly Toolkit to create roles and to link the actual roles to role names in the security-role-ref elements. For more information, see "Securing Web applications using the Assembly Toolkit" on page 114.

Example: Web applications code

The following example depicts a Web application or servlet using the programmatic security model. The following example is one usage and not necessarily the only usage of the programmatic security model. The application can use the information returned by the `getUserPrincipal()`, `isUserInRole()` and `getRemoteUser()` methods in any other way that is meaningful to that application. Using the declarative security model whenever possible is strongly recommended.

File : HelloServlet.java

```
public class HelloServlet extends javax.servlet.http.HttpServlet {

 public void doPost(
  javax.servlet.http.HttpServletRequest request,
  javax.servlet.http.HttpServletResponse response)
  throws javax.servlet.ServletException, java.io.IOException {
 }
public void doGet(
  javax.servlet.http.HttpServletRequest request,
  javax.servlet.http.HttpServletResponse response)
  throws javax.servlet.ServletException, java.io.IOException {

        String s = "Hello";


        // get remote user using getUserPrincipal()
        java.security.Principal principal = request.getUserPrincipal();
        String remoteUserName = "";
        if( principal != null )
          remoteUserName = principal.getName();
// get remote user using getRemoteUser()
```

```
        String remoteUser = request.getRemoteUser();

        // check if remote user is granted Mgr role
        boolean isMgr = request.isUserInRole("Mgr");

        // display Hello username for managers and bob.
        if ( isMgr || remoteUserName.equals("bob") )
            s = "Hello " + remoteUserName;

   String message =  "<html> \n" +
              "<head><title>Hello Servlet</title></head>\n" +
         "<body> /n +"
    "<h1> "  +s+ </h1>/n " +
  byte[] bytes = message.getBytes();

  // displays "Hello" for ordinary users
        // and displays "Hello username" for managers and "bob".
        response.getOutputStream().write(bytes);
 }

}
```

After developing the servlet, you can create a security role reference for the HelloServlet as shown in the following example:

```
<security-role-ref>
<description> </description>
<role-name>Mgr</role-name>
</security-role-ref>
```

Developing servlet filters for form login processing

You can control the look and feel of the login screen using the form-based login mechanism. In form-based login, you specify a login page that is used to retrieve the user ID and password information. You also can specify an error page that displays when authentication fails.

If additional authentication or additional processing is required before and after authentication, servlet filters are an option. Servlet filters can dynamically intercept requests and responses to transform or use the information contained in the requests or responses. One or more servlet filters can attach to a servlet or a group of servlets. Servlet filters also can attach to JSP files and HTML pages. All the attached servlet filters are called before the servlet is invoked.

Both form-based login and servlet filters are supported by any servlet version 2.3 specification complaint Web container. The form login servlet performs the authentication and servlet filters perform additional authentication, auditing, or logging information.

To perform pre-login and post-login actions using servlet filters, configure these filters for either form login page support or for the `/j_security_check` URL. The j_security_check is posted by a form login page with the `j_username` parameter containing the user name and the j_password parameter containing the password. A servlet filter can use the user name parameter and password information to perform more authentication or other special needs.

A servlet filter implements the javax.servlet.Filter class. There are three methods in the filter class that need implementing:

- **init(javax.servlet.FilterConfig cfg)**. This method is called by the container exactly once when the servlet filter is placed into service. The `FilterConfig` passed to this method contains the init-parameters of the servlet filter. Specify the init-parameters for a servlet filter during configuration using the assembly tool.
- **destroy()**. This method is called by the container when the servlet filter is taken out of a service.
- **doFilter(ServletRequest req, ServletResponse res, FilterChain chain)**. This method is called by the container for every servlet request that maps to this filter before invoking the servlet. FilterChain passed to this method can be used to invoke the next filter in the chain of filters. The original requested servlet executes when the last filter in the chain calls the `chain.doFilter()` method. Therefore, all filters should call the chain.doFilter() method for the original servlet to execute after filtering. If an additional authentication check is implemented in the filter code and results in failure, the original servlet does not be execute. The chain.doFilter() method is not called and can be redirected to some other error page.

If a servlet maps to many servlet filters, servlet filters are called in the order that is listed in the deployment descriptor of the application (`web.xml`).

An example of a servlet filter follows: This login filter can map to /j_security_check to perform pre-login and post-login actions.

```
import javax.servlet.*;

     public class LoginFilter implements Filter {

     protected FilterConfig filterConfig;

     // Called once when this filter is instantiated.
     // If mapped to j_security_check, called
     // very first time j_security_check is invoked.
     public void init(FilterConfig filterConfig) throws ServletException {
        this.filterConfig = filterConfig;
        }

     public void destroy() {
        this.filterConfig = null;
        }

     // Called for every request that is mapped to this filter.
     // If mapped to j_security_check,
     // called for every  j_security_check action
     public void doFilter(ServletRequest request,
     ServletResponse response, FilterChain chain)
         throws java.io.IOException, ServletException   {

         // perform pre-login action here

         chain.doFilter(request, response);
         // calls the next filter in chain.

         // j_security_check if this filter is
```

```
        // mapped to j_security_check.

       // perform post-login action here.

                }
      }
```

Place the servlet filter class file in the `WEB-INF/classes` directory of the application.

Configuring servlet filters:

WebSphere Application Development Studio or the Assembly Toolkit can configure the servlet filters.

There are two steps in configuring a servlet filter.

1. Name the servlet filter and assign the corresponding implementation class to the servlet filter.

   Optionally, assign initialization parameters that get passed to the `init()` method of the servlet filter.After configuring the servlet filter, the application deployment descriptor, `web.xml`, contains a servlet filter configuration similar to the following example:

   ```
   <filter id="Filter_1">
      <filter-name>LoginFilter</filter-name>
      <filter-class>LoginFilter</filter-class>
      <description>Performs pre-login and post-login
           operation</description>
      <init-param>// optional
        <param-name>ParameterName</param-name>
        <param-value>ParameterValue</param-value>
      </init-param>
   </filter>
   ```

2. Map the servlet filter to URL or servlet.

   After mapping the servlet filter to a servlet or a URL, the application deployment descriptor (`web.xml`) contains servlet mapping similar to the following example:

   ```
   <filter-mapping>
      <filter-name>LoginFilter</filter-name>
      <url-pattern>/j_security_check</url-pattern>
                  // can be servlet <servlet>servletName</servlet>
   </filter-mapping>
   ```

You can use servlet filters to replace the CustomLoginServlet, and to perform additional authentication, auditing, and logging.

Example: Servlet filters: This example illustrates one way the servlet filters can perform pre-login and post-login processing during form login.

```
Servlet filter source code: LoginFilter.java
/**
 * A servlet filter example: This example filters j_security_check and
 * performs pre-login action to determine if the user trying to log in
 * is in the revoked list. If the user is on the revoked list, an error is
```

```
 * sent back to the browser.
 *
 * This filter reads the revoked list file name from the FilterConfig
 * passed in the init() method. It reads the revoked user list file and
 * creates a revokedUsers list.
 *
 * When the doFilter method is called, the user logging in is checked
 * to make sure that the user is not on the revoked Users list.
 *
 */

import javax.servlet.*;
import javax.servlet.http.*;
import java.io.*;

public class LoginFilter implements Filter {

   protected FilterConfig filterConfig;

   java.util.List revokeList;


   /**
    * init() : init() method called when the filter is instantiated.
    * This filter is instantiated the first time j_security_check is
    * invoked for the application (When a protected servlet in the
    * application is accessed).
    */
   public void init(FilterConfig filterConfig) throws ServletException {
      this.filterConfig = filterConfig;

      // read revoked user list
      revokeList = new java.util.ArrayList();
      readConfig();
   }


   /**
    * destroy() : destroy() method called when the filter is taken
    * out of service.
    */
   public void destroy() {
      this.filterConfig = null;
      revokeList = null;
   }

   /**
    * doFilter() : doFilter() method called before the servlet to
    * which this filteris mapped is invoked. Since this filter is
    * mapped to j_security_check,this method is called before
    * j_security_check action is posted.
    */
   public void doFilter(ServletRequest request, ServletResponse response,
FilterChain chain) throws java.io.IOException, ServletException {
```

```
        HttpServletRequest req = (HttpServletRequest)request;
        HttpServletResponse res = (HttpServletResponse)response;

        // pre login action

        // get username
        String username = req.getParameter("j_username");

        // if user is in revoked list send error
        if ( revokeList.contains(username) ) {
        res.sendError(javax.servlet.http.HttpServletResponse.SC_UNAUTHORIZED);
        return;
        }

        // call next filter in the chain : let j_security_check authenticate
        // user
        chain.doFilter(request, response);

        // post login action

    }

    /**
     * readConfig() : Reads revoked user list file and creates a revoked
     * user list.
     */
    private void readConfig() {
        if ( filterConfig != null ) {

            // get the revoked user list file and open it.
            BufferedReader in;
            try {
                  String filename = filterConfig.getInitParameter("RevokedUsers");
                  in = new BufferedReader( new FileReader(filename));
            } catch ( FileNotFoundException fnfe) {
                  return;
            }

            // read all the revoked users and add to revokeList.
            String userName;
            try {
                  while ( (userName = in.readLine()) != null )
                      revokeList.add(userName);
            } catch (IOException ioe) {
            }

        }

    }


}
```

Important: In the previous code sample, the line that begins `public void doFilter(ServletRequest request` was broken into two lines due to

the width of the page. The `public void doFilter(ServletRequest request` line and the line after it are one continuous line.

Portion of the `web.xml` file showing the LoginFilter configured and mapped to j_security_check:

```
<filter id="Filter_1">
    <filter-name>LoginFilter</filter-name>
    <filter-class>LoginFilter</filter-class>
        <description>Performs pre-login and post-login operation</description>
    <init-param>
    <param-name>RevokedUsers</param-name>
    <param-value>c:\WebSphere\AppServer\installedApps\
                                <app-name>\revokedUsers.lst</param-value>
    </init-param>
</filter-id>

<filter-mapping>
 <filter-name>LoginFilter</filter-name>
     <url-pattern>/j_security_check</url-pattern>
</filter-mapping>
```

An example of a revoked user list file:

```
user1
cn=user1,o=ibm,c=us
user99
cn=user99,o=ibm,c=us
```

Developing form login pages

A Web client or browser can authenticate a user to a Web server using one of the following mechanisms:

- **HTTP basic authentication**: A Web server requests the Web client to authenticate and the Web client passes a user ID and password in the HTTP header.
- **HTTPS client authentication**: This mechanism requires a user (Web client) to possess a public key certificate. The Web client sends the certificate to a Web server that requests the client certificates. This is a strong authentication mechanism and uses the Hypertext Transfer Protocol with Secure Sockets Layer (HTTPS) protocol.
- **Form-based Authentication**: A developer controls the look and feel of the login screens using this authentication mechanism.

The Hypertext Transfer Protocol (HTTP) basic authentication transmits a user password from the Web client to the Web server in simple base64 encoding. Form-based authentication transmits a user password from the browser to the Web server in plain text. Therefore, both HTTP basic authentication and form-based authentication are not very secure unless the HTTPS protocol is used.

The Web application deployment descriptor contains information about which authentication mechanism to use. When form-based authentication is used, the deployment descriptor also contains entries for login and error pages. A login page can be either an HTML page or a JavaServer pages (JSP) page. This login page displays on the Web client side when a secured resource (servlet, JSP file, HTML page) is accessed from the application. On authentication failure, an error page displays. You can write login and error pages to suit the application needs and

control the look and feel of these pages. During assembly of the application, an assembler can set the authentication mechanism for the application and set the login and error pages in the deployment descriptor.

Form login uses the servlet sendRedirect() method, which has several implications for the user. The sendRedirect() method is used twice during form login:

- The sendRedirect() method initially displays the form login page in the Web browser. It later redirects the Web browser back to the originally requested protected page. The sendRedirect(String URL) method tells the Web browser to use the HTTP GET (not the HTTP POST) request to get the page specified in the URL. If HTTP POST is the first request to a protected servlet or JavaServer pages (JSP) file, and no previous authentication or login occurred, then HTTP POST is not delivered to the requested page. However, HTTP GET is delivered because form login uses the sendRedirect() method, which behaves as an HTTP GET request that tries to display a requested page after a login occurs.
- Using HTTP POST, you might experience a scenario where an unprotected HTML form collects data from users and then posts this data to protected servlets or JSP files for processing, but the users are not logged in for the resource. To avoid this scenario, structure your Web application or permissions so that users are forced to use a form login page before the application performs any HTTP POST actions to protected servlets or JSP files.

See the "Example: Form login" article for sample form login pages.

1. Create a form login page with the required look and feel including the required elements to perform form-based authentication. For an example, see "Example: Form login"
2. Create an error page. You can program error pages to retry authentication or display an appropriate error message.
3. Place the login page and error page in the Web archive (WAR) file relative to the top directory. For example, if the login page is configured as `/login.html` in the deployment descriptor, place it in the top directory of the WAR file. An assembler can also perform this step using the assembly tool.
4. Create a form logout page and insert it to the application only if required.

This step is required when a Web application requires a form-based authentication mechanism.

After developing login and error pages, add them to the Web application. Use the assembly tool to configure an authentication mechanism and insert the developed login page and error page in the deployment descriptor of the application.

Example: Form login

For the authentication to proceed appropriately, the action of the login form must always be `j_security_check`. The following example shows how to code the form into the HTML page:

```
<form method="POST" action="j_security_check">
<input type="text" name="j_username">
<input type="text" name="j_password">
<\form>
```

use the **j_username** input field to get the user name and use the **j_password** input field to get the user password.

On receiving a request from a Web client, the Web server sends the configured form page to the client and preserves the original request. When the Web server receives the completed Form page from the Web client, it extracts the user name and password from the form and authenticates the user. On successful authentication, the Web server redirects the call to the original request. If authentication fails, the Web server redirects the call to the configured error page.

The following example depicts a login page in HTML (`login.html`):

```
<!DOCTYPE HTML PUBLIC "-//W3C/DTD HTML 4.0 Transitional//EN">
<html>
<META HTTP-EQUIV = "Pragma" CONTENT="no-cache">
<title> Security FVT Login Page </title>
<body>
<h2>Form Login</h2>
<FORM METHOD=POST ACTION="j_security_check">
<p>
<font size="2"> <strong> Enter user ID and password: </strong></font>
<BR>
<strong> User ID</strong> <input type="text" size="20" name="j_username">
<strong> Password </strong>  <input type="password" size="20" name="j_password">
<BR>
<BR>
<font size="2">  <strong> And then click this button: </strong></font>
<input type="submit" name="login" value="Login">
</p>

</form>
</body>
</html>
```

The following example depicts an error page in a JSP file:

```
<!DOCTYPE HTML PUBLIC "-//W3C/DTD HTML 4.0 Transitional//EN">
<html>
<head><title>A Form login authentication failure occurred</head></title>
<body>
<H1><B>A Form login authentication failure occurred</H1></B>
<P>Authentication may fail for one of many reasons. Some possibilities include:
<OL>
<LI>The user-id or password may be entered incorrectly; either misspelled or the
wrong case was used.
<LI>The user-id or password does not exist, has expired, or has been disabled.
</OL>
</P>


</body>
</html>
```

After an assembler configures the Web application to use form-based authentication, the deployment descriptor contains the login configuration as shown:

```
<login-config id="LoginConfig_1">
<auth-method>FORMauth-method>FORM>
```

```
<realm-name>Example Form-Based Authentication Area</realm-name>
<form-login-config id="FormLoginConfig_1">
<form-login-page>/login.html</form-login-page>
<form-error-page>/error.jsp</form-error-page>
</form-login-config>
</login-config>
```

A sample Web application archive (WAR) file directory structure showing login and error pages for the previous login configuration:

```
META-INF
     META-INF/MANIFEST.MF
     login.html
     error.jsp
     WEB-INF/
     WEB-INF/classes/
     WEB-INF/classes/aServlet.class
```

Form logout

Form logout is a mechanism to log out without having to close all Web-browser sessions. After logging out the form logout mechanism, access to a protected Web resource requires reauthentication. This feature is not required by J2EE specifications, but is provided as an additional feature in WebSphere security.

Suppose that it is desirable to log out after logging into a Web application and perform some actions. A form logout works in the following manner:
1. The logout-form URI is specified in the Web browser and loads the form.
2. The user clicks **Submit** on the form to log out.
3. The WebSphere security code logs the user out.
4. Upon logout, the user is redirected to a logout exit page.

Form logout does not require any attributes in a deployment descriptor. It is an HTML or JSP file that is included with the Web application. The form-logout page is like most HTML forms except that like the form-login page, it has a special post action. This post action is recognized by the Web container, which dispatches it to a special internal WebSphere form-logout servlet. The post action in the form-logout page must be `ibm_security_logout`.

You can specify a logout-exit page in the logout form and the exit page can represent an HTML or JSP file within the same Web application to which that the user is redirected after logging out. The logout-exit page is specified as a parameter in the form-logout page. If no logout-exit page is specified, a default logout HTML message is returned to the user. Here is a sample form logout HTML form. This form configures the logout-exit page to redirect the user back to the login page after logout.

```
<!DOCTYPE HTML PUBliC "-//W3C/DTD HTML 4.0 Transitional//EN">
<html>
  <META HTTP-EQUIV = "Pragma" CONTENT="no-cache">
  <title>Logout Page </title>
  <body>
  <h2>Sample Form Logout</h2>
      <FORM METHOD=POST ACTION="ibm_security_logout" NAME="logout">
      <p>
      <BR>
```

```
      <BR>
      <font size="2"><strong> Click this button to log out: </strong></font>
      <input type="submit" name="logout" value="Logout">
      <INPUT TYPE="HIDDEN" name="logoutExitPage" VALUE="/login.html">
      </p>
      </form>
  </body>
</html>
```

Developing with programmatic APIs for EJB applications

Programmatic security is used by security-aware applications when declarative security alone is not sufficient to express the security model of the application. The `javax.ejb.EJBContext` interface provides two methods whereby the bean provider can access security information about the enterprise bean caller.

- **IsCallerInRole**(String rolename): Returns true if the bean caller is granted the specified security role (specified by role name). If the caller is not granted the specified role, or if the caller is not authenticated, it returns false. If the specified role is granted **Everyone** access, it always returns true.
- **getCallerPrincipal()**: Returns the java.security.Principal object containing the bean caller name. If the caller is not authenticated, it returns a principal containing UNAUTHENTICATED name.

When the `isCallerInRole()` method is used, declare a security-role-ref element in the deployment descriptor with a role-name subelement containing the role name passed to this method. Since actual roles are created during the assembly stage of the application, you can use a logical role as the role name and provide enough hints to the assembler in the description of the security-role-ref element to link that role to actual role. During assembly, assembler creates a role-link sub element to link the role-name to the actual role. Creation of a security-role-ref element is possible if development tools such as WebSphere Studio Application Developer is used. You also can create the security-role-ref element during the assembly stage using an assembly tool.

1. Add the required security methods in the EJB module code.
2. Create a security-role-ref element with a role-name field for all the role names used in the `isCallerInRole()` method. If a security-role-ref element is not created during development, make sure it is created during the assembly stage.

A programmatically secured EJB application.

Hard coding security policies in applications is strongly discouraged. The Java 2 Platform, Enterprise Edition (J2EE) security model capabilities of declaratively specifying security policies is encouraged wherever possible. Use these APIs to develop security-aware EJB applications. An example where this implementation is useful is when an EJB application wants to access external resources and wants to control the access to these external resources using its own authorization table (external-resource to user mapping). In this case, use the `getCallerPrincipal()` method to get the caller identity and then the application can consult its own authorization table to perform authorization. The caller identification also can help retrieve the corresponding user information from an external source, such as database or from another enterprise bean. You can use the isCallerInRole() method in a similar way.

After development, a security-role-ref element can be created:

```
<security-role-ref>
<description>Provide hints to assembler for linking this role-name to
actual role here<\description>
<role-name>Mgr<\role-name>
</security-role-ref>
```

During assembly, the assembler creates a role-link element:

```
<security-role-ref>
<description>Hints provided by developer to map role-name to role-link</description>
<role-name>Mgr</role-name>
<role-link>Manager</role-link>
</security-role-ref>
```

You can add programmatic EJB component security methods (isCallerInRole() and getCallerPrincipal()) inside any business methods of an enterprise bean. The following example of programmatic security APIs includes a session bean:

```
public class aSessionBean implements SessionBean {

       .....

       // SessionContext extends EJBContext. If it is entity bean use EntityContext
       javax.ejb.SessionContext context;

       // The following method will be called by the EJB container
       // automatically
       public void setSessionContext(javax.ejb.SessionContext ctx) {
              context = ctx; // save the session bean's context
       }

       ....

       private  void aBusinessMethod()  {
       ....

       // to get  bean's caller using getCallerPrincipal()
       java.security.Principal principal = context.getCallerPrincipal();
       String  callerId= principal.getName();

       // to check if  bean's caller is granted Mgr role
       boolean isMgr = context.isCallerInRole("Mgr");

       // use the above information in any way as needed by the
       //application

       ....
       }

       ....
}
```

After developing an application, use the Assembly Toolkit to create roles and to link the actual roles to role names in the security-role-ref elements. For more information, see "Securing enterprise bean applications using the Assembly Toolkit" on page 111.

Example: Enterprise bean application code

The following EJB component example illustrates the use of isCallerInRole() and getCallerPrincipal() methods in an EJB module. Using that declarative security is recommended. The following example is one way of using the isCallerInRole() and getCallerPrincipal() methods. The application can use this result in any way that is suitable.

A remote interface

```
File : Hello.java

package tests;
import java.rmi.RemoteException;
/**
 * Remote interface for Enterprise Bean: Hello
 */
public interface Hello extends javax.ejb.EJBObject {
      public abstract String getMessage()throws RemoteException;
     public abstract void setMessage(String s)throws RemoteException;
}
```

A home interface

```
File : HelloHome.java
package tests;
/**
 * Home interface for Enterprise Bean: Hello
 */
public interface HelloHome extends javax.ejb.EJBHome {
 /**
  * Creates a default instance of Session Bean: Hello
  */
 public tests.Hello create() throws javax.ejb.CreateException,
  java.rmi.RemoteException;
}
```

A bean implementation

```
File : HelloBean.java

package tests;
/**
 * Bean implementation class for Enterprise Bean: Hello
 */
public class HelloBean implements javax.ejb.SessionBean {
 private javax.ejb.SessionContext mySessionCtx;
 /**
  * getSessionContext
  */
 public javax.ejb.SessionContext getSessionContext() {
  return mySessionCtx;
 }
 /**
  * setSessionContext
  */
 public void setSessionContext(javax.ejb.SessionContext ctx) {
```

```
 mySessionCtx = ctx;
}
/**
 * ejbActivate
 */
public void ejbActivate() {
}
/**
 * ejbCreate
 */
public void ejbCreate() throws javax.ejb.CreateException {
}
/**
 * ejbPassivate
 */
public void ejbPassivate() {
}
/**
 * ejbRemove
 */
public void ejbRemove() {
}

public java.lang.String message;


     //business methods

     // all users can call getMessage()
     public String getMessage() throws java.rmi.RemoteException {
         return message;
     }

     // all users can call setMessage() but only few users can set new message.
     public void setMessage(String s) throws java.rmi.RemoteException {

       // get  bean's caller using getCallerPrincipal()
       java.security.Principal principal = mySessionCtx.getCallerPrincipal();
       java.lang.String  callerId= principal.getName();

       // check if  bean's caller is granted Mgr role
       boolean isMgr = mySessionCtx.isCallerInRole("Mgr");

       // only set supplied message if caller is "bob" or caller is granted Mgr role
       if ( isMgr || callerId.equals("bob") )
           message = s;
       else
           message = "Hello";
     }

}
```

After development of the entity bean, create a security role reference in the deployment descriptor under the session bean, Hello:

```
<security-role-ref>
<description>Only Managers can call setMessage() on this bean (Hello)</description>
<role-name>Mgr</role-name>
</security-role-ref>
```

For an explanation of how to create a <security-role-ref> element, see "Securing enterprise bean applications using the Assembly Toolkit" on page 111. Use the information under Map security-role-ref and role-name to role-link to create the element.

Programmatic login

Programmatic login is a type of form login that supports application presentation site-specific login forms for the purpose of authentication.

When enterprise bean client applications require the user to provide identifying information, the writer of the application must collect that information and authenticate the user. You can broadly classify the work of the programmer in terms of where the actual user authentication is performed:
- In a client program
- In a server program

Users of Web applications can receive prompts for authentication data in many ways. The <login-config> element in the Web application deployment descriptor file defines the mechanism used to collect this information. Programmers who want to customize login procedures, rather than relying on general purpose devices like a 401 dialog window in a browser, can use a form-based login to provide an application-specific HTML form for collecting login information.

No authentication occurs unless WebSphere Application Server global security is enabled. If you want to use form-based login for Web applications, you must specify FORM in the auth-method tag of the <login-config> element in the deployment descriptor of each Web application.

Applications can present site-specific login forms by using the WebSphere Application Server form-login type. The Java 2 Platform, Enterprise Edition (J2EE) specification defines form login as one of the authentication methods for Web applications. However, the Servlet Version 2.2 specification does not define a mechanism for logging out. WebSphere Application Server extends J2EE by also providing a form-logout mechanism.

Java Authentication and Authorization Service programmatic login

Java Authentication and Authorization Service (JAAS) is a new feature in WebSphere Application Server. It is also mandated by the J2EE 1.3 Specification. JAAS is a collection of WebSphere strategic authentication APIs and replace of the CORBA programmatic login APIs. WebSphere Application Server provides some extensions to JAAS:

Before you begin developing with programmatic login APIs, consider the following points :
- For the pure Java client application or client container application, initialize the client Object Request Broker (ORB) security prior to performing a JAAS login. Do this by executing the following code prior to the JAAS login:

```
...
import java.util.Hashtable;
import javax.naming.Context;
import javax.naming.InitialContext;
...
// Perform an InitialContext and default lookup prior to logging
// in to initialize ORB security and for the bootstrap host/port
// to be determined for SecurityServer lookup. If you do not want
// to validate the userid/password during the JAAS login, disable
// the com.ibm.CORBA.validateBasicAuth property in the
// sas.client.props file.

Hashtable env = new Hashtable();
env.put(Context.INITIAL_CONTEXT_FACTORY,
    "com.ibm.websphere.naming.WsnInitialContextFactory");
env.put(Context.PROVIDER_URL,
     "corbaloc:iiop:myhost.mycompany.com:2809");
Context initialContext = new InitialContext(env);
Object obj = initialContext.lookup("");
```

For more information, see "Example: Programmatic logins" on page 65.

- For the pure Java client application or client container application, make sure that the host name and the port number of the target JNDI bootstrap properties are specified properly. See the Developing applications that use CosNaming (CORBA Naming interface) section for details.
- If the application uses custom JAAS login configuration, make sure that the custom JAAS login configuration is properly defined. See the "Configuring application logins for Java Authentication and Authorization Service" on page 243 section for details.
- Some of the JAAS APIs are protected by Java 2 security permissions. If these APIs are used by application code, make sure that these permissions are added to the application `was.policy` file. See "Adding the was.policy file to applications" on page 467 to the application, "Using PolicyTool to edit policy files" on page 451 and "Configuring the was.policy file" on page 463 sections for details. For more details of which APIs are protected by Java 2 Security permissions, check the IBM Developer Kit, Java edition; JAAS and the WebSphere public APIs Javadoc for more details. The following list indicates the APIs used in the samples code provided in this documentation.
  - javax.security.auth.login.LoginContext constructors are protected by javax.security.auth.AuthPermission "createLoginContext".
  - javax.security.auth.Subject.doAs() and com.ibm.websphere.security.auth.WSSubject.doAs() are protected by javax.security.auth.AuthPermission "doAs".
  - javax.security.auth.Subject.doAsPrivileged() and com.ibm.websphere.security.auth.WSSubject.doAsPrivileged() are protected by javax.security.auth.AuthPermission "doAsPrivileged".
- com.ibm.websphere.security.auth.WSSubject: Due to a design oversight in the JAAS 1.0, javax.security.auth.Subject.getSubject() does not return the Subject associated with the thread of execution inside a java.security.AccessController.doPrivileged() code block. This can present an inconsistent behavior that is problematic and causes undesirable effort. The com.ibm.websphere.security.auth.WSSubject API provides a work around to associate Subject to thread of execution. The com.ibm.websphere.security.auth.WSSubject API extends the JAAS model to J2EE resources for authorization checks. The Subject associated with the thread

of execution within com.ibm.websphere.security.auth.WSSubject.doAs() or com.ibm.websphere.security.auth.WSSubject.doAsPrivileged() code block is used for J2EE resources authorization checks.

- UI support for defining new JAAS login configuration: You can configure JAAS login configuration in the administrative console and store it in the WebSphere Configuration API. Applications can define new JAAS login configuration in the administrative console and the data is persisted in the configuration repository (stored in the WebSphere Configuration API). However, WebSphere Application Server still supports the default JAAS login configuration format (plain text file) provided by the JAAS default implementation. But if there are duplication login configurations defined in both the WebSphere Configuration API and the plain text file format, the one in the WebSphere Configuration API takes precedence. There are advantages to defining the login configuration in the WebSphere Configuration API:
  - UI support in defining JAAS login configuration.
  - You can manage the JAAS configuration login configuration centrally.
  - The JAAS configuration login configuration is distributed in a Network Deployment installation.
- WebSphere Application Server JAAS login configurations: WebSphere Application Server provides JAAS login configurations for application to perform programmatic authentication to the WebSphere Application Server security run time. These WebSphere Application Server JAAS login configurations perform authentication to the WebSphere Application Server configured authentication mechanism (SWAM or LTPA) and user registry (Local OS, LDAP, or Custom) based on the authentication data supplied. The authenticated Subject from these JAAS login configurations contain the required Principal and Credentials that can be used by WebSphere Application Server security run time to perform authorization checks on J2EE role-based protected resources. Here is the JAAS login configurations provided by WebSphere Application Server:
  - *WSLogin JAAS login configuration*: A generic JAAS login configuration that a Java Client, client container application, servlet, JSP file, enterprise bean, and so on, can use to perform authentication based on a user ID and password, or a token to the WebSphere Application Server security run time. However, this does not honor the CallbackHandler specified in the Client Container deployment descriptor.
  - *ClientContainer JAAS login configuration*: This JAAS login configuration honors the CallbackHandler specified in the client container deployment descriptor. The login module of this login configuration uses the CallbackHandler in the client container deployment descriptor if one is specified, even if the application code specified one CallbackHandler in the LoginContext. This is for client container application.
  - Subject authenticated with the previously mentioned JAAS login configurations contain a com.ibm.websphere.security.auth.WSPrincipal and a com.ibm.websphere.security.auth.WSCredential. If the authenticated Subject is passed the in com.ibm.websphere.security.auth.WSSubject.doAs() (or the other doAs() methods), the WebSphere Application Server security run time can perform authorization checks on J2EE resources, based on the Subject com.ibm.websphere.security.auth.WSCredential.
- **Customer-defined JAAS login configurations**: You can define other JAAS login configurations. See "Configuring application logins for Java Authentication and Authorization Service" on page 243 section for details. Use these login configurations to perform programmatic authentication to the customer authentication mechanism. However, the subjects from these customer-defined

JAAS login configurations might not be used by WebSphere Application Server security run time to perform authorization checks if the subject does not contain the required principal and credentials.

Finding the root cause login exception from a JAAS login

If you get a LoginException after issuing the LoginContext.login() API, you can find the root cause exception from the configured user registry. In the login modules, the registry exceptions are wrapped by a `com.ibm.websphere.security.auth.WSLoginFailedException`. This exception has a getCause() method that allows you to pull out the exception that was wrapped after issuing the above command.

Note: You are not always guaranteed to get an exception of type WSLoginFailedException, but you should note that most of the exceptions generated from the user registry show up here.

The following is a LoginContext.login() API example with associated catch block. WSLoginFailedException has to be casted to `com.ibm.websphere.security.auth.WSLoginFailedException` if you want to issue the getCause() API.

Note: The determineCause() example below can be used for processing CustomUserRegistry exception types.

```
try
    {
         lc.login();
    }
    catch (LoginException le)
    {
 // drill down through the exceptions as they might cascade through the runtime
 Throwable root_exception = determineCause(le);

 // now you can use "root_exception" to compare to a particular exception type
 // for example, if you have implemented a CustomUserRegistry type, you would
  //  know what to look for here.
    }


/* Method used to drill down into the WSLoginFailedException to find the
"root cause" exception */

    public Throwable determineCause(Throwable e)
      {
    Throwable root_exception = e, temp_exception = null;

    // keep looping until there are no more embedded WSLoginFailedException or
    // WSSecurityException exceptions
    while (true)
    {
      if (e instanceof com.ibm.websphere.security.auth.WSLoginFailedException)
      {
       temp_exception = ((com.ibm.websphere.security.auth.WSLoginFailedException)
       e).getCause();
      }
```

```
      else if (e instanceof com.ibm.websphere.security.WSSecurityException)
      {
       temp_exception = ((com.ibm.websphere.security.WSSecurityException)
       e).getCause();
      }
      else if (e instanceof javax.naming.NamingException)
        // check for Ldap embedded exception
        {
          temp_exception = ((javax.naming.NamingException)e).getRootCause();
        }
      else if (e instanceof your_custom_exception_here)
      {
        // your custom processing here, if necessary
      }
      else
      {
        // this exception is not one of the types we are looking for,
        // lets return now, this is the root from the WebSphere
        //  Application Server perspective
        return root_exception;
      }
      if (temp_exception != null)
      {
        // we have an exception, let's go back an see if this has another
        // one embedded within it.
        root_exception = temp_exception;
        e = temp_exception;
        continue;
      }
      else
      {
        // we finally have the root exception from this call path, this
        // has to occur at some point
        return root_exception;
      }
    }
  }
```

Finding the root cause login exception from a Servlet filter

You can also receive the root cause exception from a servlet filter when addressing post-Form Login processing. This is suitable because it shows the user what happened. The following API can be issued to obtain the root cause exception:

```
Throwable t = com.ibm.websphere.security.auth.WSSubject.getRootLoginException();
if (t != null)
         t = determineCause(t);
```

Note: Once you have the exception you can run it through the determineCause() example above to get the native registry root cause.

Enabling root cause login exception propagation to pure Java clients

Currently, the root cause does not get propagated to a pure client for security reasons. However, you might want to propagate the root cause to a pure client in a trusted environment. If you want to enable root cause login exception propagation

to a pure client, click **Security > Global Security > Custom Properties** on the WebSphere Application Server administrative console and set the following property:

```
com.ibm.websphere.security.registry.propagateExceptionsToClient=true
```

Non-prompt programmatic login

WebSphere Application Server provides a non-prompt implementation of the javax.security.auth.callback.CallbackHandler interface, which is called com.ibm.websphere.security.auth.callback.WSCallbackHandlerImpl. Using this interface, an application can push authentication data to the WebSphere Application Server LoginModule instance to perform authentication. This capability proves useful for server-side application code to authenticate an identity and to use that identity to invoke downstream J2EE resources.

```
javax.security.auth.login.LoginContext lc = null;

try {
lc = new javax.security.auth.login.LoginContext("WSLogin",
new com.ibm.websphere.security.auth.callback.WSCallbackHandlerImpl("user",
      "securityrealm", "securedpassword"));

// create a LoginContext and specify a CallbackHandler implementation
// CallbackHandler implementation determine how authentication data is collected
// in this case, the authentication data is "push" to the authentication mechanism
//   implemented by the LoginModule.
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: failed to instantiate a LoginContext and the exception: "
+ e.getMessage());
e.printStackTrace();

// may be javax.security.auth.AuthPermission "createLoginContext" is not granted
//   to the application, or the JAAS login configuration is not defined.
}

if (lc != null)
try {
lc.login();  // perform login
javax.security.auth.Subject s = lc.getSubject();
// get the authenticated subject

// Invoke a J2EE resource using the authenticated subject
com.ibm.websphere.security.auth.WSSubject.doAs(s,
new java.security.PrivilegedAction() {
public Object run() {
try {
bankAccount.deposit(100.00);  // where bankAccount is a protected EJB
} catch (Exception e) {
System.out.println("ERROR: error while accessing EJB resource, exception: "
+ e.getMessage());
e.printStackTrace();
}
return null;
}
}
```

```
);
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: login failed with exception: " + e.getMessage());
e.printStackTrace();

// login failed, might want to provide relogin logic
}
```

You can use the com.ibm.websphere.security.auth.callback.WSCallbackHandlerImpl callback handler with a pure Java client, a client application container, enterprise bean, JavaServer page (JSP) files, servlet, or other Java 2 Platform, Enterprise Edition (J2EE) resources. See "Example: Programmatic logins" on page 65 for more information about object request broker (ORB) security initialization requirements in a Java pure client.

User interface prompt programmatic login

WebSphere Application Server also provides a user interface implementation of the javax.security.auth.callback.CallbackHandler implementation to collect authentication data from user through user interface login prompts. This callack handler, com.ibm.websphere.security.auth.callback.WSGUICallbackHandlerImpl, presents a user interface login panel to prompt users for authentication data.

```
javax.security.auth.login.LoginContext lc = null;

try {
lc = new javax.security.auth.login.LoginContext("WSLogin",
new com.ibm.websphere.security.auth.callback.WSGUICallbackHandlerImpl());

// create a LoginContext and specify a CallbackHandler implementation
// CallbackHandler implementation determine how authentication data is collected
// in this case, the authentication date is collected by GUI login prompt
//   and pass to the authentication mechanism implemented by the LoginModule.
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: failed to instantiate a LoginContext and the exception: "
+ e.getMessage());
e.printStackTrace();

// may be javax.security.auth.AuthPermission "createLoginContext" is not granted
//   to the application, or the JAAS login configuration is not defined.
}

if (lc != null)
try {
lc.login();  // perform login
javax.security.auth.Subject s = lc.getSubject();
// get the authenticated subject

// Invoke a J2EE resources using the authenticated subject
com.ibm.websphere.security.auth.WSSubject.doAs(s,
new java.security.PrivilegedAction() {
public Object run() {
try {
bankAccount.deposit(100.00);  // where bankAccount is a protected enterprise bean
} catch (Exception e) {
System.out.println("ERROR: error while accessing EJB resource, exception: "
```

```
+ e.getMessage());
e.printStackTrace();
}
return null;
}
}
);
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: login failed with exception: " + e.getMessage());
e.printStackTrace();

// login failed, might want to provide relogin logic
}
```

Attention: Do not use the com.ibm.websphere.security.auth.callback.WSGUICallbackHandlerImpl callback handler for server-side resources (like enterprise bean, servlet, JSP file, or any other server side resources). The user interface login prompt blocks the server for user input. This behavior is not desirable for a server process.

Stdin prompt programmatic login

WebSphere Application Server also provides a stdin implementation of the javax.security.auth.callback.CallbackHandler interface to collect authentication data from a user through stdin, which is called `com.ibm.websphere.security.auth.callback.WSStdinCallbackHandlerImpl`. This callback handler prompts a user for authentication data.

```
javax.security.auth.login.LoginContext lc = null;

try {
lc = new javax.security.auth.login.LoginContext("WSLogin",
new com.ibm.websphere.security.auth.callback.WSStdinCallbackHandlerImpl());

// create a LoginContext and specify a CallbackHandler implementation
// CallbackHandler implementation determine how authentication data is collected
// in this case, the authentication date is collected by stdin prompt
//   and pass to the authentication mechanism implemented by the LoginModule.
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: failed to instantiate a LoginContext and the exception:
          " + e.getMessage());
e.printStackTrace();

// may be javax.security.auth.AuthPermission "createLoginContext" is not granted
//   to the application, or the JAAS login configuration is not defined.
}

if (lc != null)
try {
lc.login();  // perform login
javax.security.auth.Subject s = lc.getSubject();
// get the authenticated subject

// Invoke a J2EE resource using the authenticated subject
com.ibm.websphere.security.auth.WSSubject.doAs(s,
```

```
new java.security.PrivilegedAction() {
public Object run() {
try {
bankAccount.deposit(100.00);
// where bankAccount is a protected enterprise bean
} catch (Exception e) {
System.out.println("ERROR: error while accessing EJB resource, exception: "
       + e.getMessage());
e.printStackTrace();
}
return null;
}
}
);
} catch (javax.security.auth.login.LoginException e) {
System.err.println("ERROR: login failed with exception: " + e.getMessage());
e.printStackTrace();

// login failed, might want to provide relogin logic
}
```

Do not use the com.ibm.websphere.security.auth.callback.WSStdinCallbackHandlerImpl callback handler for server side resources (like enterprise beans, servlets, JSP files, and so on). The input from the stdin prompt is not sent to the server environment. Most servers run in the background and do not have a console. However, if the server does have a console, the stdin prompt blocks the server for user input. This behavior is not desirable for a server process.

Developing programmatic logins with the Java Authentication and Authorization Service

Java Authentication and Authorization Service (JAAS) is a new feature in WebSphere Application Server Version 5. Java Authentication and Authorization Service represents the strategic application programming interfaces (API) for authentication and it replaces the CORBA programmatic login APIs. WebSphere Application Server provides some extension to JAAS:

- Refer to the Developing applications that use CosNaming (CORBA Naming interface) article for details on how to set up the environment for thin client applications to access remote resources on a server.
- If the application uses custom JAAS login configuration, verify that it is properly defined. See the “Configuring application logins for Java Authentication and Authorization Service” on page 243 article for details.
- Some of the JAAS APIs are protected by Java 2 Security permissions. If these APIs are used by application code, verify that these permissions are added to the application `was.policy` file. See “Adding the was.policy file to applications” on page 467, “Using PolicyTool to edit policy files” on page 451 and “Configuring the was.policy file” on page 463 articles for details. For more details on which APIs are protected by Java 2 Security permissions, check the IBM Application Developer Kit, Java Technology Edition; JAAS and WebSphere Application Server public APIs Javadoc in “Security: Resources for learning” on page 495. Some of the APIs used in the sample code in this documentation and the Java 2 Security permissions required by these APIs follow:
  - javax.security.auth.login.LoginContext constructors are protected by javax.security.auth.AuthPermission "createLoginContext"

  - javax.security.auth.Subject.doAs() and com.ibm.websphere.security.auth.WSSubject.doAs() are protected by javax.security.auth.AuthPermission "doAs"
  - javax.security.auth.Subject.doAsPrivileged() and com.ibm.websphere.security.auth.WSSubject.doAsPrivileged() are protected by javax.security.auth.AuthPermission "doAsPrivileged"
- **Enhanced model to J2EE resources for authorization checks**. Due to a design oversight in JAAS Version 1.0, the `javax.security.auth.Subject.getSubject()` method does not return the Subject associated with the thread of execution inside a `java.security.AccessController.doPrivileged()` code block. This can present an inconsistent behavior, which might have undesirable effects. The `com.ibm.websphere.security.auth.WSSubject` provides a workaround to associate a Subject to a thread of execution. The `com.ibm.websphere.security.auth.WSSubject` extends the JAAS model to J2EE resources for authorization checks. If the Subject associates with the thread of execution within the `com.ibm.websphere.security.auth.WSSubject.doAs()` method or if the `com.ibm.websphere.security.auth.WSSubject.doAsPrivileged()` code block contains product credentials, the Subject is used for J2EE resources authorization checks.
- **User Interface support for defining new JAAS login configuration**. You can configure JAAS login configuration in the administrative console and store it in the WebSphere Common Configuration Model. Applications can define a new JAAS login configuration in the administrative console and the data is persisted in the configuration repository (stored in the WebSphere Common Configuration Model). However, WebSphere Application Server still supports the default JAAS login configuration format (plain text file) provided by the JAAS default implementation. If there are duplication login configurations defined in both the WebSphere Common Configuration and the plain text file format, the one in the WebSphere Common Configuration takes precedence. There are advantages to defining the login configuration in the WebSphere Common Configuration:
  - UI support in defining JAAS login configuration
  - JAAS configuration login configuration can be managed centrally
  - JAAS configuration login configuration is distributed in a Network Deployment installation
- **Application support for programmatic authentication**. WebSphere Application Server provides JAAS login configurations for applications to perform programmatic authentication to the WebSphere security run time. These configurations perform authentication to the WebSphere-configured authentication mechanism (Simple WebSphere Authentication Mechanism (SWAM) or Lightweight Third Party Authentication (LTPA)) and user registry (Local OS, Lightweight Directory Access Protocol (LDAP) or Custom) based on the authentication data supplied. The authenticated Subject from these JAAS login configurations contains the required Principal and Credentials that the WebSphere security run time can use to perform authorization checks on J2EE role-based protected resources. Here are the JAAS login configurations provided by the WebSphere Application Server:
  - **WSLogin JAAS login configuration**. A generic JAAS login configuration can use Java clients, client container applications, servlets, JSP files, and EJB components to perform authentication based on a user ID and password, or a token to the WebSphere security run time. However, this does not honor the CallbackHandler specified in the client container deployment descriptor.
  - **ClientContainer JAAS login configuration**. This JAAS login configuration honors the CallbackHandler specified in the client container deployment descriptor. The login module of this login configuration uses the CallbackHandler in the client container deployment descriptor if one is

specified, even if the application code specified one CallbackHandler in the LoginContext. This is for a client container application.

A Subject authenticated with the previously mentioned JAAS login configurations contains a `com.ibm.websphere.security.auth.WSPrincipal` principal and a `com.ibm.websphere.security.cred.WSCredential` credential. If the authenticated Subject is passed in `com.ibm.websphere.security.auth.WSSubject.doAs()` or the other doAs() methods, the product security run time can perform authorization checks on J2EE resources based on the `Subject com.ibm.websphere.security.cred.WSCredential` .

- **Customer-defined JAAS login configurations**. You can define other JAAS login configurations to perform programmatic authentication to your authentication mechanism. See the "Configuring application logins for Java Authentication and Authorization Service" on page 243 article for details. For the product security run time to perform authorization checks, the subjects from these customer-defined JAAS login configurations must contain the required principal and credentials.
- **Naming requirements for programmatic login on a pure Java client**. When programmatic login occurs on a pure Java client and the property `com.ibm.CORBA.validateBasicAuth` equals `true`, it is necessary for the security code to know where the SecurityServer resides. Typically, the default InitialContext is sufficient when a `java.naming.provider.url` property is set as a system property or when the property is set in the `jndi.properties` file. In other cases it is not desirable to have the same `java.naming.provider.url` properties set in a system wide scope. In this case, there is a need to specify security specific bootstrap information in the `sas.client.props` file. The following steps present the order of precedence for determining how to find the SecurityServer in a pure Java client:

1. Use the `sas.client.props` file and look for the following properties:

   ```
   com.ibm.CORBA.securityServerHost=myhost.mydomain
   com.ibm.CORBA.securityServerPort=mybootstrap port
   ```

   If you specify these properties, you are guaranteed that security looks here for the SecurityServer. The host and port specified can represent any valid WebSphere host and bootstrap port. The SecurityServer resides on all server processes and therefore it is not important which host or port you choose. If specified, the security infrastructure within the client process look up the SecurityServer based on the information in the `sas.client.props` file.
2. Place the following code in your client application to get a new InitialContext():

   ```
   ...
      import java.util.Hashtable;
      import javax.naming.Context;
      import javax.naming.InitialContext;
      ...

   // Perform an InitialContext and default lookup prior to logging
   // in so that target realm and bootstrap host/port can be
   // determined for SecurityServer lookup.

         Hashtable env = new Hashtable();
         env.put(Context.INITIAL_CONTEXT_FACTORY,    "
                 com.ibm.websphere.naming.WsnInitialContextFactory");
         env.put(Context.PROVIDER_URL,
                 "corbaloc:iiop:myhost.mycompany.com:2809");
         Context initialContext = new InitialContext(env);
         Object obj = initialContext.lookup("");

      // programmatic login code goes here.
   ```

Complete this step prior to executing any programmatic login. It is in this code that you specify a URL provider for your naming context, but it must point to a valid WebSphere Application Server within the cell that you are authenticating to. This allows thread specific programmatic logins going to different cells to have a single system-wide SecurityServer location.

3. Use the new default InitialContext() method relying on the naming precedence rules. These rules are defined in the article, Example: Getting the default initial context.

See the article, Example: Java Authentication and Authorization Service programmatic login.

Example: Programmatic logins

The following example illustrates how application programs can perform a programmatic login using Java Authentication and Authorization Service (JAAS):

```
LoginContext lc = null;

 try {
        lc = new LoginContext("WSLogin",
                        new WSCallbackHandlerImpl("userName", "realm", "password"));
 } catch (LoginException le) {
          System.out.println("Cannot create LoginContext. " + le.getMessage());
          // insert error processing code
 } catch(SecurityException se) {
          System.out.println("Cannot create LoginContext." + se.getMessage();
          // Insert error processing
  }

  try {
           lc.login();
  } catch(LoginExcpetion le) {
           System.out.println("Fails to create Subject. " + le.getMessage());
            // Insert error processing code
```

As shown in the example, the new LoginContext is initialized with the `WSLogin` login configuration and the `WSCallbackHandlerImpl CallbackHandler`. Use the `WSCallbackHandlerImpl` instance on a server-side application where prompting is not desirable. A `WSCallbackHandlerImpl` instance is initialized by the specified user ID, password, and realm information. The present `WSLoginModuleImpl` class implementation that is specified by `WSLogin` can only retrieve authentication information from the specified `CallbackHandler`. You can construct a `LoginContext` with a Subject object, but the Subject is disregarded by the present `WSLoginModuleImpl` implementation. For product client container applications, replace `WSLogin` by `ClientContainer` login configuration, which specifies the `WSClientLoginModuleImpl` implementation that is tailored for client container requirements.

For a pure Java application client, the product provides two other `CallbackHandler` implementations: `WSStdinCallbackHandlerImpl` and `WSGUICallbackHandlerImpl`, which prompt for user ID, password, and realm information on the command line and pop-up panel, respectively. You can choose either of these product `CallbackHandler` implementations depending on the particular application environment. You can develop a new `CallbackHandler` if neither of these implementations fit your particular application requirement.

You also can develop your own `LoginModule` if the default `WSLoginModuleImpl` implementation fails to meet all your requirements. This product provides utility functions that the custom LoginModule can use, which are described in the next section.

In cases where there is no `java.naming.provider.url` set as a system property or in the `jndi.properties` file, a default `InitialContext` does not function if the product server is not at the `localhost:2809` location. In this situation, perform a new `InitialContext` programmatically ahead of the JAAS login. JAAS needs to know where the SecurityServer resides to verify that the user ID or password entered is correct, prior to doing a commit(). By performing a new `InitialContext` in the way specified below, the security code has the information needed to find the SecurityServer location and the target realm.

Attention: The first line starting with `env.put` was split into two lines because it extends beyond the width of the printed page.

```
...
    import java.util.Hashtable;
    import javax.naming.Context;
    import javax.naming.InitialContext;
    ...

// Perform an InitialContext and default lookup prior to logging in so that target realm
// and bootstrap host/port can be determined for SecurityServer lookup.

    Hashtable env = new Hashtable();
    env.put(Context.INITIAL_CONTEXT_FACTORY,
              "com.ibm.websphere.naming.WsnInitialContextFactory");
    env.put(Context.PROVIDER_URL, "corbaloc:iiop:myhost.mycompany.com:2809");
    Context initialContext = new InitialContext(env);
    Object obj = initialContext.lookup("");

     LoginContext lc = null;
     try {
         lc = new LoginContext("WSLogin",
                       new WSCallbackHandlerImpl("userName", "realm", "password"));
     } catch (LoginException le) {
          System.out.println("Cannot create LoginContext. " + le.getMessage());
          // insert error processing code
     } catch(SecurityException se) {
          System.out.println("Cannot create LoginContext." + se.getMessage();
          // Insert error processing
     }

     try {
           lc.login();
     } catch(LoginException le) {
           System.out.println("Fails to create Subject. " + le.getMessage());
            // Insert error processing code
     }
```

Custom login module development for a system login configuration

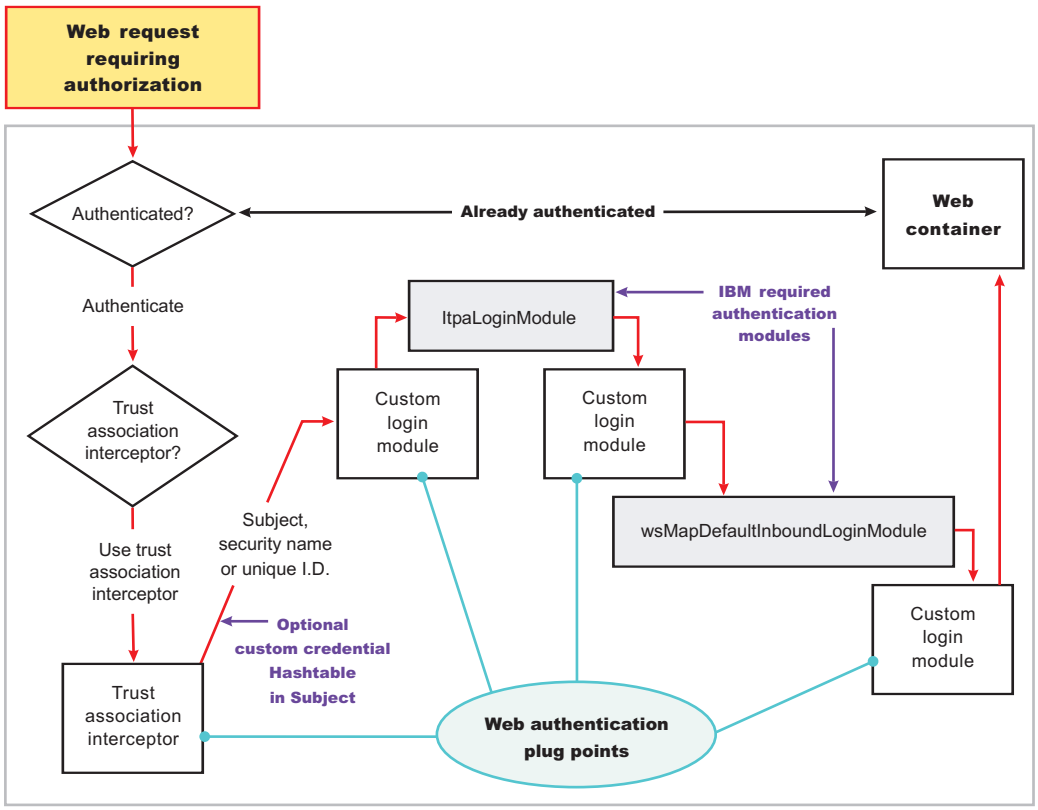
For WebSphere Application Server, there are multiple Java Authentication and Authorization Service (JAAS) plug in points for configuring system logins. WebSphere Application Server uses system login configurations to authenticate incoming requests, outgoing requests, and internal server logins. Application login configurations are called by Java 2 Platform, Enterprise Edition (J2EE) applications for obtaining a Subject based on specific authentication information. This login configuration enables the application to associate the Subject with a specific protected remote action. The Subject is picked up on the outbound request processing. The following list are the main system plug in points. If you write a login module that adds information to the Subject of a system login, these are the main login configurations to plug in:

- WEB_INBOUND
- RMI_OUTBOUND
- RMI_INBOUND
- DEFAULT

WEB_INBOUND login configuration

The WEB_INBOUND login configuration authenticates Web requests. Figure 1 shows an example of a configuration using a Trust Association Interceptor (TAI) that creates a Subject with the initial information that is passed into the WEB_INBOUND login configuration. If the trust association interceptor is not configured, the authentication process goes directly to the WEB_INBOUND system login configuration, which consists of all of the login modules combined in Figure 1. Figure 1 shows where you can plug in custom login modules and where the ltpaLoginModule and wsMapDefaultInboundLoginModule are required.

Figure 1



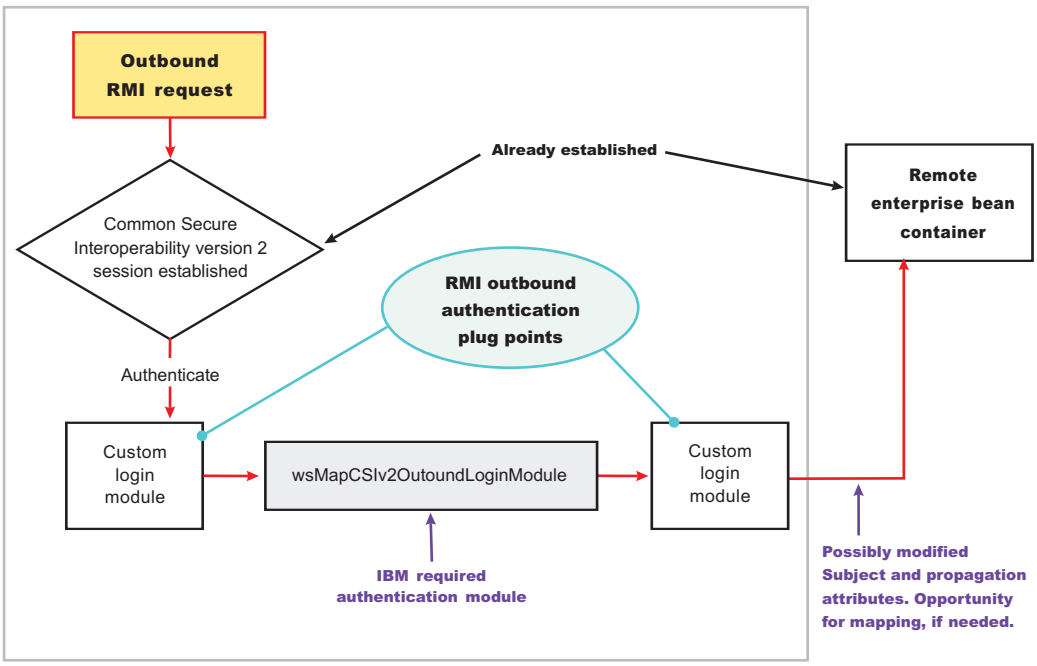
Single application server

For more detailed information on the WEB_INBOUND configuration including its associated callbacks, see "RMI_INBOUND, WEB_INBOUND, DEFAULT" in "System login configuration entry settings for Java Authentication and Authorization Service" on page 249.

RMI_OUTBOUND login configuration

The RMI_OUTBOUND login configuration is a plug point for handling outbound requests. WebSphere Application Server uses this plug point to create the serialized information that is sent downstream based on the Subject passed in (the invocation Subject) and other security context information such as PropagationTokens. A custom login module can use this plug point to change the identity. For more information, see "Configuring outbound mapping to a different target realm" on page 271. Figure 2 shows where you can plug in custom login modules and shows where the wsMapCSIv2OutboundLoginModule is required.

Figure 2

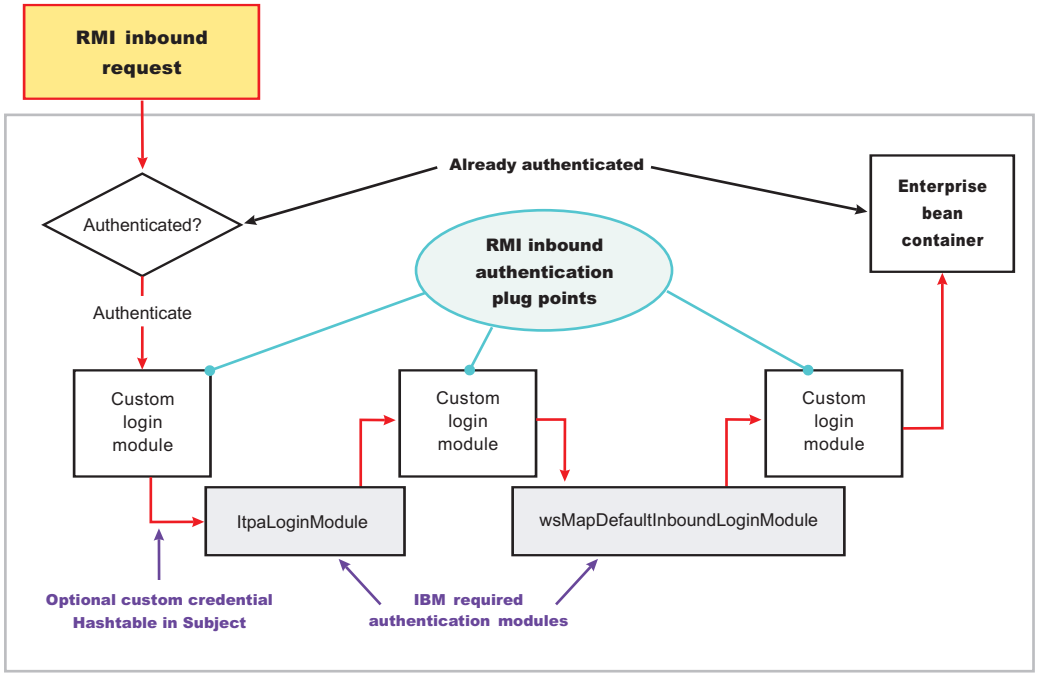


For more information on the RMI_OUTBOUND login configuration including its associated callbacks, see ″RMI_OUTBOUND″ in “System login configuration entry settings for Java Authentication and Authorization Service” on page 249.

RMI_INBOUND login configuration

The RMI_INBOUND login configuration is a plug point that handles inbound authentication for enterprise bean requests. WebSphere Application Server uses this plug point for either an initial login or a propagation login. For more information about these two login types, see “Security attribute propagation” on page 276. During a propagation login, this plug point is used to de-serialize the information received from an upstream server. A custom login module can use this plug point to change the identity, handle custom tokens, add custom objects into the Subject, and so on. For more information on changing the identity using a Hashtable, which is referenced in figure 3, see “Configuring inbound identity mapping” on page 262. Figure 3 shows where you can plug in custom login modules and shows that the ltpaLoginModule and wsMapDefaultInboundLoginModule are required.

Figure 3



Single application server

For more information on the RMI_INBOUND login configuration including its associated callbacks, see "RMI_INBOUND, WEB_INBOUND, DEFAULT" in "System login configuration entry settings for Java Authentication and Authorization Service" on page 249.

DEFAULT login configuration

The DEFAULT login configuration is a plug point that handles all of the other types of authentication requests, including administrative Simple Object Access Protocol (SOAP) requests and internal authentication of the server ID. Propagation logins typically do not occur at this plug point.

For more information on the DEFAULT login configuration including its associated callbacks, see "RMI_INBOUND, WEB_INBOUND, DEFAULT" in "System login configuration entry settings for Java Authentication and Authorization Service" on page 249.

Writing a login module

When you write a login module that plugs into a WebSphere Application Server application login or system login configuration, read the JAAS programming model located at:http://java.sun.com/products/jaas. The JAAS programming model provides basic information about JAAS. However, before writing a login module for the WebSphere Application Server environment, read the following sections in this article

- Useable callbacks
- Shared state variables
- Initial versus propagation logins
- Sample custom login module

Useable callbacks

Each login configuration must document the callbacks that are recognized by the login configuration. However, the callbacks are not always passed data. Thus, the login configuration must contain logic to know when specific information is present and how to use the information. For example, if you write a custom login module that can plug into all four of the pre-configured system login configurations mentioned previously, three sets of callbacks might be presented to authenticate a request. Other callbacks might be present for other reasons, including propagation and making other information available to the login configuration.

Login information can be presented in the following combinations:

User name (NameCallback) and password (PasswordCallback)
This information is a typical authentication combination.

User name only (NameCallback)
This information used for identity assertion, Trust Association Interceptor (TAI) logins, and certificate logins.

Token (WSCredTokenCallbackImpl)
This information is for Lightweight Third Party Authentication (LTPA) token validation.

Propagation token list (WSTokenHolderCallback)
This information is used for a propagation login.

The first three combinations are used for typical authentication. However, when the WSTokenHolderCallback is present in addition to one of the first three information combinations, the login is called a *propagation login*. A propagation login means that some security attributes are propagated to this server from another server. The servers can reuse these security attributes if the authentication information validates successfully. In some cases, a WSTokenHolderCallback might not have sufficient attributes for a full login. Thus, check the requiresLogin() method on the WSTokenHolderCallback to determine if a new login is required. You can always ignore the information returned by the requiresLogin() method, but, as a result, you might duplicate information.

The following is a list of the callbacks that might be present in the system login configurations. The list includes a description of their responsibility.

Callback	Description
`callbacks[0] = new javax.security.auth.callback.NameCallback ("Username: ");`	This callback handler collects the user name for the login. The result can be the user name for a basic authentication login (user name and password) or a user name for an identity assertion login.
`callbacks[1] = new javax.security.auth.callback.PasswordCallback ("Password: ", false);`	This callback handler collects the password for the login.
`callbacks[2] = new com.ibm.websphere.security.auth.callback.WSCredTokenCallbackImpl ("Credential Token: ");`	This callback handler collects the Lightweight Third Party Authentication (LTPA) token, or other token type, for the login. It is typically present when a user name and password is not present.

Callback	Description
`callbacks[3] = new com.ibm. wsspi.security.auth.callback. WSTokenHolderCallback ("Authz Token List: ");`	This callback handler collects the ArrayList of TokenHolder objects that are returned from a call to the WSOpaqueTokenHelper. createTokenHolderListFromOpaqueToken () API using the Common Secure Interoperability version 2 (CSIv2) authorization token as input.
`callbacks[4] = new com.ibm. websphere.security.auth.callback. WSServletRequestCallback ("HttpServletRequest: ");`	This callback handler collects the HTTP servlet request object, if present. It enables login modules to get information from the HTTP request for use in the login. This callback handler is presented from the WEB_INBOUND login configuration only.
`callbacks[5] = new com.ibm. websphere.security.auth.callback. WSServletResponseCallback ("HttpServletResponse: ");`	This callback handler collects the HTTP servlet response object, if present. It enables login modules to put information into the HTTP response as a result of the login. An example of this situation might be adding the SingleSignonCookie to the response.This callback handler is presented from the WEB_INBOUND login configuration only.
`callbacks[6] = new com.ibm. websphere.security.auth.callback. WSAppContextCallback ("ApplicationContextCallback: ");`	This callback handler collects the Web application context used during the login. It consists of a HashMap, which contains the application name and the redirect URL, if present. This callback handler is presented from the WEB_INBOUND login configuration only.

Shared state variables

Shared state variables are used to share information between login modules during the login phase. The following list contains recommendations for using the shared state variables:

- When you have a custom login module, use the shared state variables to communicate to a WebSphere Application Server login module using a documented shared state variable as shown in the following table.
- Try not to update the Subject until the commit phase. If you call the abort() method, you must remove any objects added to the Subject.
- Enable the login module that adds information into the shared state Map during login to remove this information during commit in case the same shared state is used for another login.
- If an abort or logout occurs, clean up the information in the login configuration for the shared state and the Subject.

The com.ibm.wsspi.security.token.AttributeNameConstants.WSCREDENTIAL_PROPERTIES_KEY shared state variable can inform the WebSphere Application Server login configurations about asserted privilege attributes. This variable references the com.ibm.wsspi.security.cred.propertiesObject property. You should associate a java.util.Hashtable with this property. This hashtable contains properties used by WebSphere Application Server for login purposes and ignores the callback information. This hashtable enables a custom login module, which is carried out

first in the login configuration, to map user identities or enable WebSphere Application Server to avoid making unnecessary user registry calls if you already have the required information. For more information, see “Configuring inbound identity mapping” on page 262.

If you want to access the objects that WebSphere Application Server creates during a login, refer to the following shared state variables.

Login module in which variables are set:

ltpaLoginModule, swamLoginModule, and wsMapDefaultInboundLoginModule

Shared state variable
com.ibm.wsspi.security.auth.callback.Constants.WSPRINCIPAL_KEY

Purpose
Specifies the com.ibm.websphere.security.auth.WSPrincipal object. See the WebSphere Application Server Javadoc for application programming interface (API) usage. This shared state variable is for read-only purposes. Do not set this variable in the shared state for custom login modules.

Login module in which variables are set:

ltpaLoginModule, swamLoginModule, and wsMapDefaultInboundLoginModule

Shared state variable
com.ibm.wsspi.security.auth.callback.Constants.WSCREDENTIAL_KEY

Purpose
Specifies the com.ibm.websphere.security.cred.WSCredential object. See the WebSphere Application Server Javadoc for API usage. This shared state variable is for read-only purposes. Do not set this variable in the shared state for custom login modules.

Login module in which variables are set:

wsMapDefaultInboundLoginModule

Shared state variable
com.ibm.wsspi.security.auth.callback.Constants.WSAUTHZTOKEN_KEY

Purpose
Specifies the default com.ibm.wsspi.security.token.AuthorizationToken object. Login modules can use this object to set custom attributes plugged in after wsMapDefaultInboundLoginModule. The information set here is propagated downstream and available to the Application. See the WebSphere Application Server Javadoc for API usage.

Initial versus propagation logins

As mentioned previously, some logins are considered initial logins because of the following reasons:

- It is the first time authentication information is presented to WebSphere Application Server.
- The login information is received from a server that does not propagate security attributes so this information must be gathered from a user registry.

Other logins are considered propagation logins when a WSTokenHolderCallback is present and contains sufficient information from a sending server to recreate all the required objects needed by WebSphere Application Server run time. In cases where there is sufficient information for WebSphere Application Server run time, the information you might add to the Subject is likely exists from the previous login. To verify if your object is present, you can get access to the ArrayList present in the WSTokenHolderCallback, and search through this list looking at each TokenHolder getName() method. This search is used to determine if WebSphere Application Server is deserializing your custom object during this login. Check the class name returned from the getName() method using the String startsWith() method because the run time might add additional information at the end of the name to know which Subject set to add the custom object after de-serialization.

The following code snippet can be used in your login() method to determine when sufficient information is present. For another example, see "Configuring inbound identity mapping" on page 262.

Sample code

```
// This is a hint provided by WebSphere Application Server that
   // sufficient propagation information does not exist and, therefore,
   // a login is required to provide the sufficient information. In this
   // situation, a Hashtable login might be used.
  boolean requiresLogin = ((com.ibm.wsspi.security.auth.callback.
        WSTokenHolderCallback) callbacks[1]).requiresLogin();

  if (requiresLogin)
  {
   // Check to see if your object exists in the TokenHolder list,
           if not, add it.
       java.util.ArrayList authzTokenList = ((WSTokenHolderCallback) callbacks[6]).
         getTokenHolderList();boolean found = false;

       if (authzTokenList != null)
            {
               Iterator tokenListIterator = authzTokenList.iterator();

               while (tokenListIterator.hasNext())
            {
       com.ibm.wsspi.security.token.TokenHolder th = (com.ibm.wsspi.security.token.
          TokenHolder) tokenListIterator.next();

       if (th != null && th.getName().startsWith("com.acme.myCustomClass"))
            {
               found=true;
               break;
            }
       }
       if (!found)
       {
       // go ahead and add your custom object.
       }
       }
     }
  else
  {
```

```
      // This code indicates that sufficient propagation information is present.
      // User registry calls are not needed by WebSphere Application Server to
      // create a valid Subject. This code might be a no-op in your login module.
  }
```

Sample custom login module

You can use the following sample to get ideas on how to use some of the callbacks and shared state variables.

```
public customLoginModule()
{
 // Defines your login module variables
 com.ibm.wsspi.security.token.AuthenticationToken customAuthzToken = null;
 com.ibm.wsspi.security.token.AuthenticationToken defaultAuthzToken = null;
 com.ibm.websphere.security.cred.WSCredential credential = null;
 com.ibm.websphere.security.auth.WSPrincipal principal = null;
 private javax.security.auth.Subject _subject;
 private javax.security.auth.callback.CallbackHandler _callbackHandler;
 private java.util.Map _sharedState;
 private java.util.Map _options;

 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
  _subject = subject;
  _callbackHandler = callbackHandler;
  _sharedState = sharedState;
  _options = options;
 }

 public boolean login() throws LoginException
 {
  boolean succeeded = true;

  // Gets the CALLBACK information
  javax.security.auth.callback.Callback callbacks[] = new javax.security.
        auth.callback.Callback[7];
  callbacks[0] = new javax.security.auth.callback.NameCallback(
        "Username: ");
  callbacks[1] = new javax.security.auth.callback.PasswordCallback(
        "Password: ", false);
  callbacks[2] = new com.ibm.websphere.security.auth.callback.
        WSCredTokenCallbackImpl ("Credential Token: ");
  callbacks[3] = new com.ibm.wsspi.security.auth.callback.
        WSServletRequestCallback ("HttpServletRequest: ");
  callbacks[4] = new com.ibm.wsspi.security.auth.callback.
        WSServletResponseCallback ("HttpServletResponse: ");
  callbacks[5] = new com.ibm.wsspi.security.auth.callback.
        WSAppContextCallback ("ApplicationContextCallback: ");
  callbacks[6] = new com.ibm.wsspi.security.auth.callback.
         WSTokenHolderCallback ("Authz Token List: ");

  try
  {
   callbackHandler.handle(callbacks);
```

```
}
catch (Exception e)
{
 // Handles exceptions
 throw new WSLoginFailedException (e.getMessage(), e);
}

// Sees which callbacks contain information
uid = ((NameCallback) callbacks[0]).getName();
char password[] = ((PasswordCallback) callbacks[1]).getPassword();
byte[] credToken = ((WSCredTokenCallbackImpl) callbacks[2]).getCredToken();
javax.servlet.http.HttpServletRequest request = ((WSServletRequestCallback)
      callbacks[3]).getHttpServletRequest();
javax.servlet.http.HttpServletResponse response = ((WSServletResponseCallback)
      callbacks[4]).getHttpServletResponse();
java.util.Map appContext = ((WSAppContextCallback)
      callbacks[5]).getContext();
java.util.List authzTokenList = ((WSTokenHolderCallback)
      callbacks[6]).getTokenHolderList();

// Gets the SHARED STATE information
principal = (WSPrincipal) _sharedState.get(com.ibm.wsspi.security.
      auth.callback.Constants.WSPRINCIPAL_KEY);
credential = (WSCredential) _sharedState.get(com.ibm.wsspi.security.
      auth.callback.Constants.WSCREDENTIAL_KEY);
defaultAuthzToken = (AuthorizationToken) _sharedState.get(com.ibm.
      wsspi.security.auth.callback.Constants.WSAUTHZTOKEN_KEY);

   // What you tend to do with this information depends upon the scenario
   // that you are trying to accomplish. This example demonstrates how to
   // access various different information:
   // - Determine if a login is initial versus propagation
   // - Deserialize a custom authorization token (For more information, see
   //   "Security attribute propagation" on page 276
   // - Add a new custom authorization token (For more information, see
   //   "Security attribute propagation" on page 276
   // - Look for a WSCredential and read attributes, if found.
   // - Look for a WSPrincipal and read attributes, if found.
   // - Look for a default AuthorizationToken and add attributes, if found.
   // - Read the header attributes from the HttpServletRequest, if found.
   // - Add an attribute to the HttpServletResponse, if found.
   // - Get the web application name from the appContext, if found.

   // - Determines if a login is initial versus propagation. This is most
   //  useful when login module is first.
boolean requiresLogin = ((WSTokenHolderCallback) callbacks[6]).requiresLogin();

// initial login - asserts privilege attributes based on user identity
if (requiresLogin)
{

 // If you are validating a token from another server, there is an
     // application programming interface  (API) to get the uniqueID from it.
 if (credToken != null && uid == null)
 {
  try
```

```
 {
  String uniqueID = WSSecurityPropagationHelper.
            validateLTPAToken(credToken);
  String realm = WSSecurityPropagationHelper.getRealmFromUniqueID
             (uniqueID);
         // Now set it to the UID so you can use that to either map or
         // login with.
  uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);
 }
 catch (Exception e)
 {
  // handle exception
 }
}
    // Adds a Hashtable to shared state.
    // Note: You can perform custom mapping on the NameCallback value returned
    // to change the identity based upon your own mapping rules.
uid = mapUser (uid);

// Gets the default InitialContext for this server.
javax.naming.InitialContext ctx = new javax.naming.InitialContext();

// Gets the local UserRegistry object.
com.ibm.websphere.security.UserRegistry reg = (com.ibm.websphere.security.
         UserRegistry) ctx.lookup("UserRegistry");

    // Gets the user registry uniqueID based on the uid specified in the
    // NameCallback.
String uniqueid = reg.getUniqueUserId(uid);
 uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);

// Gets the display name from the user registry based on the uniqueID.
String securityName = reg.getUserSecurityName(uid);

// Gets the groups associated with this uniqueID.
java.util.List groupList = reg.getUniqueGroupIds(uid);

    // Creates the java.util.Hashtable with the information you gathered from
    // the UserRegistry.
java.util.Hashtable hashtable = new java.util.Hashtable();
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
        WSCREDENTIAL_UNIQUEID, uniqueid);
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
        WSCREDENTIAL_SECURITYNAME, securityName);
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
        WSCREDENTIAL_GROUPS, groupList);

    // Adds a cache key that is used as part of the lookup mechanism for
    // the created Subject. The cache key can be an Object, but should
    // implement the toString() method. Make sure the cacheKey contains
    // enough information to scope it to the user and any additional
    // attributes that you use. If you do not specify this property the
    // Subject is scoped to the WSCREDENTIAL_UNIQUEID returned, by default.
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
       WSCREDENTIAL_CACHE_KEY,
  "myCustomAttribute" + uniqueid);
```

```
  // Adds the hashtable to the sharedState of the Subject.
  _sharedState.put(com.ibm.wsspi.security.token.AttributeNameConstants.
           WSCREDENTIAL_PROPERTIES_KEY,hashtable);
}
// propagation login - process propagated tokens
else
{
 // - Deserializes a custom authorization token. For more information, see
     //    "Security attribute propagation" on page 276.
     //    This can be done at any login module plug in point (first,
     //     middle, or last).
 if (authzTokenList != null)
 {
  // Iterates through the list looking for your custom token
  for (int i=0; i<authzTokenList.size(); i++)
  {
   TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

   // Looks for the name and version of your custom AuthorizationToken
          // implementation
   if (tokenHolder.getName().equals("com.ibm.websphere.security.token.
              CustomAuthorizationTokenImpl") && tokenHolder.getVersion() == 1)
   {
    // Passes the bytes into your custom AuthorizationToken constructor
             // to deserialize
    customAuthzToken = new
     com.ibm.websphere.security.token.
                 CustomAuthorizationTokenImpl(tokenHolder.getBytes());

   }
  }
 }
     // - Adds a new custom authorization token (For more information,
     //   see "Security attribute propagation" on page 276)
     //    This can be done at any login module plug in point (first, middle,
     //    or last).
 else
 {
  // Gets the PRINCIPAL from the default AuthenticationToken. This must
       // match all of the tokens.
  defaultAuthToken = (com.ibm.wsspi.security.token.AuthenticationToken)
   sharedState.get(com.ibm.wsspi.security.auth.callback.Constants.
             WSAUTHTOKEN_KEY);
  String principal = defaultAuthToken.getPrincipal();

  // Adds a new custom authorization token. This is an initial login.
       // Pass the principal into the constructor
  customAuthzToken = new com.ibm.websphere.security.token.
             CustomAuthorizationTokenImpl(principal);

  // Adds any initial attributes
  if (customAuthzToken != null)
  {
   customAuthzToken.addAttribute("key1", "value1");
   customAuthzToken.addAttribute("key1", "value2");
```

```
   customAuthzToken.addAttribute("key2", "value1");
   customAuthzToken.addAttribute("key3", "something different");
  }
 }
}

// - Looks for a WSCredential and read attributes, if found.
//   This is most useful when plugged in as the last login module.
if (credential != null)
{
 try
 {
  // Reads some data from the credential
  String securityName = credential.getSecurityName();
  java.util.ArrayList = credential.getGroupIds();
 }
 catch (Exception e)
 {
  // Handles exceptions
  throw new WSLoginFailedException (e.getMessage(), e);
 }
}

// - Looks for a WSPrincipal and read attributes, if found.
//   This is most useful when plugged as the last login module.
if (principal != null)
{
 try
 {
  // Reads some data from the principal
  String principalName = principal.getName();
 }
 catch (Exception e)
 {
  // Handles exceptions
  throw new WSLoginFailedException (e.getMessage(), e);
 }
}

// - Looks for a default AuthorizationToken and add attributes, if found.
//   This is most useful when plugged in as the last login module.
if (defaultAuthzToken != null)
{
 try
 {
  // Reads some data from the defaultAuthzToken
  String[] myCustomValue = defaultAuthzToken.getAttributes ("myKey");
  // Adds some data if not present in the defaultAuthzToken
  if (myCustomValue == null)
   defaultAuthzToken.addAttribute ("myKey", "myCustomData");
 }
 catch (Exception e)
 {
  // Handles exceptions
  throw new WSLoginFailedException (e.getMessage(), e);
 }
```

```
 }

 // - Reads the header attributes from the HttpServletRequest, if found.
 //  This can be done at any login module plug in point (first, middle,
    //  or last).
 if (request != null)
 {
  java.util.Enumeration headerEnum = request.getHeaders();
  while (headerEnum.hasMoreElements())
  {
   System.out.println ("Header element: " + (String)headerEnum.nextElement());
  }
 }

 // - Adds an attribute to the HttpServletResponse, if found
    //  This can be done at any login module plug in point (first, middle,
    //  or last).
 if (response != null)
 {
  response.addHeader ("myKey", "myValue");
 }

 // - Gets the web application name from the appContext, if found
 //   This can be done at any login module plug in point (first, middle,
    //   or last).
 if (appContext != null)
 {
  String appName = (String) appContext.get(com.ibm.wsspi.security.auth.
         callback.Constants.WEB_APP_NAME);
 }

 return succeeded;
}

public boolean commit() throws LoginException
{
 boolean succeeded = true;

 // Add any objects here that you have created and belong in the
 // Subject. Make sure the objects are not already added. If you added
 // any sharedState variables, remove them before you exit. If the abort()
    // method gets called, make sure you cleanup anything added to the
 // Subject here.

 if (customAuthzToken != null)
 {
  // Sets the customAuthzToken token into the Subject
  try
  {
   // Do this in a doPrivileged code block so that application code
         // does not need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
   {
    public Object run()
    {
     try
```

```
      {
       // Adds the custom authorization token if it is not
                 //  null and not already in the Subject
                                 if ((customAuthzTokenPriv != null) &&
          (!_subject.getPrivateCredentials().contains(customAuthzTokenPriv)))
       {
        _subject.getPrivateCredentials().add(customAuthzTokenPriv);
       }
      }
      catch (Exception e)
      {
       throw new WSLoginFailedException (e.getMessage(), e);
      }

      return null;
     }
    });
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }

  return succeeded;
 }

 public boolean abort() throws LoginException
 {
  boolean succeeded = true;

  // Makes sure to remove all objects that have already been added (both into the
     // Subject and shared state).

  if (customAuthzToken != null)
  {
   // remove the customAuthzToken token from the Subject
   try
   {
    final AuthorizationToken customAuthzTokenPriv = customAuthzToken;
    // Do this in a doPrivileged block so that application code does not need
          // to add additional permissions
    java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
    {
     public Object run()
     {
      try
      {
       // Removes the custom authorization token if it is not
                  // null and not already in the Subject
                      if ((customAuthzTokenPriv != null) &&
                       (_subject.getPrivateCredentials().
                        contains(customAuthzTokenPriv)))
      {
       _subject.getPrivateCredentials().
                     remove(customAuthzTokenPriv);
```

```
      }
     }
     catch (Exception e)
     {
      throw new WSLoginFailedException (e.getMessage(), e);
     }

     return null;
    }
   });
  }
  catch (Exception e)
  {
   throw new WSLoginFailedException (e.getMessage(), e);
  }
 }

 return succeeded;
}


public boolean logout() throws LoginException
{
 boolean succeeded = true;

 // Makes sure to remove all objects that have already been added
    // (both into the Subject and shared state).

 if (customAuthzToken != null)
 {
  // Removes the customAuthzToken token from the Subject
  try
  {
   final AuthorizationToken customAuthzTokenPriv = customAuthzToken;
   // Do this in a doPrivileged code block so that application code does
         // not need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.
           PrivilegedAction()
   {
    public Object run()
    {
     try
     {
      // Removes the custom authorization token if it is not null and not
                //  already in the Subject
                    if ((customAuthzTokenPriv != null) && (_subject.
                    getPrivateCredentials().
                    contains(customAuthzTokenPriv)))
      {
       _subject.getPrivateCredentials().remove(customAuthzTokenPriv);
      }
     }
     catch (Exception e)
     {
      throw new WSLoginFailedException (e.getMessage(), e);
     }
```

```
      return null;
     }
    });
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }

  return succeeded;

 }

}
```

The following code snippet can be used in your login() method to determine when sufficient information is present. For another example, see "Configuring inbound identity mapping" on page 262.

After developing your custom login module for a system login configuration, you can configure the system login using either the administrative console or using the wsadmin utility. To configure the system login using the administrative console, click **Security > JAAS Configuration > System logins**. For more information on using the wsadmin utility for system login configuration, see "Example: Customizing a server-side Java Authentication and Authorization Service authentication and login configuration." Also refer to the "Example: Customizing a server-side Java Authentication and Authorization Service authentication and login configuration" article for information on system login modules and to determine whether to add additional login modules.

Example: Customizing a server-side Java Authentication and Authorization Service authentication and login configuration

WebSphere Application Server supports plugging in a custom Java Authentication and Authorization Service (JAAS) login module before or after the WebSphere Application Server system login module. However, WebSphere Application Server does not support the replacement of the WebSphere Application Server system login modules, which are used to create WSCredential and WSPrincipal in the Subject. By using a custom login module, you can either make additional authentication decisions or add information to the Subject to make additional, potentially finer-grained, authorization decisions inside a Java 2 Platform, Enterprise Edition (J2EE) application.

5.1.1 WebSphere Application Server enables you to propagate information downstream that is added to the subject by a custom login module. For more information, see 5.1.1 "Security attribute propagation" on page 276. To determine which login configuration to use for plugging in your custom login modules, see the descriptions of the login configurations located in the 5.1.1 "System login configuration entry settings for Java Authentication and Authorization Service" on page 249 article.

5.1.1 WebSphere Application Server supports the modification of the system login configuration through the administrative console and by using the wsadmin

scripting utility. To configure the system login configuration using the administrative console, click **Security > JAAS Configuration > System logins**.

Refer to the following code sample to configure a system login configuration using the wsadmin tool. The following sample JACL script adds a customLoginModule into the Lightweight Third-party Authentication (LTPA) Web system login configuration:

Attention: Lines 32, 33, and 34 in the following code sample were split onto two lines because of the width of the printed page.

```
1. ########################################
2. #
3. # Open security.xml
4. #
5. ########################################
6.
7.
8. set sec [$AdminConfig getid /Cell:hillside/Security:/]
9.
10.
11. ########################################
12. #
13. # Locate systemLoginConfig
14. #
15. ########################################
16.
17.
18. set slc [$AdminConfig showAttribute $sec systemLoginConfig]
19.
20. set entries [lindex [$AdminConfig showAttribute $slc entries] 0]
21.
22.
23. ########################################
24. #
25. # Append a new LoginModule to LTPA_WEB
26. #
27. ########################################
28.
29. foreach entry $entries {
30.    set alias [$AdminConfig showAttribute $entry alias]
31.    if {$alias == "LTPA_WEB"} {
32.       set newJAASLoginModuleId [$AdminConfig create JAASLoginModule
           $entry {{moduleClassName
           "com.ibm.ws.security.common.auth.module.proxy.WSLoginModuleProxy"}}]
33.       set newPropertyId [$AdminConfig create Property
           $newJAASLoginModuleId {{name delegate}{value
           "com.ABC.security.auth.CustomLoginModule"}}]
34.       $AdminConfig modify $newJAASLoginModuleId
           {{authenticationStrategy REQUIRED}}
35.       break
36.    }
37. }
38.
39.
40. ########################################
```

```
41. #
42. # save the change
43. #
44. ######################################
45.
46. $AdminConfig save
47.
```

Attention: The wsadmin scripting utility inserts a new object to the end of the list. To insert the custom LoginModule before the AuthenLoginModule, delete the AuthenLoginModule and then recreate it after inserting the custom LoginModule. Save the sample script into a file, sample.jacl, executing the sample script using the following command:

```
Wsadmin -f sample.jacl
```

You can use the following sample JACL script to remove the current LTPA_WEB login configuration and all the LoginModules:

```
48. ######################################
49. #
50. # Open security.xml
51. #
52. ######################################
53.
54.
55. set sec [$AdminConfig getid /Cell:hillside/Security:/]
56.
57.
58. ######################################
59. #
60. # Locate systemLoginConfig
61. #
62. ######################################
63.
64.
65. set slc [$AdminConfig showAttribute $sec systemLoginConfig]
66.
67. set entries [lindex [$AdminConfig showAttribute $slc entries] 0]
68.
69.
70. ######################################
71. #
72. # Remove the LTPA_WEB login configuration
73. #
74. ######################################
75.
76. foreach entry $entries {
77.    set alias [$AdminConfig showAttribute $entry alias]
78.    if {$alias == "LTPA_WEB"} {
79.       $AdminConfig remove $entry
80.       break
81.    }
82. }
83.
84.
```

```
85. ########################################
86. #
87. # save the change
88. #
89. ########################################
90.
91. $AdminConfig save
```

You can use the following sample JACL script to recover the original LTPA_WEB configuration:

Attention: Lines 122, 124, and 126 in the following code sample were split onto two or more lines because of the width of the printed page. The two lines of code for line 122 are normally one continuous line. The three lines of code for line 124 are normally one continuous line. Also, the three lines of code for line 126 are normally one continuous line.

```
92. ########################################
93. #
94. # Open security.xml
95. #
96. ########################################
97.
98.
99. set sec [$AdminConfig getid /Cell:hillside/Security:/]
100.
101.
102. ########################################
103. #
104. # Locate systemLoginConfig
105. #
106. ########################################
107.
108.
109. set slc [$AdminConfig showAttribute $sec systemLoginConfig]
110.
111. set entries [lindex [$AdminConfig showAttribute $slc entries] 0]
112.
113.
114.
115. ########################################
116. #
117. # Recreate the LTPA_WEB login configuration
118. #
119. ########################################
120.
121.
122. set newJAASConfigurationEntryId [$AdminConfig create JAASConfigurationEntry
     $slc {{alias LTPA_WEB}}]
123.
124. set newJAASLoginModuleId [$AdminConfig create JAASLoginModule
     $newJAASConfigurationEntryId
     {{moduleClassName
     "com.ibm.ws.security.common.auth.module.proxy.WSLoginModuleProxy"}}]
125.
126. set newPropertyId [$AdminConfig create Property
```

```
    $newJAASLoginModuleId {{name delegate}
    {value "com.ibm.ws.security.web.AuthenLoginModule"}}]
127.
128. $AdminConfig modify $newJAASLoginModuleId {{authenticationStrategy REQUIRED}}
129.
130.
131. ######################################
132. #
133. # save the change
134. #
135. ######################################
136.
137. $AdminConfig save
```

The WebSphere Application Server Version 5.1 ltpaLoginModule and AuthenLoginModule use the shared state to save state information so that custom LoginModules can modify the information. The ltpaLoginModule initializes the callback array in the login() method using the following code. The callback array is created by ltpaLoginModule only if an array is not defined in the shared state area. In the following code sample, the error handling code was removed to make the sample concise. If you insert a custom LoginModule before the ltpaLoginModule, custom LoginModule might follow the same style to save the callback into the shared state.

Attention: In the following code sample, several lines of code have been split onto two lines because of the width of the printed page. Each of these split lines are one continuous line.

```
138.         Callback callbacks[] = null;
139.         if (!sharedState.containsKey(
                 com.ibm.wsspi.security.auth.callback.Constants.
                 CALLBACK_KEY)) {
140.             callbacks = new Callback[3];
141.             callbacks[0] = new NameCallback("Username: ");
142.             callbacks[1] = new PasswordCallback("Password: ", false);
143.             callbacks[2] = new com.ibm.websphere.security.auth.callback.
                 WSCredTokenCallbackImpl( "Credential Token: ");
144.             try {
145.                 callbackHandler.handle(callbacks);
146.             } catch (java.io.IOException e) {
147.                 . . .
148.            } catch (UnsupportedCallbackException uce) {
149.                 . . .
150.            }
151.            sharedState.put(
                com.ibm.wsspi.security.auth.callback.Constants.CALLBACK_KEY,
                callbacks);
152.         } else {
153.             callbacks = (Callback [])
                 sharedState.get( com.ibm.wsspi.security.auth.callback.
                 Constants.CALLBACK_KEY);
154.         }
```

ltpaLoginModule and AuthenLoginModule generate both a WSPrincipal and a WSCredential object to represent the authenticated user identity and security credentials. The WSPrincipal and WSCredential objects also are saved in the shared

state. A JAAS login uses a two-phase commit protocol. First, the login methods in login modules, which are configured in the login configuration, are called. Then, their commit methods are called. A custom LoginModule, which is inserted after the ltpaLoginModule and the AuthenLoginModule, can modify the WSPrincipal and WSCredential objects before they are committed. The WSCredential and WSPrincipal objects must exist in the Subject after the login is completed. Without these objects in the Subject, WebSphere Application Server run-time code rejects the Subject when it is used to make any security decisions.

AuthenLoginModule uses the following code to initialize the callback array:

Attention: In the following code sample, several lines of code have been split onto two lines because of the width of the printed page. Each of these split lines are one continuous line.

```
155.          Callback callbacks[] = null;
156.          if (!sharedState.containsKey(
                  com.ibm.wsspi.security.auth.callback.Constants.
                  CALLBACK_KEY)) {
157.              callbacks = new Callback[6];
158.              callbacks[0] = new NameCallback("Username: ");
159.              callbacks[1] = new PasswordCallback("Password: ", false);
160.              callbacks[2] =
                  new com.ibm.websphere.security.auth.callback.WSCredTokenCallbackImpl(
                  "Credential Token: ");
161.              callbacks[3] =
                  new com.ibm.wsspi.security.auth.callback.WSServletRequestCallback(
                  "HttpServletRequest: ");
162.              callbacks[4] =
                  new com.ibm.wsspi.security.auth.callback.WSServletResponseCallback(
                  "HttpServletResponse: ");
163.              callbacks[5] =
                  new com.ibm.wsspi.security.auth.callback.WSAppContextCallback(
                  "ApplicationContextCallback: ");
164.              try {
165.                  callbackHandler.handle(callbacks);
166.              } catch (java.io.IOException e) {
167.                . . .
168.              } catch (UnsupportedCallbackException uce {
169.                . . .
170.              }
171.              sharedState.put( com.ibm.wsspi.security.auth.callback.
                  Constants.CALLBACK_KEY, callbacks);
172.          } else {
173.              callbacks = (Callback []) sharedState.get(
                  com.ibm.wsspi.security.auth.callback.
                  Constants.CALLBACK_KEY);
174.          }
```

Three more objects, which contain callback information for the login, are passed from the Web container to the AuthenLoginModule: a `java.util.Map`, a `HttpServletRequest`, and a `HttpServletResponse` object. These objects represent the Web application context. The WebSphere Application Server Version 5.1 application context, `java.util.Map` object, contains the application name and the error page URL. You can obtain the application context, `java.util.Map` object, by calling the

getContext() method on the WSAppContextCallback object. The java.util.Map object is created with the following deployment descriptor information.

Attention: In the following code sample, several lines of code have been split onto two lines because of the width of the printed page. Each of these split lines are one continuous line.

```
175.        HashMap appContext = new HashMap(2);
176.        appContext.put(
            com.ibm.wsspi.security.auth.callback.Constants.WEB_APP_NAME,
            web_application_name);
177.        appContext.put(
            com.ibm.wsspi.security.auth.callback.Constants.REDIRECT_URL,
            errorPage);
```

The application name and the HttpServletRequest object might be read by the custom LoginModule to perform mapping functions. The error page of the form-based login might be modified by a custom LoginModule. In addition to the JAAS framework, WebSphere Application Server supports the Trust Association Interface (TAI).

Other credential types and information can be added to the caller Subject during the authentication process using a custom LoginModule. The third-party credentials in the caller Subject are managed by WebSphere Application Server as part of the security context. The caller Subject is bound to the thread of execution during the request processing. When a Web or EJB module is configured to use the caller identity, the user identity is propagated to the downstream service in an EJB request. WSCredential and any third-party credentials in the caller Subject are not propagated downstream. Instead, some of the information can be regenerated at the target server based on the propagated identity. Add third-party credentials to the caller Subject at the authentication stage. The caller Subject, which is returned from the WSSubject.getCallerSubject() method, is read-only and thus cannot be modified. For more information on the WSSubject, see "Example: Getting the Caller Subject from the Thread."

Example: Getting the Caller Subject from the Thread

The Caller subject (or ″received subject″) contains the user authentication information used in the call for this request. This subject is returned after issuing the WSSubject.getCallerSubject() API to prevent replacing existing objects. The subject is marked read-only. This API can be used to get access to the WSCredential (documented in the Javadoc information) so that you can put or set data in the hashmap within the credential.

Most data within the subject is not propagated downstream to another server. Only the credential token within the WSCredential is propagated downstream (and a new caller subject generated).

```
try
{
 javax.security.auth.Subject caller_subject;
 com.ibm.websphere.security.cred.WSCredential caller_cred;

 caller_subject = com.ibm.websphere.security.auth.WSSubject.getCallerSubject();

 if (caller_subject != null)
```

```
 {
  caller_cred = caller_subject.getPublicCredentials
     (com.ibm.websphere.security.cred.WSCredential.class).iterator().next();
  String CALLERDATA = (String) caller_cred.get ("MYKEY");
  System.out.println("My data from the Caller credential is:  " + CALLERDATA);
 }
}
catch (WSSecurityException e)
{
 // log error
}
catch (Exception e)
{
 // log error
}
```

Requirement: You need the following Java 2 Security permissions to execute this API: `permission javax.security.auth.AuthPermission "wssecurity.getCallerSubject;".`

Example: Getting the RunAs Subject from the Thread

The RunAs subject (or invocation subject) contains the user authentication information for the RunAs mode set in the application deployment descriptor for this method.

The RunAs subject (or invocation subject) contains the user authentication information for the RunAs mode set in the application deployment descriptor for this method. This subject is marked read-only when returned from theWSSubject.getRunAsSubject() application programming interface (API) to prevent replacing existing objects. You can use this API to get access to the WSCredential (documented in the Javadoc information) so that you can put or set data in the hashmap within the credential.

Note: Most data within the Subject is not propagated downstream to another server. Only the credential token within the WSCredential is propagated downstream and a new Caller subject is generated.

```
try
{
 javax.security.auth.Subject  runas_subject;
 com.ibm.websphere.security.cred.WSCredential  runas_cred;

 runas_subject  =  com.ibm.websphere.security.auth.WSSubject.getRunAsSubject();

 if  (runas_subject  !=  null)
 {
  runas_cred  =  runas_subject.getPublicCredentials(
                    com.ibm.websphere.security.cred.WSCredential.class).iterator().next();
  String  RUNASDATA  =  (String)  runas_cred.get  ("MYKEY");
  System.out.println("My  data  from  the  RunAs  credential  is:  " + RUNASDATA );
 }
}
catch  (WSSecurityException  e)
{
 //  log  error
```

```
}
catch (Exception e)
{
 // log error
}
```

Requirements: You need the following Java 2 Security permissions to run this API: `permission javax.security.auth.AuthPermission "wssecurity.getRunAsSubject;".`

Example: User revocation from a cache

In WebSphere Application Server, Version 5.0.2 and later, revocation of a user from the security cache using an MBean interface is supported. The following Java Command Language (JACL) revokes a user when given the realm and user ID, and cycles through all security administration MBean instances returned for the entire cell when run from the Deployment Manager WSADMIN. The command also purges the user from the cache during each process.

Note: This procedure can be called from a JACL script.

Attention: In some of the following lines of code, the lines have been split onto two or more lines.

```
proc revokeUser {realm userid} {
 global AdminControl AdminConfig

        if {[catch {$AdminControl queryNames WebSphere:type=SecurityAdmin,*}
       result]} {
  puts stdout "\$AdminControl queryNames WebSphere:type=SecurityAdmin,*
        caught an exception $result\n"
  return
 } else {
  if {$result != {}} {
                 foreach secBean $result {
                         if {$secBean != {} || $secBean != "null"} {
                          if {[catch {$AdminControl invoke $secBean
                    purgeUserFromAuthCache "$realm $userid"} result]} {
                           puts stdout "\$AdminControl invoke $secBean
                       purgeUserFromAuthCache $realm $userid caught an
                       exception $result\n"
                            return
                           } else {
                            puts stdout "\nUser $userid has been purged from the
                      cache of process $secBean\n"
                           }
                          } else {
                           puts stdout "unable to get securityAdmin Mbean, user
                    $userid not revoked"
                      }
                        }
 } else {
  puts stdout "Security Mbean was not found\n"
  return
 }
```

```
        }
        return true
}
```

Developing your own J2C principal mapping module

WebSphere Application Server provides principal mapping when Java 2 Connector (J2C) connection factory is configured to perform container managed sign-on. For example, the application server can map the caller principal to a resource principal to open a new connection to the backend server. With the container-managed signon, WebSphere Application Server creates a Subject instance that contains enterprise information systems (EIS) security domain credentials. A Subject object returned by a principal mapping module contains a Principal object represents the caller identity and a `PasswordCredential` or a `GenericCredential`. WebSphere Application Server provides a default principal mapping module that maps any authenticated user credentials to password credentials for the EIS security domain. The default mapping module is defined in the Application Login Configuration panel in the `DefaultPrincipalMapping` entry. The user ID and password for the EIS security domain is defined under each connection factory by an `authDataAlias` attribute *container-managed authentication alias* in the administrative console. The `authDataAlias` attribute does not actually contain the user name and password. An `authDataAlias` attribute contains an alias that refers to a user name and password pair that is defined in the security configuration document. Since it contains sensitive data, the security configuration document requires the most privileged **administrator** role for both read and write access. This indirection avoids saving sensitive user name and password in configuration documents other than the security document.

The J2C connection factory configuration contains a mapping module, which defines a principal mapping module alias (`mappingConfigAlias` attribute) and an authentication data alias (`authDataAlias` attribute). At run time, the J2C-managed connection factory code passes a reference of the `ManagedConnectionFactory` and an `authDataAlias` object to the configured principal mapping module through the `WSPrincipalMappingCallbackHandler` object. WebSphere Application Server supports plugging in a custom principal mapping module for a connection factory if the any-authenticated-to-one mapping provided by the default principal mapping module is insufficient. A custom mapping module is a special purpose Java Authentication and Authorization Service (JAAS) Login Module that performs principal or credential mapping in the login method. The `WSSubject.getCallerPrincipal()` method can be used to retrieve the application client identity. Plugging in a custom mapping module is very simple. Change the value of the `mappingConfigAlias` object to the custom mapping module. However, the configuration must be done through the `wsadmin` tool.

The following steps are needed to perform this task. You can use the administrative console for these steps. However, you also can use the `wsadmin` tool to configure the J2C Connection Factory.

1. Start the administrative console. To add a custom mapping module for an application server, click **Servers > Application Servers**. Click the particular server on the right navigation panel.
2. Click **Security > JAAS Configuration**.
3. Select **JAAS Configuration** and **Application Logins**. Click **New**.
4. Enter a unique alias for the new mapping module, and click **Apply**.

5. Under Additional Properties, click **JAAS Login Modules** to define the custom mapping module class.
6. Click **New** and enter the **Module Classname** and the **Authentication Strategy**.
7. Click **Apply**. Click **Save** to save the new configuration.
8. Configure the J2C Connection Factory to use the new mapping module
   a. Using the administrative console to configure the J2C Connection Factory.
      1) Click **Resources > Resource Adapters >** *resource_adapter*.
      2) Under Additional Properties, click **CMP Connection Factories**.
      3) Click the name of your connection factory.
      4) Enter the resource name, Java Naming and Directory Interface (JNDI) name, a description of the resource, and a category in which to classify the resource.
      5) Click **OK**.
      6) Click **Save** in the upper-left section of the administrative console to save your configuration changes.
   b. Using the `wsadmin` tool to configure the J2C Connection Factory.
      1) At the wsadmin prompt, type the following command to show a list of `J2CConnectionFactory` objects: `wsadmin>$AdminConfig list J2CConnectionFactory`.
      2) Select the **J2C Connection Factory** and enter the following command to show all the attributes. For example,

         wsadmin>$AdminConfig show PetStore_CF(cells/hillsideNetwork/nodes /hillside/servers/server1:resources.xml#CMPConnectorFactory_4)

         The previous example was split onto two lines because it displayed beyond the width of the page.
      3) Type the following command to examine the current mapping module configuration:

         wsadmin>$AdminConfig show {mapping (cells/hillsideNetwork/nodes /hillside/servers/server1:resources.xml#MappingModule_7)}

         The previous example was split onto two lines because it displayed beyond the width of the page.

         The following shows sample results of the above command: `{authDataAlias {}} {mappingConfigAlias DefaultPrincipalMapping}`. As shown in the previous example, the J2C Connection factory is configured to use the DefaultPrincipalMapping login configuration.
      4) Type the following command to modify the mapping module configuration to use the new mapping module:

         wsadmin>$AdminConfig modify {mapping (cells/hillsideNetwork/nodes /hillside/servers/server1:resources.xml#MappingModule_7)} { {mappingConfigAlias myMappingModule}}

         The previous example was split onto three lines because it displayed beyond the width of the page.

         You can check the result by typing:

         wsadmin>$AdminConfig show {mapping (cells/hillsideNetwork/nodes /hillside/servers/server1:resources.xml#MappingModule_7)} {authDataAlias {}} {mappingConfigAlias myMappingModule}

The previous example was split onto three lines because it displayed beyond the width of the page.

5) Type `save` at the `wsadmin` prompt to save your changes.

Note: The authDataAlias is left undefined. In practice, the authDataAlias passes at run time to the custom mapping module. But using the authDataAlias to look up user ID and password requires the WebSphere Configuration application programming interface (API), which is not available at this time.

A mapping module is defined and is configured for the specified J2C Connection factory.

Completing this task allows you to use your own mapping module to fit your application environment. The WebSphere Application Server default principal mapping module maps all authenticated user credentials to the same user id and password credentials of the EIS security domain. The user ID and password are stored in the security configuration document and is looked up using the configured alias as a key. Your mapping module may be programmed to perform more sophisticated mapping and store passwords in other persistent storage or from a remote service.

To develop your own principal and credential mapping LoginModule, refer to the JAAS documentation for general information. The JAAS documentation can be found at http://www.ibm.com/developerworks/java/jdk/security. Scroll down to find the JAAS documentation for your platform. Refer to the `login.html` file for details of how to develop JAAS login module.

In particular, a mapping module needs to obtain the security identity of the caller. The `WSSubject.getCallerPrincipal()` static method returns an `com.ibm.websphere.security.auth.WSPrincipal` object, which represents the security identity of an authenticated caller.

Developing custom user registries

WebSphere Application Server security supports the use of custom registries in addition to Local OS and Lightweight Directory Access Protocol (LDAP) registries for authentication and authorization purposes. A custom user registry is a customer implemented user registry which implements the UserRegistry Java interface as provided by WebSphere Application Server. A custom implemented user registry can support virtually any type or notion of an accounts repository from a relational database, flat file, and so on. The custom user registry provides considerable flexibility in adapting WebSphere Application Server security to various environments where some notion of a user registry, other than LDAP or LocalOS, already exist in the operational environment.

Implementing a custom user registry is a software development effort. Use the methods defined in the UserRegistry interface to make calls to the desired registry to obtain user and group information. The interface defines a very general set of methods, for encapsulating a wide variety of registries. You can configure a custom user registry as the active user registry when configuring WebSphere Application Server global security.

Make sure that your implementation of the custom registry does not depend on any WebSphere Application Server components such as data sources, enterprise

beans, and so on. Do not have this dependency because security is initialized and enabled prior to most of the other WebSphere Application Server components during startup. If your previous implementation used these components, make a change that will eliminate the dependency. For example, if your previous implementation used data sources to connect to a database, use Java database connectivity (JDBC) to connect to the database.

For backward compatibility, the WebSphere Application Server Version 4 custom registry is also supported. Refer to the "Migrating custom user registries" on page 27 for more information on migrating. If your previous implementation uses data sources to connect to a database, change the implementation to use Java database connectivity (JDBC) connections. However, it is recommended that you use the new interface to implement your custom registry.

1. If not familiar with the custom user registry concept, refer to the article, "Custom user registries" on page 212. This section explains each of the methods in the interface in detail and the changes for these methods from the version 4 release.
2. Implement all the methods in the interface except for the `CreateCredential` method, which is implemented by WebSphere Application Server. "FileRegistrySample.java file for WebSphere Application Server" on page 221 is provided for reference.
3. Build your implementation. You need the *%install_root%*`/lib/sas.jar` and *%install_root%*`/lib/wssec.jar` files in your class path. For example: *%install_root%*`\java\bin\javac -classpath` *%install_root%*`\lib\wssec.jar;`*%install_root%*`\lib\sas.jar yourImplementationFile.java`.
4. Copy the class files generated in the previous step to the product class path. The preferred location is the *%install_root%*`/lib/ext` directory. This should be copied to all the product processes (cell, all NodeAgents) class path.
5. Follow the steps in "Configuring custom user registries" on page 214 to configure your implementation using the administrative console.

This step is required to implement custom user registries in Version 5.

If you enabling security, make sure you complete the remaining steps. Once this is done, make sure you save and synchronize the configuration and restart all the servers. Try accessing some J2EE resources to verify that the custom registry implementation is successful.

Example: Custom user registries

A *custom user registry* is a customer-implemented user registry that implements the `UserRegistry` Java interface as provided by WebSphere Application Server. A custom-implemented user registry can support virtually any type or form of an accounts repository from a relational database, flat file, and so on. The custom user registry provides considerable flexibility in adapting WebSphere Application Server security to various environments where some form of a user registry, other than Lightweight Directory Access Protocol (LDAP) or Local OS, already exist in the operational environment.

Implementing a custom user registry is a software development effort. You must use the methods defined in the UserRegistry interface to make calls to the desired registry for obtaining user and group information. The interface defines a very general set of methods, so it can encapsulate a wide variety of registries. You can configure a custom user registry as the active user registry when configuring the product global security.

If you are using the WebSphere Application Server Version 4.0 custom registry you can plug in your registry without any changes. However, using the new interface to implement your custom registry is recommended.

To view a sample custom registry, refer to the following files:

- "FileRegistrySample.java file for WebSphere Application Server" on page 221
- "users.props file" on page 239
- "groups.props file" on page 239

UserRegistry interface methods

Implementing this interface enables WebSphere Application Server security to use custom registries. This capability should extend the `java.rmi` file. With a remote registry, you can complete this process remotely.

Implementation of this interface must provide implementations for:
- initialize(java.util.Properties)
- checkPassword(String,String)
- mapCertificate(X509Certificate[])
- getRealm
- getUsers(String,int)
- getUserDisplayName(String)
- getUniqueUserId(String)
- getUserSecurityName(String)
- isValidUser(String)
- getGroups(String,int)
- getGroupDisplayName(String)
- getUniqueGroupId(String)
- getUniqueGroupIds(String)
- getGroupSecurityName(String)
- isValidGroup(String)
- getGroupsForUser(String)
- getUsersForGroup(String,int)
- createCredential(String)

```
public void initialize(java.util.Properties props)
      throws CustomRegistryException,
             RemoteException;
```

This method is called to initialize the UserRegistry method. All the properties defined in the Custom User Registry panel propagate to this method.

For the sample, the initialize method retrieves the names of the registry files containing the user and group information.

This method is called during server bring up to initialize the registry. This method is also called when validation is performed by the administrative console, when security is on. This method remains the same as in version 4.0.

```
public String checkPassword(String userSecurityName, String password)
      throws PasswordCheckFailedException,
             CustomRegistryException,
             RemoteException;
```

The `checkPassword` method is called to authenticate users when they log in using a name (or user ID) and a password. This method returns a string which, in most cases, is the user being authenticated. Then, a credential is created for the user for

authorization purposes. This user name is also returned for the enterprise bean call, `getCallerPrincipal()`, and the servlet calls, `getUserPrincipal()` and `getRemoteUser()`. See the `getUserDisplayName` method for more information if you have display names in your registry. In some situations, if you return a user other than the one who is logged in, verify that the user is valid in the registry.

For the sample, the `mapCertificate` method gets the distinguished name (DN) from the certificate chain and makes sure it is a valid user in the registry before returning the user. For the sample, the checkPassword method checks the name and password combination in the registry and (if they match) returns the user being authenticated.

This method is called for various scenarios. It is called by the administrative console to validate the user information once the registry is initialized. It is also called when you access protected resources in the product for authenticating the user and before proceeding with the authorization. This method is the same as in WebSphere Application Server Version 4.

```
public String mapCertificate(X509Certificate[] cert)
      throws CertificateMapNotSupportedException,
             CertificateMapFailedException,
             CustomRegistryException,
             RemoteException;
```

The `mapCertificate` method is called to obtain a user name from an X.509 certificate chain supplied by the browser. The complete certificate chain is passed to this method and the implementation can validate the chain if needed and get the user information. A credential is created for this user for authorization purposes. If browser certificates are not supported in your configuration, you can throw the exception, CertificateMapNotSupportedException. The consequence of not supporting certificates is authentication failure if the challenge type is certificates, even if valid certificates are in the browser.

This method is called when certificates are provided for authentication. For Web applications, when the authentication constraints are set to CLIENT-CERT in the `web.xml` file of the application, this method is called to map a certificate to a valid user in the registry. For Java clients, this method is called to map the client certificates in the transport layer, when using the transport layer authentication. Also, when the Identity Assertion Token (when using the CSIv2 authentication protocol) is set to contain certificates, this method is called to map the certificates to a valid user.

In WebSphere Application Server Version 4.0, the input parameter was the X509Certificate certificate. In WebSphere Application Server Version 5, this parameter changes to accept an array of X509Certificate certificates (such as a certificate chain). In version 4, this parameter was called only for Web applications, but in version 5.0 you can call this method for both Web and Java clients.

```
public String getRealm()
      throws CustomRegistryException,
             RemoteException;
```

The getRealm method is called to get the name of the security realm. The name of the realm identifies the security domain for which the registry authenticates users. If this method returns a null value, a default name of `customRealm` is used.

For the sample, the getRealm method returns the string, customRealm. One of the calls to this method is when the registry information is validated. This method is the same as in version 4.

```
public Result getUsers(String pattern, int limit)
      throws CustomRegistryException,
             RemoteException;
```

The getUsers method returns the list of users from the registry. The names of users depend on the pattern parameter. The number of users are limited by the limit parameter. In a registry that has many users, getting all the users is not practical. So the limit parameter is introduced to limit the number of users retrieved from the registry. A limit of 0 indicates to return all the users that match the pattern and might cause problems for large registries. Use this limit with care.

The custom registry implementations are expected to support at least the wildcard search (*). For example, a pattern of (*) returns all the users and a pattern of (b*) returns the users starting with *b*.

The return parameter is an object of type com.ibm.websphere.security.Result. This object contains two attributes, a java.util.List and a java.lang.boolean. The list contains the users returned and the Boolean flag indicates if there are more users available in the registry for the search pattern. This Boolean flag is used to indicate to the client whether more users are available in the registry.

In the sample, the getUsers retrieves the required number of users from the registry and sets them as a list in the result object. To find out if there are more users than requested, the sample gets one more user than requested and if it finds the additional user, it sets the Boolean flag to true. For pattern matching, the match method in the RegExpSample class is used, which supports wildcard characters such as the asterisk (*) and question mark (?).

This method is called by the administrative console to add users to roles in the various map users to roles panels. The administrative console uses the Boolean set in the result object to indicate that more entries matching the pattern are available in the registry.

In WebSphere Application Server Version 4, this method specifies to take only the pattern parameter. The return is a list. In WebSphere Application Server Version 5, this method is changed to take one additional parameter, the limit. Ideally, your implementation should change to take the limit value and limit the users returned. The return is changed to return a result object, which consists of the list (as in version 4) and a flag indicating if more entries exist. So, when the list returns, use the Result.setList(List) to set the List in the result object. If there are more entries than requested in the limit parameter, set the Boolean attribute to true in the result object, using Result.setHasMore() method. The default for the Boolean attribute in the result object is false.

```
public String getUserDisplayName(String userSecurityName)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

The getUserDisplayName method returns a display name for a user, if one exists. The display name is an optional string that describes the user that you can set in some registries. This is a descriptive name for the user and does not have to be

unique in the registry. For example in Windows systems, you can display the full name of the user. If you do not need display names in your registry, return null or an empty string for this method.

Note: In WebSphere Application Server Version 4, if display names existed for any user these names were useful for the EJB method call `getCallerPrincipal()` and the servlet calls `getUserPrincipal()` and `getRemoteUser()`. If the display names were not the same as the security name for any user, the display names are returned for the previously mentioned enterprise beans and servlet methods. Returning display names for these methods might become problematic is some situations because the display names might not be unique in the registry. Avoid this problem by changing the default behavior to return the user's security name instead of the user's display name in this version of the product. However, if you want to have the same behavior as in version 4, set the property `WAS_UseDisplayName` to `true` in the **Custom Registry Properties** panel in the administrative console. For more information on how to set properties for the custom registry, see the section on *Setting Properties for Custom Registries*.

In the sample, this method returns the display name of the user whose name matches the user name provided. If the display name does not exist this returns an empty string.

This method can be called by the product to present the display names in the administrative console, or using the command line using the `wsadmin` tool. Use this method only for displaying. This method is the same as in Version 4.0.

```
public String getUniqueUserId(String userSecurityName)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns the unique ID of the user given the security name.

In the sample, this method returns the uniqueId of the user whose name matches the supplied name. This method is called when forming a credential for a user and also when creating the authorization table for the application.

```
public String getUserSecurityName(String uniqueUserId)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns the security name of a user given the unique ID. In the sample, this method returns the security name of the user whose unique ID matches the supplied ID.

This method is called to make sure a valid user exists for a given uniqueUserId. This method is called to get the security name of the user when the uniqueUserId is obtained from a token. This method is the same as in Version 4.

```
public boolean isValidUser(String userSecurityName)
      throws CustomRegistryException,
             RemoteException;
```

This method indicates whether the given user is a valid user in the registry.

In the Sample, this method returns `true` if the user is found in the registry, otherwise this method returns `false`. This method is primarily called in situations where knowing if the user exists in the directory prevents problems later. For example, in the mapCertificate call, once the name is obtained from the certificate if the user is found to be an invalid user in the registry, you can avoid trying to create the credential for the user. This method is the same as in WebSphere Application Server Version 4.0.

```
public Result getGroups(String pattern, int limit)
     throws CustomRegistryException,
            RemoteException;
```

The `getGroups` method returns the list of groups from the registry. The names of groups depend on the pattern parameter. The number of groups is limited by the limit parameter. In a registry that has many groups, getting all the groups is not practical. So, the limit parameter is introduced to limit the number of groups retrieved from the registry. A limit of 0 implies to return all the groups that match the pattern and can cause problems for large registries. Use this limit with care. The custom registry implementations are expected to support at least the wildcard search (*). For example, a pattern of (*) returns all the users and a pattern of (b*) returns the users starting with *b*.

The return parameter is an object of type `com.ibm.websphere.security.Result`. This object contains two attributes, a `java.util.List` and a `java.lang.boolean`. The list contains the groups returned and the Boolean flag indicates whether there are more groups available in the registry for the pattern searched. This Boolean flag is used to indicate to the client if more groups are available in the registry.

In the sample, the `getUsers` retrieves the required number of groups from the registry and sets them as a list in the result object. To find out if there are more groups than requested, the sample gets one more user than requested and if it finds the additional user, it sets the Boolean flag to `true`. For pattern matching, the match method in the `RegExpSample` class is used. It supports wildcards like *, ?.

This method is called by the administrative console to add groups to roles in the various map groups to roles panels. The administrative console will use the boolean set in the Result object to indicate that more entries matching the pattern are available in the registry.

In WebSphere Application Server Version 4, this method is used to take the pattern parameter only and returns a list. In WebSphere Application Server Version 5, this method is changed to take one additional parameter, the limit. Change to take the limit value and limit the users returned. The return is changed to return a result object, which consists of the list (as in version 4) and a flag indicating whether more entries exist. Use the `Result.setList(List)` to set the list in the result object. If there are more entries than requested in the limit parameter, set the Boolean attribute to `true` in the result object using `Result.setHasMore()`. The default for the Boolean attribute in the result object is `false`.

```
public String getGroupDisplayName(String groupSecurityName)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

The `getGroupDisplayName` method returns a display name for a group if one exists. The display name is an optional string describing the group that you can set in

some registries. This name is a descriptive name for the group and does not have to be unique in the registry. If you do not need to have display names for groups in your registry, return null or an empty string for this method.

In the sample, this method returns the display name of the group whose name matches the group name provided. If the display name does not exist, this method returns an empty string.

The product can call this method to present the display names in the administrative console or through command line using the `wsadmin` tool. This method is only used for displaying and is the same as in Version 4.0.

```
public String getUniqueGroupId(String groupSecurityName)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns the unique ID of the group given the security name.

In the sample, this method returns the unique ID of the group whose name matches the supplied name. This method is called when creating the authorization table for the application and is the same as in Version 4.0.

```
public List getUniqueGroupIds(String uniqueUserId)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns the unique IDs of all the groups to which a user belongs.

In the sample, this method returns the unique ID of all the groups that contain this uniqueUserID. This method is called when creating the credential for the user. As part of creating the credential, all the `groupUniqueIds` in which the user belongs are collected and put in the credential for authorization purposes when groups are given access to a resource. This method is the same as in version 4.

```
public String getGroupSecurityName(String uniqueGroupId)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns the security name of a group given its unique ID.

In the sample, this method returns the security name of the group whose unique ID matches the supplied ID. This method verifies that a valid group exists for a given uniqueGroupId. This method is the same as in version 4.

```
public boolean isValidGroup(String groupSecurityName)
      throws CustomRegistryException,
             RemoteException;
```

This method indicates if the given group is a valid group in the registry.

In the sample, this method returns `true` if the group is found in the registry, otherwise the method returns `false`. This method can be used in situations where knowing whether the group exists in the directory might prevent problems later. This method is the same as in version 4.

```
public List getGroupsForUser(String userSecurityName)
      throws EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method returns all the groups to which a user belongs whose name matches the supplied name. This method is similar to the `getUniqueGroupIds` method with the exception that the security names are used instead of the unique IDs.

In the sample, this method returns all the group security names that contain the userSecurityName.

This method is called by the administrative console or the scripting tool to verify that the users entered for the `RunAs` roles are already part of that role in the users and groups to role mapping. This check is required to ensure that a user cannot be added to a `RunAs` role unless that user is assigned to the role in the users and groups to role mapping either directly or indirectly (through a group that contains this user). Since a group in which the user belongs can be part of the role in the users and groups to role mapping, this method is called to check if any of the groups that this user belongs to mapped to that role. This method is the same as in Version 4.0.

```
public Result getUsersForGroup(String groupSecurityName, int limit)
      throws NotImplementedException,
             EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
```

This method retrieves users from the specified group. The number of users returned is limited by the limit parameter. A limit of **0** indicates to return all the users in that group. This method is not directly called by the WebSphere Application Server security component. However, this can be called by other components. For example, this method issued by the process choreographer when staff assignments are modeled using groups. In rare situations, if you are working with a registry where getting all the users from any of your groups is not practical (for example, if there are a large number of users), you can throw the `NotImplementedException` exception for the particular groups. In this case, verify that if the process choreographer is installed (or if it is installed later) the staff assignments are not modeled using these particular groups. If there is no concern about returning the users from groups in the registry, it is recommended that you do not throw the `NotImplemented` exception when implementing this method.

The return parameter is an object of type `com.ibm.websphere.security.Result`. This object contains two attributes, `java.util.List` and `java.lang.boolean`. The list contains the users returned and the Boolean flag, which indicates whether there are more users available in the registry for the search pattern. This Boolean flag indicates to the client whether users are available in the registry.

In the example, this method gets one user more than the requested number of users for a group if the limit parameter is not set to **0**. If it succeeds in getting one more user, it sets the Boolean flag to `true`.

In WebSphere Application Server Version 4, this method was mandatory for the product. For WebSphere Application Server Version 5, this method can throw the exception `NotImplementedException` exception in situations where it is not practical to get the requested set of users. However, this exception should be thrown in rare situations, as other components can be affected. In version 4, this method accepted only the pattern parameter and the returned a list. In version 5, this method accepts one additional parameter, the limit. Change your implementation to take the limit value and limit the users returned. The return changes to return a result object, which consists of the list (as in version 4) and a flag indicating whether more entries exist. As in version 4, when the list is returned, use the `Result.setList(List)` method to set the list in the Result object. If there are more entries than requested in the limit parameter, set the Boolean attribute to `true` in the result object using `Result.setHasMore()`. The default for the Boolean attribute in the Result object is `false`.

Attention: The first two lines of the following code sample is one continuous line.

```
public com.ibm.websphere.security.cred.WSCredential
        createCredential(String userSecurityName)
     throws NotImplementedException,
            EntryNotFoundException,
            CustomRegistryException,
            RemoteException;
```

In this release of the WebSphere Application Server, this method is not called. You can return *null*. In the example, a *null* is returned.

Developing a custom interceptor for trust associations

If you are using a third party reverse proxy server other than Tivoli WebSEAL, you must provide an implementation class for the product interceptor interface for your proxy server. This article describes the interface you must implement.

5.1.1 Although WebSphere Application Server Version 5.1.1 supports com.ibm.websphere.security.TrustAssociationInterceptor, it is recommended that you use the new trust association interceptor, com.ibm.wsspi.security.tai.TrustAssociationInterceptor. For more information, see "Trust association interceptor support for Subject creation" on page 108.

1. Define the interceptor class method. WebSphere Application Server provides the interceptor Java interface, com.ibm.websphere.security.TrustAssociationInterceptor, which defines the following methods:
   - **`public boolean isTargetInterceptor(HttpServletRequest req)`** throws `WebTrustAssociationException;`.

     The `isTargetInterceptor` method determines whether the request originated with the proxy server associated with the interceptor. The implementation code must examine the incoming request object and determine if the proxy server forwarding the request is a valid proxy server for this interceptor. The result of this method determines whether the interceptor processes the request or not.
   - **`public void validateEstablishedTrust (HttpServletRequest req)`** throws `WebTrustAssociationException;`.

     The `validateEstablishedTrust` method determines if the proxy server from which the request originated is trusted or not. This method is called after the `isTargetInterceptor` method. The implementation code must authenticate

the proxy server. The authentication mechanism is proxy-server specific. For example, in the product implementation for the WebSEAL server, this method retrieves the basic authentication information from the HTTP header and validates the information against the user registry used by WebSphere Application Server. If the credentials are invalid, the code throws the `WebTrustAssociationException`, indicating that the proxy server is not trusted and the request is to be denied.

- **`public String getAuthenticatedUsername(HttpServletRequest req)`** throws `WebTrustAssociationException;`.

  The `getAuthenticatedUsername` method is called after trust is established between the proxy server and WebSphere Application Server. The product has accepted the proxy server authentication of the request and must now authorize the request. To authorize the request, the name of the original requestor must be subjected to an authorization policy to determine if the requestor has the necessary privilege. The implementation code for this method must extract the user name from the HTTP request header and determine if that user is entitled to the requested resource. For example, in the product implementation for the WebSEAL server, the method looks for an `iv-user` attribute in the HTTP request header and extracts the user ID associated with it for authorization.

2. Configuring the interceptor. To make an interceptor configurable, the interceptor must extend `com.ibm.websphere.security.WebSphereBaseTrustAssociationInterceptor`. Implement the following methods:

   `public int init (java.util.Properties props);`

   The init(Properties) method accepts a `java.util.Properties` object, which contains the set of properties required to initialize the interceptor. All the properties set for an interceptor (by using the **Custom Properties** link for that interceptor or using scripting) is sent to this method. The interceptor then can use these properties to initialize itself. For example, in the productimplementation for the WebSEAL server, this method reads the hosts and ports so that a request coming in can be verified to originate from trusted hosts and ports. A return value of **0** implies that the interceptor initialization is successful. Any other value implies that the initialization is not successful and the interceptor is ignored.

   Applicability of the following list

   If a previous implementation of the trust association interceptor returns a different error status you can either change your implementation to match the expectations or make one of the following changes:

   - Add the `com.ibm.websphere.security.trustassociation.initStatus` property in the trust association interceptor custom properties. Set the property to the value that indicates that the interceptor is successfully initialized. All of the other possible values imply failure. In case of failure, the corresponding trust association interceptor is not used.
   - Add the `com.ibm.websphere.security.trustassociation.ignoreInitStatus` property in the trust association interceptor custom properties. Set the value of this property to **true**, which tells WebSphere Application Server to ignore the status of this method. If you add this property to the custom properties, WebSphere Application Server does not check the return status, which is similar to previous versions of WebSphere Application Server.

public void cleanup ();
This method is called when the application server is stopped. It is used to prepare the interceptor for termination.

public void setVersion (String s);
This methods is optional. The method is used to set the version and is for informational purpose only. The default value is `Unspecified`.

You must configure the following methods implemented by the custom interceptor implementation. **This listing only shows the methods and does not include any implementation.**

```
*********************************************************************
import java.util.*;
import javax.servlet.http.HttpServletRequest;
import com.ibm.websphere.security.*;

public class myTAIImpl extends WebSphereBaseTrustAssociationInterceptor
      implements TrustAssociationInterceptor
{

      public myTAIImpl ()
      {
      }


      public boolean isTargetInterceptor (HttpServletRequest req)
           throws WebTrustAssociationException
      {

           //return true if this is the target interceptor, else return false.
      }


      public void validateEstablishedTrust (HttpServletRequest req)
           throws WebTrustAssociationFailedException
      {
           //validate if the request is from the trusted proxy server.
           //throw exception if the request is not from the trusted server.

      }

      public String getAuthenticatedUsername (HttpServletRequest req)
           throws WebTrustAssociationUserException
      {
           //Get the user name from the request and if the user is
           //entitled to the requested resource
           //return the user. Otherwise, throw the exception

      }


      public int init (Properties props)
      {
           // Initialize the implementation.
           // If successful return 0, else return -1.
      }
```

```
        public void cleanup ()
        {
             //Cleanup code.

        }

}
**********************************************************************
```

Note: If the `init(Properties)` method is implemented as described previously in your custom interceptor, this note does not apply to your implementation, and you can move on to the next step. Previous versions of `com.ibm.websphere.security.WebSphereBaseTrustAssociationInterceptor` include the public int init (String propsfile) method. This method is no longer required since the interceptor properties are not read from a file. The properties are now entered in the administrative console **Custom Properties** link of the interceptor using the administrative console or scripts. These properties then are made available to your implementation in the `init(Properties)` method. However, for backward compatibility, the `init(String)` method still is supported. The `init(String)` method is called by the default implementation of `init(Properties)` as shown in the following example.

```
// Default implementation of init(Properties props) method. A Custom
   // implementation should override this.
   public int init (java.util.Properties props)
   {
      String type =
       props.getProperty("com.ibm.websphere.security.trustassociation.types");
      String classfile=
       props.getProperty("com.ibm.websphere.security.trustassociation."
       +type+".config");
      if (classfile != null && classfile.length() > 0 ) {
         return init(classfile);
      } else {
         return -1;
      }
   }
```

Change your implementation to implement the `init(Properties)` method instead of relying on `init(String propsfile)` method. As shown in the previous example, this default implementation reads the properties to load the property file. The `com.ibm.websphere.security.trustassociation.types` property gets the file containing the properties by concatenating `.config` to its value.

Note: The `init(String)` method still works if you want to use it instead of implementing the init(Properties) method. The only requirement is that the file name containing the custom trust association properties should now be entered using the **Custom Properties** link of the interceptor in the administrative console or by using scripts. You can enter the property using *either* of the following methods. The first method is used for backward compatibility with previous versions of WebSphere Application Server.

You can use the second method with WebSphere Application Server, Version 5.0.2 and later.

Method 1:

The same property names used in the previous release are used to obtain the file name. The file name is obtained by concatenating the `.config` to the `com.ibm.websphere.security.trustassociation.types` property value.

If the file name is called `myTAI.properties` and is located in the `C:/WebSphere/AppServer/properties` directory, set the following properties:

- `com.ibm.websphere.security.trustassociation.types = myTAItype`
- `com.ibm.websphere.security.trustassociation.myTAItype.config = C:/WebSphere/AppServer/properties/myTAI.properties`

Method 2:

You can set the `com.ibm.websphere.security.trustassociation.initPropsFile` property in the trust association custom properties to the location of the file. For example, set the following property:

```
com.ibm.websphere.security.trustassociation.initPropsFile=
c:/WebSphere/AppServer/properties/myTAI.properties
```

Type the previous code as one continuous line.

The location of the properties file is fully qualified. For example:

`C:/WebSphere/AppServer/properties/myTAI.properties`

Since the location can be different in a Network Deployment environment, use variables such as `${USER_INSTALL_ROOT}` to refer to the WebSphere Application Server installation directory.

For example, if the file name is called `myTAI.properties`, and it is located in the properties directory, then set the following properties:

- `com.ibm.websphere.security.trustassociation.types = myTAItype`
- `com.ibm.websphere.security.trustassociation.myTAItype.config = c:/WebSphere/AppServer/properties/myTAI.properties`

3. Compile the implementation once you have implemented it. For example, *install_root*`/java/bin/javac -classpath` *install_root*`/lib/wssec.jar;<install_root>/lib/j2ee.jar myTAIImpl.java`
   a. Copy the class file to a location in the class path (preferably the *install_root*`/lib/ext` directory).
   b. Restart all the servers.
4. Delete the default WebSEAL interceptor in the administrative console and click **New** to add your custom interceptor. Verify that the class name is dot separated and appears in the class path.
5. Click the **Custom Properties** link to add additional properties that are required to initialize the custom interceptor. These properties are passed to the `init(Properties)` method of your implementation when it extends the `com.ibm.websphere.security.WebSphereBaseTrustAssociationInterceptor` as described in the previous step.
6. Save and synchronize (if applicable) the configuration.
7. Restart the servers for the custom interceptor to take effect.

Refer to the “Security: Resources for learning” on page 495 article, which references the WebSphere Application Server Version 5 Redbook to view an example of a custom interceptor.

Trust association interceptor support for Subject creation

The new Trust Association Interceptor (TAI) interface, com.ibm.wsspi.security.tai.TrustAssociationInterceptor, supports several new features and is different from the existing com.ibm.websphere.security.TrustAssociationInterceptor interface. Although the existing interface is still supported, it is being deprecated in a future release.

The new TAI interface supports a multi-phase, negotiated authentication process. For example, some systems require a challenge response protocol back to the client. The two key methods in this new interface are:

Key method name

public boolean isTargetInterceptor (HttpServletRequest req)

The isTargetInterceptor method determines whether the request originated with the proxy server associated with the interceptor. The implementation code must examine the incoming request object and determine if the proxy server forwarding the request is a valid proxy server for this interceptor. The result of this method determines whether the interceptor processes the request.

Method result

A `true` value tells WebSphere Application Server to have the TAI handle the request.

A `false` value, tells WebSphere Application Server to ignore the TAI.

The negotiateValidateandEstablishTrust method determines whether to trust the proxy server from which the request originated. The implementation code must authenticate the proxy server. The authentication mechanism is proxy-server specific. For example, in the product implementation for the WebSEAL server, this method retrieves the basic authentication information from the HTTP header and validates the information against the user registry used by WebSphere Application Server. If the credentials are invalid, the code throws the WebTrustAssociationException, which indicates that the proxy server is not trusted and the request is denied. If the credentials are valid, the code returns a TAIResult, which indicates the status of the request processing along with the client identity (Subject and principal name) to be used for authorizing the Web resource.

Key method name

public TAIResult negotiateValidateandEstablishTrust (HttpServletRequest req, HttpServletResponse res)

Method result

Returns a TAIResult, which indicates the status of the request processing. The request object can be queried and the response object can be modified.

The TAIResult class has three static methods for creating a TAIResult. The TAIResult create methods take an int type as the first parameter. WebSphere Application Server expects the result to be a valid HTTP request return code and is interpreted in one of the following ways:

- If the value is `HttpServletResponse.SC_OK`, this response tells WebSphere Application Server that the TAI has completed its negotiation. The response also tells WebSphere Application Server use the information in the TAIResult to create a user identity.
- Other values tell WebSphere Application Server to return the TAI output, which is placed into the HttpServletResponse, to the Web client. Typically, the Web client provides additional information and then places another call to the TAI.

The created TAIResults have the following meanings:

TAIResult	Explanation
public static TAIResult create(int status);	Indicates a status to WebSphere Application Server. The status should not be SC_OK because the identity information is provided.
public static TAIResult create(int status, String principal);	Indicates a status to WebSphere Application Server and provides the user ID or the unique ID for this user. WebSphere Application Server creates credentials by querying the user registry.
public static TAIResult create(int status, String principal, Subject subject);	Indicates a status to WebSphere Application Server, the user ID or the unique ID for the user, and a custom Subject. If the Subject contains a Hashtable, the principal is ignored. The contents of the Subject becomes part of the eventual user Subject.

All of the following examples are within the negotiateValidateandEstablishTrust() method of a TAI.

The following code sample indicates that additional negotiation is required:

```
// Modify the HttpServletResponse object
 //  The response code is meaningful only on the client
 return TAIResult.create(HttpServletResponse.SC_CONTINUE);
```

The following code sample indicates that the TAI has determined the user identity. WebSphere Application Server receives the user ID only and then it queries the user registry for additional information:

```
// modify the HttpServletResponse object
 return TAIResult.create(HttpServletResponse.SC_OK, userid);
```

The following code sample indicates that the TAI had determined the user identity. WebSphere Application Server receives the complete user information that is contained in the Hashtable. For more information on the Hashtable, see “Configuring inbound identity mapping” on page 262. In this code sample, the Hashtable is placed in the public credential portion of the Subject:

```
// create Subject and place Hashtable in it
 Subject subject = new Subject;
 subject.getPublicCredentials().add(hashtable);
 //the response code is meaningful only the client
 return TAIResult.create(HttpServletResponse.SC_OK, "ignored", subject);
```

The following code sample indicates that there is an authentication failure. WebSphere Application Server fails the authentication request:

```
//log error message
 // ....
 throw new WebTrustAssociationFailedException("TAI failed for this reason");
```

There are a few additional methods on the TrustAssociationInterceptor interface that are discussed in the Java documentation. These methods are used for initialization, shut down, and for identifying the TAI to WebSphere Application Server.

Assembling secured applications

The Assembly Toolkit is a graphical user interface for assembling enterprise (J2EE) applications. For additional information on the Assembly Toolkit, see Assembling applications with the Assembly Toolkit.

You can use the tool to assemble an application and secure EJB and Web modules in that application. An EJB module consists of one or more beans. You can enforce security at the EJB method level. A Web module consists of one or more Web resources (an HTML page, a JSP file or a servlet). You can also enforce security for each Web resource. You can use the tool to secure an EJB module (Java archive (JAR) file) or a Web module (Web archive (WAR) file) or an application (enterprise archive (EAR) file).

You can create an application, an EJB module, or a Web Module and secure them using the Assembly Toolkit or development tools like the IBM WebSphere Studio Application Developer.

1. Secure EJB applications using the Assembly Toolkit. For more information, see"Securing enterprise bean applications using the Assembly Toolkit" on page 111.
2. Secure Web applications using the Assembly Toolkit. For more information, see "Securing Web applications using the Assembly Toolkit" on page 114.
3. Add users and groups to roles while assembling secured application using the Assembly Toolkit. For more information, see "Adding users and groups to roles using the Assembly Toolkit" on page 121.
4. Map users to RunAs roles using the Assembly Toolkit. For more information, see "Mapping users to RunAs roles using the Assembly Toolkit" on page 121
5. Add the was.policy file to applications for Java 2 security. For more information, see "Adding the was.policy file to applications" on page 467
6. Assemble the application components that you just secured using the Assembly Toolkit. For more information, see Assembling applications with the Assembly Toolkit.

After securing an application, the resulting `.ear` file contains security information in its deployment descriptor. The EJB module security information is stored in the `ejb-jar.xml` file and the Web module security information is stored in the `web.xml` file. The `application.xml` file of the application EAR file contains all the roles used in the application. The user and group to roles mapping is stored in the `ibm-application-bnd.xmi` file of the application EAR file.

The `was.policy` file of the application EAR contains the permissions granted for the application to access system resources.

This task is required to secure EJB modules and Web modules in an application. This task is also required for applications to run properly when Java 2 security is

enabled. If the was.policy file is not created and it does not contain required permissions, the application might not be able to access system resources.

After securing an application, you can install an application using the administrative console. When you install a secured application, see "Deploying secured applications" on page 122 to complete this task.

Enterprise bean component security

An EJB module consists of one or more beans. You can use development tools such as WebSphere Studio Application Developer to develop an EJB module. You can also enforce security at the EJB method level.

You can assign a set of EJB methods to a set of one or more roles. When an EJB method is secured by associating a set of roles, grant at least one role in that set so that you can access that method. To exclude a set of EJB methods from being accessed by anyone mark them **excluded**. You can give everyone access to a set of enterprise beans method by clearing those methods. You can run enterprise beans as a different identity (runAs identity) before invoking other enterprise beans.

Securing enterprise bean applications using the Assembly Toolkit

You can protect enterprise bean methods by assigning security roles to them. Before you assign security roles, you need to know which EJB methods need protecting and how.

1. Open the EJB application file. This file can be an EJB `.jar` file or an application `.ear` file that contains one or more EJB modules. In the Assembly Toolkit, open a deployment descriptor editor on the EJB application file. In a J2EE Hierarchy view, right-click the file and click **Open With** > **Deployment Descriptor Editor**. If you selected an EJB `.jar` file, an EJB deployment descriptor editor opens. If you selected an application `.ear` file, an application deployment descriptor editor opens. To see online information about the editor, press F1 and click the editor name.
2. Create security roles. You can create security roles at the application level or at the EJB module level. If you create a security role at the EJB module level, the role displays in the application level. If a security role is created at the application level, the role does not appear in all the EJB modules. You can copy and paste one or more EJB module security roles that you create at application level:
   - Create a role at an EJB module level. In an EJB deployment descriptor editor, select the **Assembly Descriptor** tab. Under **Security Roles**, click **Add**. In the Add Security Role wizard, name and describe the security role; then click **Finish**.
   - Create a role at the application level. In an application deployment descriptor editor, select the **Security** tab. Under the list of security roles, click **Add**. In the Add Security Role wizard, name and describe the security role; then click **Finish**.
3. Create method permissions. Method permissions map one or more methods to a set of roles. An enterprise bean has four types of methods: Home methods, Remote methods, LocalHome methods and Local methods. You can add permissions to enterprise beans on the method level. You cannot add a method permission to an enterprise bean unless you already have one or more security roles defined. For version 2.0 EJB projects, there is an unchecked option that

specifies that the selected methods from the selected beans do not require authorization to execute. To add a method permission to an enterprise bean:

a. On the **Assembly Descriptor** tab of an EJB deployment descriptor editor, under **Method Permissions**, click **Add**. The Add Method Permission wizard opens.

b. Select a security role from the list of roles found and click **Next**.

c. Select one or more enterprise beans from the list of beans found. You can click **Select All** or **Deselect All** to select or deselect all of the enterprise beans in the list. Click **Next**.

d. Select the methods that you want to bind to your security role. The Method Elements page lists all methods associated with the enterprise bean(s). You can click **Apply to All** or **Deselect All** to quickly select or clear multiple methods. It selects only the * method for each bean. Creating a method permission for the exact method signature overrides the default (*) method permission setting. The * method represents all methods within the bean. There are * for each interface as well. By not selecting all of the individual methods in the tree, you can set other permissions on the remaining methods.

e. Click **Finish**.

After the method permission is created, you can see the new method permission in the tree. Expand the tree to see the bean and methods defined in the method permission.

4. Exclude user access to methods. Users cannot access excluded methods. Any method in the enterprise beans that is not assigned to a role or is not excluded, is deselected during the application installation by the deployer.

a. On the **Assembly Descriptor** tab of an EJB deployment descriptor editor, under **Excludes List**, click **Add**. The Exclude List wizard opens.

b. Select one or more enterprise beans from the list of beans found and click **Next**.

c. Select one or more of the method elements for the security identity and click **Finish**.

5. Map security-role-ref and role-name to role-link. When developing enterprise beans, you can create the security-role-ref element. The security-role-ref element contains only the role-name field. The role-name field determines if the caller is in a specified `role(isCallerInRole())` and contains the name of the role that is referenced in the code. Since you create security roles during the assembly stage, the developer uses a *logical rolename* in the **role-name** field and provides enough information in the **description** field for the assembler to map the actual role (role-link). The security-role-ref element is located at the EJB level. Enterprise beans can have zero or more security-role-ref elements.

a. On the **References** tab of an EJB deployment descriptor editor, under the list of references, click **Add**. The Add Reference wizard opens.

b. Select **Security role reference** and click **Next**.

c. Name the security role reference, select a security role to link the reference to, describe the security role reference, and click **Finish**.

d. Map every role-name used during development to the role (role-link) using the previous steps.

6. Specify the RunAs Identity for enterprise beans components. The RunAs Identity of the enterprise bean is used to invoke the next enterprise beans in the chain of EJB invocations. When the next enterprise beans are invoked, the `RunAsIdentity` passes to the next enterprise beans for performing an authorization check on the next enterprise bean. If the RunAs Identity is not

specified, the client identity is propagated to the next enterprise bean. The RunAs Identity can represent each of the enterprise beans or can represent each method in the enterprise beans.

a. On the **Access** tab of an EJB deployment descriptor editor, under **Security Identity (Bean Level)**, click **Add**. The Add Security Identity wizard opens.
b. Select the run as mode, describe the security identity, and click **Next**. Select the **Use identity of caller** mode to instruct the security service to make no changes to the principal's credential settings. Select the **Use identity assigned to specific role (below)** mode to use a principal that has been assigned to the specified security role for running of the bean's methods. This association is part of the application binding in which the role is associated with a user ID and password of a user who is granted that role. If you selected **Use identity assigned to specific role (below)**, you must specify a role name and role description.
c. Select one or more enterprise beans from the list of beans found and click **Next**. If **Next** is unavailable, click **Finish**.
d. Optional: On the Method Elements page, select one or more of the method elements for the security identity and click **Finish**.

7. Close the deployment descriptor editor and, when prompted, click **Yes** to save the changes.

After securing an EJB application, the resulting `.jar` file contains security information in its deployment descriptor. The security information of the EJB modules is stored in the `ejb-jar.xml` file.

After securing an EJB application using an assembly tool, you can install the EJB application using the administrative console. During the installation of a secured EJB application, follow the steps in the Deploying secured applications article to complete the task of securing the EJB application.

Web component security

A Web module consists of servlets, JSP files, server-side utility classes, static Web content (HTML, images, sound files, Cascading Style Sheets (CSS)), and client-side classes (applets). You can use development tools such as IBM WebSphere Studio Application Developer to develop a Web module and enforce security at the method level of each Web resource.

You can identify a Web resource by its URI pattern. A Web resource method can be any HTTP method (GET, POST, DELETE, PUT, for example). You can group a set of URI patterns and a set of HTTP methods together and assign this grouping a set of roles. When a Web resource method is secured by associating a set of roles, grant a user at least one role in that set to access that method. You can exclude anyone from accessing a set of Web resources by assigning an empty set of roles. A servlet or a JSP file can run as different identities (RunAs identity) before invoking another enterprise bean component. All the secured Web resources require the user to log in by using a configured login mechanism. There are three types of Web login authentication mechanisms: basic authentication, form-based authentication and client certificate-based authentication.

For more detailed information on Web security see the product architectural overview article.

Securing Web applications using the Assembly Toolkit

There are three types of Web login authentication mechanisms that you can configure on a Web application: basic authentication, form-based authentication and client certificate-based authentication. Protect Web resources in a Web application by assigning security roles to those resources.

To secure Web applications, determine the Web resources that need protecting and determine how to protect them.

1. Open the Web application file. This file can be a Web archive (WAR) file or an application archive (EAR) file that contains one or more Web modules. In the Assembly Toolkit, open a deployment descriptor editor on the Web application file. In a J2EE Hierarchy view, right-click the file and click **Open With** > **Deployment Descriptor Editor**. If you selected Web archive (WAR) file, a Web deployment descriptor editor opens. If you selected an enterprise application (EAR) file, an application deployment descriptor editor opens. To see online information about the editor, press F1 and click the editor name.
2. Create security roles either at the application level or at Web module level. If a security role is created at the Web module level, the role also displays in the application level. If a security role is created at the application level, the role does not display in all the Web modules. You can copy and paste a security role at the application level to one or more Web module security roles.
   - Create a role at a Web-module level. In a Web deployment descriptor editor, select the **Security** tab. Under **Security Roles**, click **Add**. Double-click **(New Security Role)** and type the security role. Under **Details**, describe the security role.
   - Create a role at the application level. In an application deployment descriptor editor, select the **Security** tab. Under the list of security roles, click **Add**. In the Add Security Role wizard, name and describe the security role; then click **Finish**.
3. Create security constraints. Security constraints are a mapping of one or more Web resources to a set of roles.
   a. On the **Security** tab of a Web deployment descriptor editor, click **Security Constraints**. On the Security Constraints tab that opens, you can do the following:
      - Add or remove security constraints for specific security roles.
      - Add or remove Web resources and their HTTP methods.
      - Define which security roles are authorized to access the Web resources.
      - Specify None, Integral, or Confidential constraints on user data. *None* means that the application requires no transport guarantees. *Integral* means that data cannot be changes in transit between client and server. And *Confidential* means that data content cannot be observed while it is in transit. Integral and Confidential usually require the use of SSL.

   b. Under **Security Constraints**, click **Add**.
   c. Under **Details**, specify a display name for the security constraint.
   d. Under Web Resource Collections, click **Add**. The Web Resource Collections wizard opens.
   e. Type a name and description for the Web resource collection.
   f. Select one or more HTTP methods. The HTTP method options are: GET, PUT, HEAD, TRACE, POST, DELETE, and OPTIONS.
   g. Beside **URL Patterns**, click **Add**. Double-click on **(New URL pattern)** and type a URL pattern (for example: `- /*, *.jsp, /hello`). Consult the Servlet specification Version 2.3 for instructions on mapping URL patterns to

servlets. Security run time uses the exact match first to map the incoming URL with URL patterns. If the exact match is not present, the security run time uses the longest match. The wild card (`*.,*.jsp`) URL pattern matching is used last.

h. Repeat these steps to create multiple security constraints.

4. Map security-role-ref and role-name elements to the role-link element. During the development of a Web application, you can create the security-role-ref element. The security-role-ref element contains only the role-name field at this stage. The role-name field contains the name of the role that is referenced in the servlet or JSP code to determine if the caller is in a specified role (isUserInRole()). Since security roles are created during the assembly stage, the developer uses a logical role name in the **role-name** field and provides enough description in the **description** field for the assembler to map the role actual (role-link). The Security-role-ref element is at the servlet level. A servlet or JSP file can have zero or more security-role-ref elements.

   a. Go to the **References** tab of a Web deployment descriptor editor. On the **References** tab, you can add or remove the name of an enterprise bean reference to the deployment descriptor. There are 5 types of references you can define on this tab:
      - EJB
      - EJB Local (J2EE 1.3 only)
      - Resource
      - Resource Environment (J2EE 1.3 only)
      - JSP Tag Library

   b. Under the list of EJB references, click **Add**. Double-click on **(New EJB Ref)** and type an EJB reference.

   c. Under **Details**, click **Browse** beside **Link** and select a link for the EJB reference. Select a link type of ENTITY or SESSION. Select **Home** and **Remote** values, and describe the link.

   d. Map every role-name used during development to the role (role-link) using the previous steps. Every role name used during development maps to the actual role.

5. Specify the RunAs identity for servlets and JSP files. The RunAs identity of a servlet is used to invoke enterprise beans from within the servlet code. When enterprise beans are invoked, the RunAs identity is passed to the enterprise bean for performing an authorization check on the enterprise beans. If the RunAs identity is not specified, the client identity is propagated to the enterprise beans. The RunAs identity is assigned at the servlet level.

   a. On the **Servlets** tab of a Web deployment descriptor editor, under **Servlets and JSPs**, click **Add**. The Add Servlet or JSP wizard opens.

   b. Select whether to add a servlet or JavaServer page (JSP), define which servlet or JSP to add, and click **OK**.

   c. Under **Run As**, select the security role and describe the role.

   d. Specify a RunAs identity for each servlet and JSP file used by your Web application.

6. Configure the login mechanism for the Web module. This configured login mechanism applies to all the servlets, JavaServer page (JSP) files and HTML resources in the Web module.

   a. On the **Pages** tab of a Web deployment descriptor editor, under **Login**, select the required authentication method. Available method values include: Unspecified, Basic, Digest, Form, and Client-Cert.

   b. Specify a realm name.

c. If you select the Form authentication method, select a login page and an error page URLs (for example: `/login.jsp` and `/error.jsp`). The specified login and error pages are present in the `.war` file.

d. Install the client certificate on the browser or Web client and place the client certificate in the server trust keyring file, if `ClientCert` is selected.

7. Close the deployment descriptor editor and, when prompted, click **Yes** to save the changes.

After securing a Web application, the resulting WAR file contains security information in its deployment descriptor. The Web module security information is stored in the `web.xml` file. When you work in the Web deployment descriptor editor, you also can edit other deployment descriptors in the Web project, including information on bindings and IBM extensions in the `ibm-web-bnd.xmi` and `ibm-web-ext.xmi` files.

After using the Assembly Toolkit to secure a Web application, you can install the Web application using the administrative console. During the Web application installation, complete the steps in the "Deploying secured applications" on page 122 article to finish securing the Web application.

Role-based authorization

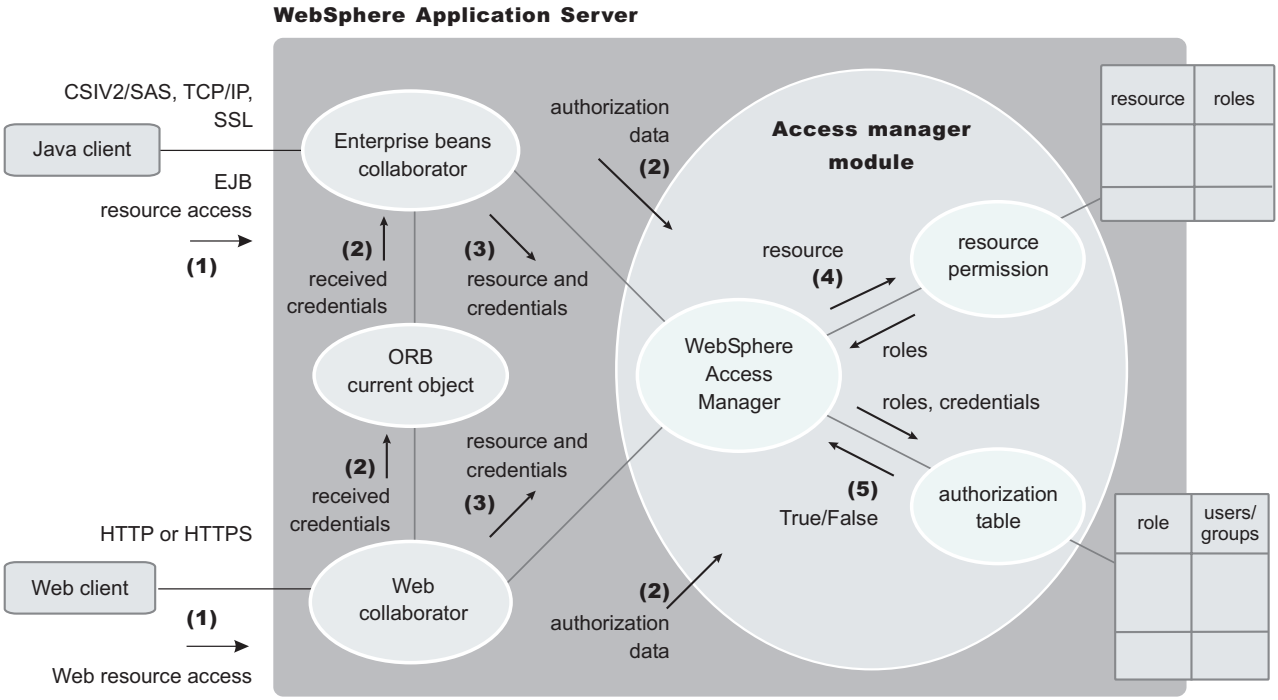
Use authorization information to determine whether a caller has the necessary privileges to request a service.

The following figure illustrates the process used during authorization. Web resource access from a Web client is handled by a Web collaborator. The EJB resource access from a Java client (can be enterprise beans or a servlet) is handled by an EJB Collaborator. The EJB collaborator and the Web collaborator extract the client credentials from the object request broker (ORB) current object. The client credentials are set during the authentication process as received credentials in the ORB Current. The resource and the received credentials are presented to WSAccessManager to check whether access is permitted to the client for accessing the requested resource.

The access manager module contains two main modules:

- Resource permission module helps determine the required roles for a given resource. It uses a resource to roles mapping table that is built by the security run time during application startup. To build the resource-to-role mapping table, the security run time reads the deployment descriptor of the enterprise beans or the Web module (`ejb-jar.xml` or `web.xml`)
- Authorization table module consults a role to user or group table to determine whether a client is granted one of the required roles. The role to user or group mapping table, also known as the *authorization table*, is created by the security run time during application startup. To build the authorization table, the security run time reads the application binding file (`ibm-application-bnd.xmi` file).

Authentication



Use authorization information to determine whether a caller has the necessary privilege to request a service. You can store authorization information many ways. For example, with each resource, you can store an *access-control list*, which contains a list of users and user privileges. Another way to store the information is to associate a list of resources and the corresponding privileges with each user. This list is called a *capability list*.

WebSphere Application Server uses the Java 2 Enterprise Edition (J2EE) authorization model. In this model, authorization information is organized as follows:

- During the assembly of an application, permission to invoke methods is granted to one or more roles. A role is a set of permissions; for example, in a banking application, roles can include teller, supervisor, clerk, and other industry-related positions. The teller role is associated with permissions to run methods related to managing the money in an account, such as the withdraw and deposit methods. The teller role is not granted permission to close accounts; this permission is given to the supervisor role. The application assembler defines a list of method permissions for each role; this list is stored in the deployment descriptor for the application.

There are two *special subjects* that are not defined by J2EE: AllAuthenticatedUsers, Everyone. A special subject is a product-defined entity independent of the user registry. It is used to generically represent a class of users or groups in the registry.

- AllAuthenticatedUsers is a special subject that permits all authenticated users to access protected methods. As long as the user can authenticate successfully, the user is permitted access to the protected resource.
- Everyone is a special subject that permits unrestricted access to a protected resource. Users do not have to authenticate to get access; this special subject provides access to protected methods as if the resources were unprotected.

During the deployment of an application, real users or groups of users are assigned to the roles. The application deployer does not need to understand the individual methods. By assigning roles to methods, the application assembler simplifies the job of the application deployer. Instead of working with a set of methods, the deployer works with the roles, which represent semantic groupings of the methods. When a user is assigned to a role, the user gets all the method permissions that are granted to that role. Users can be assigned to more than one role; the permissions granted to the user are the union of the permissions granted to each role. Additionally, if the authentication mechanism supports the grouping of users, these groups can be assigned to roles. Assigning a group to a role has the same effect as assigning each individual user to the role.

A best practice during deployment is to assign groups, rather than individual users to roles for the following reasons:
- Improves performance during the authorization check. Typically far fewer groups exist than users.
- Provides greater flexibility, by using group membership to control resource access.
- Supports the addition and deletion of users from groups outside of the product environment. This action is preferred to adding and removing them to WebSphere Application Server roles. Stop and restart the enterprise application for these changes to take effect. This action can be very disruptive in a production environment.

At run time, WebSphere Application Server authorizes incoming requests based on the user's identification information and the mapping of the user to roles. If the user belongs to any role that has permission to execute a method, the request is authorized. If the user does not belong to any role that has permission, the request is denied.

The J2EE approach represents a declarative approach to authorization, but it also recognizes that you cannot deal with all situations declaratively. For these situations, methods are provided for determining user and role information programmatically. For Enterprise JavaBeans, the following two methods are supported by WebSphere Application Server:
- **getCallerPrincipal**: This method retrieves the user identification information.
- **isCallerInRole**: This method checks the user identification information against a specific role.

For servlets, the following methods are supported by WebSphere Application Server:
- getRemoteUser
- isUserInRole
- getUserPrincipal

These methods correspond in purpose to the enterprise bean methods.

For more information on the J2EE security authorization model see the following Web site: http://java.sun.com

Admin roles

The J2EE role-based authorization concept has been extended to protect the WebSphere Application Server administrative subsystem. A number of administrative roles have been defined to provide degrees of authority needed to perform certain WebSphere administrative functions from either the Web-based

administrative console or the system management scripting interface. The authorization policy is only enforced when global security is enabled. The following table describes the admin roles:

Admin roles

Role	Description
monitor	Least privileged that basically allows a user to view the WebSphere Application Server configuration and current state.
configurator	Monitor privilege plus the ability to change the WebSphere Application Server configuration.
operator	Monitor privilege plus the ability to change run-time state, such as starting or stopping services for example.
administrator	Operator plus configuration privilege.

The identity specified when enabling global security is automatically mapped to the administrator role. Users, groups, can be added or removed from the admin roles from the WebSphere Application Server administrative console at anytime. However, a server restart is required for the changes to take effect. A best practice is to map a group or groups, rather than specific users, to admin roles because it is more flexible and easier to administer in the long run. By mapping a group to an admin role, adding or removing users to or from the group occurs outside of WebSphere Application Server and does not require a server restart for the change to take effect.

In addition to mapping user or groups, a special-subject can also be mapped to the admin roles. A special-subject is a generalization of a particular class of users. The AllAuthenticated special subject means that the access check of the admin role ensures that the user making the request has at least been authenticated. The Everyone special subject means that anyone, authenticated or not, can perform the action, as if security was not enabled.

Naming roles

The J2EE role-based authorization concept has been extended to protect the WebSphere CosNaming service.

CosNaming security offers increased granularity of security control over CosNaming functions. CosNaming functions are available on CosNaming servers such as the WebSphere Application Server. They affect the content of the WebSphere Name Space. There are generally two ways in which client programs will result in CosNaming calls. The first is through the JNDI interfaces. The second is CORBA clients invoking CosNaming methods directly.

Four security roles are introduced: **CosNamingRead, CosNamingWrite, CosNamingCreate, and CosNamingDelete**. The name of the four roles are the same with WebSphere Advanced Edition Version 4.0.2. However, the roles now have authority level from low to high as follows:

- **CosNamingRead**. Users who have been assigned the CosNamingRead role will be allowed to do queries of the WebSphere Name Space, such as through the JNDI ″lookup″ method. The special-subject Everyone is the default policy for this role.

- **CosNamingWrite**. Users who have been assigned the CosNamingWrite role will be allowed to do write operations such as JNDI ″bind″, ″rebind″, or ″unbind″, plus CosNamingRead operations. The special-subject AllAuthenticated is the default policy for this role.
- **CosNamingCreate**. Users who have been assigned the CosNamingCreate role will be allowed to create new objects in the Name Space through such operations as JNDI ″createSubcontext″, plus CosNamingWrite operations. The special-subject AllAuthenticated is the default policy for this role.
- **CosNamingDelete**. And finally users who have been assigned CosNamingDelete role will be able to destroy objects in the Name Space, for example using the JNDI ″destroySubcontext″ method, as well as CosNamingCreate operations. The special-subject AllAuthenticated is the default policy for this role.

Users, groups, or the special subjects AllAuthenticated and Everyone can be added or removed to or from the naming roles from the WebSphere Application Server administrative console at anytime. However, you must restart the server for the changes to take effect. A best practice is to map groups or one of the special-subjects, rather than specific users, to Naming roles because it is more flexible and easier to administer in the long run. By mapping a group to an naming role, adding or removing users to or from the group occurs outside of WebSphere Application Server and does not require a server restart for the change to take effect.

If a user is assigned a particular naming role and that user is a member of a group that has been assigned a different naming role, the user will be granted the most permissive access between the role he was assigned and the role his group was assigned. For example, assume that user MyUser has been assigned the CosNamingRead role. Also, assume that group MyGroup has been assigned the CosNamingCreate role. If MyUser is a member of MyGroup, MyUser will be assigned the CosNamingCreate role because he is a member of MyGroup. If MyUser were not a member of MyGroup, he would be assigned the CosNamingRead role.

The CosNaming authorization policy is only enforced when global security is enabled. When global security is enabled, attempts to do CosNaming operations without the proper role assignment will result in a org.omg.CORBA.NO_PERMISSION exception from the CosNaming Server.

In WebSphere Application Server Version 4.0.2, each CosNaming function is assigned to only one role. Therefore, users who have been assigned CosNamingCreate role will not be able to query the Name Space unless they have also been assigned CosNamingRead. In most cases a creator would need to be assigned three roles: **CosNamingRead, CosNamingWrite, and CosNamingCreate**. This has been changed in the release. The **CosNamingRead** and **CosNamingWrite** roles assignment for the creator example in above have been included in **CosNamingCreate** role. In most of the cases, WebSphere Application Server administrators do not have to change the roles assignment for every user or group when they move to this release from previous one.

Although the ability exist to greatly restrict access to the Name space by changing the default policy, doing so may result in unexpected org.omg.CORBA.NO_PERMISSION exceptions at run time. Typically, J2EE applications access the Name space and the identity they use is that of the user that authenticated to WebSphere Application Server when they access the J2EE

application. Unless the J2EE application provider clearly communicates the expected Naming roles, care should be taken when changing the default naming authorization policy.

Adding users and groups to roles using the Assembly Toolkit

Before you perform this task, you should have already completed the steps in the Securing Web applications and Securing EJB applications articles where you created new roles and assigned those roles to EJB and Web resources. Complete these steps during application installation. This is because the environment (user registry) under which the application is running is not known until deployment.

If you already know the environment in which the application is running and the user registry that is used, then you can use the Assembly Toolkit to assign users and groups to roles. Using the administrative console to assign users and groups to roles is recommended.

1. In the J2EE Hierarchy view of the Assembly Toolkit, right-click an enterprise application project (EAR file) and click **Open With** > **Deployment Descriptor Editor**. An application deployment descriptor editor opens on the EAR file. To access information about the editor, press F1 and click **Application deployment descriptor editor**.
2. Click the **Security** tab and, under the main pane, click **Add**.
3. In the Add Security Role wizard, name and describe the security role. Then click **Finish**.
4. Under **WebSphere Bindings**, select the user or group extension properties for the security role. Available values include: Everyone, All authenticated users, and Users/Groups.
5. If you selected Users/Groups, click **Add** beside the **Users** or **Groups** panes. In the wizard that opens, specify a user or group name and click **Finish**. Repeat this step until you have added all users and groups to which the security role applies.
6. Close the application deployment descriptor editor and, when prompted, click **Yes** to save the changes.

The `ibm-application-bnd.xmi` file in the application contains the users and groups to roles mapping table (*authorization table*).

After securing an application, install the application using the administrative console.

Mapping users to RunAs roles using the Assembly Toolkit

RunAs roles are used for delegation. A servlet or enterprise bean component uses the RunAs role to invoke another enterprise bean by impersonating that role. You must define RunAs roles when a servlet or an enterprise bean in an application is configured with RunAs settings. Before you perform this task:

- Secure the Web application and enterprise bean applications, including creating and assigning new roles to enterprise bean and Web resources.
- Assign users and groups to roles. Complete this step during the installation of the application. The environment or user registry under which the application is going to run is not known until deployment. If you already know the environment in which the application is going to run and you know the user registry, then you can use the Assembly Toolkit to assign users to RunAs roles.

1. In the J2EE Hierarchy view of the Assembly Toolkit, right-click an enterprise application project (EAR file) and click **Open With** > **Deployment Descriptor Editor**. An application deployment descriptor editor opens on the EAR file. To access information about the editor, press F1 and click **Application deployment descriptor editor**.
2. On the **Security** tab, under **Security Role Run As Bindings**, click **Add**.
3. Click **Add** under **RunAs Bindings**.
4. In the Security Role wizard, select one or more roles and click **Finish**.
5. Repeat steps 3 through 5 for all the RunAs roles in the application.
6. Close the application deployment descriptor editor and, when prompted, click **Yes** to save the changes.

The `ibm-application-bnd.xmi` file in the application contains the user to RunAs role mapping table.

After securing an application, you can install the application using the administrative console. You can change the RunAs role mappings of an installed application.

Deploying secured applications

Before you perform this task, verify that you have already designed, developed and assembled an application with all the relevant security configurations. For more information on these tasks refer to the “Developing secured applications” on page 38 and “Assembling secured applications” on page 110 articles. In this context, deploying and installing an application are considered the same task.

Deploying applications that have security constraints (secured applications) is not much different than deploying applications any security constraints. The only difference is that you might need to assign users and groups to roles for a secured application, which requires that you have the correct active registry. To deploy a newly secured application click **Applications > Install New Application** in the navigation panel on the left and follow the prompts. If you are installing a secured application, roles would have been defined in the application. If delegation was required in the application, RunAs roles also are defined.

One of the steps required to deploy secured applications is to assign users and groups to roles defined in the application. This task is completed as part of the step titled *Map security roles to users and groups*.

This assignment might have already been done through the Assembly Toolkit.

In that case you can confirm the mapping by going through this step. You can add new users and groups and modify existing information during this step.

If the applications support delegation, then a RunAs role is already defined in the application. If the delegation policy is set to **Specified Identity** (during assembly) the intermediary invokes a method using an identity setup during deployment. Use the RunAs role to specify the identity under which the downstream invocations are made. For example, if the RunAs role is assigned user ″bob″ and the client ″alice″ is invoking a servlet, with delegation set, which in turn calls the enterprise beans, then the method on the enterprise beans is invoked with ″bob″ as the identity. As part of the deployment process one of the steps is to assign or modify users to the RunAs roles. This step is titled ″Map RunAs roles to users″.

Use this step to assign new users or modify existing users to RunAs roles when the delegation policy is set to Specified Identity.

These steps are common for both installing an application and modifying an existing application. If the application contains roles, you see the ″Map security roles to users and groups″ link during application installation and also during managing applications, as a link in the Additional Properties section.

1. Click **Applications > Install New Application**. Complete the steps (non-security related) required prior to the step titled **Map security roles to users and groups**.
2. "Assigning users and groups to roles."
3. "Assigning users to RunAs roles" on page 130 if RunAs roles exist in the application.
4. Click **Correct use of System Identity** to specify RunAs roles if needed. Complete this action if the application has delegation set to use System Identity (applicable to enterprise beans only). System Identity uses the WebSphere Application Server security server ID to invoke downstream methods and should be used with caution as this ID has more privileges than other identities in terms of accessing WebSphere Application Server internal methods. This task is provided to make sure that the deployer is aware that the methods listed in the panel have System Identity set up for delegation and to correct them if necessary. If no changes are necessary, skip this task.
5. Complete the remaining (non-security related) steps to finish installing and deploying the application.

Once a secured application is deployed, verify that you can access the resources in the application with the correct credentials. For example, if your application has a protected Web module, make sure only the users that you assigned to the roles are able to use the application.

Assigning users and groups to roles

Before you perform this task:

- Secure the Web applications and EJB applications where new roles were created and assigned to Web and EJB resources.
- Create all the roles in your application.
- Verify that you have properly configured the user registry that contains the users that you want to assign. It is preferable to have security turned on with the user registry of your choice before beginning this process.
- Make sure that if you change anything in the security configuration (for example, enable security or change the user registry) you save the configuration and restart the server before the changes become effective.

Since the default active registry is LocalOS, it is not necessary, although it is recommended, that you enable security if you want to use the LocalOS registry to assign users and groups to roles. You can enable security once the users and groups are assigned in this case. The advantage of enabling security with the appropriate registry before proceeding with this task is that you can validate the security setup (which includes checking the user registry configuration) and avoid any problems using the registry.

These steps are common for both installing an application and modifying an existing application. If the application contains roles, you see the Map security

roles to users/groups link during application installation and also during application management, as a link in the Additional Properties section at the bottom.

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Map security roles to users/groups**. A list of all the roles that belong to this application displays. If the roles already had users or special subjects (All Authenticated, Everyone) assigned, they display here.
3. To assign the special subjects, select either the **Everyone** or the **All Authenticated** check box for the appropriate roles.
4. Click **Apply** to save any changes and then continue working with user or group roles.
5. To assign users or groups, select the role. You can select multiple roles at the same time, if the same users or groups are assigned to all the roles.
6. Click **Lookup Users** or **Lookup groups**.
7. Get the appropriate users and groups from the registry by completing the **limit** (number of items) and the **Search String** fields and clicking **Search**. The **limit** field limits the number of users that are obtained and displayed from the registry. The pattern is a searchable pattern matching one or more users and groups. For example, `user*` lists users like user1, user2. A pattern of asterisk (*) indicates all users or groups.

   Use the limit and the search strings cautiously so as not to overwhelm the registry. When using large registries (like Lightweight Directory Access Protocol (LDAP)) where information on thousands of users and groups resides, a search for a large number of users or groups can make the system very slow and can make it fail. When there are more entries than requests for entries, a message displays on top of the panel. You can refine your search until you have the required list.
8. Select the users and groups to include as members of these roles from the **Available** box and click **>>** to add them to the roles.
9. To remove existing users and groups, select them from the **Selected** box and click **<<**. When removing existing users and groups from roles use caution if those same roles are used as RunAs roles.

   For example, if user1 is assigned to RunAs role, role1, and you try to remove user1 from role1, the administrative console validation does not delete the user since a user can only be a part of a RunAs role if the user is already in a role (User1 should be in role1 in this case) either directly or indirectly through a group. For more information on the validation checks that are performed between RunAs role mapping and user and group mapping to roles, see the "Assigning users to RunAs roles" on page 130 section.
10. Click **OK**. If there are any validation problems between the role assignments and the RunAs role assignments the changes are not committed and an error message indicating the problem dispalys at the top of the panel. If there is a problem, make sure that the user in the RunAs role is also a member of the regular role. If the regular role contains a group which contains the user in the RunAs role, make sure that the group is assigned to the role using the administrative console. Follow steps 4 and 5.

    Avoid using the Assembly Toolkit or any other manual process where the complete name of the group, host name, group name, or distinguished name (DN) is not used.

The user and group information is added to the binding file in the application. This information is used later for authorization purposes.

This task is required to assign users and groups to roles, which enables the correct users and groups to access a secured application.

If you are installing an application, complete your installation. Once the application is installed and running you can access your resources according to the user and group mapping you did in this task. If you are managing applications and have modified the users and groups to role mapping, make sure you save, stop and restart the application so that the changes become effective. Try accessing the J2EE resources in the application to verify that the changes are effective.

Security role to user and group mappings

Use this page to map security roles to users. You can map roles to specific users, to specific groups, or to different categories.

To view this administrative console page, click **Application** > **Install New Application**. While running the Application Installation Wizard, prompts appear to help you map security roles to users or groups. To change role to user or group mappings for deployed applications, click **Application** > **Enterprise Application** > *deployed_application* > **Map security roles to users/groups**.

Users:

Specifies the users for role mapping. Verify that the users are defined in your chosen user registry.

To change the roles to users mapping, click **Manage Application >***application* **> Map security roles to users**.

Data type: String

Groups:

Specifies the groups for role mapping. Verify that the groups are defined in your chosen user registry.

To change the roles to users mapping, click **Manage Application >***application* **> Map security roles to groups**.

Data type: String

Roles:

Specifies the roles to which you want to map users and groups. Role privileges give users and groups permission to run as specified.

Select the check boxes to choose a role or a set of roles. Click **Look-up Users** to map users to the roles that you have selected. Click **Look-up Groups** to map groups to the selected roles. Use the check boxes to map roles to **EVERYONE** or **ALL AUTHENTICATED** special subject.

Data type: String

Everyone:

Specifies to map roles to everyone. Mapping a role to everyone means that anyone can access resources protected by this role, and essentially, there is no security.

Data type: Boolean

All Authenticated:

Specifies to authenticate all users. Roles are mapped to all authenticated users, and all authenticated users in the selected user registry are granted access to the role.

Data type: Boolean

Security role to user and group selections

Use this page to select users and groups for security roles.

To view this administrative console page, click **Application > Install New Application**.

While using the Install New Application Wizard, prompts appear to help you map security roles to users. You also can configure security roles to user mappings of deployed applications. Different roles can have different security authorizations. Mapping users or groups to a role authorizes those users or groups to access applications defined by the role. Users, groups and roles are defined when an application is installed or configured.

You also can select role to user and group mappings while you are deploying applications. After deployment in **Additional Properties**, click **Map Security roles to users** to change user and group mappings to a role.

Look up users:

Specifies whether the server looks up selected users.

Choose the role by selecting the check box beside the role and clicking **Lookup users**. Complete the **Limit** and the **Pattern** fields. The **Limit** field contains the number of entries that the search function returns. The **Pattern** field contains the search pattern used for searching entries. For example, `bob*` searches all users or groups starting with `bob`. A limit of zero returns all the entries that match the pattern. Use this value only when a small number of users or groups match this pattern in the registry. If the registry contains more entries that match the pattern than requested, a message appears in the console to indicate that there are more entries in the registry. You can either increase the limit or refine the search pattern to get all the entries.

Look up groups:

Specifies whether the server looks up selected groups.

Choose the role by selecting the check box beside the role and clicking **Lookup groups**. Complete the **Limit** and the **Pattern** fields. The **Limit** field contains the number of entries that the search function returns. The **Pattern** field contains the search pattern used for searching entries. For example, `bob*` searches all users or groups starting with `bob`. A limit of zero returns all the entries that match the pattern. Use this value only when a small number of users or groups match this pattern in the registry. If the registry contains more entries that match the pattern

than requested, a message appears in the console to indicate that there are more entries in the registry. You can either increase the limit or refine the search pattern to get all the entries.

Role:

Specifies user roles.

A number of administrative roles are defined to provide degrees of authority needed to perform certain WebSphere administrative functions from either the Web-based administrative console or the system management scripting interface. The authorization policy is only enforced when global security is enabled. The following roles are valid:

- **Monitor**--least privileged that basically allows a user to view the server configuration and current state
- **Configurator**--monitor privilege plus the ability to change the server configuration
- **Operator**--monitor privilege plus the ability to change the run time state, such as starting or stopping services
- **Administrator**--operator plus configurator privilege

Range	Monitor, Configurator, Operator, Administrator

Everyone:

Specifies to authenticate everyone.

Range	Monitor, Configurator, Operator, Administrator

All authenticated:

Range	Monitor, Configurator, Operator, Administrator

Mapped users:

Mapped groups:

Look up users and groups settings

Use this page to select users and groups for security roles.

To view this administrative console page, click **Applications** > **Enterprise Applications** > *application_name* > **Map security roles to users/groups** > **Look up users or groups** button.

Different roles can have different security authorizations. Mapping users or groups to a role authorizes those users or groups to access applications defined by the role. Users, groups and roles are defined when an application is installed or configured. Use the Search field to display users in the Available Users list. Click the arrows to add users from the Available Users list to the Selected Users list.

Limit:

Specifies the maximum number of users/groups that can be returned when assigning users/groups to roles.

A value of 0 implies a return of all users/groups that match the pattern. You can either increase the limit or refine the search pattern to get all the entries.

Data type	Integer
Units	User name
Default	20
Range	0 or more

Pattern:

Indicates the search pattern used to search for the entries.

The pattern field should contain the search pattern that should be used to search for the entries. For example, bob* will search all users or groups starting with bob. A limit of 0 gets all the entries that match the pattern and should be used only when a small number users/groups match that pattern in the registry. If the registry contains more entries that match the pattern than requested for, a message shows in the console to indicate that there are more entries in the registry.

Data type	String
Units	Number of users
Default	20
Range	A-Z with *

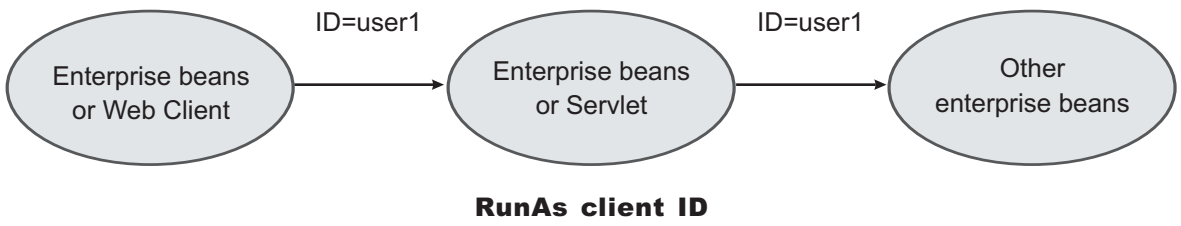
Delegations

Delegation is a process security identity propagation from a caller to a called object. As per the J2EE specification, a servlet and enterprise beans can propagate either the client (remote user) identity when invoking enterprise beans or they can use another specified identity as indicated in the corresponding deployment descriptor.

The IBM extension supports Enterprise JavaBeans (EJB) to propagate to the server ID when invoking other entity beans. There are three types of delegations:
- Delegate (RunAs) Client Identity
- Delegate (RunAs) Specified Identity
- Delegate (RunAs) System Identity

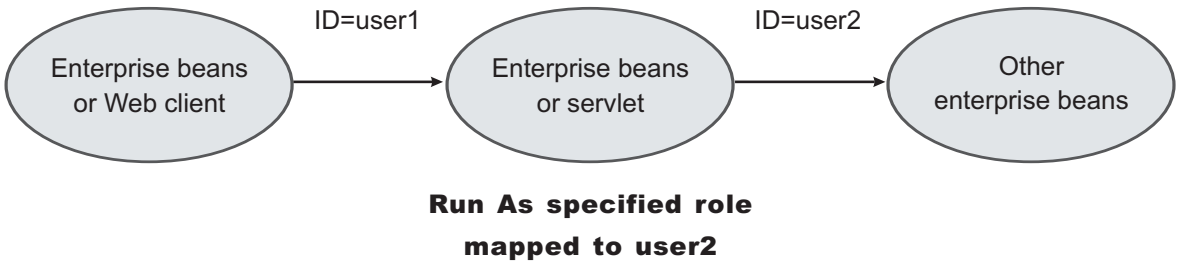
Delegate (RunAs) Client Identity

Delegate Client Identity



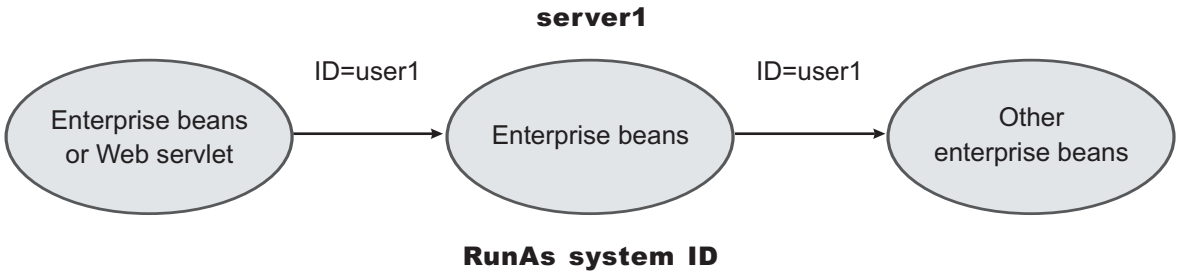
Delegate (RunAs) Specified Identity

Delegate Specified Identity



Delegate (RunAs) System Identity

Delegate System Identity



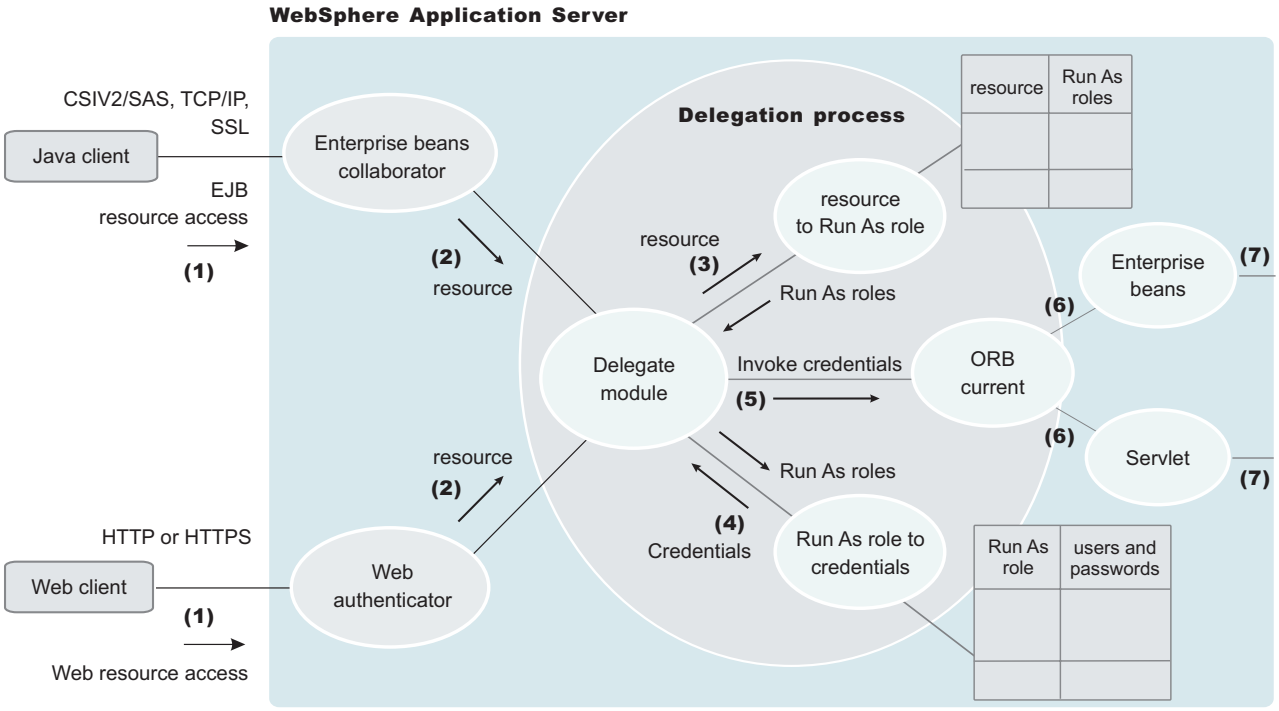
The EJB specification only supports delegation (RunAs) at the EJB level. But an IBM extension allows EJB method level RunAs specification. Method EJB method level runAs specification allows one to specify a different RunAs role for different methods within the same enterprise beans.

The RunAs specification is detailed in the deployment descriptor (the `ejb-jar.xml` file in the EJB module and the `web.xml` file in the Web module). The IBM extension to the RunAs specification is included in the `ibm-ejb-jar-ext.xmi` file.

There is also an IBM specific binding file for each application that contains a mapping from the RunAs role to the user. This file is specified in the `ibm-application-bnd.xmi` file.

These specifications are read by the run time during application startup. The following figure illustrates the delegation mechanism as implemented in the WebSphere Application Server security model.

Delegation



Delegation Process

There are two tables that help in the delegation process:
- Resource to RunAs role mapping table
- RunAs role to user ID and password mapping table

Use the Resource to RunAs role mapping table to get the role that is used by a servlet or by enterprise beans to propagate to the next enterprise beans call.

Use the RunAsRole to User ID and Password mapping table to get the user ID that belongs to the RunAs role and its password.

Delegation is performed after successful authentication and authorization. During this process, the delegation module consults the Resource to RunAs role mapping table to get the RunAs role (3). The delegation module consults the RunAs role to user ID and password mapping table to get the user that belongs to the RunAs role (4). The user ID and password is used to create a new credential using the authentication module, which is not shown in figure.The resulting credential is stored in the ORB Current as an invocation credential (5). Servlet and enterprise beans when invoking other enterprise beans pick up the invocation credential from the ORB Current (6) and call the next enterprise beans (7).

Assigning users to RunAs roles

Before you perform this task,
- Secure the Web applications and EJB applications where new RunAs roles were created and assigned to Web and EJB resources.
- Create all the RunAs roles in your application. The user in the RunAs role can only be entered if that user or a group to which that user belongs is already part of the regular role.

- Assign users and groups to security roles. Refer to Assigning users and groups to security roles for more information.
- Verify that the user registry requirements are met. These requirements are the same as those discussed in the same as in the case of Assigning users and groups to security roles task. For example, if role1 is a role that is also used as a RunAs role, then the user, user1, can be added to the RunAs role. role1, if user1 or a group that user1 belongs to, already is assigned to role1. The administrative console checks this logic when **Apply** or **OK** is clicked. If the check fails, the change is not made and an error message displays at the top of the panel.

If the special subjects ″Everyone″ or ″All Authenticated″ are assigned to a role, then no check takes place for that role.

The checking is done every time **Apply** in this panel is clicked or when **OK** is clicked in the **Map security roles to users and groups** panel. The check verifies that all the users in all the RunAs roles do exist directly or indirectly (through a group) in those roles in the **Map security roles to users and groups** panel. If a role is assigned both a user and a group to which that user belongs, then either the user or the group (not both) can be deleted from **Map security roles to users and groups** panel.

If the RunAs role user belongs to a group and if that group is assigned to that role, make sure that the assignment of this group to the role is done through administrative console and not through the Assembly Toolkit or any other method. When using the administrative console, the full name of the group is used (for example, hostname\groupName in windows systems, and distinguished names (DN) in Lightweight Directory Access Protocol (LDAP)). During the check, all the groups to which the RunAs role user belongs are obtained from the registry. Since the list of groups obtained from the registry are the full names of the groups, the check works correctly. If the short name of a group is entered using the Assembly Toolkit (for example, `group1` instead of `CN=group1, o=myCompany.com`) then this check fails.

These steps are common to both installing an application and modifying an existing application. If the application contains RunAs roles, you see the **Map RunAs roles to users** link during application installation and also during managing applications as a link in the **Additional Properties** section at the bottom.

1. Click **Map RunAs roles to users**. A list of all the RunAs roles that belong to this application displays. If the roles already had users assigned, they display here.
2. To assign a user, select the role. You can select multiple roles at the same time if the same user is assigned to all the roles.
3. Enter the user's name and password in the designated fields. The user name entered can be either the short name (preferred) or the full name (as seen when getting users and groups from the registry).
4. Click **Apply**. The user is authenticated using the active user registry. If authentication is successful, a check is made to verify that this user or group is mapped to the role in the **Map security roles to users and groups** panel. If authentication fails, verify that the user and password are correct and that the active registry configuration is correct.
5. To remove a user from a RunAs role, select the roles and click **Remove**.

The RunAs role user is added to the binding file in the application. This file is used for delegation purposes when accessing J2EE resources.

This step is required to assign users to RunAs roles so that during delegation the appropriate user is used to invoke the EJB methods.

If you are installing the application, complete installation. Once the application is installed and running you can access your resources according to the RunAS role mapping. Save the configuration.

If you are managing applications and have modified the RunAs roles to users mapping, make sure you save, stop and restart the application so that the changes become effective. Try accessing your J2EE resources to verify that the new changes are in effect.

Unprotected EJB 2.0 methods protection settings

Use this page to verify that unprotected EJB 2.0 methods have the correct level of protection before you map users to roles.

To view this administrative console page, click **Application** > **Install New Application**. While running the Install New Application Wizard, prompts appear to help you map security roles to users.

Exclude:

Specifies that the method is completely protected.

Data type:	Check box
Default:	Cleared

Uncheck:

Specifies that everyone can access the security method.

Data type:	Check box
Default:	Uncheck

Specify role:

Specifies the EJB level of protection based on the security role.

The roles listed in this menu are obtained from the application scope. If the selected role is not in the module, then it is added to the modules or Java archive (JAR) files.

Data type:	String
Units:	Role

Module name:

Specifies the name of the module.

If a module name appears in this list, then the module contains unprotected EJB methods.

Data type:	String
Units:	Module name

Protection:

Specifies the level of protection assigned to a particular module name.

Data type:	String
Default:	Cleared

EJB 1.0 method protection level settings

Use this page to verify that all unprotected EJB 1.0 methods have the correct level of protection before you map users to roles.

To view this administrative console page, click **Applications > Install New Application**. While running the Install New Application Wizard, prompts appear to help you determine that all unprotected EJB 1.0 methods have the correct level of protection.

EJB Module:

Specifies the enterprise bean module name.

Data Type:	String
Units:	EJB module name

Module URI:

Specifies the Java archive (JAR) file name.

Data Type:	String
Units:	JAR file name

Method protection:

Specifies the level of protection assigned to the EJB module.

A selected box means to *Deny All* and that the method is completely protected.

Data Type:	Check box
Default:	Cleared
Range:	Yes or No

RunAs roles to users mapping

Use this page to map RunAs roles to users. You can change the RunAs settings after an application deploys.

To view this administrative console page, click **Applications > Install New Application**. While running the application installation wizard, prompts appear to help you map RunAs roles to users. You can change the RunAs roles to users mappings for deployed applications. Click **Applications >** *application_name* **> Map RunAs roles to users** in the Additional Properties section.

The enterprise beans you are installing contain predefined RunAs roles. RunAs roles are used by enterprise beans that need to run as a particular role for recognition while interacting with another enterprise bean.

User name:

Specifies a user name for the RunAs role user.

This user already maps to the role specified in the Mapping users and groups to roles panel. You can map the user to its appropriate role by either mapping the user to that role directly or mapping a group that contains the user to that role.

Data type: String

Password:

Specifies the password for the RunAs user.

Data type: String

Confirm password:

Specifies the confirmed password of the administrative user.

Data type String

Role:

Specifies administrative user roles.

A number of administrative roles have been defined to provide degrees of authority needed to perform certain WebSphere administrative functions from either the web based administrative console or the system management scripting interface. The authorization policy is only enforced when global security is enabled. The following roles are valid:

- **Monitor**--least privileged that basically allows a user to view the WebSphere configuration and current state
- **Configurator**--monitor privilege plus the ability to change the WebSphere configuration
- **Operator**--monitor privilege plus the ability to change runtime state, such as starting or stopping services for example
- **Administrator**--operator plus configurator privilege

Updating and redeploying secured applications

Before you perform this task, secure Web applications, secure EJB applications, and deploy them in WebSphere Application Server. This section addresses the way to update existing applications.

1. Use the administrative console to modify the existing users and groups mapping to roles. The task titled Assigning users and groups to roles details the required steps.
2. Use the administrative console to modify the users for the RunAs roles. The task entitled, Assigning users to RunAs roles details the required steps.
3. Complete the changes and save them.
4. Stop and restart the application for the changes to become effective.
5. Use the Assembly Toolkit to update any other security related information.

6. Use the Assembly Toolkit to modify roles, method permissions, auth-constraints, data-constraints and so on.
7. Save the Enterprise Archive (EAR) file, uninstall the old application, deploy the modified application and start the application to make the changes effective.

The applications are modified and redeployed.

This step is required to modify existing secured applications.

If information about roles is modified make sure you update the user and group information using the administrative console. Once the secured applications are modified and either restarted or redeployed, make sure that the changes are effective by accessing the resources in the application.

Testing security

After configuring global security and restarting all of your servers in a secure mode, it is best to validate that security is properly enabled. There are a few techniques that you can use to test the various security login types. For example, you can test the Web-based BasicAuth login, Web-based form login, and the Java client BasicAuth login. There are basic tests that show that the fundamental security components are working properly. Complete the following steps to validate your security configuration:

1. Test the Web-based BasicAuth with *Snoop*, by accessing the following URL: `http://hostname.domain:9080/snoop`. A login panel appears. If a login panel does not appear, then a problem exists. If the panel appears, type in any valid user ID and password in your configured user registry.

   Note: In a Network Deployment environment, the Snoop servlet is only available in the domain if you included the **DefaultApplication** option when adding the application server to the cell. The **-includeapps** option for the **addNode** command migrates the **DefaultApplication** option to the cell. Otherwise, skip this step.
2. Test the Web-based form login by bringing up the administrative console: `http://hostname.domain:9090/admin`. A form-based login page appears. If a login page does not appear, try accessing the administrative console by typing `https://myhost.domain:9043/admin`. Type in the administrative user ID and password used for configuring your user registry when configuring security. When the authentication mechanism is set as Lightweight Third Party Authentication (LTPA), represent the host name as a fully qualified host name (that is, `myhost.mycompany.com:9090` rather than just `myhost:9090`).
3. Test Java Client BasicAuth with *dumpNameSpace* by executing the *`install_root`*`\bin\dumpNameSpace.bat` file. A login panel appears. If a login panel does not appear, there is a problem. Type in any valid user ID and password in your configured user registry.
4. Thoroughly test all of your applications in secure mode.
5. After enabling security, verify that your system comes up in secure mode.
6. If all tests pass, proceed with more rigorous testing of your secured applications. If you have any problems, review the output logs in the WebSphere Application Server `/logs/`*`nodeagent`* or WebSphere Application Server `/logs/`*`server_name`* directories, respectively. Then check the security troubleshooting article to see if it references any common problems.

The results of these tests, if successful, indicate that security is fully enabled and working properly.

Managing security

Administering secure applications requires access to the WebSphere Application Server administrative console. Otherwise, log in with a valid user ID and password that have administrative access. To administer security, complete these steps:

1. Configure global security. For more information, see “Configuring global security” on page 137.
2. Assign users to administrative roles. For more information, see “Assigning users to administrator roles” on page 150.
3. Assign users to naming roles. For more information, see “Assigning users to naming roles” on page 154.
4. Configure authentication mechanisms. For more information, see “Configuring authentication mechanisms” on page 156.
5. Configure Lightweight Third Party Authentication. For more information, see “Configuring Lightweight Third Party Authentication” on page 158.
6. Configure trust association interceptors. For more information, see “Configuring WebSEAL or custom trust association interceptors” on page 166.
7. Configure single signon. For more information, see “Configuring single signon” on page 173.
8. Configure user registries. For more information, see “Configuring user registries” on page 188.
   a. Configure local operating system user registries. For more information, see “Configuring local operating system user registries” on page 193.
   b. Configure Lightweight Directory Access Protocol user registries. For more information, see tsec_ldap.ditaae-base ae-qos zos wbifz ee-prog.
   c. Configure custom user registries. For more information, see “Configuring custom user registries” on page 214.
9. Configure Java Authentication and Authorization Service login. For more information, see “Configuring application logins for Java Authentication and Authorization Service” on page 243.
10. Configure the Common Secure Interoperability Version 2 and Security Authentication Service authentication protocols. For more information, see “Configuring Common Secure Interoperability Version 2 and Security Authentication Service authentication protocols” on page 353.
11. Configure Secure Sockets Layer. For more information, see “Configuring Secure Sockets Layer” on page 390.
12. Configure Java 2 Security Manager. For more information, see “Configuring Java 2 security” on page 448.
13. Optional: Configure security attribute propagation. For more information, see “Security attribute propagation” on page 276.

Global security

Global security applies to all applications running in the environment and determines whether security is used at all, the type of registry against which authentication takes place, and other values, many of which act as defaults.

The term *global security* represents the security configuration that is effective for the entire security domain. A *security domain* consists of all servers configured with the

same user registry *realm* name. In some cases, the realm can be the machine name of a Local OS user registry. In this case, all application servers must reside on the same physical machine. In other cases, the realm can be the machine name of an Lightweight Directory Access Protocol (LDAP) user registry. Since LDAP is a distributed user registry, a multiple node configuration is supported, such as the case for a Network Deployment environment. The basic requirement for a security domain is that the access ID returned by the registry from one server within the security domain is the same access ID as that returned from the registry on any other server within the same security domain. The *access ID* is the unique identification of a user and is used during authorization to determine if access is permitted to the resource.

Configuration of global security for a security domain consists of configuring the common user registry, the authentication mechanism, and other security information, which defines the behavior of a security domain. The other security information that you can configure includes Java 2 Security Manager, Java Authentication and Authorization Service (JAAS), Java 2 Connector authentication data entries, Common Secure Interoperability Version 2 (CSIv2)/Security Authentication Service (SAS) authentication protocol (Remote Method Invocation over the Internet Inter-ORB Protocol (RMI/IIOP) security), and other miscellaneous attributes. The global security configuration usually applies to every server within the security domain.

Configuring global security

It is helpful to understand security from an infrastructure standpoint so that you know the advantages of different authentication mechanisms, user registries, authentication protocols, and so on. Picking the right security components to meet your needs is a part of configuring global security. The following sections help you make these decisions. Read the following articles before continuing with the security configuration.

- "Global security" on page 136
- Chapter 1, "Welcome to Security," on page 1

After you understand the security components, you can proceed to configure global security in WebSphere Application Server.

1. Start the WebSphere Application Server administrative console by clicking `http://yourhost.domain:9090/admin` after starting the WebSphere Application Server. If security is currently disabled, log in with any user ID. If security is currently enabled, log in with a predefined administrative ID and password (this is typically the server user ID specified when you configured the user registry).
2. Click **Security** from the left navigation menu. Configure the authentication mechanism, user registry, and so on. The configuration order is not important. However, when you select the **Enabled** flag in the **Global Security** panel, verify that all these tasks are completed. When you click **Apply** or **OK** and the **Enabled** flag is set, a verification occurs to see if the administrative user ID and password can be authenticated to the configured user registry. If you do not configured these, the validation fails.
3. Configure a user registry. For more information, see "Configuring user registries" on page 188. Configure (LocalOS, LDAP, or Custom), and then specify details about that registry.

   One of the details common to all user registries is the **server user ID**. This ID is a member of the chosen user registry, but also has special privileges in WebSphere Application Server. The privileges for this ID and the privileges

associated with the administrative role ID are the same. The server user ID can access all protected administrative methods. On Windows systems, the ID must not be the same name as the machine name of your system, since the registry sometimes returns machine-specific information when querying a user of the same name. In LDAP user registries, verify that the server user ID is a member of the registry and not just the LDAP administrative role ID. The entry must be searchable.

The server user ID does **not** run WebSphere Application Server processes. Rather, the process ID runs the WebSphere Application Server processes.

The process ID is determined by the way the process starts. For example, if you use a command line to start processes, the user ID that is logged into the system is the process ID. If running as a service, the user ID that is logged into the system is the user ID running the service. If you choose the LocalOS registry, the process ID requires special privileges to call the operating system APIs. Specifically, the process ID must have the **Act as Part of Operating System** privileges on Windows systems or **root** privileges on a UNIX system.

4. Configure the authentication mechanism. To get details about configuring authentication mechanisms, read the "Configuring authentication mechanisms" on page 156 article. There are two authentication mechanisms to choose from in the Global Security panel: Simple WebSphere Authentication Mechanism (SWAM) and Lightweight Third-Party Authentication (LTPA). However, only LTPA requires any additional configuration parameters. Use the SWAM option for single server requirements. Use the LTPA option for multi-server distributed requirements. SWAM credentials are not forwardable to other machines and for that reason do not expire. Credentials for LTPA are forwardable to other machines and for security reasons do expire. This expiration time is configurable. If you choose to go with LTPA, then "Configuring single signon" on page 173 support. This support permits browsers to visit different product servers without having to authenticate multiple times.
5. Configure the authentication protocol for special security requirements from Java clients, if needed. This task entails choosing a protocol, either Common Secure Interoperability Version 2 (CSIv2) or Security Authentication Service (SAS). The CSIv2 protocol is new to WebSphere Application Server Version 5 and has many new and improved features. The SAS protocol is still provided as a backwards compatibility to previous product releases, but is being deprecated. For details on configuring CSIv2 or SAS, see the article, "Configuring Common Secure Interoperability Version 2 and Security Authentication Service authentication protocols" on page 353.
6. Modify the default Secure Sockets Layer (SSL) keystore and truststore files that are packaged with the product. This action protects the integrity of the messages sent across the Internet. The product provides a single location where you can specify SSL configurations that the various WebSphere Application Server features that use SSL can utilize, including the LDAP user registry, Web container and the authentication protocol (CSIv2 and SAS).

   Create a new keystore and truststore, by referring to the "Creating a keystore file" on page 422 and "Creating truststore files" on page 426 articles.

   You can create different keystore files and truststore files for different uses or you can create just one set for everything that the server uses SSL for. Once you create these new keystore and truststore files, specify them in the SSL Configuration repertoire. To get to the SSL Configuration Repertoire, click **Security > SSL**. You can either edit the `DefaultSSLConfig` file or create a new SSL configuration with a new alias name. If you create a new alias name for

your new keystore and truststore files, change every location that references the `DefaultSSLConfig` SSL configuration alias. The following list provides these locations:

- **Security** > **User Registries** > **LDAP** (at the bottom of the panel)
- **Security** > **Authentication Protocol** > **CSIv2 Inbound Transport**
- **Security** > **Authentication Protocol** > **CSIv2 Outbound Transport**
- **Security** > **Authentication Protocol** > **SAS Inbound Transport**
- **Security** > **Authentication Protocol** > **SAS Outbound Transport**
- **Servers** > **Application Servers** > *application_server_name* > **Web Container** > **HTTP transports** > *host_link*

7. Click **Security** > **Global Security** to configure the rest of the security settings and enable security. This panel performs a final validation of the security configuration. When you click **OK** or **Apply** from this panel, the security validation routine is performed and any problems are reported at the top of the page. See the "Global security settings" on page 140 article for detailed information about these fields. When you complete all of the fields, click **OK** or **Apply** to accept the selected settings. Click **Save** to persist these settings out to a file. If you see any informational messages in red text color, then a problem has occurred with the security validation. Typically, the message indicates the problem. So, review your configuration to verify that the user registry settings are accurate and the correct registry is selected. In some cases the LTPA configuration might not be fully specified.
8. Store the configuration for the server to use once it restarts. Complete this action if you have clicked **OK** or **Apply** on the **Security > Global Security** panel, and there are no validation problems. To save the configuration, click **Save** in the menu bar at the top. This action writes the settings out to the configuration repository. If you do not click **Apply** or **OK** in the **Global Security** panel before clicking **Save** on the main menu, your changes are not written to the repository.
9. Start the WebSphere Application Server administrative console by typing `http://yourhost.domain:9090/admin` after the WebSphere Application Server deployment manager has been started. If security is currently disabled, log in with any user ID. If security is currently enabled, log in with a predefined administrative ID and password, which is typically the server user ID specified when you configure the user registry.

Enabling and disabling global security

You can decide whether to enable IBM WebSphere Application Server security. You must enable security for all other security settings to function.

1. "Configuring global security" on page 137. It is important to click **Security > Global Security** and set the **Enabled** flag to `on` so that security is enabled upon a server restart.
2. Before restarting the server, log off the administrative console. You can log off by clicking **Logout** at the top menu bar.
3. Stop the server by going to the command line in the WebSphere Application Server `/bin` directory and issue a `stopServer` *`server_name`* command.
4. Restart the server in secure mode by issuing the command `startServer` *`server_name`*. Once the server is secure, you cannot stop the server again without specifying an administrative user name and password. To stop the server once security is enabled, issue the command, `stopServer` *`server_name`* `-username` *`user_id`* `-password` *`password`*. Alternatively, you can edit the

soap.client.props file in the *install_root*/properties directory and edit the com.ibm.SOAP.loginUserid or com.ibm.SOAP.loginPassword properties to contain these administrative IDs.

If you have any problems restarting the server, review the output logs in the *install_root*/logs/server_name directory. Check the "Troubleshooting security configurations" on page 479 article for any common problems.

Disabling global security:

1. Click **Security > Global Security** and set the **Enabled** flag to off so that security gets disabled upon a server restart.
2. Before restarting the server, log off of the administrative console. You can log out by clicking **Log off** at the top menu bar.
3. Stop the server by going to the command line, accessing the WebSphere Application Server /bin directory, and issuing the following command on one continuous line:
4. Issue the following command to restart the server in secure mode:
5. If you have any problems restarting the server, review the output logs in the *install_root*/logs/server_name directory.

This scenario is specifically for a stand-alone setup where you have a single application server and likely utilize your Local OS registry for your repository of users. The authentication mechanism is probably Simple WebSphere Authentication Mechanism (SWAM). The application server cannot communicate securely to other application servers as the SWAM authentication mechanism does not contain a forwardable token to send to downstream servers.

After restarting the server in secure mode, run a couple of simple tests to verify that most facets of security are working properly.

1. Test basic authentication with snoop by accessing the following URL: http://hostname.domain:9080/snoop. A login panel appears. Type in any valid user ID and password in your configured user registry. If the login panel fails to appear, there is a problem.
2. Test the Java client with dumpNameSpace by executing the *install_dir*\bin\dumpNameSpace.bat file. A login panel appears. Type in any valid user ID and password in your configured user registry. If the login panel fails to appear, there is a problem.
3. Test form login by bringing up the administrative console: http://hostname.domain:9090/admin. A form-based login page appears. Type in the administrative user ID and password that was used for configuring your user registry when configuring security. When the Authentication Mechanism is set as **LTPA**, provide a fully qualified host name (for example, myhost.mycompany.com:9090, rather than just myhost:9090). If the login panel fails to appear, there is a problem.

If you encountered a problem with any of these tests, check the WebSphere Application Server /logs/server_name/SystemOut.log file for hints about the problems that occurred. Also refer to "Troubleshooting security configurations" on page 479 for solutions.

Global security settings:

Use this page to configure security. When you enable security, you are enabling security settings on a global level. When security is disabled, WebSphere Application Server performance is increased between 10-20%. Therefore, consider disabling security when it is not needed.

To view this administrative console page, click **Security** > **Global Security**.

If you are configuring security for the first time, complete the steps in "Configuring server security" on page 144 to avoid problems. When security is configured, validate any changes to the registry or authentication mechanism panels. Click **Apply** to validate the user registry settings. An attempt is made to authenticate the server ID to the configured user registry. Validating the user registry settings after enabling global security can avoid problems when you restart the server for the first time.

Enabled:

Specifies for the server to enable security subsystems.

This flag is commonly referred to as the *global security flag* in WebSphere Application Server information. When enabling security, set the authentication mechanism configuration and specify a valid user ID and password in the selected user registry configuration.

Data type: Boolean
Default: Disable

Enforce Java 2 Security:

Specifies whether to enable or disable Java 2 security permission checking. By default, Java 2 security is disabled. However, enabling global security, automatically enables Java 2 security. You can choose to disable Java 2 security, even when global security is enabled.

When Java 2 security is enabled and if an application requires more Java 2 security permissions than are granted in the default policy, then the application might fail to run properly until the required permissions are granted in either the `app.policy` file or the `was.policy` file of the application. AccessControl exceptions are generated by applications that do have all the required permissions. Consult the WebSphere Application Server documentation and review the Java 2 Security and Dynamic Policy sections if you are unfamiliar with Java 2 security.

If your server does not restart after you enable global security, you can disable security. Go to your `$install_root\bin` directory and execute the `wsadmin -conntype NONE` command. At the `wsadmin>` prompt, enter `securityoff` and then type `exit` to return to a command prompt. Restart the server with security disabled to check any incorrect settings through the administrative console.

Data type: Boolean
Default: Disabled
Range: Enabled or Disabled

Use Domain Qualified User Names:

Specifies the user names to qualify with the security domain within which they reside.

Data type: Boolean
Default: Disabled
Range: Enable or Disable

When you specify **Use Domain Qualified User Names** from the **Security > Global Security** configuration panel, the run-time call to the getCallerPrincipal() API from an enterprise bean returns the qualified name with the realm prepended twice. For example, the format return is realm/realm/user. You can strip the first realm from the returned value when making API calls. The servlet API getUserPrincipal() works correctly.

Cache Timeout:

Specifies the timeout value in seconds for security cache. This value is a relative timeout.

If WebSphere Application Server security is enabled, the security cache timeout can influence performance. The timeout setting specifies how often to refresh the security-related caches.

Security information pertaining to beans, permissions, and credentials is cached.

When the cache timeout expires, all cached information becomes invalid.

Subsequent requests for the information result in a database lookup. Sometimes, acquiring the information requires invoking a Lightweight Directory Access Protocol (LDAP)-bind or native authentication. Both invocations are relatively costly operations for performance. Determine the best trade off for the application, by looking at usage patterns and security needs for the site.

In a 20-minute performance test, setting the cache timeout so that a timeout does not occur yields a 40% performance improvement.

Data type:	Integer
Units:	Seconds
Default:	600
Range:	Greater than 30 seconds

Issue Permission Warning:

Specifies that when the Issue permission warning option is enabled, during application deployment and application start, the security run time emits a warning if applications are granted any custom permissions. Custom permissions are permissions defined by the user applications, not Java API permissions. Java API permissions are permissions in `package java.*` and `javax.*`.

The WebSphere product provides support for policy file management. A number of policy files are available in this product, some of them are static and some of them are dynamic. Dynamic policy is a template of permissions for a particular type of resource. There is no code base defined or relative code base used in the dynamic policy template. The real code base is dynamically created from the configuration and run-time data. The `filter.policy` file contains a list of permissions that an application should not have according to the J2EE 1.3 specification. For more information on permissions, see “Java 2 security policy files” on page 452.

Data type:	Boolean
Default:	Disabled
Range:	Enable or Disable

Active Protocol:

Specifies the active authentication protocol for Remote Method Invocation over the Internet Inter-ORB Protocol (RMI IIOP) requests when security is enabled. In previous releases the Security Authentication Service (SAS) platform (or z/OS Security Authentication Service on the z/OS platform) was the only available protocol.

An Object Management Group (OMG) protocol called Common Secure Interoperability Version 2 (CSIv2) supports increased vendor interoperability and additional features. If all of the servers in your security domain are Version 5 servers, specify `CSI` as your protocol.

If some servers are 3.x or 4.x servers, specify `CSI and SAS`.

Data type:	String
Default:	BOTH
Range:	CSI and SAS, CSI

Active Authentication Mechanism:

Specifies the active authentication mechanism when security is enabled.

WebSphere Application Server, Version 5 supports the following authentication mechanisms: Simple WebSphere Authentication Mechanism (SWAM) and Lightweight Third Party Authentication (LTPA).

Data type:	String
Default:	SWAM (WebSphere Application Server)
Range:	SWAM, LTPA

Active User Registry:

Specifies the active user registry, when security is enabled. LDAP or a custom user registry is required when running as a UNIX non-root user or in a multi-node environment.

You can configure settings for one of the following user registries:
- Local operating system.
- LDAP user registry. The LDAP user registry settings are used when users and groups reside in an external LDAP directory. When security is enabled and any of these properties change, go to the Global Security panel and click **Apply** or **OK** to validate the changes.
- Custom user registry

Data type:	String
Default:	Local OS
Range:	Local OS, LDAP, Custom

Use FIPS:

Enables the use of FIPS (Federal Information Processing Standard)-approved cryptographic algorithms.

The IBM JSSE Federal Information Processing Standards (FIPS) provider is not supported on the HP-UX platform.

When **Use FIPS** is enabled, the Lightweight Third Party Authentication (LTPA) implementation uses IBMJCEFIPS. IBMJCEFIPS supports the Federal Information Processing Standard (FIPS)-approved cryptographic algorithms for DES, Triple DES, and AES. Although the LTPA keys are backwards compatible with prior releases of WebSphere Application Server, the LTPA token is not compatible with prior releases.

Important: The IBMJSSEFIPS and IBMJCEFIPS modules are undergoing certification.

WebSphere Application Server provides a FIPS-approved Java Secure Socket Extension (JSSE) provider called IBMJSSEFIPS. A FIPS-approved JSSE requires the Transport Layer Security (TLS) protocol as it is not compatible with the Secure Sockets Layer (SSL) protocol. If you select the **Use FIPS** checkbox prior to specifying a FIPS-approved JSSE provider and a TLS protocol, the following error message displays at the top of the **Global Security** panel:

```
The security policy is set to use only FIPS approved cryptographic
algorithms. However at least one SSL configuration may not be using a
FIPS approved JSSE provider. FIPS approved cryptographic algorithms
may not be used in those cases.
```

To correct this problem, configure your JSSE provider and security protocol on the **SSL Configuration Repertoires** panel by completing one of the following tasks:
- Clicking **Security > SSL** and modifying an existing configuration
- Clicking **New** and creating a new configuration

Configuring server security

You can customize security to some extent at the application server level. You can disable user security on an application server (administrative security remains enabled when global security is enabled).

You cannot configure a different authentication mechanism or user registry on an individual server basis. This feature is limited to cell-level configuration only. Also, when global security is disabled, you cannot enable application server security.

1. Start the administrative console for the deployment manager. To get to the administrative console, go to `http://host.domain:9090/admin`. If security is disabled, you can enter any ID. If security is enabled, you must enter a valid user ID and password, which is either the administrative ID (configured for the user registry) or a user ID entered as an administrative user. To add a user ID as an administrative user, click **System Administration > Console Users**.
2. Configure global security if you have not already done so. Read the "Configuring global security" on page 137 article for detailed steps. After global security is configured, configure server-level security.
3. To configure server-level security, click **Servers > Application Servers >** *server name*. Under Additional Properties, click **Server Security**. The status of the security level that is in use for this application server is displayed.

   The Server Level Security panel lists attributes that are on the Global Security panel and can be overridden at the server level. Not all of the attributes on the Global Security panel can be overridden at the server level, including Active Authentication Mechanism and Active User Registry.

4. To disable security for this application server, go to the Server Level Security panel, clear the **Enabled** flag and click **OK** or **Apply**. Click **Save**. By modifying the Server Level Security panel, you can see that this flag overrides the cell-level security.
5. To configure CSI at the server level, you can change any panel that starts with CSI. By doing so, all panels that start with CSI will override the CSI settings specified at the Cell-level. This includes all authentication and transport panels for CSI. See the "Configuring Common Secure Interoperability Version 2 and Security Authentication Service authentication protocols" on page 353 article for more detailed steps regarding configuring CSI authentication protocol.

Typically server-level security is used to disable user security for a specific application server. However, this can also be used to disable (or enable) the Java 2 Security Manager, and configure the authentication requirements for RMI/IIOP requests both incoming and outgoing from this application server.

Once you have modified the configuration for a particular application server, you must restart the application server for the changes to become effective. To restart the application server, go to **Servers > Application Servers** and click the server name that you recently modified. Then, click the **Stop** button and then the **Start** button.

If you disabled security for the application server, you can typically test a URL which is protected when security is enabled.

Server-level security settings

Use this page to enable server level security and specify other server level security configurations.

To view this administrative console page, click **Servers > Application Servers >** *server_name* **> Server Security > Server Level Security**.

Enabled:

Use this flag to disable or enable security again for this application server while global security is enabled. Server security is enabled by default when global security is enabled. You cannot enable security on an application server while global security is disabled. Administrative (administrative console and wsadmin) and naming security remain enabled while global security is enabled, regardless of the status of this flag.

Data type	Boolean
Default	Disable

Enforce Java 2 Security:

Specifies that the server enforces Java 2 Security permission checking at the server level. When cleared, the Java 2 server-level security manager is not installed and all of the Java 2 Security permission checking is disabled at the server level.

If your application policy file is not set up correctly, see "Configuring the was.policy file" on page 463 for information on how to configure an application policy file.

Data type	Boolean

Default	Disabled
Range	Enabled or Disabled

Use Domain Qualified User IDs:

Specifies whether user IDs returned by getUserPrincipal()-like calls are qualified with the server level security domain within which they reside.

Data type	Boolean
Default	Disabled
Range	Enable or Disable

Cache Timeout:

Specifies the timeout value for server level security cache in seconds.

Data type	Integer
Units	Seconds
Default	600
Range	Greater than 30 seconds. Avoid setting cache timeout value to 30 seconds or less.

Issue Permission Warning:

Specifies whether a warning is issued during application installation when an application requires a Java 2 permission that is normally not granted to an application.

WebSphere Application Server provides support for policy file management. A number of policy files are included in WebSphere Application Server. Some of these policy files are static and some of them are dynamic. Dynamic policy is a template of permissions for a particular type of resource. In dynamic policy files, the code bases are evaluated at run time using configuration data. You can add or remove permissions, as needed, for each code base. However, do not add, remove, or modify the existing code bases. The real code base is dynamically created from the configuration and run-time data. The `filter.policy` file contains a list of permissions that an application does not have, according to the J2EE 1.3 Specification. For more information on permissions, see "Java 2 security policy files" on page 452.

Data type	Boolean
Default	Enabled
Range	Enable or Disable

Active Protocol:

Specifies the active server level security authentication protocol when server level security is enabled.

You can use an Object Management Group (OMG) protocol called Common Secure Interoperability Version 2 (CSIv2) for more vendor interoperability and additional features. If all of the servers in your entire security domain are Version 5.0 servers, it is best to specify **CSI** as your protocol.

If some servers are Version 3.x or Version 4.x servers, it is best to specify **CSI and SAS**. However, by specifying **CSI and SAS**, you now have two interceptors invoking each request. However, by specifying **CSI and SAS**, you now have two interceptors invoking each request.

If some servers are Version 3.x or Version 4.x servers, it is best to specify **CSI and z/SAS**.

Data type	String
Default	CSI and SAS
Range	CSI, CSI and SAS

Administrative console and naming service authorization

WebSphere Application Server extends the Java 2 Platform, Enterprise Edition (J2EE) security role-based access control to protect the product administrative and naming subsystems.

Administrative console

Four administrative roles are defined to provide degrees of authority needed to perform certain WebSphere Application Server administrative functions from either the administrative console or the system management scripting interface. The authorization policy is only enforced when global security is enabled. The four administrative security roles are defined in the following table:

administrative roles

Role	Description
monitor	Least privileged where a user can view the WebSphere Application Server configuration and current state.
configurator	Monitor privilege plus the ability to change the WebSphere Application Server configuration.
operator	Monitor privilege plus the ability to change the run-time state, such as starting or stopping services.
administrator	Operator plus configuration privilege and the permission required to access sensitive data including the server password, LTPA password, LTPA, keys, and so on.

When WebSphere Application Server global security is enabled, the administrative subsystem role-based access control is enforced. The administrative subsystem includes security server, user registry, and all the Java Management Extensions (JMX) MBeans. When security is enabled, both the administrative console and the administrative scripting tool require users to provide the required authentication data. Moreover, the administrative console is designed so the control functions that display on the pages are adjusted according to the security roles that a user has. For example, a user who has only the monitor role can see only the non-sensitive configuration data. A user with the operator role can change the system state.

When local OS is the configured user registry, WebSphere Application Server for z/OS servers in the cell do not have to use the same security name (enabled with

PQ81586). Instead, all WebSphere Application Server for z/OS processes (as well as the default administrative user IDs) are configured to a WebSphere configuration group as part of customization. This customization process grants the Console Group administrative role to this WebSphere configuration group.

The server identity specified when enabling global security is automatically mapped to the administrative role.

You can add or remove users and groups to or from the administrative roles from the WebSphere Application Server administrative console. However, a server restart is required for the changes to take effect. A best practice is to map a group, rather than specific users, to administrative roles because it is more flexible and easier to administer. By mapping a group to an administrative role, adding or removing users to or from the group occurs outside of WebSphere Application Server and does not require a server restart for the change to take effect.

In addition to mapping users or groups, you can map a *special-subject* to the administrative roles. A special-subject is a generalization of a particular class of users. The AllAuthenticated special subject means that the access check of the administrative role ensures that the user making the request has at least been authenticated. The Everyone special subject means that anyone, authenticated or not, can perform the action, as if security is not enabled.

When global security is enabled, WebSphere Application Servers run under the server identity that is defined under the active user registry configuration. Although it is not shown on the administrative console and in other tools, a special Server subject is mapped to the administrator role. The WebSphere Application Server run-time code, which runs under the server identity, requires authorization to run run-time operations. If no other user is assigned administrative roles, you can log into the administrative console or to the wsadmin scripting tool using the server identity to perform administrative operations and to assign other users or groups to administrative roles. Because the server identity is assigned to the administrative role by default, the administrative security policy requires the administrative role to perform the following operations:

- Change server ID and server password
- Enable or disable WebSphere Application Server global security
- Enforce or disable Java 2 Security
- Change the LTPA password or generate keys
- Assign users and groups to administrative roles

When enabling security, you can assign one or more users and groups to administrative roles. For more information, see Assigning users to naming roles. However, before assigning users to naming roles, configure the active user registry. User and group validation depends on the active user registry. For more information, see Configuring user registries.

Naming service authorization

CosNaming security offers increased granularity of security control over CosNaming functions. CosNaming functions are available on CosNaming servers such as the WebSphere Application Server. They affect the content of the WebSphere Application Server name space. There are generally two ways in which client programs result in CosNaming calls. The first is through the JNDI interfaces. The second is with CORBA clients invoking CosNaming methods directly.

Four security roles are introduced :

- CosNamingRead
- CosNamingWrite
- CosNamingCreate
- CosNamingDelete

The names of the four roles are the same with WebSphere Application Server Advanced Edition Version 4.0.2. The roles now have authority levels from low to high:

CosNamingRead
: Users can query of the WebSphere Application Server name space, using, for example, the JNDI lookup method. The special-subject Everyone is the default policy for this role.

CosNamingWrite
: Users can perform write operations such as JNDI **bind**, **rebind**, or **unbind**, and CosNamingRead operations. The special-subject AllAuthenticated is the default policy for this role.

CosNamingCreate
: Users can create new objects in the name space through such operations as JNDI createSubcontext and CosNamingWrite operations. The special subject AllAuthenticated is the default policy for this role.

CosNamingDelete
: Users can destroy objects in the name space, for example using the JNDI destroySubcontext method and CosNamingCreate operations. The special-subject AllAuthenticated is the default policy for this role.

Additionally, a Server special-subject is assigned to all the four CosNaming roles by default. The Server special-subject provides a WebSphere Application Server server process, which runs under the server identity, access to all the CosNaming operations. Note that the Server special-subject does not display and cannot be modified through the administrative console or other administrative tools.

Users, groups, or the special subjects AllAuthenticated and Everyone can be added or removed to or from the naming roles from the WebSphere Application Server administrative console at any time. However, a server restart is required for the changes to take effect. A best practice is to map groups or one of the special-subjects, rather than specific users, to naming roles because it is more flexible and easier to administer in the long run. By mapping a group to a naming role, adding or removing users to or from the group occurs outside of WebSphere Application Server and does not require a server restart for the change to take effect.

The CosNaming authorization policy is only enforced when global security is enabled. When global security is enabled, attempts to do CosNaming operations without the proper role assignment result in an `org.omg.CORBA.NO_PERMISSION` exception from the CosNaming Server.

In WebSphere Application Server Version 4.0.2, each CosNaming function is assigned to only one role. Therefore, users who are assigned the CosNamingCreate role cannot query the name space unless they have also been assigned CosNamingRead. And in most cases a creator needs to be assigned three roles: CosNamingRead, CosNamingWrite, and CosNamingCreate. The CosNamingRead and CosNamingWrite roles assignment for the creator example are included in the CosNamingCreate role. In most of the cases, WebSphere Application Server administrators do not have to change the roles assignment for every user or group when they move to this release from a previous one.

Although the ability exists to greatly restrict access to the name space by changing the default policy, unexpected `org.omg.CORBA.NO_PERMISSION` exceptions can occur at run time. Typically, J2EE applications access the name space and the identity they use is that of the user that authenticated to WebSphere Application Server when they access the J2EE application. Unless the J2EE application provider clearly communicates the expected Naming roles, use caution when changing the default naming authorization policy.

Assigning users to administrator roles

The following steps are needed to assign users to administrative roles.

In the administrative console, expand the **System Administration** folder and click **Console Users** or **Console Groups**.

1. To add a user or a group, click **Add** on the **Console users** or **Console groups** panel.
2. To add a new administrative user, enter a user identity in the User field, highlight **Administrator**, and click **OK**. If there is no validation error, the specified user is displayed with the assigned security role.
3. To add a new administrative group, either enter a group name in the **Specify group** field or select EVERYONE or ALL AUTHENTICATED from the Select from special subject menu, and click **OK**. If no validation error exists, the specified group or special subject displays with the assigned security role.
4. To remove a user or group assignment, click **Remove** on the Console Users or the Console Groups panel. On the Console Users or the Console Groups panel, select the check box of the user or group to remove and click **OK**.
5. To manage the set of users or groups to display, expand the **filter** folder on the right panel and modify the filter. For example, setting the filter to `user*` only displays users with the `user` prefix.
6. After the modifications are complete, click **Save** to save the mappings.
7. Restart the server for changes to take effect.

The task of assigning users and groups to administrative roles is performed to identify users for performing WebSphere Application Server administrative functions. There are four roles: administrator, configurator, operator and monitor. Users and groups assigned to the administrator role can perform all administrative operations and can set up both J2EE role-based and Java 2 security policy. Users assigned to the configurator role can perform all day-to-day configuration tasks including installing and uninstalling applications, assigning users and groups to role mapping for applications, setting run-as configurations, setting up Java 2 security permissions for applications, and customizing Common Secure Interoperability Version 2 (CSIv2), Security Authentication Service (SAS), and Secure Sockets Layer (SSL) configurations. Users assigned to the operator role can view the WebSphere Application Server configuration and its current state, but also can change the run-time state such as stopping and starting services. Users assigned the monitor state can view the WebSphere Application server configuration and its current state only.

Before you assign users to administrative roles (administrator, configurator, operator, and monitor), you must set up your user registry, which can be LDAP, local OS, or a custom registry. You can set up your user registries without enabling security. Once you assign users to administrative roles, you must restart the server for the new roles to take effect. However, the administrative resources are not protected until you enable security.

Console users settings and CORBA naming service user settings

Use the Console users settings page to give users specific authority to administer WebSphere Application Server using tools such as the administrative console or wsadmin scripting. The authority requirements are only effective when global security is enabled. Use the common object request broker architecture (CORBA) naming service users settings page to manage CORBA naming service users settings.

To view the Console users administrative console page, click **System Administration > Console Users**.

To view the CORBA naming service users administrative console page, click **Environment > Naming > CORBA Naming Service users**.

User (Console users):

Specifies users.

The users entered must exist in the configured active user registry.

Data type: String

User (CORBA naming service users):

Specifies CORBA naming service users.

The users entered must exist in the configured active user registry.

Data type: String

Role (Console users):

Specifies user roles.

The following administrative roles provide different degrees of authority needed to perform certain WebSphere Application Server administrative functions:

Administrator
The administrator role has operator permissions, configurator permissions, and the permission required to access sensitive data including server password, Lightweight Third Party Authentication (LTPA) password and keys, and so on.

Configurator
The configurator role has monitor permissions and can change the WebSphere Application Server configuration.

Operator
The operator role has monitor permissions and can change the run-time state. For example, the operator can start or stop services.

Monitor
The monitor role has the least permissions. This role primarily confines the user to viewing the WebSphere Application Server configuration and current state.

Data type: String
Range: Administrator, Configurator, Operator, and Monitor

Role (CORBA naming service users):

Specifies naming service user roles.

A number of naming roles are defined to provide degrees of authority needed to perform certain WebSphere naming service functions. The authorization policy is only enforced when global security is enabled. The following roles are valid: CosNamingRead, CosNamingWrite, CosNamingCreate, and CosNamingDelete.

The names of the four roles are the same with WebSphere Application Server, Advanced Edition Version 4.0.2. However, the roles now have authority levels from low to high:

CosNamingRead
Users can query the WebSphere name space using, for example, the Java Naming and Directory Interface (JNDI) lookup method. The special-subject EVERYONE is the default policy for this role.

CosNamingWrite
Users can perform write operations such as JNDI bind, rebind, or unbind, plus CosNamingRead operations. The special-subject ALL AUTHENTICATED is the default policy for this role.

CosNamingCreate
Users can create new objects in the name space through operations such as JNDI createSubcontext and CosNamingWrite operations. The special-subject ALL AUTHENTICATED is the default policy for this role.

CosNamingDelete
Users can destroy objects in the name space, for example using the JNDI destroySubcontext method and CosNamingCreate operations. The special-subject ALL AUTHENTICATED is the default policy for this role.

Data type:	String
Range:	CosNamingRead, CosNamingWrite, CosNamingCreate and CosNamingDelete

Console groups and CORBA naming service groups

Use the Console Groups page to give groups specific authority to administer the WebSphere Application Server using tools such as the administrative console or wsadmin scripting. The authority requirements are only effective when global security is enabled. Use the CORBA naming service groups page to manage CORBA Naming Service groups settings.

To view the Console Groups administrative console page, click **System Administration > Console Groups**.

To view the CORBA naming service groups administrative console page, click **Environment > Naming > CORBA Naming Service Groups**.

Group (Console groups):

Specifies groups.

The ALL_AUTHENTICATED and the EVERYONE groups can have the following role privileges: Administrator, Configurator, Operator, and Monitor.

Data type: String
Range: ALL_AUTHENTICATED, EVERYONE

Group (CORBA naming service groups):

Identifies CORBA naming service groups.

The ALL_AUTHENTICATED group has the following role privileges: CosNamingRead, CosNamingWrite, CosNamingCreate, and CosNamingDelete. The EVERYONE group indicates that the users in this group have CosNamingRead privileges only.

Data type: String
Range: ALL_AUTHENTICATED, EVERYONE

Role (Console group):

Specifies user roles.

The following administrative roles provide different degrees of authority needed to perform certain WebSphere Application Server administrative functions:

Administrator
The administrator role has operator permissions, configurator permissions, and the permission required to access sensitive data including server password, LTPA password and keys, and so on.

Configurator
The configurator role has monitor permissions and can change the WebSphere Application Server configuration.

Operator
The operator role has monitor permissions and can change the run-time state. For example, the operator can start or stop services.

Monitor
The monitor role has the least permissions. This role primarily confines the user to viewing the WebSphere Application Server configuration and current state.

Data type: String
Range: Administrator, Configurator, Operator, and Monitor

Role (CORBA naming service groups):

Identifies naming service group roles.

A number of naming roles are defined to provide degrees of authority needed to perform certain WebSphere naming service functions. The authorization policy is only enforced when global security is enabled.

Four name space security roles are available: CosNamingRead, CosNamingWrite, CosNamingCreate, and CosNamingDelete. The names of the four roles are the same with WebSphere Advanced Edition, Version 4.0.2. However, the roles now have authority levels from low to high:

CosNamingRead
Users can query the WebSphere name space using, for example, the Java

Naming and Directory Interface (JNDI) lookup method. The special-subject EVERYONE is the default policy for this role.

CosNamingWrite
Users can perform write operations such as JNDI bind, rebind, or unbind, and CosNamingRead operations. The special-subject ALL_AUTHENTICATED is the default policy for this role.

CosNamingCreate
Users can create new objects in the name space through operations such as JNDI createSubcontext and CosNamingWrite operations. The special-subject ALL_AUTHENTICATED is the default policy for this role.

CosNamingDelete
Users can destroy objects in the name space, for example using the JNDI destroySubcontext method and CosNamingCreate operations. The special-subject ALL_AUTHENTICATED is the default policy for this role.

Data type:	String
Range:	CosNamingRead, CosNamingWrite, CosNamingCreate, and CosNamingDelete

Assigning users to naming roles

The following steps are needed to assign users to naming roles. In the administrative console, expand **Environment > Naming**, and click **CORBA Naming Service Users** or **CORBA Naming Service Groups**.

1. Click **Add** on the **CORBA Naming Service Users** or **CORBA Naming Service Groups** panel.
2. To add a new naming service user, enter a user identity in the **User** field, highlight one or more naming roles, and click **OK**. If no validation errors occur, the specified user is displayed with the assigned security role.
3. To add a new naming service group, either select **Specify group** and enter a group name or select **Select from special subject** and then select either **EVERYONE** or **ALL AUTHENTICATED**. Click **OK**. If no validation errors occur, the specified group or special subject is displayed with the assigned security role.
4. To remove a user or group assignment, go to the **CORBA Naming Service Users** or **CORBA Naming Service Groups** panel. Select the check box next to the user or group that you want to remove and click **Remove**.
5. To manage the set of users or groups to display, expand the **Filter** folder on the right panel, and modify the filter text box. For example, setting the filter to `user*` displays only users with the `user` prefix.
6. After modifications are complete, click **Save** to save the mappings. Restart the server for the changes to take effect.

The default naming security policy is to grant all users read access to the CosNaming space and to grant any valid user the privilege to modify the contents of the CosNaming space. You can perform the previously mentioned steps to restrict user access to the CosNaming space. However, use caution when changing the naming security policy. Unless a Java 2 Platform, Enterprise Edition (J2EE) application has clearly specified its naming space access requirements, changing the default policy can result in unexpected org.omg.CORBA.NO_PERMISSION exceptions at run time.

Authentication mechanisms

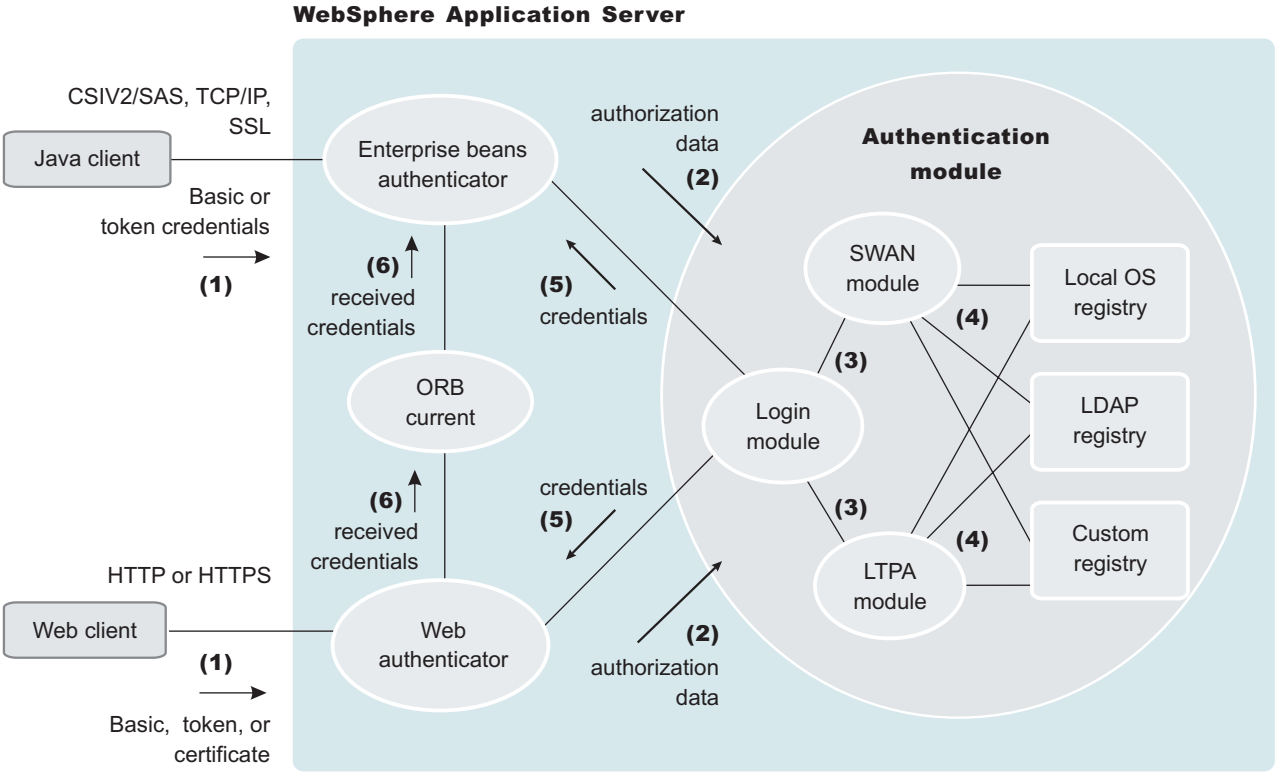
An *authentication mechanism* defines rules about security information (for example, whether a credential is forwardable to another Java process), and the format of how security information is stored in both credentials and tokens.

Authentication is the process of establishing whether a client is valid in a particular context. A client can be either an end user, a machine, or an application.

An authentication mechanism in WebSphere Application Server typically collaborates closely with a *user registry*. The user registry is the user and groups account repository that the authentication mechanism consults with when performing authentication. The authentication mechanism is responsible for creating a *credential*, which is an internal product representation of a successfully authenticated client user. Not all credentials are created equally. The abilities of the credential are determined by the configured authentication mechanism.

Although this product provides several authentication mechanisms, you can only configure a single *active* authentication mechanism at a time. The active authentication mechanism is selected when configuring WebSphere Application Server global security.

Authentication



Authentication Process

The figure demonstrates the authentication process. Basically, authentication is required for enterprise bean clients and Web clients when they access protected resources. Enterprise bean clients (a servlet or other enterprise beans or a pure client) send the authentication information to a Web application server using the Common Secure Interoperability Version 2 (CSIv2) or the Security Authentication

Service (SAS) protocol. Web clients use the HTTP or HTTPS protocol to send the authentication information as shown in the previous figure. The authentication information can be BasicAuth (user ID and password), credential token (in case of Lightweight Third Party Authentication (LTPA)), or client certificate. The Web authentication is performed by the Web Authentication module and the enterprise bean authentication is performed by the Enterprise JavaBean (EJB) authentication module, which resides in the CSIv2 and SAS layer.

The authentication module is implemented using the Java Authentication and Authorization Service (JAAS) login module. The Web authenticator and the EJB authenticator pass the authentication data to the login module (2), which can be either Lightweight Third Party Authentication (LTPA) or Simple WebSphere Authentication Mechanism (SWAM).

The authentication module uses the registry that is configured on the system to perform the authentication (4). Three types of registries are supported: LocalOS, Lightweight Directory Access Protocol (LDAP), and custom registry. External registry implementation following the registry interface specified by IBM can replace either the LocalOS or the LDAP registry.

The login module creates a JAAS subject after authentication and stores the Common Object Request Broker Architecture (CORBA) credential derived from the authentication data in the public credentials list of the subject. The credential is returned to the Web authenticator or EJB authenticator (5).

The Web authenticator and the EJB authenticator store the received credentials in the Object Request Broker (ORB) current for the authorization service to use in performing further access control checks.

WebSphere Application Server provides two authentication mechanisms: SWAM and LTPA. These authentication mechanisms differ primarily in the distributed security features that each supports.

Configuring authentication mechanisms

Configure authentication mechanisms by clicking **Authentication Mechanisms** under **Security** in the administrative console.

- If you are using Simple WebSphere Authentication Mechanism (SWAM), no setup is needed. Follow the instructions in "Configuring Lightweight Third Party Authentication" on page 158 to set up Lightweight Third Party Authentication (LTPA).
- For LTPA, follow the steps in "Configuring single signon" on page 173 for most situations. If trust association is required, follow the steps in "Configuring WebSEAL or custom trust association interceptors" on page 166.
- If you are using Tivoli Access Manager, follow the instructions in "Configuring WebSphere Application Server to use Tivoli Access Manager for authentication" on page 180.

Simple WebSphere authentication mechanism

The Simple WebSphere authentication mechanism (SWAM) is intended for simple, non-distributed, single application server run-time environments. The single application server restriction is due to the fact that SWAM does not support *forwardable* credentials. If a servlet or enterprise bean in application server process 1, invokes a remote method on an enterprise bean living in another application

server process 2, the identity of the caller identity in process 1 is not transmitted to server process 2. What is transmitted is an unauthenticated credential, which, depending on the security permissions configured on the EJB methods, can cause authorization failures.

Since SWAM is intended for a single application server process, single signon (SSO) is not supported.

The SWAM authentication mechanism is suitable for simple environments, software development environments, or other environments that do not require a distributed security solution.

Lightweight Third Party Authentication

Lightweight Third Party Authentication (LTPA) is intended for distributed, multiple application server and machine environments. It supports forwardable credentials and single signon (SSO). LTPA can support security in a distributed environment through cryptography. This supports permits LTPA to encrypt, digitally sign, and securely transmit authentication-related data, and later decrypt and verify the signature.

The Lightweight Third Party Authentication (LTPA) protocol enables the WebSphere Application Server to provide security in a distributed environment using cryptography. Application servers distributed in multiple nodes and cells can securely communicate using this protocol. It also provides the single signon (SSO) feature wherein a user is required to authenticate only once in a domain name system (DNS) domain and can access resources in other WebSphere Application Server cells without getting prompted. The realm names on each system in the SSO domain are case sensitive and must match identically. For local OS on the Windows platform, the realm name is the domain name, if a domain is in use, or the machine name. On the UNIX platform, the realm name is the same as the host name. For the Lightweight Directory Access Protocol (LDAP), the realm name is the host:port of the LDAP server.

The LTPA protocol uses cryptographic keys (LTPA keys) to encrypt and decrypt user data that passes between the servers. These keys need to be shared between the different cells for the resources in one cell to access resources in other cells (assuming that all the cells involved use the same LDAP or custom registry).

When using LTPA, a token is created with the user information and an expiration time and is signed by the keys. The LTPA token is time sensitive. All product servers participating in a protection domain must have their time, date, and time zone synchronized. If not, LTPA tokens appear prematurely expired and cause authentication or validation failures. This token passes to other servers, in the same cell or in a different cell, either through cookies (for Web resources when SSO is enabled) or through the authentication layer (Security Authentication Service (SAS) or Common Secure Interoperability Version 2 (CSIv2) for enterprise beans). If the receiving servers share the same keys as the originating server, the token can be decrypted to obtain the user information, which then is validated to make sure it has not expired and the user information in the token is valid in its registry. On successful validation, the resources in the receiving servers are accessible after the authorization check.

All the WebSphere Application Server processes in a cell (cell, nodes, application servers) share the same set of keys. If key sharing is required between different cells, export them from one cell and import them to the other. For security

purposes, the exported keys are encrypted with a user-defined password. This same password is needed when importing the keys into another cell.

In the base version of WebSphere Application Server, LTPA, ICSF, and the Simple WebSphere Authentication Mechanism (SWAM) protocols are supported. When security is enabled for the first time in WebSphere Application Server with LTPA, configuring LTPA is normally the initial step performed.

LTPA requires that the configured user registry be a centrally shared repository such as LDAP or a Windows domain type registry so that users and groups are the same regardless of the machine.

The following table summarizes the authentication mechanism capabilities and user registries with which LTPA can work.

	Forwardable Credentials	SSO	LocalOS User Registry	LDAP User Registry	Custom User Registry
SWAM	No	No	Yes	Yes	Yes
LTPA	Yes	Yes	Yes	Yes	Yes
ICSF	Yes	Yes	Yes	Yes	Yes

Configuring Lightweight Third Party Authentication

The following steps are needed to configure Lightweight Third Party Authentication (LTPA) when setting up security for the first time:

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Security** > **Authentication mechanisms** > **LTPA** in the Navigation panel on the left.
3. Enter the password and confirm it in the password fields. This password is used to encrypt and decrypt the LTPA keys during export and import of the keys. Remember this password because you enter it again when the keys from this cell are exported to another cell.
4. Enter a positive integer value in the **Timeout** field. This timeout value refers to how long an LTPA token is valid in minutes. The token contains this expiration time so that any server that receives the token can verify that the token is valid before proceeding further.

   When the token expires, the user is prompted to log in. An optimal value for this field depends on your configuration. The default value is 30 minutes.
5. Click **Apply** or **OK**. The LTPA configuration is now set. Do not generate the LTPA keys in this step because they are automatically generated later. Proceed with the rest of the steps required to enable security, starting with single signon (SSO) (if SSO is required).
6. Complete the information in the Global Security panel and click OK. The LTPA keys are generated automatically the first time. Do not generate the keys manually.

The previous steps configure LTPA by setting passwords that generate LTPA keys.

After configuring LTPA, complete the following steps to work with your key files:
1. Generate key files.
2. Export key files.

3. Import key files.
4. If you are enabling security, make sure that you complete the remaining steps starting with enabling single signon (SSO).
5. If you generated a new set of keys or imported a new set of keys, verify that the keys are saved by clicking **Save** at the top of the panel. Because LTPA authentication uses time sensitive tokens, verify that the time, date, and time zone are synchronized among all product servers that are participating in the protection domain. If the clock skew is too high between servers, the LTPA token appears prematurely expired and causes authentication or validation failures.

Configuring Lightweight Third Party Authentication keys:

Generating keys:

Lightweight Third Party Authentication (LTPA) keys are automatically generated when a password change is detected. The first time that you set the LTPA password, as part of enabling security, the LTPA keys are automatically generated after **OK** or **Apply** is clicked in the LTPA panel. You do not have to click **Generate Keys** in this situation. Complete the following steps in the administrative console to generate a new set of LTPA keys:

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Verify that all the WebSphere Application Server processes are running (cell, nodes, and all of the application servers). If any of the servers are down at the time of key generation and then brought back up later, these servers might contain old keys. Copy the new set of keys to these servers to bring them back up.
3. Click **Security > Authentication mechanisms > LTPA** in the navigation panel on the left.
4. Click **Generate Keys** if you want to use the existing password. This action generates a new set of keys that are encrypted with the same password as the old set of keys. Regardless of the password change, a new set of keys is generated when you click **Generate Keys**. This new set of keys is not propagated to the run time unless saved; save the files immediately.
5. Enter the new password and confirm it, to use a new password to generate keys. Click **OK** or **Apply**. A new set of keys is generated. A message indicating that a new set of keys is generated displays on the console. Do not click **Generate Keys**. These new keys are propagated to the run time once you save them.
6. Click **Save** to save the keys. After a new set of keys is generated and saved, the key propagation is dynamic. All of the processes running at that time (cells, node agents, application servers) are updated with the new set of keys. The next sections describe the process of exporting and importing the keys.

Exporting keys:

To support single signon (SSO) in WebSphere Application Server across multiple WebSphere Application Server domains or cells, share the LTPA keys and the password among the domains. Make sure that the time on the domains is similar to prevent the tokens from appearing as expired between the cells. You can use **Export Keys** to export the LTPA keys to other domains or cells. Complete the following steps in the administrative console to export key files for LTPA:

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Security** > **Authentication mechanisms** > **LTPA** in the navigation panel on the left.
3. In the **Key File Name** field, enter the full path of a file for key storage. This file needs write permissions.
4. Click **Export Keys**. A file is created with the LTPA keys. Exporting keys fails if a new set of keys is generated or imported and not saved prior to exporting. To avoid failure, make sure that you save the new set of keys (if any) prior to exporting them.
5. Click **Save** to save the configuration.

Importing keys:

To support single signon (SSO) in WebSphere Application Server across multiple WebSphere Application Server domains or cells, share the LTPA keys and the password among the domains. You can use **Import Keys** to import the LTPA keys from other domains. Verify that key files are exported from one of the cells involved, into a file. Complete the following steps in the administrative console to import key files for LTPA.

Importing keys is a dynamic operation. All of the servers that are running at this time are updated with the new set of keys. Any back-level tokens signed with the back-level keys fail validation and the user is prompted to log in again.

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Security** > **Authentication mechanisms** > **LTPA** in the navigation panel on the left.
3. Change the password in the **password** fields to match the password in the cell from which you are importing the keys.
4. Click **Save** to save the new set of keys in the repository. This step is important to complete before importing the keys. If the password and the keys do not match, the servers fail. If the servers fail, turn off security and redo these steps.
5. In the **Key File Name** field, enter the full path of a file for key storage. This file needs read permissions.
6. Click **Import Keys**. The keys are now imported into the system.
7. Click **Save** to save the new set of keys in the repository. It is important to save the new set of keys to match the new password so that no problems are encountered starting the servers later.

Lightweight Third Party Authentication settings:

Use this page to configure Lightweight Third Party Authentication (LTPA) settings.

To view this administrative console page, click **Security > Authentication Mechanisms > LTPA**.

If you are configuring security for the first time, only the password is required. After the password is entered, click **Apply**. Click **Single signon** (SSO) and enter the domain name. Make sure that SSO is enabled. Click **Apply**. To complete the security setup, make sure that the appropriate registry is set up and click **Apply**

from the Global Security panel. When security is enabled and any of these properties change, go to the Global Security panel and click **Apply** to validate the changes.

Generate Keys:

Specifies whether the server generates new Lightweight Third Party Authentication (LTPA) keys.

When security is turned on for the first time with LTPA as the authentication mechanism, the LTPA keys are automatically generated with the password entered in the panel. If you need a new set of keys to generate using the previously set password, click **Generate Keys**. If a new password is used, do not click this option. After the new password is entered and **OK** or **Apply** is clicked, a new set of keys is generated. *A new set of generated keys is not used until you save them.*

Import Keys:

Specifies whether the server imports new LTPA keys.

To support single signon (SSO) in the WebSphere product across multiple WebSphere domains (cells), share the LTPA keys and the password among the domains. You can use the **Import Keys** option to import the LTPA keys from other domains. The LTPA keys are exported from one of the cells to a file. To import a new set of LTPA keys, enter the appropriate password, click **OK** and click **Save**. Then, enter the directory location where the LTPA keys are located prior to clicking **Import keys**. Do not click **OK** or **Apply**, but save the settings.

Export Keys:

Specifies whether the server exports LTPA keys.

To support single signon (SSO) in the WebSphere product across multiple WebSphere Application Server domains (cells), share the LTPA keys and the password among the domains. Use the **Export Keys** option to export the LTPA keys to other domains.

To export the LTPA keys, make sure that the system is running with security enabled and is using LTPA. Enter the file name in the **Key File Name** field and click **Export Keys**. The encrypted keys are stored in the specified file.

Password:

Specifies the password to encrypt and decrypt the LTPA keys. Use this password when importing these keys into other WebSphere Application Server administrative domain configurations (if any) and when configuring SSO for a Lotus Domino server.

After the keys are generated or imported, they are used to encrypt and decrypt the LTPA token. Whenever the password is changed, a new set of LTPA keys are automatically generated when you click **OK** or **Apply**. This new set of keys is used only when you save.

Data type String

Confirm Password:

Specifies the confirmed password used to encrypt and decrypt the LTPA keys.

Use this password when importing these keys into other WebSphere Application Server administrative domain configurations (if any) and when configuring SSO for a Lotus Domino server.

Data type String

Timeout:

Specifies the time period in minutes at which an LTPA token expires. Verify that this time period is longer than the cache timeout configured in the Global Security panel.

Data type Integer
Units Minutes
Default 120

Key File Name:

Specifies the name of the file used when importing or exporting keys.

Enter a fully qualified key file name, and click **Import Keys** or **Export Keys**.

Data type String

Trust Associations

Trust Association enables the integration of IBM WebSphere Application Server security and third-party security servers. More specifically, a reverse proxy server can act as a front-end authentication server while the product applies its own authorization policy onto the resulting credentials passed by the proxy server.

Demand for such an integrated configuration has become more compelling, especially when a single product cannot meet all of the customer needs or when migration is not a viable solution. This article provides a conceptual background behind the approach.

The demand is growing to provide customers with a trust association solution between IBM WebSphere Application Server and other Web authentication servers that act as a reverse proxy security server (IBM Tivoli Access Manager for e-business - WebSEAL, Caching Proxy) as an entry point to all service requests (see the first figure). This implementation design intends to have the proxy server as the only exposed entry point. The proxy server authenticates all requests that come in and provides coarse, granularity junction point authorization.

In this setup, the WebSphere Application Server is used as a back-end server to further exploit its fine-grained access control. The reverse proxy server passes the HTTP request to the WebSphere Application Server that includes the credentials of the authenticated user. WebSphere Application Server then uses these credentials to authorize the request.

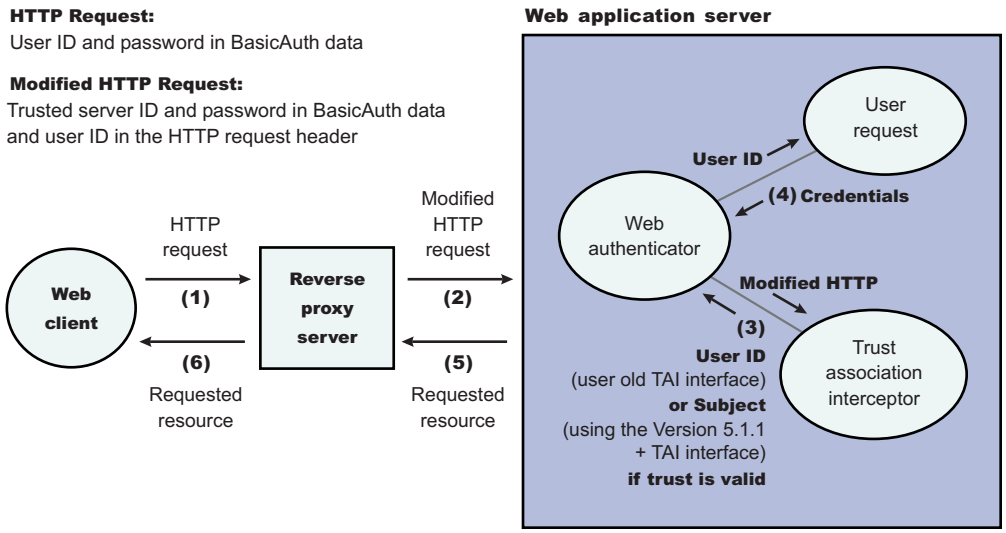
Trust association model

The idea that WebSphere Application Server can support trust association implies that the product application security recognizes and processes HTTP requests received from a reverse proxy server. WebSphere Application Server and the proxy server engage in a contract in which the product gives its full trust to the proxy server and the proxy server applies its authentication policies on every Web request that is dispatched to WebSphere Application Server. This trust is validated by the interceptors that reside in the product environment for every request received. The method of validation is agreed upon by the proxy server and the interceptor.

Running in trust association mode does not prohibit WebSphere Application Server from accepting requests that did not pass through the proxy server. In this case, no interceptor is needed for validating trust. It is possible, however, to configure WebSphere Application Server to strictly require that all HTTP requests go through a reverse proxy server. In this case, all requests that do not come from a proxy server are immediately denied by WebSphere Application Server.

5.1.1

Trust association model



IBM WebSphere Application Server--WebSEAL Integration

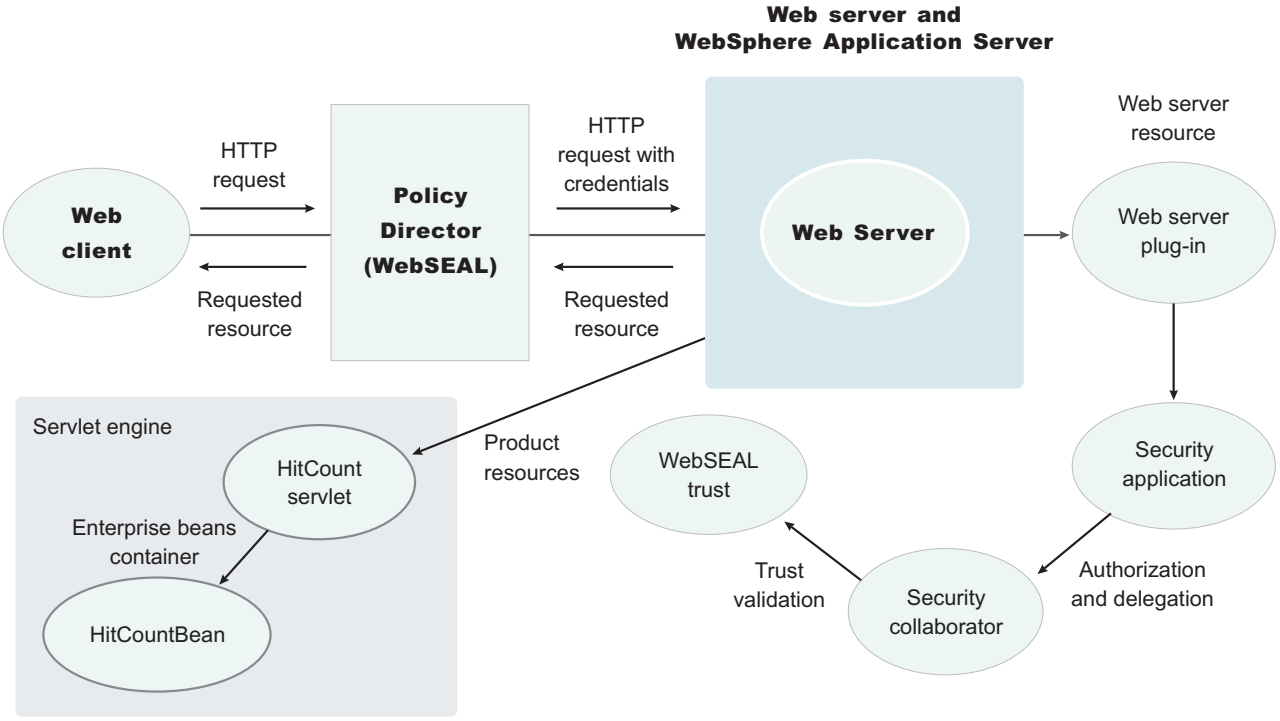
The integration of WebSEAL and WebSphere Application Server security is achieved by placing the WebSEAL server at the front-end as a reverse proxy server. See Figure 2. From a WebSEAL management perspective, a junction is created with WebSEAL on one end, and the product Web server on the other end. A junction is a logical connection created to establish a path from the WebSEAL server to another server.

In this setup, a request for Web resources stored in a protected domain of the product is submitted to the WebSEAL server where it is authenticated against the WebSEAL security realm. If the requesting user has access to the junction, the request is transmitted to the WebSphere Application Server HTTP server through the junction, and then to the application server.

Meanwhile, the WebSphere Application Server validates every request that comes through the junction to ensure that the source is a trusted party. This process is referenced as *validating the trust* and it is performed by a WebSEAL product-designated interceptor. If the validation is successful, the WebSphere Application Server authorizes the request by checking whether the client user has the required permissions to access the Web resource. If so, the Web resource is delivered to the WebSEAL server, through the Web server, which then gives it to the client user.

WebSEAL server

The policy director delegates all of the Web requests to its Web component, the WebSEAL server. One of the major functions of the server is to perform authentication of the requesting user. The WebSEAL server consults a Lightweight Directory Access Protocol (LDAP) directory. It can also map the original user ID to another user ID, such as when global single signon (GSO) is used.

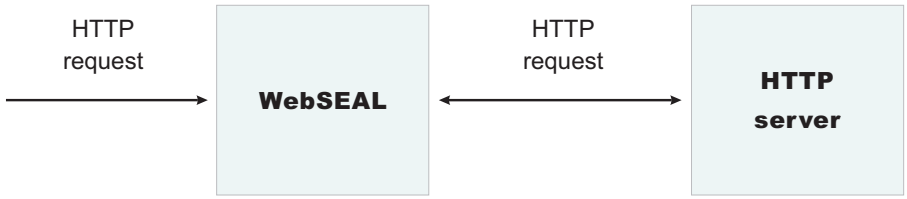


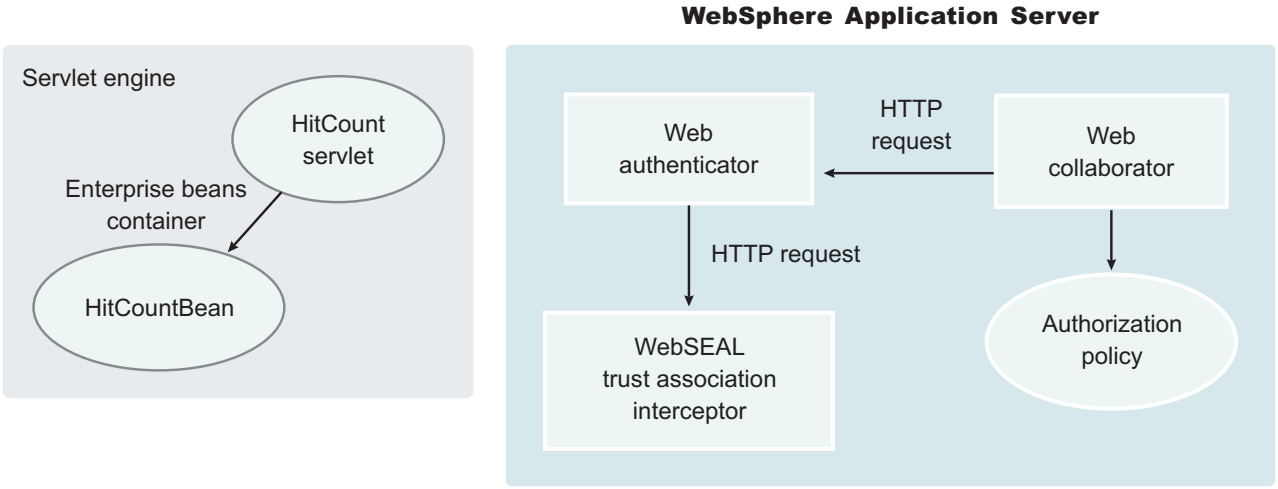
For successful authentication, the server plays the role of a client to WebSphere Application Server when channeling the request. The server needs its own user ID and password to identify itself to WebSphere Application Server. This identity must be valid in the security realm of WebSphere Application Server. The WebSEAL server replaces the basic authentication information in the HTTP request with its own user ID and password. In addition, WebSphere Application Server must determine the credentials of the requesting client so that the application server has an identity to use as a basis for its authorization decisions. This information is transmitted through the HTTP request by creating a header called `iv-creds` with the Tivoli Access Manager user credentials as its value.

HTTP server

The junction created in the WebSEAL server must get to the HTTP server that serves as the product front end. However, the HTTP server is shielded from

knowing that trust association is used. As far as it is concerned, the WebSEAL product is just another HTTP client, and as part of its normal routines, it sends the HTTP request to the product. The only requirement on the HTTP server is a Secure Sockets Layer (SSL) configuration using server authentication only. This requirement protects the requests that flow within the junction.





Web collaborator

When trust association is enabled, the Web collaborator manages the interceptors that are configured in the system. It loads and initializes these interceptors when you restart your servers. When a request is passed to WebSphere Application Server by the Web server, the Web collaborator eventually receives the request for a security check. Two actions must take place:

1. The request must be authenticated.
2. The request must be authorized.

The Web authenticator is called to authenticate the request by passing the HTTP request. If successful, a good credential record is returned by the authenticator, which the Web collaborator uses to base its authorization for the requested resource. If the authorization succeeds, the Web collaborator indicates to WebSphere Application Server that the security check has succeeded and that the requested resource can be served.

Web authenticator

The Web authenticator is asked by the Web collaborator to authenticate a given HTTP request. Knowing that trust association is enabled, the task of the Web authenticator is to find the appropriate trust association interceptor to direct the request for processing. The Web authenticator queries every available interceptor. If no target interceptor is found, the Web authenticator processes the request as though trust association is not enabled.

5.1.1 For an HTTP request sent by the WebSEAL server, the WebSEAL trust association interceptor replies with a positive response to the Web authenticator. Subsequently, the interceptor is asked to validate its trust association with the WebSEAL server and retrieve the Subject, using the new trust association interface (TAI) interface, or user ID, using the old TAI interface, of the original user client.

5.1.1 For more information, see"Trust association interceptor support for Subject creation" on page 108.

Trust association interceptor feature

The intent of the trust association interceptor feature is to have reverse proxy security servers (RPSS) exist as the exposed entry points to perform authentication and coarse-grained authorization, while the WebSphere Application Server enforces further fine-grained access control. Trust associations improve security by reducing the scope and risk of exposure.

In a typical e-business infrastructure, the distributed environment of a company consists of Web application servers, Web servers, legacy systems, and one or more RPSS, such as the Tivoli WebSEAL product. Such reverse proxy servers, front-end security servers, or security plug-ins registered within Web servers, guard the HTTP access requests to the Web servers and the Web application servers. While protecting access to the Uniform Resource Identifiers (URIs), these RPSS perform authentication, coarse-grained authorization, and request routing to the target application server.

Using the trust association interceptor feature

The following points further describe the benefits of the trust association interceptor (TAI) feature:

- RPSS can authenticate WebSphere Application Server users up front and send credential information about the authenticated user to the product so that the product can trust the RPSS to perform authentication and not prompt the end user for authentication data later. The strength of the trust relationship between RPSS and the product is based on the criteria of trust association that is particular to a RPSS and enforced through the TAI implementation. This level of trust might need relaxing based on the environment. Be aware of the vulnerabilities in cases where the RPSS is not trusted, based on a security technology.
- 5.1.1 The end user credentials most likely are sent in a special format as part of the Hypertext Transfer Protocol (HTTP) headers as in the case of RPSS authentication. The credentials can be a special header or a cookie. The data that passes is implementation specific, and the TAI feature considers this fact and accommodates the idea. The TAI implementation works with the credential data and returns a Subject, using the new TAI interface, or a user ID, using the old TAI interface, that represents the end user. WebSphere Application Server uses the information to enforce security policies.

Configuring WebSEAL or custom trust association interceptors

These steps are required to use either the WebSEAL trust association interceptor or your own trust association interceptor with a reverse proxy security server.

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Security > Authentication mechanisms > LTPA** in the left navigation panel.

3. Click **Trust Association** under Additional Properties.
4. Select the **Trust Association Enabled** option.
5. Click **Interceptors** under Additional Properties. The default value appears.
6. 5.1.1 Click **New**.
7. 5.1.1 Type `com.ibm.ws.security.web.TAMTrustAssociationInterceptorPlus` into the **Interceptor Classname** field if you are using the new WebSEAL interceptor.
8. Click **OK**.
9. Click **Custom Properties** under Additional Properties.
10. Click **New** to enter the property name and value pairs. The name and value pairs for the WebSEAL server to follow. For a new interceptor, enter the name and value pairs that correspond to your interceptor.

com.ibm.websphere.security.webseal.mutualSSL

Use this property to configure the trust association interceptor so that trust with the reverse proxy is already validated using a mutually-authenticated Secure Sockets Layer (SSL) connection. If value of the mutual SSL property is true, then authentication is not performed for the single signon (SSO) user.

5.1.1 Therefore, if the value of the mutual SSL property is true, then the com.ibm.websphere.security.webseal.loginId property and the Single sign-on password expiry property do not have any influence.

Attention: When you set this property to true, the login ID and header password combination is not verified. It is recommended that you use some form of transport level filtering so that the connections to WebSphere Application Server are Secure Sockets Layer (SSL) connections originating from WebSEAL only.

Default:	False
Range:	True or false

com.ibm.websphere.security.webseal.loginId

Use this property to configure the trust association interceptor using the user name of the WebSEAL trusted user. This user is the single signon (SSO) user that is authenticated using the password in the basic authentication header that is inserted in the request by WebSEAL. The format of the user name is the short name representation. This property is mandatory; if the property is not set in the WebSphere Application Server then the trust association interceptor initialization fails.

Data type:	String

com.ibm.websphere.security.webseal.id

Use this property to configure the trust association interceptor to ensure that specified headers exist in the request. If not all of the configured headers exist in the request, then trust can not be established. This property is mandatory and there is no default value. If this property is not set, the trust association initialization fails.

Data type:	Comma separated list of strings

com.ibm.websphere.security.webseal.hostnames

Use this property to list any hosts that are trusted. WebSphere Application Server depends upon the value of the com.ibm.websphere.security.webseal.viaDepth and the com.ibm.websphere.security.webseal.ignoreProxy properties to determine whether to trust requests that arrive from hosts listed in this property. If a host is not listed in this property, then WebSphere Application Server might not trust requests arriving from that host. The host names are case-sensitive. This request header also includes the proxy host names (if any) unless the `com.ibm.websphere.security.webseal.ignoreProxy` interceptor is set to `true`.

Data type:	Comma separated list of strings

com.ibm.websphere.security.webseal.ports

Use this property to list the port numbers of any hosts that are trusted. WebSphere Application Server depends upon the value of the com.ibm.websphere.security.webseal.viaDepth and the com.ibm.websphere.security.webseal.ignoreProxy properties to determine whether to trust requests that arrive from ports listed in this property. If a port is not listed in this property, then WebSphere Application Server might not trust any requests arriving from that port. This request header also includes the proxy ports (if any) unless the `com.ibm.websphere.security.webseal.ignoreProxy` interceptor is set to `true`.

Data type:	Comma separated list of integers

com.ibm.websphere.security.webseal.viaDepth

Use this property to configure the trust association interceptor to check only a specified number of source hosts in the VIA header to ensure that those hosts are trusted sources. By default, every host in the VIA header is checked for trust and if any of the hosts are not trusted, then trust is not established. If all of the hosts in the VIA header are not required to be trusted, then you can set the com.ibm.websphere.security.webseal.viaDepth property to indicate the number of hosts that are required to be trusted.For example:

```
Via: HTTP/1.1 webseal1:7002, 1.1 webseal2:7001
```

If the com.ibm.websphere.security.webseal.viaDepth property is not set, is set to 2, or is set to 0, and a request with the above VIA header is received, then both webseal1:7002 and webseal2:7001 need to be trusted.

- `com.ibm.websphere.security.webseal.hostnames = webseal1,webseal2`
- `com.ibm.websphere.security.webseal.ports = 7002,7001`

If the via depth property is set to 1 and the above request is received, then only the last host in the VIA header needs to be trusted.

- `com.ibm.websphere.security.webseal.hostnames = webseal2`
- `com.ibm.websphere.security.webseal.ports = 7001`

If the via depth property is set to 0, then all of the hosts in the VIA header are checked for trust.

If the via depth property is set to a negative value and the check VIA header property is set to true, then the trust association interceptor initialization fails..

Default:	1

com.ibm.websphere.security.webseal.ignoreProxy

Use this property to configure the trust association interceptor so that any hosts in the VIA header that are proxies do not need to be trusted hosts. This property works by checking the comments field of the hosts entry in the VIA header to see if that host is a proxy. This process is not a fail safe method because not all of the proxies insert comments in the VIA header to indicate that they are proxies.If this optional property is set to `true` or `yes`, it ignores the proxy host names and ports in the VIA header. By default, this property is set to `false`.

Default:	False
Data type:	String
Range:	True, false, yes, no

com.ibm.websphere.security.webseal.configURL

Use this property to configure the trust association interceptor to be able to establish trust for a request. The property requires that SvrSslCfg has run for the WebSphere Java Virtual Machine (JVM) resulting in a properties file being created. If the configuration is to occur across multiple WebSphere Application Servers in a Network Deployment environment, then the properties file generated during server SSL configuration must be in the same location on all servers. This location must be the same relative to the WebSphere Application Server install directory if the ${WAS_INSTALL_ROOT} variable is used.

For example:

```
com.ibm.websphere.security.webseal.configURL =
${WAS_INSTALL_ROOT}\java\jre\PdPerm.properties
```

When you use the previous property in a Network Deployment environment, the properties file generated during server SSL configuration must be located in the `java\jre` location relative to the WebSphere Applictaion Server installation directory on all servers.

This property is mandatory and there is no default value. If this property is not set, the trust association interceptor initialization fails.

Data type:	String

com.ibm.websphere.security.webseal.ssoPwdExpiry

Use this property to save the trust association interceptor from needing to re-authenticate the single signon user with Tivoli Access Manager for every request. After trust is established for the request, the password for the single signon user is cached for use with subsequent requests for trust validation. Therefore, you might find an increase in performance. You can modify the cache timeout period by setting the single signon password expiry property to the required time in seconds. If the password expiry property is set to 0, the cached

password never expires. If the password expiry is set to a negative value then the trust association interceptor initialization fails.

Data type:	Positive integer

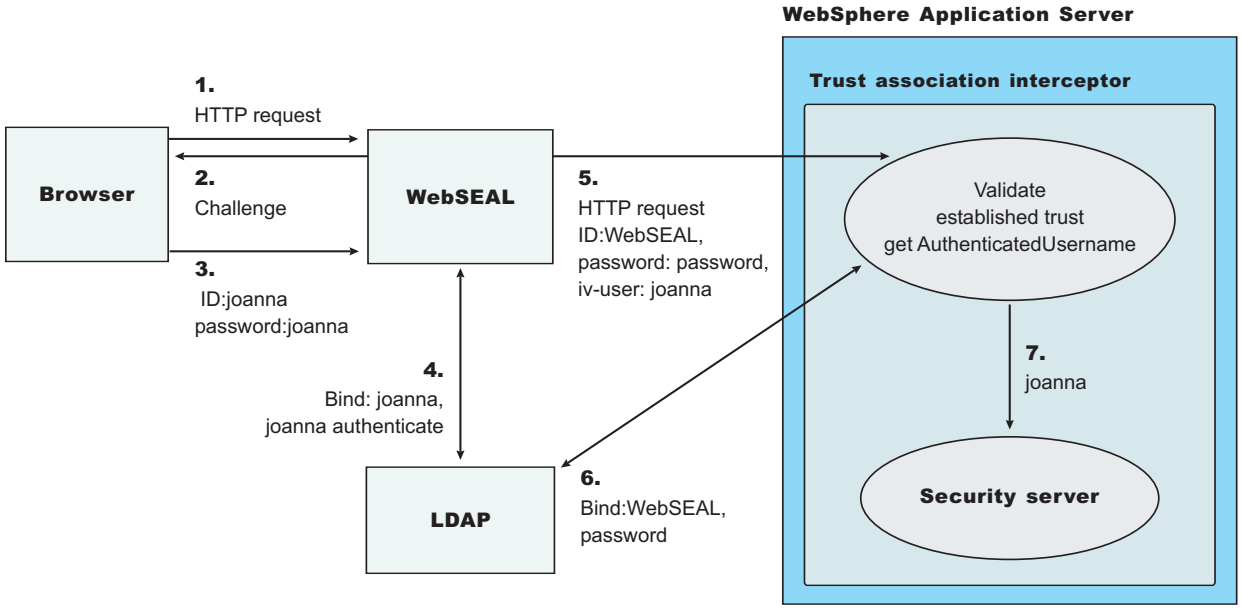
11. Click **OK**.

Enables trust association.

A typical scenario using the trust association interceptor (TAI) includes an environment where IBM Tivoli WebSEAL product is deployed and used with WebSphere Application Server. For the WebSEAL product, an implementation of the TAI is already provided with the product. The following steps outline the typical flow of an HTTP request for a secured WebSphere Application Server resource authenticated by the WebSEAL server through a Web trust association:

1. The browser makes a request for a secured WebSphere resource.
2. The WebSEAL server sends back a challenge, either an HTTP basic authentication or a form-based challenge.
3. A user name and password are supplied.
4. The WebSEAL product authenticates the user to Lightweight Directory Access Protocol (LDAP).
5. The modified request is forwarded by the WebSEAL product to the WebSphere Application Server.
6. The plug-in TAI establishes trust between WebSphere Application Server and the WebSEAL server by using the negotiateAndValidateEstablishedTrust method.
7. The plug-in extracts the end-user credentials from the iv-creds header field and passes it to WebSphere Application Server for authorization.

Web trust association authentication flow



1. If you are enabling security, make sure that you complete the remaining steps for enabling security.

2. Save, stop and restart all of the product servers (cell, nodes, and all of the application servers) for the changes to take effect.

Trust association settings:

Trust association enables the integration of IBM WebSphere Application Server security and third-party security servers. More specifically, a reverse proxy server can act as a front-end authentication server while the product applies its own authorization policy onto the resulting credentials passed by the proxy server. Use this page to configure trust association settings.

To view this administrative console page, click **Security Center > Authentication Mechanisms > LTPA > Trust Association**.

When security is enabled and any of these properties change, go to the **Global Security** panel and click **Apply** to validate the changes.

Enabled:

Specifies whether trust association is enabled.

Data type:	Boolean
Default:	Disable
Range:	Enable or Disable

Trust association interceptor collection:

Use this page to specify trust information for reverse security proxy servers.

To view this administrative console page, click **Security > Authentication Mechanisms > LTPA > Trust Association > Interceptors**.

When security is enabled and any of these properties are changed, go to the Global Security panel and click **Apply** to validate the changes.

Interceptor Class Name:

Specifies the trust association interceptor class name.

Data type
String

Default
`com.ibm.ws.security.web.WebSealTrustAssociationInterceptor`

Single Signon

With single signon (SSO) support, Web users can authenticate once when accessing both WebSphere Application Server resources, such as HTML, JavaServer page (JSP) files, servlets, enterprise beans, and Lotus Domino resources, such as documents in a Domino database, or accessing resources in multiple WebSphere domains.

Web users can authenticate once to a WebSphere Application Server or to a Domino server. Without logging in again, Web users can access any other WebSphere Application Servers or Domino servers in the same Domain Name Service (DNS) domain that are enabled for SSO. This authentication is

accomplished by configuring the WebSphere Application Servers and the Domino servers to share authentication information.

Enable SSO among WebSphere Application Servers by configuring SSO for WebSphere Application Server. To enable SSO between WebSphere Application Servers and Domino servers, you must configure SSO for both WebSphere Application Server and for Domino.

Prerequisites and conditions

To take advantage of support for single signon between WebSphere Application Servers or between WebSphere Application Server and a Domino server, applications must meet the following prerequisites and conditions:

- Verify that all servers are configured as part of the same DNS domain. For example, if the DNS domain is specified as `mycompany.com`, then SSO is effective with any Domino server or WebSphere Application Server on a host that is part of the mycompany.com domain, for example, a.mycompany.com and b.mycompany.com.
- Verify that all servers share the same user registry. This registry can be either a supported Lightweight Directory Access Protocol (LDAP) directory server or, if SSO is configured between two WebSphere Application Servers, a custom user registry. Domino servers do not support custom registries, but you can use a Domino-supported registry as a custom registry within WebSphere Application Server. For more information on custom registries, see *Introduction to custom registries*.

  You can use a Domino directory (configured for LDAP access) or other LDAP directory for the user registry. The LDAP directory product must have WebSphere Application Server support. Supported products include both Domino and IBM SecureWay LDAP directory servers. Regardless of the choice to use an LDAP or a custom registry, the SSO configuration is the same. The difference is in the configuration of the registry.
- Define all users in a single LDAP directory. Using LDAP referrals to connect more than one directory together is not supported. Using multiple Domino directory assistance documents to access multiple directories also is not supported.
- Enable HTTP cookies in browsers because the authentication information that is generated by the server is transported to the browser in a cookie. The cookie is then used to propagate the authentication information for the user to other servers, exempting the user from entering the authentication information for every request to a different server.
- For a Domino server:
  - Domino Release 5.0.6a for iSeries 400 or later and Domino Release 5.0.5 or later for other platforms are supported.
  - A Lotus Notes client Release 5.0.5 or later is required for configuring the Domino server for SSO.
  - You can share authentication information across multiple Domino domains.
- For WebSphere Application Server:
  - WebSphere Application Server Version 3.5 or later for all platforms is supported.
  - You can use any HTTP Web server supported by WebSphere Application Server.
  - You can share authentication information across multiple product administrative domains.
  - Basic authentication (user ID and password) using the basic and form-login mechanisms is supported.

– By default, WebSphere Application Server does a case-sensitive comparison for authorization. This comparison implies that a user who is authenticated by Domino matches the entry exactly (including the base distinguished name) in the WebSphere Application Server authorization table. If case sensitivity is not considered for the authorization, enable the **Ignore Case** property in the LDAP user registry settings.

Configuring single signon

With single signon (SSO) support, Web users can authenticate once when accessing Web resources across multiple WebSphere Application Servers. Form login mechanisms for Web applications require that SSO is enabled.

SSO is supported only when Lightweight Third Party Authentication (LTPA) is the authentication mechanism.

When SSO is enabled, a cookie is created containing the LTPA token and inserted into the HTTP response. When the user accesses other Web resources in any other WebSphere Application Server process in the same domain name service (DNS) domain, the cookie is sent in the request. The LTPA token is then extracted from the cookie and validated. If the request is between different cells of WebSphere Application Servers, you must share the LTPA keys and the user registry between the cells for SSO to work.

The realm names on each system in the SSO domain are case sensitive and must match identically. For local OS on the Windows platform, the realm name is the domain name if a domain is in use or the machine name. On the Linux or UNIX platforms, the release name is the same as the host name. For the Lightweight Directory Access Protocol (LDAP), the realm name is the host:port realm of the LDAP server.

The LTPA authentication mechanism requires that you enable SSO if any of the Web applications have form login as the authentication method.

5.1.1 When you enable security attribute propagation, the following cookies are added to the response:

LtpaToken
The LtpaToken is used for interoperating with previous releases of WebSphere Application Server. This token contains the authentication identity attribute only.

LtpaToken2
LtpaToken2 contains stronger encryption and enables you to add multiple attributes to the token. This token contains the authentication identity and additional information such as the attributes used for contacting the original login server and the unique cache key for looking up the Subject when considering more than just the identity in determining uniqueness.

For more information, see “Security attribute propagation” on page 276.

Token type	Purpose	How to specify
LtpaToken only	This token type is used for the same SSO behavior existing in WebSphere Application Server Version 5.1 and previous releases. Also, this token type is interoperable with those previous releases.	Disable the **Web inbound security attribute propagation** option located in the SSO configuration panel in the administrative console. To access this panel, complete the following steps: 1. Click **Security > Authentication mechanisms > LTPA**. 2. Under Additional properties, click **Single signon (SSO)**.
LtpaToken2 only	This token type is used for Web inbound security attribute propagation and uses the AES, CBC, PKCS5 padding encryption strength (128 bit key size). However, this token type is not interoperable with releases prior to WebSphere Application Server Version 5.1.1. The token type allows for multiple attributes specified in the token (mostly containing information to contact the original login server).	Enable the **Web inbound security attribute propagation** option in the SSO configuration panel within the administrative console. Disable the **Interoperability mode** option in the SSO configuration panel within the administrative console. To access this panel, complete the following steps: 1. Click **Security > Authentication mechanisms > LTPA**. 2. Under Additional properties, click **Single signon (SSO)**.
LtpaToken and LtpaToken2	These tokens together support both of the previous two options. The token types are interoperable with releases prior to WebSphere Application Server Version 5.1.1 because LtpaToken is present. The security attribute propagation function is enabled because the LtpaToken2 is present.	Enable the **Web inbound security attribute propagation** option in the SSO configuration panel within the administrative console. Enable the **Interoperability mode** option in the SSO configuration panel within the administrative console. To access this panel, complete the following steps: 1. Click **Security > Authentication mechanisms > LTPA**. 2. Under Additional properties, click **Single signon (SSO)**.

The following steps are required to configure SSO for the first time.

1. Access the administrative console by typing `http://localhost:9090/admin` in a Web browser.
2. Click **Security** > **Authentication mechanisms > LTPA** in the Navigation panel on the left. Click **Single Signon (SSO)** in the Additional Properties section.

3. Click **Enable**, if SSO is disabled. After you click **Enable**, make sure that you complete the remaining steps to enable security.
4. Enable the **Requires SSL** field if all of the requests are expected on HTTPS.
5. 5.1.1 Optional: Enable the **Interoperability mode** option if you want to allow SSO connections in WebSphere Application Server version 5.1.1 to interoperate with previous versions of the application server. This option sets the old-style LtpaToken into the response so it can be sent to other servers that only work with this token type. However, this option applies only when the **Web inbound security attribute propagation** option is enabled. In this case, both the LtpaToken and LtpaToken2 are added to the response. Otherwise, only the LtpaToken2 is added to the response. If the **Web inbound security attribute propagation** option is disabled, then only the LtpaToken is added to the response.
6. 5.1.1 Optional: Enable the **Web inbound security attribute propagation** option if you want information added during the login at a specific front-end server to propagate to other front-end servers. The SSO token does not contain any sensitive attributes, but does understand where the original login server exists in cases where it needs to contact that server to retrieve serialized information. It also contains the cache look up value for finding the serialized information in DynaCache, if both front-end servers are configured in the same DRS replication domain. For more information, see "Security attribute propagation" on page 276.

   Important: If the following statements are true, it is recommended that you disable the **Web inbound security attribute propagation** option for performance reasons:

   - You do not have any specific information added to the Subject during a login that cannot be obtained at a different front-end server.
   - You did not add custom attributes to the PropagationToken using WSSecurityHelper application programming interfaces (APIs).

   If you find you are missing custom information in the Subject, re-enable the **Web inbound security attribute propagation** option to see if the information is propagated successfully to other front-end application servers. If you disable SSO, but use a trust association interceptor instead, you might still need to enable the **Web inbound security attribute propagation** option if you want to retrieve the same Subject generated at different front-end servers.
7. 5.1.1 Optional: Enter the fully qualified domain names in the Domain name field where SSO is effective.

   The cookie is sent for all of the servers that are contained within the domains that you specify in this field. If you specify domain names, they must be fully qualified. If the domain name is not fully qualified, WebSphere Application Server does not set a domain name value for the LtpaToken cookie and SSO is only valid for the server that created the cookie.

   You can configure the Domain name field using any of the following types of values:

   - Leave the field value blank.
   - Provide a single domain name. For example, enter `austin.ibm.com`.
   - Enter the value, `UseDomainFromURL`.
   - Provide multiple domain names. For example, enter `austin.ibm.com;raleigh.ibm.com`.

- Provide multiple domain names and enter the `UseDomainFromURL` value. For example, enter austin.ibm.com;raleigh.ibm.com;UseDomainFromURL

If you specify the UseDomainFromURL value type, WebSphere Application Server sets the SSO domain name value to the domain of the host that makes the request. For example, if an HTTP request comes from server1.raleigh.ibm.com, WebSphere Application Server sets the SSO domain name value to raleigh.ibm.com.

Tip: The value, `UseDomainFromURL`, is case insensitive. You can type `usedomainfromurl` to use this value.

When you specify multiple domains, you can use the following delimiters: a semicolon (;), a space ( ), a comma (,), or a pipe (|). WebSphere Application Server searches the specified domains in order from left to right. Each domain is compared with the host name of the HTTP request until the first match is located. For example, if you specify ibm.com; austin.ibm.com and a match is found in the ibm.com domain first, WebSphere Application server does not continue to search for a match in the austin.ibm.com domain. However, if a match is not found in either the ibm.com or austin.ibm.com domains, then WebSphere Application Server does not set a domain for the LtpaToken cookie.

8. Click **OK**.

For the changes to take effect, save, stop, and restart all the product servers (cell, nodes and all the WebSphere Application Server systems).

Single signon settings:

Use this page to set the configuration values for single signon (SSO).

To view this administrative console page, click **Security** > **Authentication Mechanisms** > **LTPA** > **Single Signon (SSO)**.

Requires SSL:

Specifies that the single signon function is enabled only when requests are made over HTTPS Secure Sockets Layer (SSL) connections.

Data type:	Boolean
Default:	Disable
Range:	Enable or Disable

Domain Name:

Specifies a fully qualified domain name (.ibm.com, for example) for all single signon hosts.

5.1.1 If the domain name is not fully qualified, WebSphere Application Server does not set a domain name value for the LtpaToken cookie and SSO is only valid for the server that created the cookie.

5.1.1 You can specify multiple domains separated by a semicolon (;), a space ( ), a comma (,), or a pipe (|). WebSphere Application Server searches the specified domains in order from left to right. Each domain is compared with the host name of the HTTP request until the first match is located. For example, if you specify ibm.com;austin.ibm.com and a match is found in the ibm.com domain first, WebSphere Application server does not match the austin.ibm.com domain.

However, if a match is not found in either the ibm.com or the austin.ibm.com domains, then WebSphere Application Server does not set a domain for the LtpaToken cookie.

5.1.1 If you specify `UseDomainFromURL`, WebSphere Application Server sets the SSO domain name value to the domain of the host used in the URL. For example, if an HTTP request comes from `server1.raleigh.ibm.com`, WebSphere Application Server sets the SSO domain name value to `raleigh.ibm.com`.

Tip: 5.1.1 The `UseDomainFromURL` value, is case insensitive. You can type `usedomainfromurl` to use this value.

Data type: String

Enabled:

Specifies that the single signon function is enabled.

Web applications that use Java 2 Enterprise Edition (J2EE) FormLogin style login pages (such as the WebSphere Application Server administrative console) require single signon (SSO) enablement. Only disable SSO for certain advanced configurations where LTPA SSO-type cookies are not required.

Data type: Boolean
Default: Enabled
Range: Enabled or Disabled

Interoperability mode:

Specifies that an interoperable cookie is sent to the browser to support back-level servers.

A new cookie format is needed by the security attribute propagation functionality. When the interoperability mode flag is enabled, the server can send a maximum of two single signon (SSO) cookies back to the browser. In some cases, the server just sends the interoperable SSO cookie.

Web inbound security attribute propagation:

When Web inbound security attribution propagation is enabled, security attributes are propagated to front-end application servers. When this option is disabled, the single signon (SSO) token is used to log in and recreate the Subject from the user registry. If you disable this option, the Web inbound login module functions the same as it did in previous releases.

If the application server is a member of a cluster and the cluster is configured with a distributed replication service (DRS) domain, then propagation occurs. If DRS is not configured, then the SSO token contains the originating server information. With this information the receiving server can contact the originating server using an MBean call to get the original serialized security attributes.

Troubleshooting single signon configurations:

This article describes common problems in configuring single signon (SSO) between a WebSphere Application Server and a Domino server and suggests possible solutions.

- Failure to save the Domino Web SSO configuration document

  The client must be able to find Domino server documents for the participating SSO Domino servers. The Web SSO configuration document is encrypted for the servers that you specify, so the home server indicated by the client location record must point to a server in the Domino domain where the participating servers reside. This pointer ensures that lookups can find the public keys of the servers.

  If you receive a message stating that one or more of the participating Domino servers cannot be found, then those servers cannot decrypt the Web SSO configuration document or perform SSO.

  When the Web SSO configuration document is saved, the status bar indicates how many public keys were used to encrypt the document by finding the listed servers, authors, and administrators on the document.

- Failure of the Domino server console to load the Web SSO configuration document at Domino HTTP server startup

  During configuration of SSO, the server document is configured for **Multi-Server** in the **Session Authentication** field. The Domino HTTP server tries to find and load a Web SSO configuration document during startup. The Domino server console reports the following information if a valid document is found and decrypted: `HTTP: Successfully loaded Web SSO Configuration`.

  If a server cannot load the Web SSO configuration document, SSO does not work. In this case, a server reports the following message: `HTTP: Error Loading Web SSO configuration`. Reverting to single-server session authentication.

  Verify that only one Web SSO Configuration document is in the Web Configurations view of the Domino directory and in the $WebSSOConfigs hidden view. You cannot create more than one document, but you can insert additional documents during replication.

  If you can verify only one Web SSO Configuration document, consider another condition. When the public key of the Server document does not match the public key in the ID file, this same error message can display. In this case, attempts to decrypt the Web SSO configuration document fail and the error message is generated.

  This situation can occur when the ID file is created multiple times but the Server document is not updated correctly. Usually, an error message is displayed on the Domino server console stating that the public key does not match the server ID. If this situation occurs, then SSO does not work because the document is encrypted with a public key for which the server does not possess the corresponding private key.

  To correct a key-mismatch problem:
  1. Copy the public key from the server ID file and paste it into the Server document.
  2. Create the Web SSO configuration document again.

- Authentication fails when accessing a protected resource.

  If a Web user is repeatedly prompted for a user ID and password, SSO is not working because either the Domino or the WebSphere Application Server security server cannot authenticate the user with the Lightweight Directory Access Protocol (LDAP) server. Check the following possibilities:
  - Verify that the LDAP server is accessible from the Domino server machine. Use the **TCP/IP ping** utility to check TCP/IP connectivity and to verify that the host machine is running.

– Verify that the LDAP user is defined in the LDAP directory. Use the **ldapsearch** utility to confirm that the user ID exists and that the password is correct. For example, you can run the following command, entered as a single line, from the OS/400 Qshell, a UNIX shell, or a Windows DOS prompt:

```
% ldapsearch -D "cn=John Doe, ou=Rochester, o=IBM, c=US" -w mypassword
-h myhost.mycompany.com -p 389
-b "ou=Rochester, o=IBM, c=US" (objectclass=*)
```

(The percent character (%) indicates the prompt and is not part of the command.) A list of directory entries is expected. Possible error conditions and causes are contained in the following list:
- No such object: This error indicates that the directory entry referenced by either the user's distinguished name (DN) value, which is specified after the -D option, or the base DN value, which is specified after the -b option, does not exist.
- Invalid credentials: This error indicates that the password is invalid.
- Cannot contact the LDAP server: This error indicates that the host name or port specified for the server is invalid or that the LDAP server is not running.
- An empty list means that the base directory specified by the -b option does not contain any directory entries.

– If you are using the user's short name (or user ID) instead of the distinguished name, verify that the directory entry is configured with the short name. For a Domino directory, verify the **Short name/UserID** field of the Person document. For other LDAP directories, verify the userid property of the directory entry.
– If Domino authentication fails when using an LDAP directory other than a Domino directory, verify the configuration settings of the LDAP server in the Directory assistance document in the Directory assistance database. Also verify that the Server document refers to the correct Directory assistance document. The following LDAP values specified in the Directory Assistance document must match the values specified for the user registry in the WebSphere administrative domain:
- Domain name
- LDAP host name
- LDAP port
- Base DN

Additionally, the rules defined in the Directory assistance document must refer to the base distinguished name (DN) of the directory containing the directory entries of the users.

You can trace Domino server requests to the LDAP server by adding the following line to the server `notes.ini` file:

```
webauth_verbose_trace=1
```

After restarting the Domino server, trace messages are displayed in the Domino server console as Web users attempt to authenticate to the Domino server.

- Authorization failure when accessing a protected resource.

After authenticating successfully, if an authorization error message is displayed, security is not configured correctly. Check the following possibilities:
– For Domino databases, verify that the user is defined in the access-control settings for the database. Refer to the Domino Administrative documentation for the correct way to specify the user's DN. For example, for the `DN cn=John Doe, ou=Rochester, o=IBM, c=US`, the value on the access-control list must be set as `John Doe/Rochester/IBM/US`.

– For resources protected by WebSphere Application Server, verify that the security permissions are set correctly.
  - If granting permissions to selected groups, make sure that the user attempting to access the resource is a member of the group. For example, you can verify the members of the groups by using the following Web site to display the directory contents:
    `Ldap://myhost.mycompany.com:389/ou=Rochester, o=IBM, c=US??sub`
  - If you have changed the LDAP configuration information (host, port, and base DN) in a WebSphere Application Server administrative domain since the permissions were set, the existing permissions are probably invalid and need to be recreated.

- SSO failure when accessing protected resources.

  If a Web user is prompted to authenticate with each resource, SSO is not configured correctly. Check the following possibilities:
  1. Configure both the WebSphere Application Server and the Domino server to use the same LDAP directory. The HTTP cookie used for SSO stores the full DN of the user, for example, `cn=John Doe, ou=Rochester, o=IBM, c=US`, and the domain name service (DNS) domain.
  2. Define Web users by hierarchical names if the Domino Directory is used. For example, update the **User name** field in the Person document to include names of this format as the first value: `John Doe/Rochester/IBM/US`.
  3. Specify the full DNS server name, not just the host name or TCP/IP address for Web sites issued to Domino servers and WebSphere Application Servers configured for SSO. For browsers to send cookies to a group of servers, the DNS domain must be included in the cookie, and the DNS domain in the cookie must match the Web address. (This requirement is why you cannot use cookies across TCP/IP domains.)
  4. Configure both Domino and the WebSphere Application Server to use the same DNS domain. Verify that the DNS domain value is exactly the same, including capitalization. The DNS domain value is found on the Configure Global Security Settings panel of the WebSphere Application Server administrative console and in the Web SSO Configuration document of a Domino server. If you make a change to the Domino Web SSO Configuration document, replicate the modified document to all of the Domino servers participating in SSO.
  5. Verify that the clustered Domino servers have the host name populated with the full DNS server name in the Server document. By using the full DNS server name, Domino Internet Cluster Manager (ICM) can redirect to cluster members using SSO. If this field is not populated, by default, ICM redirects Web addresses to clustered Web servers by using the host name of the server only. It cannot send the SSO cookie because the DNS domain is not included in the Web address. To correct the problem:
     a. Edit the Server document.
     b. Click **Internet Protocols > HTTP** tab.
     c. Enter the full DNS name of the server in the **Host names** field.
  6. If a port value for an LDAP server was specified for a WebSphere Application Server administrative domain, edit the Domino Web SSO configuration document and insert a backslash character (\) into the value of the **LDAP Realm** field before the colon character (:). For example, replace `myhost.mycompany.com:389` with `myhost.mycompany.com\:389`.

Configuring WebSphere Application Server to use Tivoli Access Manager for authentication

Use WebSphere Application Server Version 5.1 to install and pre-configure the Tivoli Access Manager Java run-time component, which uses the WebSphere

Application Server version of the Java run time during the installation. This article does not provide support for the HP-UX operating system, and the steps assume that an external Tivoli Access Manager server Version 5.1 already exists. Refer to the IBM Tivoli Access Manager for e-business documentation for more information, including theIBM Tivoli Access Manager for WebSphere Application Server documentation.

To enable and disable Tivoli Access Manager for authentication, complete the following steps:

1. To enable and disable Tivoli Access Manager for authentication, complete the following steps:
   a. Issue the PDJrteCfg command. In a cell, run the following command on the Deployment Manager first and then on the nodes.

      Attention: The first two lines of the following code sample are one continuous line. The line was split to fit within the width of the printed page.

      ```
      java -Djava.ext.dirs -Dpd.home="%WAS_HOME%\java\jre\PolicyDirector"
      com.tivoli.pd.jcfg.PDJrteCfg

              -action [ config | unconfig ]
              -was
              -config_type [ full | standalone ]
            -java_home <jre_home>
            -host <Policy_Server_host_name>
      ```

      Detailed information on the PDJrteCfg class is located in the com.tivoli.pd.jcfg.PDJrteCfg in the Command Reference of the Tivoli Access Manager Version 5.1 product documentation. Here is an example of the configuration script to run.

      Attention: The following code example should be written as one line of code.

      ```
      %WAS_HOME%\java\jre\bin\java -Djava.ext.dirs
      -Dpd.home="%WAS_HOME%\java\jre\PolicyDirector" \
      -cp  "%WAS_HOME%\java\jre\lib\ext\PD.jar;
      %WAS_HOME%\java\jre\lib\ext\ibmjceprovider.jar;
      %WAS_HOME%\java\jre\lib\ext\ibmpkcs.jar;
      %CLASSPATH%" \com.tivoli.pd.jcfg.PDJrteCfg -action config -was
      -config_type full -host TAM_policy_server_host_name
      ```

   b. Issue the SvrSslCfg command. In a cell, run the following command on the Deployment Manager first and then on the nodes. Refer to SvrSslCfg usage syntax for more information. Also, see the following example for issuing this command:

      Note: The following code example should be written as one line of code.

      ```
      %WAS_HOME%\java\jre\bin\java com.tivoli.pd.jcfg.SvrSslCfg
      -action config -admin_id sec_master -admin_pwd password
      -appsvr_id appsvr_name -appsvr_pwd security -port 8888
      -mode remote -host was_server_host_name
      -policysvr TAM_policysvr_host_name:7135:1
      -authzsvr TAM_authzsvr_host_name:7136:1
      ```

```
-cfg_file %WAS_HOME%\java\jre\PdPerm.properties
-key_file %WAS_HOME%\java\jre\lib\security\PdPerm.ks
-cfg_action create
```

c. Start WebSphere Application Server, if not started already.

d. Enable Tivoli Access Manager in the WebSphere Application Server administrative console. Check the **Use Tivoli Access Manager for Account Policies** check box on the **Security** > **User Registries** > **LDAP** page. If security within the LDAP user registry is not already enabled, then refer to "Configuring Lightweight Directory Access Protocol user registries" on page 196 for more information.

e. Stop and restart WebSphere Application Server for your changes to take effect.

2. To disable Tivoli Access Manager for authentication, complete the following steps:

a. Deselect the **Use Tivoli Access Manager for Account Policies** option on the LDAP user registry page in the administrative console.

b. Stop the WebSphere Application Server.

c. Run the `SvrSslCfg` command to unconfigure the WebSphere Application Server to use an existing Tivoli Access Manager server. For more information, see "Configuring WebSphere Application Server to use Tivoli Access Manager server" on page 183. For example,

Attention: The following code example should be written as one line of code.

```
%WAS_HOME%\java\jre\bin\java com.tivoli.pd.jcfg.SvrSslCfg
-action unconfig -admin_id sec_master -admin_pwd password
-appsvr_id appsvr_name -policysvr TAM_policysvr_host_name:7135:1
-cfg_file %WAS_HOME%\java\jre\PdPerm.properties
-host was_server_host_name
```

d. Run the `PDJrteCfg` command with the unconfig action. Command usage:

Attention: The following code example should be written as one line of code.

```
java -Djava.ext.dirs -Dpd.home="%WAS_HOME%\java\jre\PolicyDirector"
com.tivoli.pd.jcfg.PDJrteCfg

 -action [ config | unconfig ]
 -was
 -config_type [ full | standalone ]
 -java_home <jre_home>
 -host <Policy_Server_host_name>
```

Detailed information on the PDJrteCfg class is located in the `com.tivoli.pd.jcfg.PDJrteCfg` in the Command Reference of the Tivoli Access Manager Version 5.1 product documentation. Here is an example of the unconfiguration script.

Attention: The following code example should be written as one line of code.

```
%WAS_HOME%\java\jre\bin\java -Djava.ext.dirs
-Dpd.home="%WAS_HOME%\java\jre\PolicyDirector" \
-cp  "%WAS_HOME%\java\jre\lib\ext\PD.jar;
```

```
%WAS_HOME%\java\jre\lib\ext\ibmjceprovider.jar;
%WAS_HOME%\java\jre\lib\ext\ibmpkcs.jar;%CLASSPATH%" \
com.tivoli.pd.jcfg.PDJrteCfg -action unconfig -was -java_home
%WAS_HOME%\java\jre
```

Configuring WebSphere Application Server to use Tivoli Access Manager server:

The SvrSslCfg utility is used to configure every WebSphere Developer Kit, Java Technology Edition installation. For example, in a Network Deployment environment, run the SvrSslCfg utility on the Deployment Manager first and then run the utility on all of the application server nodes, even if the nodes are on the same machine.

1. Configure WebSphere Application Server to use Tivoli Access Manager by using the "SvrSslCfg usage syntax" on page 186. This utility is used to configure, to remove, and to modify the configuration information associated with the WebSphere Application Server and the Tivoli Access Manager server that you have configured. After running the SvrSslCfg utility successfully on WebSphere Application Server, a user account and server entries representing the WebSphere Application Server are created in the Tivoli Access Manager user registry. In addition, a configuration file and a Java key store file, which securely stores a client certificate, are created locally on the Application Server. This client certificate permits callers to use Tivoli Access Manager authentication services.
2. Use the "SvrSslCfg usage syntax" on page 186 also to unconfigure the communication of the WebSphere Application Server with Tivoli Access Manager. When unconfiguring, you are choosing to remove the user and server entries from the user registry, and clean up the local configuration and key store files.

Configuring an application server in remote mode:

1. After obtaining the necessary information, use the SvrSslCfg class to create the Tivoli Access Manager application name, the configuration file, and the key store file. Configuring an application server creates user and server information in the user registry as well as local configuration and key store files.
2. Based on the sample information shown in the SvrSslCfg syntax article, the following example script establishes a connection between austin.ibm.com and the Tivoli Access Manager secure domain:

```
java com.tivoli.pd.jcfg.SvrSslCfg -action config  \
-admin_id sec_master  -admin_pwd secpw   \
-appsvr_id PDPermissionjapp  -appsvr_pwd pw  -host austin.ibm.com  \
-mode remote  -port 999  -policysvr ampolicy.ibm.com:7135:1 \
-authzsvr amazn.ibm.com:7136:1
-cfg_file <install_root>/java/jre/PdPerm.properties \
-key_file <install_root>/java/jre/lib/security/pdperm.ks \
-cfg_action create
```

   Use the -cfg_action create option to initially create the configuration and keystore files. Use the -cfg_action replace option if these files already exist. If the -cfg_action create option is used and the configuration or keystore files already exist, an exception is thrown.

Removing configuration information from an application server:

The -action unconfig option removes the user and server information from the user registry, deletes the local keystore file, and removes information for this application from the configuration file. The configuration file is not deleted. This option is illustrated in the following example:

```
java com.tivoli.pd.jcfg.SvrSslCfg -action unconfig  \
         -admin_id sec_master  -admin_pwd secpw     \
         -appsvr_id PDPermissionjapp   -host austin.ibm.com  \
         -policysvr ampolicy.ibm.com:7135:1
```

This operation fails when the caller is unauthorized. Errors encountered during this process are ignored to ensure that all steps are attempted. This procedure succeeds even if local configuration information or information in the user registry is accidentally deleted.

Enabling WebSphere Application Server to use Tivoli Access Manager for authentication:

The WebSphere Application Server can use the Tivoli Access Manager for authenticating users only when the following LDAP directory servers are used as the user registry:

- IBM Directory Server
- Sun ONE directory server
- Lotus Domino Enterprise Server
- Novell Directory Server eDirectory
- Microsoft Windows Active Directory
- z/OS LDAP Server

When one of these directory servers is used as the registry, you can use the Tivoli Access Manager to authenticate users instead of directly binding to the LDAP registry by accepting the password and the account policies set in the Tivoli Access Manager. The following steps explain how to set a property in the LDAP custom properties section when enabling security.

1. Verify that the PDJrteCfg and SvrSslCfg commands have been run as detailed in Configuring WebSphere Application Server to use Tivoli Access Manager for authentication and Configuring WebSphere Application Server to use Tivoli Access Manager server.
2. Select the LDAP user registry by clicking **Security** > **User Registries** > **LDAP** in the administrative console. Confirm that you selected one of the supported LDAP directory servers listed previously.
3. On the LDAP user registry page, select the **Use Tivoli Access Manager for Account Policies** check box in the administrative console. Tivoli Access Manager authentication is valid only when you select **LDAP**. The login polices set in Tivoli Access Manager are honored only when the user logs in with a password. The login policies, however, are not honored when a user logs in without a password (If the user uses X.509 certificates instead of passwords, for example). For more information see the Tivoli Access Manager documentation.
4. If you create groups using Tivoli Access Manager, add the objectClass=accessGroup value to the IBM_Directory_Server group filter. For example the following code is one continuous line:

   (&(cn=%v)(|(objectclass=groupOfNames)(objectclass=accessGroup)
   (objectclass=groupOfUniqueNames)))

This addition is required because by default, the Tivoli Access Manager creates the accessGroup object class and uses it for all the groups it creates. The default WebSphere Application Server LDAP filters only look for the groupOfNames or groupOfUniqueNames object classes. If this change is not made, authorization problems result when groups are assigned to roles.

If the groups are first created in the IBM_Directory_Server registry and then imported into the Tivoli Access Manager, you do not need to change the filters because the groups have the object classes that the WebSphere Application Server requires.

5. Enable security. If security is already enabled, save these changes and restart the servers for the Tivoli Access Manager authentication to take effect.

Best practices for establishing Secure Sockets Layer communications with Tivoli Access Manager server: To create the files necessary for establishing Secure Sockets Layer (SSL) communications in the secure domain, the SvrSslCfg class requires information about the secure domain as well as information related to the application. The following information about the Tivoli Access Manager secure domain is required:

- **Administrative user password**

  The password associated with the Tivoli Access Manager administrative user. Typically, the user name is `sec_master`.

- **Policy server name**

  The name of the system running the Tivoli Access Manager policy server named `ivmgrd`.

- **Authorization server name**

  The name of the system running the Tivoli Access Manager authorization server named `ivacld`. This system might be the same system as the policy server.

- **Policy server SSL port number**

  The number of the port used for SSL communications with the policy server. The default is **7135**.

- **Authorization server SSL port number**

  The number of the port used for SSL communications with the authorization server. The default is **7136**.

  Note: If either the `pdPerm.properties` file or the SSL keystore file becomes damaged, you must repeat the configuration steps. Creating backups of these files is recommended.

  – **Configuration file URL**

    The URL to the configuration file that is manipulated by the SvrSslCfg class.

  – **Keystore file URL**

    The URL to the keystore file that is manipulated by the SvrSslCfg class.

  – **Tivoli Access Manager application name**

    The name of the Tivoli Access Manager application name that is created and associated with the SSL connection between this system and the Tivoli Access Manager servers. The configuration and keystore files are sensitive files that need protection. The contents of the configuration file are not externalized and are subject to change without notice in future releases of Tivoli Access Manager. Do not use the information in the configuration file directly.

Use the previously mentioned information about the secure domain to configure WebSphere Application Server to use Tivoli Access Manager.

SvrSslCfg usage syntax:

The following information is a summary of how to use the com.tivoli.pd.jcfg.SvrSslCfg class:

```
 java com.tivoli.pd.jcfg.SvrSslCfg -action {config |unconfig | addsvr  |  rmsvr
|chgsvr     | setport  |setdblisten  | replcert }

       -admin_id administrator_user_ID
       -admin_pwd administrator_password
       -appsvr_id application_server_name
       -port port_number
       -mode { local | remote }
       [Note: local mode is not supported in this release.]
       -policysvr policy_server_name:port:rank [,...]
       -authzsvr authorization_server_name:port:rank [,...]
       -cfg_file fully_qualified_name_of_configuration_file
       -key_file fully_qualified_name_of_keystore_file
       -appsvr_pwd application_server_password
       -host host_name_of_application_server
       -dblisten { true | false }
       -dbdir name_of_directory_for_local_policy_database
       -dbrefresh refresh_interval_in_seconds
       -cfg_action  { create | replace }
```

Detailed information on the SvrSslCfg class is located in the com.tivoli.pd.jcfg.SvrSslCfg class description in the Authorization Java Classes Developer's Reference of the Tivoli Access Manager product documentation.

Information required to run SvrSslCfg command

Information	Value
Administrator user ID	Sec_master
Administrator password	Secpw
Policy server, TCP/IP communications port number, and rank (default port is 7135)	ampolicy.Tivoli.com:7135:1
Authorization server, TCP/IP communications port number, and rank (default port is 7136)	amazn.Tivoli.com:7136:1
Host name of Java application system (used in remote mode examples)	Jsys.Tivoli.com
TCP/IP port on which the application server listens for communications from the policy server	999
Application server password	pw
Tivoli Access Manager application ID	PDPermissionjapp The application ID must be unique. Other instances of the application running on this system or other systems must each have a unique ID. You can use a distinguished name if an LDAP-based user registry is used by Tivoli Access Manager.
Configuration file	<*install_root*>/java/jre/PdPerm.properties
Key store file	<*install_root*>/java/jre /lib/security/pdperm.ks

Best practices for mapping credentials using IBM Tivoli Access Manager

IBM Tivoli Access Manager credential mapping

Currently, IBM Tivoli Access Manager supports a flexible global signon (GSO) solution that features the ability to provide alternate user names and passwords to the back-end Web application server. For detailed information on a global signon solution, refer to Chapter 8 of the WebSEAL Administrator's Guide, which is located in the Tivoli software information center. After accessing the Tivoli software information center, click **IBM Tivoli Access Manager for e-business** and locate the WebSEAL Administrator's Guide.

For more information, access the Tivoli software information center. Click **IBM Tivoli Access Manager for e-business** and locate the WebSphere Application Server Integration Guide.

Global signon and IBM Tivoli Access Manager user and group management

For global signon resource management and IBM Tivoli Access Manager user and group management, access the Tivoli software information center and click **IBM Tivoli Access Manager for e-business**.

5.1.1 For more information on when you might use the credential mapping services found in Tivoli Access Manager with WebSphere Application Server, see "Configuring inbound identity mapping" on page 262 and "Configuring outbound mapping to a different target realm" on page 271.

User registries

Information about users and groups reside in a user registry. With WebSphere Application Server, a user registry authenticates a user and retrieves information about users and groups to perform security-related functions, including authentication and authorization.

WebSphere Application Server provides several implementations to support multiple types of operating system base user registries. You can use the custom LDAP feature to support any LDAP server by setting up the correct configuration (user and group filters). However, support is not extended to these custom LDAP servers because there are many configuration possibilities.

In addition to Local operating system (OS) and LDAP registries, WebSphere Application Server also provides a plug-in that supports any registry by using the custom registry feature (also referred to as a custom user registry). The custom registry feature supports any user registry that is not implemented by WebSphere Application Server. You can use any registry used in the product environment by implementing the *UserRegistry interface* interface.

The UserRegistry interface is very helpful in situations where the current user and group information exists in some other format (for example, a database) and cannot move to Local OS or LDAP. In such a case, implement the UserRegistry interface so that WebSphere Application Server can use the existing registry for all of the security-related operations. Using a custom registry is a software implementation effort, it is expected that the implementation does not depend on other WebSphere Application Server resources, for example, data sources, for its operation.

Although WebSphere Application Server supports different types of user registries, only one user registry can be active. This active registry is shared by all of the product server processes. If the product processes in one node or cell need to communicate with other product processes in other nodes or cells using Lightweight Third Party Authentication (LTPA), all of the nodes and cells share the same user registry.

Configuring user registries

Before configuring the user registry, decide which registry to use. Though different types of registries are supported, all of the processes in WebSphere Application Server can use one active registry. Configuring the correct registry is a prerequisite to assigning users and groups to roles for applications. When no registry is configured, the LocalOS registry is used by default. So, if your choice of registry is not Local OS you need to first configure the registry, which is normally done as part of enabling security, restart the servers, and then assign users and groups to roles for all your applications.

After the applications are assigned users and groups, and you need to change the registries (for example from Lightweight Directory Access Protocol (LDAP) to Custom), delete all the users and groups (including any RunAs role) from the applications, and reassign them after changing the registry through the administrative console or by using wsadmin scripting. The following wsadmin command removes all of the users and groups (including the RunAs role) from any application:

```
$AdminApp deleteUserAndGroupEntries yourAppName
```

where *yourAppName* is the name of the application. Backing up the old application is advised before performing this operation. However, if both of the following conditions are true, you might be able to switch the registries without having to delete the users and groups information:

- All of the user and group names (including the password for the RunAs role users) in all of the applications match in both registries.
- The application bindings file does not contain the `accessIDs`, which are unique for each registry even for the same user or group name.

By default, an application does not contain `accessIDs` in the bindings file (these IDs are generated when the applications start). However, if you migrated an existing application from an earlier release, or if you used the wsadmin script to add accessIDs for the applications to improve performance you have to remove the existing user and group information and add the information after configuring the new registry.

For more information on updating accessIDs, see updateAccessIDs in the AdminApp object for scripted administration article.

Complete one of the following steps to configure your user registry:

- Configure the local operating system user registry.
- Configure the LDAP user registry.
- Configure the custom user registry.

This step is required as part of enabling security in WebSphere Application Server.

1. If you are enabling security, make sure that you complete the remaining steps. Verify that the Active User Registry field in the **Global Security** panel is set to the appropriate registry. As the final step, validate the user ID and the password by clicking **OK** or **Apply** in the Global Security panel. Save, stop and start all the WebSphere Application Servers.
2. For any changes in user registry panels to be effective, you must validate the changes by clicking **OK** or **Apply** in the Global Security panel. After validation, save the configuration, stop and start all of the WebSphere Application Servers (cells, nodes and all the application servers). To avoid inconsistencies between the WebSphere Application Server processes, make sure that any changes to the registry are done when all of the processes are running. If any of the processes are down, force synchronization to make sure that the process can start later.
3. If the server or servers start without any problems, the setup is correct.

Local operating system user registries

With the local operating system, or Local OS, user registry implementation, the WebSphere authentication mechanism can use the user accounts database of the local operating system.

WebSphere Application Server provides implementations for the Windows local accounts registry and domain registry, as well as implementations for the Linux, Solaris, and AIX user accounts registries. Windows Active Directory is supported through the Lightweight Directory Access Protocol (LDAP) user registry implementation discussed later.

A Local OS user registry is not a centralized user registry like LDAP.

Do not use a Local OS user registry in a WebSphere Application Server environment, where application servers are dispersed across more than one machine because each machine has its own user registry.

Exceptions include a Windows domain registry, which is a centralized registry and Network Information Services (NIS), which is not supported by WebSphere Application Server.

As mentioned previously, the access-IDs taken from the user registry are used during authorization checks.

Because these IDs are typically unique identifiers, they vary from machine to machine, even if the exact users and passwords exist on each machine.

Web client certificate authentication is not currently supported when using the local operating system user registry. However, Java client certificate authentication does function with a local operating user registry. Java client certificate authentication maps the first attribute of the certificate domain name to the user ID in the user registry.

Even though Java client certificates function correctly, the following error displays in the `SystemOut.log` file:

```
SECJ0337E: The mapCertificate method is not supported
```

The error is intended for Web client certificates; however, it also displays for Java client certificates. Ignore this error for Java client certificates.

Using Windows operating system registries

When enabling security on Windows operating systems, if the local operating system (LocalOS) is selected as the registry, consider the following points:

Required privileges

The user that is running the WebSphere Application Server process requires enough operating system privilege to call the Windows systems application programming interface (API) for authenticating and obtaining user and group information from the Windows operating system. This user logs into the machine, or if running as a service, is the **Log On As** user. Depending on the machine (whether the machine is a stand-alone machine or a machine that is part of a domain or is the domain controller), the access requirements vary.

- For a stand-alone machine, the user:
  - Is a member of the administrative group.
  - Has the **Act as part of the operating system** privilege.
  - Hase the **Log on as a service** privilege, if the server is run as a service.
- For a machine that is a member of a domain, only a domain user can start the server process and:
  - Is a member of the domain administrative groups in the domain controller.
  - Has the **Act as part of the operating system** privilege in the Domain Security Policy on the domain controller.
  - Has the **Act as part of the operating system** privilege in the Local Security Policy on the local machine.
  - Has the **Log on as a service** privilege on the local machine, if the server is run as a service.

    The user is a domain user and not a local user, which implies that when a machine is part of a domain, only a domain user can start the server.
- For a domain controller machine, the user:
  - Is a member of the domain administrative groups in the domain controller.
  - Has the **Act as part of the operating system** privilege in the Domain Security Policy on the domain controller.
  - Has the **Log on as a service** privilege on the domain controller, if the server is run as a service.

To give a user the Act as part of the operating system or Log on as a service on Windows 2000 systems:

1. Click **Start** > **Settings** > **Control Panel** > **Administrative Tools** > **Local Security Policy** > **Local Policies** > **User Rights Assignments** > **Act as part of the operating system** (or **Log on as a service**) .
2. Add the user name by clicking **Add**.
3. Restart the machine.

   Windows 2000 domain controller users: For a Windows 2000 domain controller replace **Local Security Policy** with **Domain Security Policy** in the previous step.

   Note: In all of the previous configurations, the server can be run as a service using the `LocalSystem` for the Log On As entry. `LocalSystem` has the required privileges and there is no need to give any user special privilege. However, because the `LocalSystem` has special privileges, make sure that it is appropriate to use it in your environment.

If the user running the server does not have the required privilege, you might see one of the following exception messages in the log files:

- A required privilege is not held by the client.
- Access is denied.

Domain and local registries

When WebSphere Application Server is started, the security run time initialization process dynamically attempts to determine if the local machine is a member of a Windows domain. If the machine is part of a domain then by default both the local registry users or groups and the domain registry users or groups can be used for authentication and authorization purposes with the domain registry taking precedence. The list of users and groups presented during the security role mapping would then include users and groups from both the local user registry and the domain user registry. The users and groups can be distinguished by the host names associated with them.

WebSphere Application Server does not support trusted domains.

If the machine is not a member of a Windows system domain, the user registry local to that machine is used.

Using both the domain registry and the local registry

When the machine hosting the WebSphere Application Server process is a member of a domain, both the local and the domain registries are used by default. The following section describes more on this topic and recommends some best practices to avoid undesirable consequences.

- **Best Practices**

  In general, if the local and the domain registries do not contain common users or groups, it is simpler to administer and it eliminates undesirable side effects. So if possible, give users and groups access to unique security roles (including the server ID and administrative roles). In this situation, select the users and groups from either the local registry or the domain registry to map to the roles.

  In cases where the same users or groups exist in both the local registry and the domain registry, it is recommended that at least the server ID and the users and groups that are mapped to the administrative roles be unique in the registries (exist only on the domain).

  If a common set of users exists, set a different password to make sure that the appropriate user is authenticated.
- **How it works**

  When a machine is part of a domain, the domain user registry takes precedence over the local user registry. For example, when a user logs into the system, the domain registry tries to authenticate the user first. If the authentication fails the local registry is used. When a user or a group is mapped to a role, the user and group information is first obtained from the domain registry. In case of failure, the local registry is tried. However, when a fully qualified user or a group name (one that has a domain or host name attached to it) is mapped to a role, then only that registry is used to get the information. Use the administrative console or scripts to get the fully qualified user and group names and is the recommended way to map users and groups to roles.

  Note: A user **Bob** on one machine (the local registry, for example) is not the same as the user **Bob** on another machine (say the domain registry) because the `uniqueID` of **Bob** (the security identifier [SID], in this case) is different in different registries.
- **Examples**

The machine MyMachine is part of the domain MyDomain. MyMachine contains the following users and groups:
– MyMachine\user2
– MyMachine\user3
– MyMachine\group2

MyDomain contains the following users and groups:
– MyDomain\user1
– MyDomain\user2
– MyDomain\group1
– MyDomain\group2

Here are some scenarios that assume the previous set of users and groups.
1. When user2 logs into the system, the domain registry is used for authentication. If the authentication fails (the password is different) the local registry is used.
2. If the user MyMachine\user2 is mapped to a role, only the user2 in MyMachine has access. So if the user2 password is the same on both the local and the domain registries, user2 cannot access the resource, because user2 is always authenticated using the domain registry. Hence, if both registries have common users, it is recommended that the password be different.
3. If the group2 is mapped to a role, only the users who are members of the MyDomain\group2 can access the resource because group2 information is first obtained from the domain registry.
4. If the group MyMachine\group2 is mapped to a role, only the users who are members of the MyMachine\group2 can access the resource. A specific group is mapped to the role (MyMachine\group2 instead of just group2).
5. Use either user3 or MyMachine\user3 to map to a role, because user3 is unique; it exists in one registry only.

Authorizing with the domain user registry first can cause problems if a user exists in both the domain and local user registries with the same password. Role-based authorization can fail in this situation because the user is first authenticated within the domain user registry. This authentication produces a unique domain security ID that is used in WebSphere Application Server during the authorization check. However, the local user registry is used for role assignment. The domain security ID does not match the unique security ID associated with the role. To avoid this problem, map security roles to domain users instead of local users.

Using either the local or the domain registry. If you want to access users and groups from either the local registry or the domain registry, instead of both, set the property com.ibm.websphere.registry.UseRegistry. This property can be set to either **local** or **domain**. When this property is set to **local** (case insensitive) only the local registry is used. When this property is set to **domain** (case insensitive) only the domain registry is used. Set this property by clicking **Custom Properties** in the **Security** > **User Registries** > **Local OS** panel in the administrative console or by using scripts. When the property is set, the privilege requirement for the user who is running the product process does not change. For example, if this property is set to **local**, the user running the process requires the same privilege, as if the property was not set.

Using UNIX system registries

When using UNIX system registries, the process ID that runs the WebSphere Application Server process needs the root authority to call the local operating system APIs for authentication and for obtaining user or group information.

Note: In UNIX systems, only the local machine registry is used. Network Information Service (NIS) (Yellow Pages) is not supported.

Using Linux and Solaris system registries

For WebSphere Application Server Local OS security registry to work on the Linux and Solaris platforms, a shadow password file must exist. The shadow password file is named `shadow` and is located in the `/etc` directory. If the shadow password file does not exist, an error occurs after enabling global security and configuring the user registry as Local OS.

To create the shadow file, run the **pwconv** command (with no parameters). This command creates an `/etc/shadow` file from the `/etc/passwd` file. After creating the shadow file, you can enable local operating system security successfully.

Remote registries

By default, the registry is local to all of the product processes. The performance is higher, (no need for remote calls) and the registry also increases availability. Any process failing does not effect other processes. When using LocalOS as the registry, every product process must run with privilege access (`root` in UNIX, `Act as part of operating system` in Windows systems). If this process is not practical in some situations, you can use a remote registry from the node (or in very rare situations from the cell). Using a remote registry affects performance and creates a single point of failure. **Use remote registries only in rare situations.**

The node and the cell processes are meant for manipulating configuration information and using them to host the registry for all the application servers creates traffic and can cause problems. Using a node agent (instead of the cell) to host the remote registry is preferable because since the cell process is not designed to be highly available. Also, using a node to host the remote registry indicates that only the application servers in that node are using it. Because the Node Agent does not contain any application code, giving it the access required, privilege is not a concern.

You can set up a remote registry by setting the WAS_UseRemoteRegistry property in the Global Security panel using the **Custom Properties** link at the bottom of the administrative console panel. Use either the **Cell** or the **Node** (case insensitive) value. If the value is `Cell`, the cell registry is used by all of the product processes including the node agent and all of the application servers. If the cell process is down for any reason, restart all of the processes after the cell is restarted. If the node agent registry needs is used for the remote registry, set the value, `WAS_UseRemoteRegistry`, to `node`. In this case, all the application server processes use the node agent registry. In this case, if the node agent fails and does not start automatically, then depending on that node agent, you might need to restart all the application servers, after the node agent is started.

Configuring local operating system user registries

For security purposes, the WebSphere Application Server provides and supports the implementation for Windows operating system registries, AIX, Solaris and multiple versions of Linux operating systems. The respective operating system APIs are called by the product processes (servers) for authenticating a user and other security-related tasks (for example, getting user or group information). Access to these APIs are restricted to users who have special privileges. These privileges depend on the operating system and are described below.

Before configuring the LocalOS registry you need to know the user name (ID) and password to use here. This user can be any valid user in the registry. This user is referred to as either a product security server ID, a server ID or a server user ID in the documentation. Having a server ID means that a user has special privileges when calling protected internal methods. Normally, this ID and password are used to log into the administrative console after security is turned on. You can use other users to log in if those users are part of the administrative roles. When security is enabled in the product, this server ID and password are authenticated with the registry during product startup. If authentication fails, the server does not come up. So it is important to choose an ID and password that do not expire or change often. If the product server user ID or password need to change in the registry, ensure that the changes are performed when all the product servers are up and running. After the changes are completed in the registry, use the following steps to change the ID and the password information. Save, stop, and restart all the servers so that the product can use the new ID or password. If any problem arises after starting the product because of authentication problems (that cannot be fixed), disable security before the server can start up. To avoid this step, make sure that the changes are validated in the Global Security panel. After the server is up, change the ID and password information and enable security.

When using the Windows operating system, consider the following issues:

- The server ID needs to be different from the Windows machine name where the product is installed. For example, if the Windows machine name is *vicky* and the security server ID is vicky, the Windows system fails when getting the information (group information, for example) for user *vicky*.
- WebSphere Application Server dynamically determines whether the machine is a member of a Windows system domain.
- WebSphere Application Server does not support Windows trusted domains.
- If a machine is a member of a Windows domain, both the domain user registry and the local user registry of the machine participate in authentication and security role mapping.
- The domain user registry takes precedence over the local user registry of the machine and can have undesirable implications if users with the same password exist in both user registries.
- The user that the product processes run under requires the `Administrative` and `Act as part of the operating system` privileges to call the Windows operating system APIs that authenticate or collect user and group information. The process needs special authority, which is given by these privileges. The user in this example might not be the same as the security server ID (the requirement for which is a valid user in the registry). This user logs into the machine (if using the command line to start the product process) or the Log On User setting in the services panel if the product processes have started using the services. If the machine is also part of a domain, this user is a part of the Domain Admin group in the domain to call the operating system APIs in the domain in addition to having the Act as part of operating system privilege in the local machine.

When using the UNIX operating systems (AIX and Solaris) and Linux, consider the following points:

- The user that the product processes run under requires the `root` privilege. This privilege is needed to call the UNIX operating system APIs to authenticate or to collect user and group information. The process needs special authority, which is given by the `root` privilege. This user may not be the same as the security server ID (the requirement is that it should be a valid user in the registry). This user logs into the machine and is running the product processes.
- When using the Linux operating system, you might need to have the password shadow file in your system.

The following steps are needed to perform this task initially when setting up security for the first time.

1. Click **Security** > **User Registries** > **LocalOS** in the left navigation panel of the administrative console.
2. Enter a valid user name in the Server User ID field.
3. Enter the user password in the Server User Password field.
4. Click **OK**. Validation of the user and password does not happen in this panel. Validation is only done when you click **OK** or **Apply** in the Global Security panel. If you are enabling security for the first time, complete the other steps and go to the Global Security panel. Make sure that LocalOS is the Active User Registry. If security was already enabled and you had changed either the user or the password information in this panel, make sure to go to the Global Security panel and click **OK** or **Apply** to validate your changes. If your changes are not validated, the server might not come up.

The Local OS user registry has been configured.

1. If you are enabling security, complete the remaining steps. As the final step, ensure that you validate the user and password by clicking **OK** or **Apply** in the Global Security panel. Save, stop, and start all the product servers.
2. For any changes in this panel to be effective, you need to save, stop and start all the product servers (cell, nodes and all the application servers).
3. If the server comes up without any problems the setup is correct.

Local operating system user registry settings:

Use this page to configure local operating system user registry settings.

To view this administrative console page, click **Security** > **User Registries** > **Local OS**.

Server user ID:

Specifies a valid user ID in the Local OS registry.

This ID is the security server ID, which is only used for WebSphere Application Server security and is not associated with the system process that runs the server. The server calls the Local OS registry to authenticate and obtain privilege information about users by calling the native APIs in that particular registry. Access to native APIs is normally restricted to users having special privileges (for example, **root** in UNIX systems and **Act as part of operating system** in Windows systems). To use security in the application server, the process ID (not the security server ID) on which WebSphere Application Server runs requires enough privileges to call the system APIs. The special privilege means that the process running the WebSphere Application Server needs to be part of the **Administrators** group and have the **Act as part of operating system** privilege on Windows systems, and be **root**, or have root authority on UNIX systems.

When using a Windows system registry, this ID cannot match the name of the Windows machine. Windows systems treat the machine name bob as having an account similar to user bob.

Data type:	String
Units:	Alphanumeric characters

Server user password:

Specifies a valid user password that corresponds to a valid user ID in the Local OS registry.

Data type String

Lightweight Directory Access Protocol

Lightweight Directory Access Protocol (LDAP) is a user registry in which authentication is performed using an LDAP binding.

WebSphere Application Server security provides and supports implementation of most major LDAP directory servers, which can act as the repository for user and group information. These LDAP servers are called by the product processes (servers) for authenticating a user and other security-related tasks (for example, getting user or group information). This support is provided by using different user and group filters to obtain the user and group information. These filters have default values that you can modify to fit your needs. The custom LDAP feature enables you to use any other LDAP server (which is not in the product supported list of LDAP servers) for its user registry by using the appropriate filters.

To use LDAP as the user registry, you need to know a valid user name (ID), the user password, the server host and port, the base distinguished name (DN) and if necessary the bind DN and the bind password. You can choose any valid user in the registry that is searchable. In some LDAP servers, the administrative users are not searchable and cannot be used (for example, `cn=root` in SecureWay). This user is referred to as WebSphere Application Server security server ID, server ID, or server user ID in the documentation. Being a server ID means a user has special privileges when calling some protected internal methods. Normally, this ID and password are used to log into the administrative console after security is turned on. You can use other users to log in if those users are part of the administrative roles.

When security is enabled in the product, this server ID and password are authenticated with the registry during the product startup. If authentication fails, the server does not start. Choosing an ID and password that do not expire or change often is important. If the product server user ID or password need to change in the registry, make sure that the changes are performed when all the product servers are up and running.

When the changes are done in the registry, use the steps described in Configuring LDAP user registries. Change the ID, password, and other configuration information, save, stop, and restart all the servers so that the new ID or password is used by the product. If any problems occur starting the product when security is enabled, disable security before the server can start up (to avoid these problems, make sure that any changes in this panel are validated in the Global Security panel). When the server is up, you can change the ID, password and other configuration information and then enable security.

Configuring Lightweight Directory Access Protocol user registries

Review the article on Lightweight Directory Access Protocol (LDAP) before beginning this task.

1. In the administrative console, click **Security** > **User Registries** > **LDAP** in the left navigation panel.

2. Enter a valid user name in the **Server User ID** field. You can either enter the complete distinguished name (DN) of the user or the short name of the user as defined by the User Filter in the Advanced LDAP settings panel. For example, enter the user ID for Netscape.
3. Enter the password of the user in the Server User Password field.
4. Select the type of LDAP server that is used from the **Type** list. The type of LDAP server determines the default filters that are used by the WebSphere Application Server. These default filters change the **Type** field to **Custom**, which indicates that custom filters are used. This action occurs after you click **OK** or **Apply** in the Advanced LDAP settings panel. Choose the **Custom** type from the list and modify the user and group filters to use other LDAP servers, if required. If either the IBM Directory Server or the iPlanet Directory Server is selected, also select the **Ignore Case** field.
5. Enter the fully qualified host name of the LDAP server in the **Host** field.
6. Enter the LDAP server port number in the **Port** field. The host name and the port number represent the realm for this LDAP server in the WebSphere Application Server cell. So, if servers in different cells are communicating with each other using Lightweight Third Party Authentication (LTPA) tokens, these realms must match exactly in all the cells. **Important**: If you are using single signon between a WebSphere Application Server Version 5.0.x or 5.1 server and a WebSphere Application Server Version 4.0.x application server, you must specify an LDAP server port number in the administrative console by clicking **Security > User registries > LDAP**. You must set the LDAP ports numbers to the same numerical value because for WebSphere Application Server Version 5.0.x or 5.1 the default value is 0 and for WebSphere Application Server Version 4.0.x the default value for the port is not 0.
7. Enter the Base distinguished name (DN) in the **Base Distinguished Name** field. The Base DN indicates the starting point for searches in this LDAP directory server. For example, for a user with a DN of `cn=John Doe, ou=Rochester, o=IBM, c=US`, specify the Base DN as any of the following options (assuming a suffix of `c=us`): `ou=Rochester, o=IBM, c=us` or `o=IBM c=us` or `c=us`. This field can be case sensitive. Match the case in your directory server. This field is required for all LDAP directories except the Domino Directory. The Base DN field is optional for the Domino server.
8. Enter the Bind DN name in the **Bind Distinguished Name** field, if necessary. The Bind DN is required if anonymous binds are not possible on the LDAP server to obtain user and group information. If the LDAP server is set up to use anonymous binds, leave this field blank.
9. Enter the password corresponding to the Bind DN in the **Bind password** field, if necessary.
10. Modify the **Search Time Out** value if required. This timeout value is the maximum amount of time that the LDAP server waits to send a response to the product client before aborting the request. The default is 120 seconds.
11. Disable the **Reuse Connection** field only if you use routers to send requests to multiple LDAP servers, and if the routers do not support affinity. Leave this field enabled for all other situations.
12. Enable the **Ignore Case** flag, if required. When this flag is enabled, the authorization check is case insensitive. Normally, an authorization check involves checking the complete DN of a user, which is unique in the LDAP server and is case sensitive. However, when using either the IBM Directory Server or the iPlanet Directory Server LDAP servers, this flag needs enabling because the group information obtained from the LDAP servers is not consistent in case. This inconsistency only effects the authorization check.

13. Enable Secure Sockets Layer (SSL) if the communication to the LDAP server is through SSL. For more information on setting up LDAP for SSL, refer to Configuring SSL for LDAP clients.
14. If SSL is enabled, select the appropriate SSL alias configuration from the list in the **SSL configuration** field.
15. Click **OK**. The validation of the user, password, and the setup do not take place in this panel. Validation is only done when you click **OK** or **Apply** in the **Global Security** panel. If you are enabling security for the first time, complete the remaining steps and go to the **Global Security** panel. Select **LDAP** as the Active User Registry. If security is already enabled, but information on this panel changes, go to the **Global Security** panel and click **OK** or **Apply** to validate your changes. If your changes are not validated, the server might not come up.

Sets the LDAP registry configuration.

This step is required to set up the LDAP registry. This step is required as part of enabling security in the WebSphere Application Server.
1. If you are enabling security, complete the remaining steps. As the final step, validate this setup by clicking **OK** or **Apply** in the Global Security panel.
2. Save, stop, and restart all the product servers (cell, nodes and all the application servers) for changes in this panel to take effect.
3. If the server comes up without any problems the setup is correct.

Lightweight Directory Access Protocol settings:

Use this page to configure Lightweight Directory Access Protocol (LDAP) settings when users and groups reside in an external LDAP directory.

To view this administrative console page, click **Security** > **User Registries** > **LDAP**.

When security is enabled and any of these properties change, go to the Global Security panel and click **Apply** to validate the changes.

Server User ID:

Specifies the user ID under which the server runs, for security purposes.

Although this ID is not the LDAP administrator user ID, specify a valid entry in the LDAP directory located under the Base Distinguished Name.

Server User Password:

Specifies the password corresponding to the security server ID.

Type:

Specifies the type of LDAP server to which you connect.

The type is used to preload default LDAP properties. IBM Directory Server users can choose either IBM_Directory_Server or SecureWay as the directory type. Use the IBM_Directory_server directory type for better performance. Users of the iPlanet Directory Server can choose either iPlanet Directory Server or NetScape as the directory type. Use the iPlanet Directory Server directory type for better performance after configuring iPlanet to use `role (nsRole)` as the grouping method.

IBM SecureWay Directory Server is not supported.

For a list of supported LDAP servers, see ″Supported directory services.″ in the documentation.

Host:

Specifies the host ID (IP address or domain name service (DNS) name) of the LDAP server.

Port:

Specifies the host port of the LDAP server.

If multiple WebSphere Application Servers are installed and configured to run in the same single signon domain, or if the WebSphere Application Server interoperates with a previous version of the WebSphere Application Server, then it is important that the port number match all configurations. For example, if the LDAP port is explicitly specified as `389` in a Version 4.0.x configuration, and a WebSphere Application Server at Version 5 is going to interoperate with the Version 4.0.x server, then verify that port `389` is specified explicitly for the Version 5 server.

Default: 389

Base Distinguished Name:

Specifies the base distinguished name of the directory service, indicating the starting point for LDAP searches of the directory service.

For example, for a user with a distinguished name (DN) of `cn=John Doe, ou=Rochester, o=IBM, c=US`, you can specify the base DN as (assuming a suffix of `c=us`): `ou=Rochester,o=IBM,c=us` or `o=IBM,c=us`. For authorization purposes, this field is case sensitive. This specification implies that if a token is received (for example, from another cell or Domino) the base DN in the server must match the base DN from the other cell or Domino server exactly. If case sensitivity is not a consideration for authorization, enable the **Ignore Case** field.

If you need to interoperate between WebSphere Application Server Version 5 and a Version 5.0.1 or later server, you must enter a normalized base distinguished name. A normalized base distinguished name does not contain spaces before or after commas and equal symbols. An example of a non-normalized base distinguished name is `o = ibm, c = us` or `o=ibm, c=us`. An example of a normalized base distinguished name is `o=ibm,c=us`. In WebSphere Application Server, Version 5.0.1 or later, the normalization occurs automatically at the run time

This field is required for all Lightweight Directory Access Protocol (LDAP) directories except for the Domino Directory, where this field is optional.

Bind Distinguished Name:

Specifies the distinguished name for the application server to use when binding to the directory service.

If no name is specified, the application server binds anonymously. See the Base Distinguished Name field description for examples of distinguished names.

Bind Password:

Specifies the password for the application server to use when binding to the directory service.

Search Timeout:

Specifies the timeout value in seconds for an Lightweight Directory Access Protocol (LDAP) server to respond before aborting a request.

Default: 120

Reuse connection:

Specifies whether the server reuses the Lightweight Directory Access Protocol (LDAP) connection. Clear this option only in rare situations where a router is used to spray requests to multiple LDAP servers and when the router does not support affinity.

Default: Enabled
Range: Enabled or Disabled

Ignore Case:

Specifies that a case insensitive authorization check is performed.

This field is required when IBM Directory Server is selected as the LDAP directory server.

This field is required when Sun ONE Directory Server is selected as the LDAP directory server. For more information, see ″Using specific directory servers as the LDAP server″ in the documentation.

Otherwise, this field is optional and can be enabled when a case-sensitive authorization check is required. For example, use this field when the certificates and the certificate contents do not match the case used for the entry in the LDAP server. You can enable the **Ignore Case** field when using single signon (SSO) between WebSphere Application Server and Lotus Domino.

Default: Disabled
Range: Enabled or Disabled

SSL Enabled:

Specifies whether secure socket communication is enabled to the Lightweight Directory Access Protocol (LDAP) server. When enabled, the LDAP Secure Sockets Layer (SSL) settings are used, if specified.

SSL Configuration:

Specifies the Secure Sockets Layer configuration to use for the Lightweight Directory Access Protocol (LDAP) connection. This configuration is used only when SSL is enabled for LDAP.

Default: DefaultSSLSettings

Use Tivoli Access Manager for Account Policies:

Select this option to indicate that the Tivoli Access Manager is used for authentication to honor password and account policies. This option requires that you have previously installed the Tivoli Access Manager.

Do not select this option unless you have a Tivoli Access Manager Server installed and configured to be used by WebSphere Application Server. The Lightweight Directory Access Protocol (LDAP) directory server used by the Tivoli Access Manager must be the same LDAP directory server that is used by WebSphere Application Server.

Important: When you select this option, IBM SecureWay Directory Server is not supported as an LDAP directory server.

Lightweight Directory Access Protocol advanced settings:

Use this page to configure advanced Lightweight Directory Access Protocol (LDAP) user registry settings when users and groups reside in an external LDAP directory.

To view this administrative page, click **Security** > **User Registries** > **LDAP Advanced LDAP settings**.

Default values for all the user and group related filters are already completed in the appropriate fields. You can change these values depending on your requirements. These default values are based on the type of LDAP server selected in the **LDAP settings** panel. If this type changes (for example from Netscape to Secureway) the default filters automatically change. When the default filter values change, the LDAP server type changes to `Custom` to indicate that custom filters are used. When security is enabled and any of these properties change, go to the **Global Security** panel and click **Apply** or **OK** to validate the changes.

User Filter:

Specifies the LDAP user filter that searches the registry for users.

This option is typically used for Security Role to User assignments. It specifies the property by which to look up users in the directory service. For example, to look up users based on their user IDs, specify `(&(uid=%v)(objectclass=inetOrgPerson))`. For more information about this syntax, see the LDAP directory service documentation.

Data type: String

Group Filter:

Specifies the LDAP group filter that searches the user registry for groups

This option is typically used for Security Role to Group assignments. It specifies the property by which to look up groups in the directory service. For more information about this syntax, see the LDAP directory service documentation.

Data type: String

User ID Map:

Specifies the LDAP filter that maps the short name of a user to an LDAP entry.

Specifies the piece of information that represents users when users appear. For example, to display entries of the type `object class = inetOrgPerson` by their IDs, specify `inetOrgPerson:uid`. This field takes multiple objectclass:property pairs delimited by a semicolon (;).

Data type: String

Group ID Map:

Specifies the LDAP filter that maps the short name of a group to an LDAP entry.

Specifies the piece of information that represents groups when groups appear. For example, to display groups by their names, specify `*:cn`. The asterisk (`*`) is a wildcard character that searches on any object class in this case. This field takes multiple `objectclass:property` pairs delimited by a semicolon (;).

Data type: String

Group Member ID Map:

Specifies the LDAP filter which identifies user to group relationships.

For directory types SecureWay, Netscape, and Domino, this field takes multiple objectclass:property pairs, delimited by a semicolon (;). In an objectclass:property pair, the objectclass value is the same objectclass that is defined in the Group Filter, and the property is the member attribute. If the objectclass value does not match the objectclass in Group Filter, authorization might fail if groups are mapped to security roles. For more information about this syntax, see your LDAP directory service documentation.

For IBM Directory Server, iPlanet Directory Server and Active Directory, this field takes multiple (`group attribute:member attribute`) pairs delimited by a semicolon (;). They are used to find the group memberships of a user by enumerating all the group attributes possessed by a given user. For example, attribute pair (`memberof:member`) is used by Active Directory, and (ibm-allGroup:member) is used by IBM Directory Server . This field also specifies which property of an objectclass stores the list of members belonging to the group represented by the objectclass. For supported LDAP directory servers, see ″Supported directory services″.

Data type: String

Perform a nested group search:

Specifies a recursive nested group search.

Select this option if the Lightweight Directory Access Protocol (LDAP) server does not support recursive server-side group member searches (and if recursive group member search is required). It is not recommended that you select this option to locate recursive group memberships for LDAP servers. WebSphere security

leverages the LDAP server's recursive search functionality to search a user's group memberships, including recursive group memberships. For example:

- IBM Directory Server is pre-configured by WebSphere Application Server security to recursively calculate a user's group memberships using the `ibm-allGroup` attribute
- SunONE directory server is pre-configured to calculate nested group memberships using the `nsRole` attribute

Data type: String

Certificate Map Mode:

Specifies whether to map X.509 certificates into an LDAP directory by EXACT_DN or CERTIFICATE_FILTER. Specify CERTIFICATE_FILTER to use the specified certificate filter for the mapping.

Data type: String

Certificate Filter:

Specifies whether to use the filter certificate mapping property to specify the LDAP filter, which is used to map attributes in the client certificate to entries in the LDAP registry.

To enable this field, click **CERTIFICATE_FILTER** for the certificate mapping. If more than one LDAP entry matches the filter specification at run time, then authentication fails because it results in an ambiguous match. The syntax or structure of this filter is: `LDAP attribute=${Client certificate attribute}` (for example, `uid=${SubjectCN}`). The left side of the filter specification is an LDAP attribute that depends on the schema that your LDAP server is configured to use. The right side of the filter specification is one of the public attributes in your client certificate. The right side must begin with a dollar sign ($) and open bracket ({) and end with a close bracket (}). You can use the following certificate attribute values on the right side of the filter specification. The case of the strings is important:

- `${UniqueKey}`
- `${PublicKey}`
- `${PublicKey}`
- `${Issuer}`
- `${NotAfter}`
- `${NotBefore}`
- `${SerialNumber}`
- `${SigAlgName}`
- `${SigAlgOID}`
- `${SigAlgParams}`
- `${SubjectCN}`
- `${Version}`

Data type: String

Configuring Lightweight Directory Access Protocol search filters

The WebSphere Application Server uses Lightweight Directory Access Protocol (LDAP) filters to search and obtain information about users and groups from an

LDAP directory server. A default set of filters is provided for each LDAP server that the product supports. You can modify these filters to fit your LDAP configuration. After the filters are modified (and **OK** or **Apply** is clicked) the directory type in the **LDAP Registry** panel changes to `custom`, which indicates that custom filters are used. Also, you can develop filters to support any additional type of LDAP server. The effort to support additional LDAP directories is optional and other LDAP directory types are not supported.

1. In the administrative console, click **Security > User Registries > LDAP** in the left navigation panel. Click **Advanced LDAP Setting** in Additional Properties.
2. Modify the **User** filter, if necessary. The user filter is used for searching the registry for users and is typically used for the security role to user assignment. Also, the filter is used to authenticate a user using the attribute specified in the filter. The filter specifies the property used to look up users in the directory service. In the following example, the property that is assigned to `%v`, which is the short name of the user, must be a unique key. Two LDAP entries with the same object class cannot have the same short name. To look up users based on their user IDs (uid) and to use the inetOrgPerson object class, specify the following syntax:

   ```
   (&(uid=%v)(objectclass=inetOrgPerson)
   ```

   For more information about this syntax, see the LDAP directory service documentation.
3. Modify the **Group** filter, if necessary. The group filter is used in searching the registry for groups and is typically used for the security role to group assignment. Also, the filter is used to specify the property by which to look up groups in the directory service. In the following example, the property that is assigned to `%v`, which is the short name of the group, must be a unique key. Two LDAP entries with the same object class cannot have the same short name. To look up groups based on their common names (CN) and to use either the groupOfNames or the groupOfUniqueNames object class, specify the following syntax:

   ```
   (&(cn=%v)(|(objectclass=groupOfNames)(objectclass=groupOfUniqueNames)))
   ```

   For more information about this syntax, see the LDAP directory service documentation.
4. Modify the **User ID map** filter, if necessary. This filter maps the short name of a user to an LDAP entry. It specifies the piece of information that represents users when these users are displayed with their short names. For example, to display entries of the type object class = inetOrgPerson by their IDs, specify `inetOrgPerson:uid`. This field takes multiple objectclass:property pairs delimited by a semicolon (;). To provide a consistent value for methods like getCallerPrincipal( ), getUserPrincipal() the short name obtained by using this filter is used. For example, the user `CN=Bob Smith, ou=austin.ibm.com, o=IBM, c=US` can log in using any attributes that are defined (for example, e-mail address, social security number, and so on) but when these methods are called, the user ID **bob** is returned no matter how the user logs in.
5. Modify the **Group ID Map** filter, if necessary. This filter maps the short name of a group to an LDAP entry. It specifies the piece of information that represents groups when groups display. For example, to display groups by their names, specify `*:cn`. The (*) is a wildcard character that searches on any object class in this case. This field takes multiple objectclass:property pairs delimited by a semicolon (;).
6. Modify the **Group Member ID Map** filter, if necessary. This filter identifies user to group memberships. For SecureWay, Netscape, and Domino directory

types, this field is used to query all the groups that match the specified object classes to find if the user is contained in the attribute specified. For example, to get all the users belonging to groups with the groupOfNames object class and the users contained in the member attributes, specify `groupOfNames:member`. This syntax which property of an objectclass stores the list of members belonging to the group represented by the objectclass. This field takes multiple objectclass:property pairs delimited by a semicolon (;). For more information about this syntax, see the LDAP directory service documentation.

For the IBM Directory Server, iPlanet Directory Server, and Active Directory, this field is used to query all users in a group by using the information stored in the user object (instead of querying all the groups individually to find if the user exists in that group). For example, the memberof:member filter (for Active Directory) is used to get the memberof attribute of the user object to get all the groups to which the user belongs. The member attribute is used to get all the users in a group using the group object. Using the user object to obtain the group information is expected to improve performance.

7. Modify the **Certificate Map Mode**, if necessary. You can use the X.590 certificates for user authentication when LDAP is selected as the user registry. This field is used to indicate whether to map the X.509 certificates into an LDAP directory user by **EXACT_DN** or **CERTIFICATE_FILTER**. If **EXACT_DN** is selected, the DN in the certificate must exactly match the user entry in the LDAP server (including case and spaces). Use the **Ignore Case** field in the LDAP settings to make the authorization case insensitive. If you select **CERTIFICATE_FILTER**, fill in the appropriate certificate filter (in the next field) to use for mapping the certificate to a user in LDAP.
8. If you specify the filter certificate mapping in step 7, use this property to specify the LDAP filter for mapping attributes in the client certificate to entries in LDAP. If more than one LDAP entry matches the filter specification at run time, authentication fails because an ambiguous match results. The syntax or structure of this filter is: `LDAP attribute=${Client certificate attribute}` (for example, `uid=${SubjectCN}`). The left side of the filter specification is an LDAP attribute that depends on the schema that your LDAP server is configured to use. The right side of the filter specification is one of the public attributes in your client certificate. Note that the right side must begin with a dollar sign ($), open bracket ({), and end with a close bracket ({). Use the following certificate attribute values on the right side of the filter specification. The case of the strings is important.
   - ${UniqueKey}
   - ${PublicKey}
   - ${Issuer}
   - ${NotAfter}
   - ${NotBefore}
   - ${SerialNumber}
   - ${SigAlgName}
   - ${SigAlgOID}
   - ${SigAlgParams}
   - ${SubjectDN}
   - ${Version}

   To enable this field, select **CERTIFICATE_FILTER** for the certificate mapping.
9. Click **Apply**.

   When any LDAP user or group filter is modified in the Advanced LDAP Settings panel click **Apply**. Clicking **OK** navigates you to the LDAP User Registry panel, which contains the previous LDAP directory type, rather than the custom LDAP directory type. Clicking **OK** or **Apply** in the LDAP User

Registry panel saves the back-level LDAP directory type and the default filters of that directory. This action overwrites any changes to the filters that you made. To avoid overwriting changes, you can take either of the following actions:
- Click **Apply** in the Advanced LDAP Settings panel. To proceed to another panel, use the left navigation. Using the navigation to access the LDAP User Registry panel changes the directory type to `Custom`.
- Choose **Custom** type from the LDAP User Registry panel. Click **Apply** and then change the filters by clicking the **Advanced LDAP Settings** panel. After you complete your changes, click **Apply** or **OK**.

The validation of the changes (if any) does not take place in this panel. Validation is done when you click **OK** or **Apply** in the Global Security panel. If you are in the process of enabling security for the first time, complete the remaining steps and go to the Global Security panel. Select **LDAP** as the Active User Registry. If security already is enabled and any information on this panel changes, go to the Global Security panel and click **OK** or **Apply** to validate your changes. If your changes are not validated, the server might not come up.

Sets the LDAP search filters.

This step is required to modify existing user and group filters for a particular LDAP directory type. It is also used to set up certificate filters to map certificates to entries in the LDAP server.
1. If you are enabling security, complete the remaining steps. As the final step make sure that you validate this setup by clicking **OK** or **Apply** in the Global Security panel.
2. Save, stop, and start all the product servers (cell, nodes and all the application servers) for any changes in this panel to become effective.
3. After the server comes up, go through all the security-related tasks (getting users, getting groups and so on) to verify that the changes to the filters function.

Using specific directory servers as the LDAP server

For *Using MS Active Directory server as the LDAP server* below, note that to use Microsoft Active Directory as the LDAP server for authentication with WebSphere Application Server you must take specific steps. By default, Microsoft Active Directory does not permit anonymous LDAP queries. To create LDAP queries or to browse the directory, an LDAP client must bind to the LDAP server using the distinguished name (DN) of an account that belongs to the administrator group of the Windows system. A group membership search in the Active Directory is done by enumerating the memberof attribute possessed by a given user entry, rather than browsing through the member list in each group. If you change this default behavior to browse each group, you can change the **Group Member ID Map** field from `memberof:member` to `group:member`.

Using Tivoli Directory Server as the LDAP server

To use IBM Directory Server, choose **IBM Directory Server** as the directory type.

You can choose the directory type of either **IBM Directory Server** or **SecureWay** for the IBM Directory Server.

For supported directory servers, refer to the article, Supported directory services. The difference between these two types is group membership lookup. It is recommended that you choose the IBM Directory Server for optimum performance

during run time. In the IBM Directory Server, the group membership is an operational attribute. With this attribute, a group membership lookup is done using the `ibm-allGroups` attribute for the entry. All group memberships, including the static groups, dynamic groups, and nested groups, can be returned with the `ibm-allGroups` attribute. WebSphere Application Server supports dynamic groups, nested groups, and static groups in IBM Directory Server using the `ibm-allGroups` attribute. To utilize this attribute in a security authorization application, use a case-insensitive match so that attribute values returned by the ibm-allGroups attribute are all in uppercase.

Important: It is recommended that you do not install Tivoli Directory Server Version 5.2 on the same machine that you install WebSphere Application Server, Version 5.1.x. Tivoli Directory Server, Version 5.2 includes WebSphere Application Server Express, Version 5.0.2, which the directory server uses for its administrative console. Install the Web Administration tool Version 5.2 and WebSphere Application Server Express, Version 5.0.2, which are both bundled with Tivoli Directory Server, Version 5.2, on a different machine from WebSphere Application Server, Version 5.1.x. You cannot use WebSphere Application Server, Version 5.1.x as the administrative console for Tivoli Directory Server. If Tivoli Directory Server, Version 5.2 and WebSphere Application Server, Version 5.1.x are installed on the same machine, you might encounter port conflicts.

If you must install Tivoli Directory Server Version 5.2 and WebSphere Application Server Version 5.1.x on the same machine, consider the following information:

- During the Tivoli Directory Server installation process, you must select both the **Web Administration tool** and **WebSphere Application Server Express, Version 5.0.2**.
- Install WebSphere Application Server, Version 5.1.x.
- When you install WebSphere Application Server, Version 5.1.x, change the port number for the application server. For more information, see Changing HTTP transport ports.
- You might need to adjust the WebSphere Application Server environment variables on the version 5.1.x application server for *WAS_HOME* and *WAS_INSTALL_ROOT*. To change the variables using the administrative console, click **Environment > Manage WebSphere Variables**.

Using a Lotus Domino Server as the LDAP server

If you choose the Lotus Domino LDAP server Version 6 and the attribute short name is not defined in the schema, you can take either of the following actions:

- Change the schema to add the short name attribute.
- Change the user ID map filter to replace the short name with any other defined attribute (preferably to UID). For example, change `person:shortname` to `person:uid`.

The userID map filter has been changed to use the **uid** attribute instead of the **shortname** attribute as the current version of Lotus Domino does not create the **shortname** attribute by default. If you want to use the **shortname** attribute, define the attribute in the schema and change the userID map filter to the following:

```
User ID Map :    person:shortname
```

Roles unify entries. Roles are designed to be more efficient and easier to use for applications. For example, an application can locate the role of an entry by enumerating all the roles possessed by a given entry, rather than selecting a group and browsing through the members list. With the iPlanet Directory Server directory, WebSphere Application Server security supports groups defined by `nsRole` only. If you plan to use traditional grouping methods to group entries in the iPlanet Directory Server, select **Netscape** as the directory type.

Using Sun ONE Directory Server as the LDAP server

You can choose **Sun ONE Directory Server** for your Sun ONE Directory Server system. For supported directory servers, refer to the article, Supported directory services. In Sun ONE Directory Server, the default object class is `groupOfUniqueName` when you create a group. For better performance, WebSphere Application Server uses the user object to locate the user group membership from the *nsRole* attribute. Thus, create the group from the role. If you want to use `groupOfUniqueName` to search groups, specify your own filter setting. Roles unify entries. Roles are designed to be more efficient and easier to use for applications. For example, an application can locate the role of an entry by enumerating all the roles possessed by a given entry, rather than selecting a group and browsing through the members list. When using roles, you can create a group could be created using a:

- Managed role
- Filtered role
- Nested role

All of these roles are computable by `nsRole` attribute.

Using Microsoft Active Directory server as the LDAP server

To set up Microsoft Active Directory as your LDAP server, complete the following steps.

1. Determine the full DN and password of an account in the **administrators** group. For example, if the Active Directory administrator creates an account in the Users folder of the Active Directory Users and Computers Windows control panel and the DNS domain is `ibm.com`, the resulting DN has the following structure:

   ```
   cn=<adminUsername>, cn=users, dc=ibm,
   dc=com
   ```

2. Determine the short name and password of any account in the Microsoft Active Directory. This password does not have to be the same account that is used in the previous step.
3. Use the WebSphere Application Server administrative console to set up the information needed to use Microsoft Active Directory:
   a. Start the administrative server for the domain, if necessary.
   b. On the administrative console, click **Security** on the left navigation panel.
   c. Click the **Authentication mechanisms** tabbed page. Select **Lightweight Third Party Authentication** (LTPA) as the authentication mechanism.
   d. Enter the following information in the LDAP settings fields:
      - **Security Server ID**: The short name of the account chosen in 2
      - **Security Server Password**: The password of the account chosen in step 2
      - **Directory Type**: Active Directory

- **Host**: The domain name service (DNS) name of the machine running Microsoft Active Directory
- **Base Distinguished Name**: The domain components of the DN of the account chosen in step 1. For example: `dc=ibm, dc=com Bind`
- **Distinguished Name**: The full DN of the account chosen in step 1. For example: `cn=<adminUsername>, cn=users, dc=ibm, dc=com`
- **Bind Password**: The password of the account chosen in step 1

e. Click **OK** to save the changes.

f. Stop and restart the administrative server so that the changes take effect.

Supported directory services:

WebSphere Application Server security supports several different LDAP servers.

For a list of supported LDAP servers, refer to the **Supported hardware, software and APIs** prerequisite Web site in the "Security: Resources for learning" on page 495 article. *The z/OS Security Server LDAP is supported when the DB2 TDBM backend is used. Use the SecureWay Directory Server filters to connect to the z/os LDAP*.

It is expected that other LDAP servers follow the LDAP specification function. Support is limited to these specific directory servers only. You can use any other directory server by using the custom directory type in the list and by filling in the filters required for that directory.

To improve performance for LDAP searches, the default filters for IBM Directory Server, iPlanet Directory Server, and Active Directory are defined such that when you search for a user, the result contains all the relevant information about the user (user ID, groups, and so on). As a result, the product does not call the LDAP server multiple times. This definition is possible only in these directory types, which support searches where the complete user information is obtained.

If you use the IBM Directory Server, enable the Ignore case flag. This flag is required because when the group information is obtained from the user object attributes, the case is not the same as when you get the group information directly. For the authorization to work in this case, perform a case insensitive check and verify the requirement for the Ignore case flag.

Locating a user's group memberships in Lightweight Directory Access Protocol

WebSphere Application Server security can be configured to search group memberships directly or indirectly. It can also be configured to search only a static group, or it can be configured to search static groups, recursive (or nested) groups, and dynamic groups for some Lightweight Directory Access Protocol (LDAP) servers.

Evaluate group memberships from user object directly

Several popular LDAP servers enable user objects to contain information about the groups to which they belong (such as Microsoft Active Directory Server, or eDirectory). Or, a user's group memberships can be computable attributes from the user object itself (such as IBM Directory Server or SunOne directory server). In some LDAP servers, this attribute can be used to include a user's dynamic group memberships, nesting group memberships, and static group memberships in order to locate all group memberships from a single attribute. For example, in IBM Directory Server all group memberships, including the static groups, dynamic groups, and nested groups, can be returned using the `ibm-allGroups` attribute. In Sun

ONE, all roles, including managed roles, filtered roles, and nested roles, are calculated using the nsRole attribute. If an LDAP server has such an attribute in a user object to include dynamic groups, nested groups, and static groups, WebSphere Application Server security can be configured to use this attribute to support dynamic groups, nested groups, and static groups.

Evaluate group memberships from group object indirectly
Some LDAP servers enable only group objects such as the Lotus Domino LDAP server to contain information about users, The LDAP server does not enable the user object to contain information about groups. For this type of LDAP server, group membership searches are performed by locating the user on the member list of groups. The member list evaluation is currently used in the static group membership search for all of the releases before WebSphere Application Server Version 5.

It is recommended that you use the direct method for searching group memberships if your LDAP server has such an attribute in user object to include group information. To use the direct method or the indirect method, enter the appropriate value in the Group Member ID Map field on the Advanced LDAP Settings panel using:

- objectclass:attribute pairs for the indirect method
- attribute:attribute pairs for the direct method

Sample entries of attribute:attribute pairs in Group Member ID Map fields include:

- ibm-allGroups:member for IBM Directory server
- nsRole:nsRole for SunONE directory if groups are created with Role inside SunONE
- memberOf:member in Microsoft Active Directory Server

Sample entries of objectClass:attribute pairs in the Group Member ID Map field include:

- dominoGroup:member for Domino
- groupOfNames:member for eDirectory

While using the direct method dynamic groups, recursive groups, and static groups can be returned as multiple values of a single attribute. For example, in IBM Directory Server all group memberships, including the static groups, dynamic groups, and nested groups, can be returned using the ibm-allGroups attribute. In Sun ONE, all roles, including managed roles, filtered roles, and nested roles, are calculated using the nsRole attribute. If an LDAP server can use the nsRole attribute, dynamic groups, nested groups, and static groups are all supported by WebSphere Application Server.

Some LDAP servers do not have recursive computing functionality. For example, although Microsoft Active Directory server has direct group search capability using the memberOf attribute, memberOf lists the groups beneath which the group is directly nested only and does not contain the recursive list of nested predecessors. Another example is that the Lotus Domino LDAP server, which only allows you to use the indirect method to locate the group memberships for a user (you cannot obtain recursive group memberships from a Domino server directly). For LDAP servers without recursive searching capability, WebSphere Application Server security provides a recursive function that is enabled by clicking **Perform a Nested**

Group Search in the Advanced LDAP user registry settings. Check this option only if your LDAP server does not provide recursive searches (and only if a recursive search is desired).

Dynamic groups and nested group support

Dynamic groups contain a group name and membership criteria:

1. The group membership information is as current as the information on the user object.
2. There is no need to manually maintain members on the group object.
3. Dynamic groups are designed such so an application does not need to pull a large amount of information from the directory to find out if someone is a member of a group.

Nested groups enable the creation of hierarchical relationships used to define inherited group membership. A nested group is defined as a child group entry whose distinguished name (DN) is referenced by a parent group entry attribute.

Dynamic and nested groups simplify WebSphere Application Server security management and increase its effectiveness and flexibility. You only need to assign a larger parent group if all nested groups share the same privilege. Assigning a role to a single parent group simplifies the runtime authorization table.

Dynamic and nested group support for the SunONE or iPlanet Directory Server

The SunONE or iPlanet Directory Server uses two grouping mechanisms:

Groups
: Groups are entries that name other entries as a list of members or as a filter for members.

Roles
: Roles are also entries that name other entries as a list of members or as a filter for members. Additional functionality is provided by generating the `nsrole` attribute on each role member.

There are three types of roles:

Filtered roles
: Entries are members if they match a specified LDAP filter. In this way, the role depends upon the attributes contained in each entry. This is equivalent to a dynamic group.

Nested roles
: Allows you to create roles that contain other roles. This is equivalent to a nested group.

Managed roles
: Explicitly assigns a role to member entries. This is equivalent to a static group.

Roles and groups are defined and administered similarly. An additional function allows member entries to have a generated attribute to indicate active roles. For example, an application can simply read the roles of an entry rather than select a group and browse the members list. This simplifies and eases administration.

Refer to “Configuring dynamic and nested group support for the SunONE or iPlanet Directory Server” on page 212 for more information.

Configuring dynamic and nested group support for the SunONE or iPlanet Directory Server

To use dynamic and nested groups with WebSphere Application Server security, you must be running WebSphere Application Server Version 5.1.1. Refer to Dynamic and nested group support for the SunONE or iPlanet Directory Server for more information on this topic.

1. On the LDAP registry panel, select `SunONE` for the LDAP server.
2. Select the **Ignore case** option
3. On LDAP settings panel change the Group Filter setting to `&(cn=%v)(objectclass=ldapsubentry))`
4. On LDAP settings panel change the Group Member ID Map setting to `nsRole:nsRole`.

Dynamic groups and nested group support for the IBM Directory Server

WebSphere Application Server Version 5 supports all LDAP dynamic and nested groups when using IBM Directory Server 4.1 (or a more current version). This function is enabled by default and is enabled by taking advantage a new feature in IBM Directory Server. IBM Directory Server 4.1 uses the `ibm-allGroups` forward reference group attribute that automatically calculates all group memberships (including dynamic and recursive memberships) for a user. Security directly locates a user group membership from a user object rather than indirectly search all groups to match group members.

Refer to "Configuring dynamic and nested group support for the IBM Directory Server" for more information.

Configuring dynamic and nested group support for the IBM Directory Server

When creating groups follow the steps below to ensure that nested and dynamic group memberships work correctly, . Refer to "Dynamic groups and nested group support for the IBM Directory Server" for more information on this topic.

1. In the WebSphere Application Server security LDAP user registry configuration panel, select `IBM_Directory_Server` for the LDAP server.
2. On LDAP settings panel change the Group Filter setting. Change the setting to the following value:

   ```
   (&(cn=%v)(|(objectclass=groupOfNames)(objectclass=groupOfUniqueNames)
   (objectclass=groupOfURLs))).
   ```

3. On LDAP settings panel change the Group Member ID Map setting. Change the setting to the following value:

   ```
   ibm-allGroups:member;ibm-allGroups:uniqueMember
   ```

4. On the Add an LDAP entry panel the Auxiliary object class value is `ibm-nestedGroup` when creating a nested group. On the Add an LDAP entry panel the Auxiliary object class value is ibm-dynamicGroup when creating a dynamic group.

Custom user registries

A *custom user registry* is a customer-implemented user registry, which implements the UserRegistry Java interface as provided by the product. A custom-implemented user registry can support virtually any type of an account repository from a

relational database, flat file, and so on. The custom user registry provides considerable flexibility in adapting product security to various environments where some form of a user registry, other than Lightweight Directory Access Protocol (LDAP) or Local Operating System (LocalOS), already exists in the operational environment.

WebSphere Application Server security provides an implementation that uses various local operating system-based registries (Windows, AIX, Solaris, Linux) and various Lightweight Directory Access Protocol (LDAP)-based registries. However, situations can exist where your user and group data resides in other repositories or custom registries (a database, for example) and moving this information to either a LocalOS or an LDAP registry implementation might not be feasible. For these situations WebSphere Application Server security provides a service provider interface (SPI) that you can implement to interact with your current registry. The SPI is the UserRegistry interface. This interface has a set of methods to implement for the product security to interact with your registries for all security-related tasks. The LocalOS and LDAP registry implementations that are provided also implement this interface. Custom user registries are sometimes called the *pluggable user registries* or *custom registries* for short. Your custom user registry implementation is expected to be thread-safe.

The *UserRegistry interface* is a collection of methods required to authenticate individual users using either password or certificates and to collect information about the user (privilege attributes) for authorization purposes. This interface also includes methods that obtain user and group information so that they can be given access to resources. When implementing the methods in the interface, you must decide how to map the information manipulated by the UserRegistry interface to the information in your registry.

Make sure that your implementation of the custom registry does not depend on any WebSphere Application Server components such as data sources, enterprise beans, and so on. Do not have this dependency because security is initialized and enabled prior to most of the other WebSphere Application Server components during startup. If your previous implementation used these components, make a change that eliminates the dependency. For example, if your previous implementation used data sources to connect to a database, use Java database connectivity (JDBC) to connect to the database.

The methods in the UserRegistry interface operate on the following information for users:

User Security Name
: The user name, which is similar to the user name in the Windows systems and the UNIX systems Local OS registries. This name is used to log in when prompted by a secured application. By default, the Enterprise JavaBean (EJB) method getCallerPrincipal and the servlet methods getRemoteUser and getUserPrincipal return this name. The user security name is also referred to as *userSecurityName*, *userName* or *user name*.

Unique ID
: This ID represents a unique identifier for the user. The UserRegistry interface requires this identifier to be unique. The unique ID similar to the system ID (SID) in Windows systems, Unique ID (UID) in UNIX systems, distinguished name (DN) in Lightweight Directory Authentication Protocol (LDAP). This ID is also referred to as *uniqueUserId*. The unique ID is used to make the authorization decisions for protected resources.

Display name
: This name is an optional string that describes a user, and it is similar to the

FullName attribute in Windows operating systems. The implementation can use display names for informational purposes only; these names are not required to exist or to be unique. The user interface can use the display name to present more information about the user.

Group Security name
This name, which represents the security group, is also referred to as *groupSecurityName*, *groupName* and *group name*.

Unique ID
The unique ID is the identifier for a group. This name is also referred to as *uniqueGroupId*.

Display name
The display name is an optional string that describes a group.

The article on UserRegistry interface describes each of the methods in the UserRegistry interface that need implementing. An explanation of each of the methods and their usage in the Sample and any changes from the Version 4 interface are provided. The Related references section provides links to all other custom user registries documentation, including a file-based registry Sample. The Sample provided is very simple and is intended to familiarize you with this feature. Do not use this sample in an actual production environment.

Configuring custom user registries

Before you begin this task, implement and build the UserRegistry interface. For more information on developing custom user registries refer to the article, "Developing custom user registries" on page 94. The following steps are required to configure custom user registries through the administrative console.

1. In the administrative console, click **Security > User Registries > Custom** in the left navigation panel.
2. Enter a valid user name in the **Server User ID** field.
3. Enter the password of the user in the **Server User Password** field.
4. Enter the full name of the location of the implementation class file in the **Custom Registry Classname** field a dot-separated file name. For the sample, this file name is `com.ibm.websphere.security.FileRegistrySample`. The file exists in the WebSphere Application Server class path (preferably in the *install_root*`/lib/ext` directory). This file exists in all the product processes. So, if you are operating in a Network Deployment environment, this file exists in the cell class path and in all of the node class paths.
5. Select the **Ignore Case** option for the authorization to perform a case insensitive check. Enabling this option is necessary only when your registry is case insensitive and does not provide a consistent case when queried for users and groups.
6. Click **Apply** if you have any other additional properties to enter for the registry initialization. Otherwise click **OK** and complete the steps required to turn on security.
7. If you need to enter additional properties to initialize your implementation, click **Custom Properties** at the bottom of the panel. Click **New**. Enter the property name and value. Click **OK**. Repeat this step to add other additional properties. For the sample, enter the following two properties: (assuming that the `users.props` and the `groups.props` file are in the `myDir` directory under the product installation directory).

Property name	Property value
usersFile	`${USER_INSTALL_ROOT}/myDir/users.props`

Property name	Property value
groupsFile	${USER_INSTALL_ROOT}/myDir/groups.props

The Description, Required, and Validation Expression fields are not used and you can leave them blank.

Note: In a Network Deployment environment where multiple WebSphere Application Server processes exist (cell and multiple nodes in different machines), these properties are available for each process. Use the relative name ${USER_INSTALL_ROOT} to locate any files, as this name expands to the product installation directory. If this name is not used, ensure that the files exist in the same location in all the nodes.

This step is required to set up the custom user registry and to enable security in WebSphere Application Server.

1. Complete the remaining steps, if you are enabling security.
2. After security is turned on, save, stop, and start all the product servers (cell, nodes and all the application servers) for any changes in this panel to take effect.
3. If the server comes up without any problems, the setup is correct.
4. Validate the user and password by clicking **OK** or **Apply** in the Global Security panel. Save, synchronize (in the cell environment), stop and start all the product servers.

UserRegistry.java files:

```
// 5639-D57, 5630-A36, 5630-A37, 5724-D18
// (C) COPYRIGHT International Business Machines Corp. 1997, 2003
// All Rights Reserved * Licensed Materials - Property of IBM
//
// DESCRIPTION:
//
//    This file is the UserRegistry interface that custom registries in WebSphere
//    Application Server implement to enable WebSphere security to use the custom
//    registry.
//package com.ibm.websphere.security;

import java.util.*;
import java.rmi.*;
import java.security.cert.X509Certificate;
import com.ibm.websphere.security.cred.WSCredential;/**
 * Implementing this interface enables WebSphere Application Server Security
 * to use custom registries. This interface extends java.rmi.Remote because the
 * registry can be in a remote process.
 *
 * Implementation of this interface must provide implementations for:
*
* initialize(java.util.Properties)
* checkPassword(String,String)
* mapCertificate(X509Certificate[])
* getRealm
* getUsers(String,int)
* getUserDisplayName(String)
* getUniqueUserId(String)
* getUserSecurityName(String)
* isValidUser(String)
* getGroups(String,int)
* getGroupDisplayName(String)
* getUniqueGroupId(String)
* getUniqueGroupIds(String)
* getGroupSecurityName(String)
* isValidGroup(String)
* getGroupsForUser(String)
```

```
* getUsersForGroup(String,int)
* createCredential(String)
**/

public interface UserRegistry extends java.rmi.Remote
{

  /**
   * Initializes the registry. This method is called when creating the
   * registry.
   *
   * @param props the registry-specific properties with which to
   *              initialize the  custom registry
   * @exception CustomRegistryException
   *                    if there is any registry specific problem
   * @exception RemoteException
   *    as this extends java.rmi.Remote
   **/
   public void initialize(java.util.Properties props)
      throws CustomRegistryException,
             RemoteException;  /**
   * Checks the password of the user. This method is called to authenticate a
   * user when the user's name and password are given.
   *
   * @param userSecurityName the name of user
   * @param password the password of the user
   * @return a valid userSecurityName. Normally this is
   *   the name of same user whose password was checked but if the
   *  implementation wants to return any other valid
   *  userSecurityName in the registry it can do so
   * @exception CheckPasswordFailedException if userSecurityName/
   *  password combination does not exist in the registry
   * @exception CustomRegistryException if there is any registry specific
   *            problem
   * @exception RemoteException as this extends java.rmi.Remote
   **/
   public String checkPassword(String userSecurityName, String password)
      throws PasswordCheckFailedException,
             CustomRegistryException,
             RemoteException;  /**
   * Maps a certificate (of X509 format) to a valid user in the registry.
   * This is used to map the name in the certificate supplied by a browser
   * to a valid userSecurityName in the registry
   *
   * @param cert the X509 certificate chain
   * @return the mapped name of the user userSecurityName
   * @exception CertificateMapNotSupportedException if the particular
   *            certificate is not supported.
   * @exception CertificateMapFailedException if the mapping of the
   *            certificate fails.
   * @exception CustomRegistryException if there is any registry specific
   *            problem
   * @exception RemoteException as this extends java.rmi.Remote
   **/
   public String mapCertificate(X509Certificate[] cert)
      throws CertificateMapNotSupportedException,
             CertificateMapFailedException,
             CustomRegistryException,
             RemoteException;  /**
   * Returns the realm of the registry.
   *
   * @return the realm. The realm is a registry-specific string indicating
   *            the realm or domain for which this registry
   *            applies.  For example, for OS400 or AIX this would be the
   *            host name of the system whose user registry this object
   *            represents.
   *            If null is returned by this method realm defaults to the
```

```
*            value of "customRealm". It is recommended that you use
*            your own value for realm.
* @exception CustomRegistryException if there is any registry specific
*            problem
* @exception RemoteException as this extends java.rmi.Remote
**/
public String getRealm()
   throws CustomRegistryException,
          RemoteException;  /**
* Gets a list of users that match a pattern in the registry.
* The maximum number of users returned is defined by the limit
* argument.
* This method is called by administrative console and by scripting (command
* line) to make available the users in the registry for adding them (users)
* to roles.
*
* @parameter pattern the pattern to match. (For example., a* will match all
*   userSecurityNames starting with a)
* @parameter limit the maximum number of users that should be returned.
*  This is very useful in situations where there are thousands of
*            users in the registry and getting all of them at once is not
*            practical. A value of 0 implies get all the users and hence
*            must be used with care.
* @return a Result object that contains the list of users
*   requested and a flag to indicate if more users exist.
* @exception CustomRegistryException if there is any registry specific
*            problem
* @exception RemoteException as this extends java.rmi.Remote
**/
public Result getUsers(String pattern, int limit)
   throws CustomRegistryException,
          RemoteException;  /**
* Returns the display name for the user specified by userSecurityName.
*
* This method is called only when the user information displays
* (information purposes only, for example, in the administrative console) and not used
* in the actual authentication or authorization purposes. If there are no
* display names in the registry return null or empty string.
*
* In WebSphere Application Server Version 4.0 custom registry, if you had a display
* name for the user and  if it was different from the security name, the display name
* was returned for the EJB methods getCallerPrincipal() and the servlet methods
* getUserPrincipal() and  getRemoteUser().
* In WebSphere Application Server Version 5.0 for the same methods the security
* name is returned by default. This is the recommended way as the display name
* is not unique and might create security holes.
* However, for backward compatibility if one needs the display name to
* be returned set the property WAS_UseDisplayName to true.
*
* See the documentation for more information.
*
* @parameter userSecurityName the name of the user.
* @return the display name for the user. The display name
*   is a registry-specific string that represents a descriptive, not
*  necessarily unique, name for a user. If a display name does
*            not exist return null or empty string.
* @exception EntryNotFoundException if userSecurityName does not exist.
* @exception CustomRegistryException if there is any registry specific
*            problem
* @exception RemoteException as this extends java.rmi.Remote
**/
public String getUserDisplayName(String userSecurityName)
   throws EntryNotFoundException,
          CustomRegistryException,
          RemoteException;  /**
* Returns the unique ID for a userSecurityName. This method is called when
* creating a credential for a user.
```

```
 *
 * @parameter userSecurityName the name of the user.
 * @return the unique ID of the user. The unique ID for an user is
 *   the stringified form of some unique, registry-specific, data
 *  that serves to represent the user.  For example, for the UNIX
 *  user registry, the unique ID for a user can be the UID.
 * @exception EntryNotFoundException if userSecurityName does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getUniqueUserId(String userSecurityName)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;  /**
 * Returns the name for a user given its unique ID.
 *
 * @parameter uniqueUserId the unique ID of the user.
 * @return the userSecurityName of the user.
 * @exception EntryNotFoundException if the uniqueUserID does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getUserSecurityName(String uniqueUserId)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;

/**
 * Determines if the userSecurityName exists in the registry
 *
 * @parameter userSecurityName the name of the user
 * @return true if the user is valid. false otherwise
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public boolean isValidUser(String userSecurityName)
    throws CustomRegistryException,
           RemoteException;

/**
 * Gets a list of groups that match a pattern in the registy.
 * The maximum number of groups returned is defined by the limit
 * argument.
 * This method is called by the administrative console and scripting
 * (command line) to make available the groups in the registry for adding
 * them (groups) to roles.
 *
 * @parameter pattern the pattern to match. (For e.g., a* will match all
 *   groupSecurityNames starting with a)
 * @parameter limit the maximum number of groups to return.
 *  This is very useful in situations where there are thousands of
 *            groups in the registry and getting all of them at once is not
 *            practical. A value of 0 implies get all the groups and hence
 *            must be used with care.
 * @return a Result object that contains the list of groups
 *   requested and a flag to indicate if more groups exist.
 * @exception CustomRegistryException if there is any registry-specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public Result getGroups(String pattern, int limit)
    throws CustomRegistryException,
           RemoteException;
```

```
/**
 * Returns the display name for the group specified by groupSecurityName.
 *
 * This method may be called only when the group information displayed
 * (for example, the administrative console) and not used in the actual
 * authentication or authorization purposes. If there are no display names
 * in the registry return null or empty string.
 *
 * @parameter groupSecurityName the name of the group.
 * @return the display name for the group. The display name
 *   is a registry-specific string that represents a descriptive, not
 *  necessarily unique, name for a group. If a display name does
 *            not exist return null or empty string.
 * @exception EntryNotFoundException if groupSecurityName does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getGroupDisplayName(String groupSecurityName)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;

/**
 * Returns the unique ID for a group.

 * @parameter groupSecurityName the name of the group.
 * @return the unique ID of the group. The unique ID for
 *   a group is the stringified form of some unique,
 *   registry-specific, data that serves to represent the group.
 *            For example, for the UNIX user registry, the unique IDd could
 *  be the GID.
 * @exception EntryNotFoundException if groupSecurityName does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getUniqueGroupId(String groupSecurityName)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;


/**
 * Returns the unique IDs for all the groups that contain the unique ID of
 * a user.
 * Called during creation of a user's credential.
 *
 * @parameter uniqueUserId the unique ID of the user.
 * @return a list of all the group unique IDs that the unique user ID
 *   belongs to. The unique ID for an entry is the stringified
 *  form of some unique, registry-specific, data that serves
 *  to represent the entry.  For example, for the
 *   UNIX user registry, the unique ID for a group could be the GID
 *  and the unique ID for the user could be the UID.
 * @exception EntryNotFoundException if unique user ID does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public List getUniqueGroupIds(String uniqueUserId)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;

/**
 * Returns the name for a group given its unique ID.
```

```
 *
 * @parameter uniqueGroupId the unique ID of the group.
 * @return the name of the group.
 * @exception EntryNotFoundException if the uniqueGroupId does not exist.
 * @exception CustomRegistryException if there is any registry-specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getGroupSecurityName(String uniqueGroupId)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;

/**
 * Determines if the groupSecurityName exists in the registry
 *
 * @parameter groupSecurityName the name of the group
 * @return true if the groups exists, false otherwise
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public boolean isValidGroup(String groupSecurityName)
    throws CustomRegistryException,
           RemoteException;

/**
 * Returns the securityNames of all the groups that contain the user
 *
 * This method is called by administrative console and scripting
 * (command line) to verify the user entered for RunAsRole mapping belongs
 * to that role  in the roles to user mapping. Initially, the check is done
 * to see if the role contains the user. If the role does not contain the user
 * explicitly, this method is called to get the groups that this user
 * belongs to so that checks are made on the groups that the role contains.
 *
 * @parameter userSecurityName the name of the user
 * @return a List of all the group securityNames that the user
 *   belongs to.
 * @exception EntryNotFoundException if user does not exist.
 * @exception CustomRegistryException if there is any registry specific
 *            problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public List getGroupsForUser(String userSecurityName)
    throws EntryNotFoundException,
           CustomRegistryException,
           RemoteException;

/**
 * Gets a list of users in a group.
 *
 * The maximum number of users returned is defined by the limit
 * argument.
 *

 * This method is used by the process choreographer when staff
 * assignments are modeled using groups.
 *
 * In rare situations if you are working with a registry where getting all of
 * the users from any of your groups is not practical (for example if
 * a large number of users exist) you can throw the NotImplementedException
 * for that particular groups. Make sure that if the Process Choreographer
 * is installed (or if installed later) that are not modeled using these
 * particular groups. If no concern exists about the staff assignments
 * returning the users from groups in the registry it is recommended that
 * this method be implemented without throwing the NotImplemented exception.
```

```
   *
   * @parameter groupSecurityName that represents the name of the group
   * @parameter limit the maximum number of users to return.
   *            This option is very useful in situations where lots of
   *            users are in the registry and getting all of them at
   *            once is not practical. A value of 0 means  get all of
   *            the users and must be used with care.
   * @return    a Result object that contains the list of users
   *            requested and a flag to indicate if more users exist.
   * @deprecated This method will be deprecated in the future.
   * @exception NotImplementedException throw this exception in rare situations
   *            if it is not practical to get this information for any of the
   *            groups from the registry.
   * @exception EntryNotFoundException if the group does not exist in
   *            the registry
   * @exception CustomRegistryException if any registry-specific
   *            problem occurs
   * @exception RemoteException as this extends java.rmi.Remote interface
   **/
   public Result getUsersForGroup(String groupSecurityName, int limit)
      throws NotImplementedException,
             EntryNotFoundException,
             CustomRegistryException,
             RemoteException;

  /**
   * This method is implemented internally by the WebSphere Application Server
   * code in this release. This method is not called for the custom registry
   * implementations for this release. Return null in the implementation.
   *
   * Note that because this method is not called you can also return the
   * NotImplementedException as the previous documentation says.
   *
   **/
   public com.ibm.websphere.security.cred.WSCredential
                               createCredential(String userSecurityName)
      throws NotImplementedException,
      EntryNotFoundException,
             CustomRegistryException,
             RemoteException;
}
```

FileRegistrySample.java file for WebSphere Application Server: The user and group information required by this sample is contained in the users.props and groups.props files.

The contents of the `FileRegistrySample.java` file:

```
//
// 5639-D57, 5630-A36, 5630-A37, 5724-D18
// (C) COPYRIGHT International Business Machines Corp. 1997, 2003
// All Rights Reserved * Licensed Materials - Property of IBM
////--------------------------------------------------------------------
// This program may be used, executed, copied, modified and distributed
// without royalty for the purpose of developing, using, marketing, or
// distributing.
//--------------------------------------------------------------------
//

// This sample is for the custom user registry feature in WebSphere
// Application Server.

import java.util.*;
import java.io.*;
import java.security.cert.X509Certificate;
import com.ibm.websphere.security.*;
/**
```

```
 *  The main purpose of this sample is to demonstrate the use of the
 *  custom user registry feature available in WebSphere Application Server. This
 *  sample is a file-based registry sample where the users and the groups
 *  information is listed in files (users.props and groups.props). As such
 *  simplicity and not the performance was a major factor behind this. This
 *  sample should be used only to get familiarized with this feature. An
 *  actual implementation of a realistic registry should consider various
 *  factors like performance, scalability, thread safety, and so on.
 **/
public class FileRegistrySample implements UserRegistry {

   private static String USERFILENAME = null;
   private static String GROUPFILENAME = null;

   /** Default Constructor **/
   public FileRegistrySample() throws java.rmi.RemoteException {
   }

  /**
   * Initializes the registry. This method is called when creating the
   * registry.
   *
   * @param     props - The registry-specific properties with which to
   *                    initialize the custom registry
   * @exception CustomRegistryException
   *                    if there is any registry-specific problem
   **/
  public void initialize(java.util.Properties props)
         throws CustomRegistryException {
      try {
         /* try getting the USERFILENAME and the GROUPFILENAME from
          * properties that are passed in (For example, from the
          * administrative console). Set these values in the administrative
          * console. Go to the special custom settings in the custom
          * user registry section of the Authentication panel.
          * For example:
          * usersFile   c:/temp/users.props
          * groupsFile  c:/temp/groups.props
          */
          if (props != null) {
             USERFILENAME = props.getProperty("usersFile");
             GROUPFILENAME = props.getProperty("groupsFile");
          }

      } catch(Exception ex) {
         throw new CustomRegistryException(ex.getMessage(),ex);
      }

      if (USERFILENAME == null || GROUPFILENAME == null) {
         throw new CustomRegistryException("users/groups information missing");
      }

   }  /**
   * Checks the password of the user. This method is called to authenticate
   * a user when the user's name and password are given.
   *
   * @param  userSecurityName the name of user
   * @param  password the password of the user
   * @return a valid userSecurityName. Normally this is
   *         the name of same user whose password was checked
   *         but if the implementation wants to return any other
   *         valid userSecurityName in the registry it can do so
   * @exception CheckPasswordFailedException if userSecurityName/
   *            password combination does not exist
   *            in the registry
   * @exception CustomRegistryException if there is any registry-
   *            specific problem
```

```
**/
public String checkPassword(String userSecurityName, String passwd)
   throws PasswordCheckFailedException,
          CustomRegistryException {
   String s,userName = null;
   BufferedReader in = null;

   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            int index1 = s.indexOf(":",index+1);
            // check if the userSecurityName:passwd combination exists
            if ((s.substring(0,index)).equals(userSecurityName) &&
                    s.substring(index+1,index1).equals(passwd)) {
               // Authentication successful, return the userId.
               userName = userSecurityName;
               break;
            }
         }
      }
   } catch(Exception ex) {
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }


   if (userName == null) {
      throw new PasswordCheckFailedException("Password check failed for user: "
      + userSecurityName);
   }

   return userName;
}  /**
* Maps a X.509 format certificate to a valid user in the registry.
* This is used to map the name in the certificate supplied by a browser
* to a valid userSecurityName in the registry
*
* @param     cert the X509 certificate chain
* @return    The mapped name of the user userSecurityName
* @exception CertificateMapNotSupportedException if the
*            particular certificate is not supported.
* @exception CertificateMapFailedException if the mapping of
*            the certificate fails.
* @exception CustomRegistryException if there is any registry
*            -specific problem
**/
public String mapCertificate(X509Certificate[] cert)
   throws CertificateMapNotSupportedException,
          CertificateMapFailedException,
          CustomRegistryException {
   String name=null;
   X509Certificate cert1 = cert[0];
   try {
      // map the SubjectDN in the certificate to a userID.
      name = cert1.getSubjectDN().getName();
   } catch(Exception ex) {
      throw new CertificateMapNotSupportedException(ex.getMessage(),ex);
   }

   if(!isValidUser(name)) {
      throw new CertificateMapFailedException("user: " + name
      + " is not valid");
   }
```

```
   return name;
}  /**
* Returns the realm of the registry.
*
* @return the realm. The realm is a registry-specific string
* indicating the realm or domain for which this registry
* applies. For example, for OS/400 or AIX this would be
* the host name of the system whose user registry this
* object represents. If null is returned by this method,
* realm defaults to the value of "customRealm". It is
* recommended that you use your own value for realm.
*
* @exception CustomRegistryException if there is any registry-
* specific problem
**/
public String getRealm()
   throws CustomRegistryException {
   String name = "customRealm";
   return name;
}  /**
* Gets a list of users that match a pattern in the registry.
* The maximum number of users returned is defined by the limit
* argument.
* This method is called by the administrative console and scripting
* (command line) to make the users in the registry available for
* adding them (users) to roles.
*
* @param      pattern the pattern to match. (For example, a* will
*             match  all userSecurityNames starting with a)
* @param      limit the maximum number of users that should be
*             returned. This is very useful in situations where
*             there are thousands of users in the registry and
*             getting all of them at once is not practical. The
*             default is 100. A value of 0 implies get all the
*             users and hence must be used with care.
* @return     a Result object that contains the list of users
*             requested and a flag to indicate if  more users
*             exist.
* @exception  CustomRegistryException if there is any registry-
*             specificproblem
**/
public Result getUsers(String pattern, int limit)
   throws CustomRegistryException {
   String s;
   BufferedReader in = null;
   List allUsers = new ArrayList();
   Result result = new Result();
   int count = 0;
   int newLimit = limit+1;
   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            String user = s.substring(0,index);
            if (match(user,pattern)) {
               allUsers.add(user);
               if (limit !=0 && ++count == newLimit) {
                  allUsers.remove(user);
                  result.setHasMore();
                  break;
               }
            }
         }
      }
   } catch (Exception ex) {
```

```
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }

   result.setList(allUsers);
   return result;
}  /**
* Returns the display name for the user specified by
*  userSecurityName.
*
* This method may be called only when the user information
* is displayed (information purposes only, for example, in
* the administrative console) and hence not used in the actual
* authentication or authorization purposes. If there are no
* display names in the registry return null or empty string.
*
* In WebSphere Application Server 4 custom registry, if you
* had a display name for the user and if it was different from the
* security name, the display name was returned for the EJB
* methods getCallerPrincipal() and the servlet methods
* getUserPrincipal() and  getRemoteUser().
* In WebSphere Application Server Version 5, for the same
* methods, the security name will be returned by default. This
* is the recommended way as the display name is not unique
* and might create security holes. However, for backward
* compatibility if one needs the display name to be returned
* set the property WAS_UseDisplayName to true.
*
*See the InfoCenter documentation for more information.
*
* @param     userSecurityName the name of the user.
* @return    the display name for the user. The display
*            name is a registry-specific string that
*            represents a descriptive, not necessarily
*            unique, name for a user. If a display name
*            does not exist return null or empty string.
* @exception EntryNotFoundException if userSecurityName
*            does not exist.
* @exception CustomRegistryException if there is any registry-
 *           specific problem
**/
public String getUserDisplayName(String userSecurityName)
   throws CustomRegistryException,
          EntryNotFoundException {

   String s,displayName = null;
   BufferedReader in = null;

   if(!isValidUser(userSecurityName)) {
      EntryNotFoundException nsee = new EntryNotFoundException("user: "
      + userSecurityName + " is not valid");
      throw nsee;
   }

   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            int index1 = s.lastIndexOf(":");
            if ((s.substring(0,index)).equals(userSecurityName)) {
               displayName = s.substring(index1+1);
               break;
            }
         }
```

```
            }
        } catch(Exception ex) {
            throw new CustomRegistryException(ex.getMessage(), ex);
        } finally {
            fileClose(in);
        }

        return displayName;
    }

    /**
     * Returns the unique ID for a userSecurityName. This method is called
     * when creating a credential for a user.
     *
     * @param    userSecurityName - The name of the user.
     * @return   The unique ID of the user. The unique ID for an user
     *           is the stringified form of some unique, registry-specific,
     *           data that serves to represent the user. For example, for
     *           the UNIX user registry, the unique ID for a user can be
     *           the UID.
     * @exception EntryNotFoundException if userSecurityName does not
     *            exist.
     * @exception CustomRegistryException if there is any registry-
     *            specific problem
     **/
    public String getUniqueUserId(String userSecurityName)
        throws CustomRegistryException,
               EntryNotFoundException {

        String s,uniqueUsrId = null;
        BufferedReader in = null;
        try {
            in = fileOpen(USERFILENAME);
            while ((s=in.readLine())!=null)
            {
                if (!(s.startsWith("#") || s.trim().length() <=0 )) {
                    int index = s.indexOf(":");
                    int index1 = s.indexOf(":", index+1);
                    if ((s.substring(0,index)).equals(userSecurityName)) {
                        int index2 = s.indexOf(":", index1+1);
                        uniqueUsrId = s.substring(index1+1,index2);
                        break;
                    }
                }
            }
        } catch(Exception ex) {
            throw new CustomRegistryException(ex.getMessage(),ex);
        } finally {
            fileClose(in);
        }

        if (uniqueUsrId == null) {
            EntryNotFoundException nsee =
            new EntryNotFoundException("Cannot obtain uniqueId for user: "
            + userSecurityName);
            throw nsee;
        }

        return uniqueUsrId;
    }  /**
     * Returns the name for a user given its uniqueId.
     *
     * @param      uniqueUserId  - The unique ID of the user.
     * @return     The userSecurityName of the user.
     * @exception  EntryNotFoundException if the unique user ID does not exist.
     * @exception  CustomRegistryException if there is any registry-specific
     *             problem
```

```
**/
public String getUserSecurityName(String uniqueUserId)
   throws CustomRegistryException,
          EntryNotFoundException {
   String s,usrSecName = null;
   BufferedReader in = null;
   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            int index1 = s.indexOf(":", index+1);
            int index2 = s.indexOf(":", index1+1);
            if ((s.substring(index1+1,index2)).equals(uniqueUserId)) {
               usrSecName = s.substring(0,index);
               break;
            }
         }
      }
   } catch (Exception ex) {
      throw new CustomRegistryException(ex.getMessage(), ex);
   } finally {
      fileClose(in);
   }

   if (usrSecName == null) {
      EntryNotFoundException ex =
         new EntryNotFoundException("Cannot obtain the
         user securityName for " + uniqueUserId);
      throw ex;
   }

   return usrSecName;

}  /**
* Determines if the userSecurityName exists in the registry
*
* @param     userSecurityName - The name of the user
* @return    True if the user is valid; otherwise false
* @exception CustomRegistryException if there is any registry-
*            specific problem
* @exception RemoteException as this extends java.rmi.Remote
*            interface
**/
public boolean isValidUser(String userSecurityName)
   throws CustomRegistryException {
   String s;
   boolean isValid = false;
   BufferedReader in = null;
   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            if ((s.substring(0,index)).equals(userSecurityName)) {
               isValid=true;
               break;
            }
         }
      }
   } catch (Exception ex) {
      throw new CustomRegistryException(ex.getMessage(), ex);
   } finally {
      fileClose(in);
   }
```

```
   return isValid;
}  /**
* Gets a list of groups that match a pattern in the registry
* The maximum number of groups returned is defined by the
* limit argument. This method is called by administrative console
* and scripting (command line) to make available the groups in
* the registry for adding them (groups) to roles.
*
* @param       pattern the pattern to match. (For example, a* matches
*              all groupSecurityNames starting with a)
* @param       Limits the maximum number of groups to return
*              This is very useful in situations where there
*              are thousands of groups in the registry and getting all
*              of them at once is not practical. The default is 100.
*              A value of 0 implies get all the groups and hence must
*              be used with care.
* @return      A Result object that contains the list of groups
*              requested and a flag to indicate if more groups exist.
* @exception CustomRegistryException if there is any registry-specific
*              problem
**/
public Result getGroups(String pattern, int limit)
   throws CustomRegistryException {
   String s;
   BufferedReader in = null;
   List allGroups = new ArrayList();      Result result = new Result();
   int count = 0;
   int newLimit = limit+1;
   try {
      in = fileOpen(GROUPFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            String group = s.substring(0,index);
            if (match(group,pattern)) {
               allGroups.add(group);
               if (limit !=0 && ++count == newLimit) {
                  allGroups.remove(group);
                  result.setHasMore();
                  break;
               }
            }
         }
      }
   } catch (Exception ex) {
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }

   result.setList(allGroups);
   return result;
}

/**
 * Returns the display name for the group specified by groupSecurityName.
 * For this version of WebSphere Application Server, the only usage of
 * this method is by the clients (administrative console and scripting)
 * to present a descriptive name of the user if it exists.
 *
 * @param groupSecurityName the name of the group.
 * @return  the display name for the group. The display name
 *          is a registry-specific string that represents a
 *          descriptive, not necessarily unique, name for a group.
 *          If a display name does not exist return null or empty
```

```
 *          string.
 * @exception EntryNotFoundException if groupSecurityName does
 *          not exist.
 * @exception CustomRegistryException if there is any registry-
 *          specific problem
 **/
 public String getGroupDisplayName(String groupSecurityName)
    throws CustomRegistryException,
           EntryNotFoundException {
    String s,displayName = null;
    BufferedReader in = null;

    if(!isValidGroup(groupSecurityName)) {
       EntryNotFoundException nsee = new EntryNotFoundException("group: "
       + groupSecurityName + " is not valid");
       throw nsee;
    }

    try {
       in = fileOpen(GROUPFILENAME);
       while ((s=in.readLine())!=null)
       {
          if (!(s.startsWith("#") || s.trim().length() <=0 )) {
             int index = s.indexOf(":");
             int index1 = s.lastIndexOf(":");
             if ((s.substring(0,index)).equals(groupSecurityName)) {
                displayName = s.substring(index1+1);
                break;
             }
          }
       }
    } catch(Exception ex) {
       throw new CustomRegistryException(ex.getMessage(),ex);
    } finally {
       fileClose(in);
    }

    return displayName;
 }

/**
 * Returns the Unique ID for a group.

 * @param     groupSecurityName the name of the group.
 * @return    The unique ID of the group. The unique ID for
 *            a group is the stringified form of some unique,
 *            registry-specific, data that serves to represent
 *            the group. For example, for the UNIX user registry,
 *            the unique ID might be the GID.
 * @exception EntryNotFoundException if groupSecurityName does
 *            not exist.
 * @exception CustomRegistryException if there is any registry-
 *            specific problem
 * @exception RemoteException as this extends java.rmi.Remote
 **/
 public String getUniqueGroupId(String groupSecurityName)
    throws CustomRegistryException,
           EntryNotFoundException {
    String s,uniqueGrpId = null;
    BufferedReader in = null;
    try {
       in = fileOpen(GROUPFILENAME);
       while ((s=in.readLine())!=null)
       {
          if (!(s.startsWith("#") || s.trim().length() <=0 )) {
             int index = s.indexOf(":");
             int index1 = s.indexOf(":", index+1);
```

```
            if ((s.substring(0,index)).equals(groupSecurityName)) {
               uniqueGrpId = s.substring(index+1,index1);
               break;
            }
         }
      }
   } catch(Exception ex) {
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }

   if (uniqueGrpId == null) {
      EntryNotFoundException nsee =
      new EntryNotFoundException("Cannot obtain the uniqueId for group: "
      + groupSecurityName);
      throw nsee;
   }

   return uniqueGrpId;
}

/**
 * Returns the Unique IDs for all the groups that contain the UniqueId
 * of a user. Called during creation of a user's credential.
 *
 * @param     uniqueUserId the unique ID of the user.
 * @return    A list of all the group unique IDs that the unique user
 *            ID belongs to. The unique ID for an entry is the
 *            stringified form of some unique, registry-specific, data
 *            that serves to represent the entry.  For example, for the
 *            UNIX user registry, the unique ID for a group might be
 *            the GID and the Unique ID for the user might be the UID.
 * @exception EntryNotFoundException if uniqueUserId does not exist.
 * @exception CustomRegistryException if there is any registry-specific
 *            problem
 **/
public List getUniqueGroupIds(String uniqueUserId)
   throws CustomRegistryException,
          EntryNotFoundException {
   String s,uniqueGrpId = null;
   BufferedReader in = null;
   List uniqueGrpIds=new ArrayList();
   try {
      in = fileOpen(USERFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            int index = s.indexOf(":");
            int index1 = s.indexOf(":", index+1);
            int index2 = s.indexOf(":", index1+1);
            if ((s.substring(index1+1,index2)).equals(uniqueUserId)) {
               int lastIndex = s.lastIndexOf(":");
               String subs = s.substring(index2+1,lastIndex);
               StringTokenizer st1 = new StringTokenizer(subs, ",");
               while (st1.hasMoreTokens())
                  uniqueGrpIds.add(st1.nextToken());
               break;
            }
         }
      }
   } catch(Exception ex) {
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }
```

```
    return uniqueGrpIds;
 }

/**
 * Returns the name for a group given its uniqueId.
 *
 * @param     uniqueGroupId the unique ID of the group.
 * @return    The name of the group.
 * @exception EntryNotFoundException if the uniqueGroupId does
 *            not exist.
 * @exception CustomRegistryException if there is any registry-
 *            specific problem
 **/
 public String getGroupSecurityName(String uniqueGroupId)
    throws CustomRegistryException,
           EntryNotFoundException {
    String s,grpSecName = null;
    BufferedReader in = null;
    try {
       in = fileOpen(GROUPFILENAME);
       while ((s=in.readLine())!=null)
       {
          if (!(s.startsWith("#") || s.trim().length() <=0 )) {
             int index = s.indexOf(":");
             int index1 = s.indexOf(":", index+1);
             if ((s.substring(index+1,index1)).equals(uniqueGroupId)) {
                grpSecName = s.substring(0,index);
                break;
             }
          }
       }
    } catch (Exception ex) {
       throw new CustomRegistryException(ex.getMessage(),ex);
    } finally {
       fileClose(in);
    }

    if (grpSecName == null) {
       EntryNotFoundException ex =
          new EntryNotFoundException("Cannot obtain the group
         security name for: " + uniqueGroupId);
       throw ex;
    }

    return grpSecName;

 }

/**
 * Determines if the groupSecurityName exists in the registry
 *
 * @param     groupSecurityName the name of the group
 * @return    True if the groups exists; otherwise false
 * @exception CustomRegistryException if there is any registry-
 *            specific problem
 **/
 public boolean isValidGroup(String groupSecurityName)
    throws CustomRegistryException {
    String s;
    boolean isValid = false;
    BufferedReader in = null;
    try {
       in = fileOpen(GROUPFILENAME);
       while ((s=in.readLine())!=null)
       {
          if (!(s.startsWith("#") || s.trim().length() <=0 )) {
             int index = s.indexOf(":");
```

```
            if ((s.substring(0,index)).equals(groupSecurityName)) {
               isValid=true;
               break;
            }
         }
      }
   } catch (Exception ex) {
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
   }

   return isValid;
}

/**
 * Returns the securityNames of all the groups that contain the user
 *
 * This method is called by the administrative console and scripting
 * (command line) to verify the user entered for RunAsRole mapping
 * belongs to that role in the roles to user mapping. Initially, the
 * check is done to see  if the role contains the user. If the role does
 * not contain the user explicitly, this method is called to get the groups
 * that this user belongs to so that check can be made on the groups that
 * the role contains.
 *
 * @param     userSecurityName the name of the user
 * @return    A list of all the group securityNames that the user
 *            belongs to.
 * @exception EntryNotFoundException if user does not exist.
 * @exception CustomRegistryException if there is any registry-
 *            specific problem
 * @exception RemoteException as this extends the java.rmi.Remote
 *            interface
 **/
public List getGroupsForUser(String userName)
   throws CustomRegistryException,
          EntryNotFoundException {
   String s;
   List grpsForUser = new ArrayList();
   BufferedReader in = null;
   try {
      in = fileOpen(GROUPFILENAME);
      while ((s=in.readLine())!=null)
      {
         if (!(s.startsWith("#") || s.trim().length() <=0 )) {
            StringTokenizer st = new StringTokenizer(s, ":");
            for (int i=0; i<2; i++)
               st.nextToken();
            String subs = st.nextToken();
            StringTokenizer st1 = new StringTokenizer(subs, ",");
            while (st1.hasMoreTokens()) {
               if((st1.nextToken()).equals(userName)) {
                  int index = s.indexOf(":");
                  grpsForUser.add(s.substring(0,index));
               }
            }
         }
      }
   } catch (Exception ex) {
      if (!isValidUser(userName)) {
         throw new EntryNotFoundException("user: " + userName
         + " is not valid");
      }
      throw new CustomRegistryException(ex.getMessage(),ex);
   } finally {
      fileClose(in);
```

```
    }

    return grpsForUser;
 }

/**
 * Gets a list of users in a group.
 *
 * The maximum number of users returned is defined by the
 * limit argument.
 *

 * This method is being used by the process choreographer
 * when staff assignments are modeled using groups.
 *
 * In rare situations, if you are working with a registry where
 * getting all the users from any of your groups is not practical
 * (for example if there are a large number of users) you can throw
 * the NotImplementedException for that particular group. Make sure
 * that if the process choreographer is installed (or if installed later)
 * the staff assignments are not modeled using these particular groups.
 * If there is no concern about returning the users from groups
 * in the registry it is recommended that this method be implemented
 * without throwing the NotImplemented exception.
 * @param         groupSecurityName the name of the group
 * @param         Limits the maximum number of users that should be
 *                returned. This is very useful in situations where there
 *                are lot of users in the registry and getting all of
 *                them at once is not practical. A value of 0 implies
 *                get all the users and hence must be used with care.
 * @return        A result object that contains the list of users
 *                requested and a flag to indicate if more users exist.
 * @deprecated    This method will be deprecated in future.
 * @exception     NotImplementedException throw this exception in rare
 *                situations if it is not practical to get this information
 *                for any of the group or groups from the registry.
 * @exception     EntryNotFoundException if the group does not exist in
 *                the registry
 * @exception     CustomRegistryException if there is any registry-specific
 *                problem
 **/
 public Result getUsersForGroup(String groupSecurityName, int limit)
    throws NotImplementedException,
           EntryNotFoundException,
           CustomRegistryException {
    String s, user;
    BufferedReader in = null;
    List usrsForGroup = new ArrayList();
    int count = 0;
    int newLimit = limit+1;
    Result result = new Result();

    try {
       in = fileOpen(GROUPFILENAME);
       while ((s=in.readLine())!=null)
       {
          if (!(s.startsWith("#") || s.trim().length() <=0 )) {
             int index = s.indexOf(":");
             if ((s.substring(0,index)).equals(groupSecurityName))
             {
                StringTokenizer st = new StringTokenizer(s, ":");
                for (int i=0; i<2; i++)
                   st.nextToken();
                String subs = st.nextToken();
                StringTokenizer st1 = new StringTokenizer(subs, ",");
                while (st1.hasMoreTokens()) {
                   user = st1.nextToken();
```

```
                    usrsForGroup.add(user);
                    if (limit !=0 && ++count == newLimit) {
                       usrsForGroup.remove(user);
                       result.setHasMore();
                       break;
                    }
                 }
              }
           }
        }
     } catch (Exception ex) {
        if (!isValidGroup(groupSecurityName)) {
           throw new EntryNotFoundException("group: "
           + groupSecurityName
           + " is not valid");
        }
        throw new CustomRegistryException(ex.getMessage(),ex);
     } finally {
        fileClose(in);
     }

     result.setList(usrsForGroup);
     return result;
  }

 /**
  * This method is implemented internally by the WebSphere Application
  * Server code in this release. This method is not called for the custom
  * registry implementations for this release. Return null in the
  * implementation.
  *
  **/
  public com.ibm.websphere.security.cred.WSCredential
        createCredential(String userSecurityName)
        throws CustomRegistryException,
               NotImplementedException,
               EntryNotFoundException {

     // This method is not called.
     return null;
  }

  // private methods
  private BufferedReader fileOpen(String fileName)
     throws FileNotFoundException {
     try {
        return new BufferedReader(new FileReader(fileName));
     } catch(FileNotFoundException e) {
        throw e;
     }
  }

  private void fileClose(BufferedReader in) {
     try {
        if (in != null) in.close();
     } catch(Exception e) {
        System.out.println("Error closing file" + e);
     }
  }

  private boolean match(String name, String pattern) {
     RegExpSample regexp = new RegExpSample(pattern);
     boolean matches = false;
     if(regexp.match(name))
         matches = true;
     return matches;
  }
```

```
}


//-------------------------------------------------------------------------
// The program provides the Regular Expression implementation
// used in the sample for the custom user registry (FileRegistrySample).
// The pattern matching in the sample uses this program to search for the
// pattern (for users and groups).
//-------------------------------------------------------------------------

class RegExpSample
{

    private boolean match(String s, int i, int j, int k)
    {
        for(; k < expr.length; k++)
label0:
            {
                Object obj = expr[k];
                if(obj == STAR)
                {
                    if(++k >= expr.length)
                        return true;
                    if(expr[k] instanceof String)
                    {
                        String s1 = (String)expr[k++];
                        int l = s1.length();
                        for(; (i = s.indexOf(s1, i)) >= 0; i++)
                            if(match(s, i + l, j, k))
                                return true;

                        return false;
                    }
                    for(; i < j; i++)
                        if(match(s, i, j, k))
                            return true;

                    return false;
                }
                if(obj == ANY)
                {
                    if(++i > j)
                        return false;
                    break label0;
                }
                if(obj instanceof char[][])
                {
                    if(i >= j)
                        return false;
                    char c = s.charAt(i++);
                    char ac[][] = (char[][])obj;
                    if(ac[0] == NOT)
                    {
                        for(int j1 = 1; j1 < ac.length; j1++)
                            if(ac[j1][0] <= c && c <= ac[j1][1])
                                return false;

                        break label0;
                    }
                    for(int k1 = 0; k1 < ac.length; k1++)
                        if(ac[k1][0] <= c && c <= ac[k1][1])
                            break label0;

                    return false;
                }
                if(obj instanceof String)
                {
```

```
                String s2 = (String)obj;
                int i1 = s2.length();
                if(!s.regionMatches(i, s2, 0, i1))
                    return false;
                i += i1;
            }
        }

    return i == j;
}

public boolean match(String s)
{
    return match(s, 0, s.length(), 0);
}

public boolean match(String s, int i, int j)
{
    return match(s, i, j, 0);
}

public RegExpSample(String s)
{
    Vector vector = new Vector();
    int i = s.length();
    StringBuffer stringbuffer = null;
    Object obj = null;
    for(int j = 0; j < i; j++)
    {
        char c = s.charAt(j);
        switch(c)
        {
        case 63: /* '?' */
            obj = ANY;
            break;

        case 42: /* '*' */
            obj = STAR;
            break;

        case 91: /* '[' */
            int k = ++j;
            Vector vector1 = new Vector();
            for(; j < i; j++)
            {
                c = s.charAt(j);
                if(j == k && c == '^')
                {
                    vector1.addElement(NOT);
                    continue;
                }
                if(c == '\\')
                {
                    if(j + 1 < i)
                        c = s.charAt(++j);
                }
                else
                if(c == ']')
                    break;
                char c1 = c;
                if(j + 2 < i && s.charAt(j + 1) == '-')
                    c1 = s.charAt(j += 2);
                char ac1[] = {
                    c, c1
                };
                vector1.addElement(ac1);
            }
```

```
                char ac[][] = new char[vector1.size()][];
                vector1.copyInto(ac);
                obj = ac;
                break;

            case 92: /* '\\' */
                if(j + 1 < i)
                    c = s.charAt(++j);
                break;

            }
            if(obj != null)
            {
                if(stringbuffer != null)
                {
                    vector.addElement(stringbuffer.toString());
                    stringbuffer = null;
                }
                vector.addElement(obj);
                obj = null;
            }
            else
            {
                if(stringbuffer == null)
                    stringbuffer = new StringBuffer();
                stringbuffer.append(c);
            }
        }

        if(stringbuffer != null)
            vector.addElement(stringbuffer.toString());
        expr = new Object[vector.size()];
        vector.copyInto(expr);
    }

    static final char NOT[] = new char[2];
    static final Integer ANY = new Integer(0);
    static final Integer STAR = new Integer(1);
    Object expr[];

}
```

Result.java file: This module is used by user registries in WebSphere Application Server when calling the getUsers and getGroups methods. The user registries use this method to set the list of users and groups and to indicate if there are more users and groups in the registry than requested.

```
//  @(#) 1.20 src/en/ae/rsec_result.xml, WEBSJAVA.INFO.DOCSRC,
//  ASVINFO1 10/17/02 16:43:01 [10/18/02 07:31:30]
//  5639-D57, 5630-A36, 5630-A37, 5724-D18
// (C) COPYRIGHT International Business Machines Corp. 1997, 2003
//  All Rights Reserved * Licensed Materials - Property of IBM
//
package com.ibm.websphere.security;

import java.util.List;

public class Result implements java.io.Serializable {
    /**
      Default constructor
    */
    public Result() {
```

```
    }

    /**
       Returns the list of users and groups
       @return the list of users and groups
    */
    public List getList() {
      return list;
    }

    /**
       indicates if there are more users and groups in the registry
    */
    public boolean hasMore() {
      return more;
    }
    /**
       Set the flag to indicate that there are more users and groups
       in the registry to true
    */
    public void setHasMore() {
      more = true;
    }

    /*
      Set the list of users and groups
      @param list   list of users/groups
    */
    public void setList(List list) {
      this.list = list;
    }

    private boolean more = false;
    private List list;
}
```

Custom user registry settings:

Use this page to configure the custom user registry.

To view this administrative console page, click **Security** > **User Registries** > **Custom**.

After the properties are set in this panel, click **Apply**. Use the Properties panel for additional properties that the custom registry requires. When security is enabled and any of these properties change, go to the Global Security panel and click **Apply** to validate the changes.

Server User ID:

Specifies the user ID under which the server runs, for security purposes.

This server ID represents a valid user in the custom registry.

Data type: String

Server User Password:

Specifies the password corresponding to the security server ID.

Data type: String

Custom Registry Classname:

Specifies a dot-separated class name that implements the com.ibm.websphere.security.UserRegistry interface.

Put the custom registry class name in the class path. A suggested location is the *%install_root%*/lib/ext directory. Although the custom registry implements the com.ibm.websphere.security.UserRegistry interface, for backward compatibility, a user registry can alternately implement the com.ibm.websphere.security.CustomRegistry interface.

Data type: String
Default: com.ibm.websphere.security.FileRegistrySample

Ignore Case:

Specifies that a case insensitive authorization check is performed.

Default: Enabled
Range: Enabled or Disabled

Use **Custom Properties** to add any additional properties required to initialize the custom registry. The following property is predefined by the product; set this property when required only:

- WAS_UseDisplayName--When set to true, the getCallerPrincipal(), getUserPrincipal(), and getRemoteUser() methods return the display name. By default, the securityName of the user is returned. This default is introduced to support backward compatibility with the Version 4.0 custom registry.

users.props file: Following is the format for the users.props file:

```
# 5639-D57, 5630-A36, 5630-A37, 5724-D18
# (C) COPYRIGHT International Business Machines Corp. 1997, 2003
# All Rights Reserved * Licensed Materials - Property of IBM
#
# Format:
# name:passwd:uid:gids:display name
# where name   = userId/userName of the user
#       passwd = password of the user
#       uid    = uniqueId of the user
#       gid    = groupIds of the groups that the user belongs to
#       display name = a (optional) display name for the user.
bob:bob1:123:567:bob
dave:dave1:234:678:
jay:jay1:345:678,789:Jay-Jay
ted:ted1:456:678:Teddy G
jeff:jeff1:222:789:Jeff
vikas:vikas1:333:789:vikas
bobby:bobby1:444:789:
```

groups.props file: The following example illustrates the format for the groups.props file:

```
# 5639-D57, 5630-A36, 5630-A37, 5724-D18
# (C) COPYRIGHT International Business Machines Corp. 1997, 2003
# All Rights Reserved * Licensed Materials - Property of IBM
#
# Format:
# name:gid:users:display name
# where name   = groupId of the group
#       gid    = uniqueId of the group
#       users  = list of all the userIds that the group contains
#       display name = a (optional) display name for the group.
admins:567:bob:Administrative group
operators:678:jay,ted,dave:Operators group
users:789:jay,jeff,vikas,bobby:
```

Java Authentication and Authorization Service

The standard Java 2 security API helps enforce access control, based on the location of the code and who signed it. The current principal of the running thread is not considered in the Java 2 security authorization. Instances where authorization is based on the principal, rather than the code base and the signer exist. The Java Authentication and Authorization Service is a standard Java API that supports the Java 2 security authorization to extend the code base on the principal as well as the code base and signers.

The Java Authentication and Authorization Service (JAAS) Version 1.0 extends the Java 2 security architecture of the Java 2 platform with additional support to authenticate and enforce access control with users. It implements a Java version of the standard Pluggable Authentication Module (PAM) framework, and extends the access control architecture of the Java 2 platform in a compatible fashion to support user-based authorization. WebSphere Application Server fully supports the JAAS architecture and extends the access control architecture to support role-based authorization for Java 2 Platform, Enterprise Edition (J2EE) resources including servlets, JavaServer Pages (JSP) files, and Enterprise JavaBeans (EJB) components.

The following sections cover the JAAS implementation and programming model:
- Java Authentication and Authorization Service login configuration
- Programmatic Login
- Java Authentication and Authorization Service authorization

The JAAS documentation can be found at http://www.ibm.com/developerworks/java/jdk/security. Scroll down to find the JAAS documentation for your platform.

Java Authentication and Authorization Service authorization

Java 2 security architecture uses a security policy to specify which access rights are granted to running code. This architecture is *code-centric*. That is, the permissions are granted based on code characteristics including where the code is coming from, whether it is digitally signed, and by whom. Authorization of the Java Authentication and Authorization Service (JAAS) augments the existing code-centric access controls with new user-centric access controls. Permissions are granted based on what code is running and who is running it.

When using JAAS authentication to authenticate a user, a subject is created to represent the authenticated user. A subject is comprised of a set of principals, where each principal represents an identity for that user. You can grant permissions in the policy to specific principals. After the user is authenticated, the application can associate the subject with the current access control context. For each subsequent security-checked operation, the Java run time automatically

determines whether the policy grants the required permission to a specific principal only. If so, the operation is supported if the subject associated with the access control context contains the designated principal only.

Associate a subject with the current access control context by calling the static doAs method from the subject class, passing it an authenticated subject and java.security.PrivilegedAction or java.security.PrivilegedExceptionAction. The doAs method associates the provided subject with the current access control context and then invokes the run method from the action. The run method implementation contains all the code that ran as the specified subject. The action runs as the specified subject.

In the Java 2 Platform, Enterprise Edition (J2EE) programming model, when invoking the EJB method from an enterprise bean or servlet, the method runs under the user identity that is determined by the run-as setting. The J2EE Version 1.3 Specification does not indicate which user identity to use when invoking an enterprise bean from a Subject.doAs action block within either the EJB code or the servlet code. A logical extension is to use the proper identity specified in the subject when invoking the EJB method within the Subject doAs action block.

This simple rule of letting Subject.doAs overwrite the run-as identity setting is an ideal way to integrate the JAAS programming model with the J2EE run-time environment. However, a design oversight was introduced into IBM Developer Kit, Java Technology Edition Version 1.3 when integrating the JAAS Version 1.0 implementation with the Java 2 security architecture. A subject, which is associated with the access control context is cut off by a doPrivileged call when a doPrivileged call occurs within the Subject.doAs action block. Until this problem is corrected, no reliable and run-time efficient way is available to guarantee the correct behavior of Subject.doAs in a J2EE run-time environment.

The problem can be explained better with the following example:

```
Subject.doAs(subject, new java.security.PrivilegedAction() {
   Public Object run() {
       // Subject is associated with the current thread context
       java.security.AccessController.doPrivileged( new
           java.security.PrivilegedAction() {
                       public Object run() {
                       // Subject was cut off from the current
                       // thread context
   return null;
              }
        });
        // Subject is associated with the current thread context
        return null;
   }
});
```

At line three, the subject object is associated with the context of the current thread. As indicated on line 7 within the run method of a doPrivileged action block, the subject object is removed from the thread context. After leaving the doPrivileged block, the subject object is restored to the current thread context. Because doPrivileged blocks can be placed anywhere along the running path and instrumented quite often in a server environment, the run-time behavior of a doAs action block becomes difficult to manage.

The credential is used by the Security Authentication Service (SAS) run time for EJB invocation.

The WSSubject.doAs and WSSubject.doAsPrivileged methods then invoke the corresponding Subject.doAs and Subject.doAsPrivileged methods. The original credential is restored and associated with the running thread upon leaving the WSSubject.doAs and WSSubject.doAsPrivileged methods.

To resolve this difficulty, WebSphere Application Server provides a WSSubject helper class to extend the JAAS authorization to a J2EE EJB method invocation as described previously. The WSSubject class provides static doAs and doAsPrivileged methods that have identical signatures to the subject class. The WSSubject.doAs method associates the Subject to the currently running thread.

The credential is used by the Security Authentication Service (SAS) run time for EJB invocation.

The WSSubject.doAs and WSSubject.doAsPrivileged methods then invoke the corresponding Subject.doAs and Subject.doAsPrivileged methods. The original credential is restored and associated with the running thread upon leaving the WSSubject.doAs and WSSubject.doAsPrivileged methods.

Note that the WSSubject class is not a replacement of the subject object, but rather a helper class to ensure consistent run-time behavior as long as an EJB method invocation is a concern.

Note: When using application Sync to OS thread the operating system identity is modified to match the subject identity. Refer to Understanding application Synch to OS Thread Allowed for more information.

The following example illustrates the run-time behavior of the WSSubject.doAs method:

```
WSSubject.doAs(subject, new java.security.PrivilegedAction() {
   Public Object run() {
       // Subject is associated with the current thread context
       java.security.AccessController.doPrivileged( new
           java.security.PrivilegedAction() {
                      public Object run() {
                         // Subject was cut off from the current thread
                         // context.
   return null;
              }
        });
        // Subject is associated with the current thread context
   return null;
   }
});
```

The Subject.doAs and Subject.doAsPrivileged methods are not integrated with the J2EE run-time environment. EJB methods that are invoked within the Subject.doAs and Subject.doAsPrivileged action blocks run under the identity specified by the run-as setting and not by the subject identity.

- The subject object generated by the WSLoginModuleImpl instance and the WSClientLoginModuleImpl instance contains a principal that implements the WSPrincipal interface. Using the getCredential() method for a WSPrincipal object

returns an object that implements the WSCredential interface. You can also find the WSCredential object instance in the PublicCredentials list of the subject instance. Retrieve the WSCredential object from the PublicCredentials list instead of using the getCredential() method.
- The getCallerPrincipal() method for the WSSubject class returns a string representing the caller security identity. The return type differs from the getCallerPrincipal method of the EJBContext interface, which is java.security.Principal.
- The Subject object generated by the J2C DefaultPrincipalMapping module contains a resource principal and a PasswordCredentials list. The resource principal represents the caller.

Refer to "Java 2 Connector security" on page 257 for more information

Configuring application logins for Java Authentication and Authorization Service

Java Authentication and Authorization Service (JAAS) is a new feature in WebSphere Application Server. It is a collection of WebSphere Application Server strategic authentication APIs and replaces the Common Object Request Broker Architecture (CORBA) programmatic login APIs.

WebSphere Application Server provides some extensions to JAAS:
- **com.ibm.websphere.security.auth.WSSubject**. Due to a design oversight in the JAAS V1.0, javax.security.auth.Subject.getSubject() method does not return the subject associated with the running thread inside a java.security.AccessController.doPrivileged() code block. This problem presents an inconsistent behavior that is problematic and causes undesirable effort. The com.ibm.websphere.security.auth.WSSubject API provides a workaround to associate the subject to a running thread. The com.ibm.websphere.security.auth.WSSubject API extends the JAAS authorization model to J2EE resources.
- You can configure JAAS login in the administrative console and store this configuration in the WebSphere configuration application programming interface (API). However, WebSphere Application Server still supports the default JAAS login configuration format (plain text file) provided by the JAAS default implementation. If duplicate login configurations are defined in both the WebSphere configuration API and the plain text file format, the one in the WebSphere configuration API takes precedence. Advantages to defining the login configuration in the WebSphere configuration API include:
  - User interface support in defining JAAS login configuration
  - Central management of the JAAS login configuration
  - Distribution of the JAAS login configuration in a Network Deployment product installation
- **Proxy LoginModule**. The default JAAS implementation does not use the thread context class loader to load classes. The LoginModule module cannot load if the LoginModule class file is not in the application class loader or the Java extension class loader class path. Due to this class loader visibility problem, WebSphere Application Server provides a proxy LoginModule module to load the JAAS LoginModule using the thread context class loader. You do not need to place the LoginModule implementation on the application class loader or the Java extension class loader class path with this proxy LoginModule module.

  If you do not want to use the Proxy LoginModule, you can place the LoginModule in the `jre/lib/ext` directory. However, this is not recommended due to the security risks.

Two JAAS login configurations are defined in the WebSphere Configuration API security document for applications to use. In the left navigation pane, click **Security > JAAS Configuration > Application Login >WSLogin** and **ClientContainer**. The following three JAAS login configurations are available:

WSLogin
Defines a login configuration and a LoginModule implementation that applications can use in general.

ClientContainer
Defines a login configuration and a LoginModule implementation that is similar to that of the WSLogin configuration, but enforces the requirements of the WebSphere Application Server client container.

DefaultPrincipalMapping,
Defines a special LoginModule module that is typically used by Java 2 Connector to map an authenticated WebSphere user identity to a set of user authentication data (user ID and password) for the specified back-end enterprise information system (EIS). For more information about Java 2 Connector and the DefaultMappingModule module, refer to the Java 2 security section.

A new JAAS login configuration can be added and modified using the administrative console. The changes are saved in the cell-level security document and are available to all managed application servers. An application server restart is required for the changes to take effect at run time.

Attention: Do not remove or delete the predefined JAAS login configurations (ClientContainer, WSLogin and DefaultPrincipalMapping). Deleting or removing them can cause other enterprise applications to fail.

1. Delete a JAAS login configuration.
   a. Click **Security** in the navigation tree.
   b. Click **JAAS Configuration** > **Application Logins**. The Application Login Configuration panel appears.
   c. Select the check box for the login configurations to delete and click **Delete**.
2. Create a new JAAS login configuration.
   a. Click **Security** in the navigation tree.
   b. Click **JAAS Configuration** > **Application Logins**.
   c. Click **New**. The Application Login Configuration panel appears.
   d. Specify the alias name of the new JAAS login configuration and click **Apply**. This value is the name of the login configuration that you pass in the javax.security.auth.login.LoginContext implementation for creating a new LoginContext.

      Click **Apply** to save changes and to add the extra node name that precedes the original alias name. Clicking **OK** does not save the new changes in the `security.xml` file.
   e. Click **JAAS Login Modules**.
   f. Click **New**.
   g. Specify the Module Classname. Specify WebSphere Proxy LoginModule because of the limitation of the class loader visibility problem.
   h. Specify the LoginModule implementation as the delegate property of the Proxy LoginModule. The WebSphere Proxy LoginModule class name is com.ibm.ws.security.common.auth.module.proxy.WSLoginModuleProxy.
   i. Select **Authentication Strategy** from the list and click **Apply**.

j. Click **Custom Properties**. The **Custom Properties** panel is displayed for the selected LoginModule.

k. Create a new property with the name `delegate` and the value of the real LoginModule implementation. You can specify other properties like `debug` with the value `true`. These properties are passed to the LoginModule class as options to the initialize() method of the LoginModule instance.

l. Click **Save**.

There are several locations within the WebSphere Application Server directory structure where you can place a JAAS login module. The following list provides locations for the JAAS login module in order of recommendation:

- Within an Enterprise Archive (EAR) file for a specific Java 2 Enterprise Edition (J2EE) application.

  If you place the login module within the EAR file, it is accessible to the specific application only.

- In the WebSphere Application Server shared library.

  If you place the login module in the shared library, you must specify which applications can access the module. For more information on shared libraries, see Managing shared libraries.

- In the Java extensions directory (*WAS_HOME*`\jre\lib\ext`)

  If you place the JAAS login module in the Java extensions directory, the login module is available to all applications.

Although the Java extensions directory provides the greatest availability for the login module, it is recommended that you place the login module in an application EAR file. If other applications need to access the same login module, consider using shared libraries.

3. Change the plain text file. WebSphere Application Server supports the default JAAS login configuration format (plain text file) provided by the JAAS default implementation. However, a tool is not provided that edits plain text files in this format. You can define the JAAS login configuration in the plain text file (*install_root*`/properties/wsjaas.conf`). Any syntax errors can cause the incorrect parsing of the plain JAAS login configuration text file. This problem can cause other applications to fail.

   Java client programs that use the Java Authentication and Authorization Service (JAAS) for authentication must invoke with the JAAS configuration file specified. This configuration file is set in the */install_root*`/bin/launchClient.bat` file as `set JAAS_LOGIN_CONFIG=-Djava.security.auth.login.config=%install_root%\properties\wsjaas_client.conf`. If the `launchClient.bat` file is not used to invoke the Java client program, verify that the appropriate JAAS configuration file is passed to the Java virtual machine with the `-Djava.security.auth.login.config` flag.

A new JAAS login configuration is created or an old JAAS login configuration is removed. An enterprise application can use a newly created JAAS login configuration without restarting the application server process.

However, new JAAS login configurations defined in the *install_root*`/properties/wsjaas.conf` file, do not refresh automatically. Restart the application servers to validate changes. These JAAS login configurations are specific to a particular node and are not available for other application servers running on other nodes.

Create new JAAS login configurations used by enterprise applications to perform custom authentication.

Use these newly defined JAAS login configurations to perform programmatic login.

Login configuration for Java Authentication and Authorization Service

Java Authentication and Authorization Service (JAAS) is a new feature in WebSphere Application Server. JAAS is WebSphere strategic APIs for authentication and it will replace of the CORBA programmatic login APIs. WebSphere Application Server provides some extensions to JAAS:

- com.ibm.websphere.security.auth.WSSubject: Due to a design oversight in the JAAS 1.0, javax.security.auth.Subject.getSubject() does not return the Subject associated with the thread of execution inside a java.security.AccessController.doPrivileged() code block. This can present a inconsistent behavior that is problematic and causes undesirable effort. com.ibm.websphere.security.auth.WSSubject provides a work around to associate Subject to thread of execution. com.ibm.websphere.security.auth.WSSubject extends the JAAS authorization model to J2EE resources.

  Note: You can retrieve the subjects in a Subject.doAs() block with the Subject.getSubject() call. However, this procedure does not work if there is an AccessController.doPrivileged() call within the Subject.doAs() block. In the following example, s1 is equal to s, but s2 is null:

  ```
  * AccessController.doPrivileged() not only truncates the Subject propagation,
  * but also reduces the permissions. It does not include the JAAS security
  * policy defined for the principals in the Subject.
  Subject.doAs(s, new PrivilegedAction() {
    public Object run() {
      System.out.println("Within Subject.doAsPrivileged()");
      Subject s1 = Subject.getSubject(AccessController.getContext());
      AccessController.doPrivileged(new PrivilegedAction() {
        public Object run() {
        Subject s2 = Subject.getSubject(AccessController.getContext());
        return null;
      }
    });
    return null;
  }
  });
  ```

- JAAS Login Configuration can be configured in administrative console and stored in the WebSphere configuration application programming interface (API). An application can define new JAAS login configuration in the administrative console and the data is persisted in the configuration repository (stored in the WebSphere configuration API). However, WebSphere still support the default JAAS login configuration format (plan text file) provided by the JAAS default implementation. But if there are duplication login configurations defined in both the WebSphere configuration API and the plan text file format, the one in the WebSphere configuration API takes precedence. There are advantages to define the login configuration in the WebSphere configuration API:
  - UI support in defining JAAS login configuration.
  - The JAAS configuration login configuration can be managed centrally.
  - The JAAS configuration login configuration is distributed in a Network Deployment installation.
- Proxy LoginModule: The default JAAS implementation does not use the thread context class loader to load classes, the LoginModule could not be loaded if the

LoginModule class file is not in the application class loader or the Java extension class loader classpath. Due to this class loader visibility problem, WebSphere provides a proxy LoginModule to load JAAS LoginModule using the thread context class loader. The LoginModule implementation does not have to be placed on the application class loader or the Java extension class loader classpath with this proxy LoginModule.

Note: Do not remove or delete the pre-defined JAAS Login Configurations (ClientContainer, WSLogin and DefaultPrincipalMapping). Deleting or removing them could cause other enterprise applications to fail.

A system administrator determines the authentication technologies, or LoginModules, to be used for each application and configures them in a login configuration. The source of the configuration information (for example, a file or a database) is up to the current javax.security.auth.login.Configuration implementation. The WebSphere Application Server implementation permits the login configuration to be defined in both the WebSphere configuration API security document and in a JAAS configuration file where the former takes precedence.

Two JAAS login configurations are defined in the WebSphere configuration API security document for applications to use. They may be found in the left navigation pane at **Security** > **JAAS Configuration** > **Application Login Config**: **WSLogin** and **ClientContainer**. The **WSLogin** defines a login configuration and LoginModule implementation that may be used by applications in general. The **ClientContainer** defines a login configuration and LoginModule implementation that is similar to that of WSLogin but enforces the requirements of the WebSphere Application Server Client Container. The third entry, **DefaultPrincipalMapping**, defines a special LoginModule that is typically used by Java 2 Connector to map an authenticated WebSphere user identity to a set of user authentication data (user ID and password) for the specified back end enterprise information system (EIS). For more information about Java 2 Connector and the DefaultMappingModule please refer to the Java 2 Security section.

New JAAS login configuration may be added and modified using Security Center. The changes are saved in the cell level security document and are available to all managed application servers. An application server restart is required for the changes to take effect at run time.

WebSphere Application Server also reads JAAS Configuration information from the wsjaas.conf file under the properties sub directory of the root directory under which WebSphere Application Server is installed. Changes made to the wsjaas.conf file is used only by the local application server and will take effect after restarting the application server. Note that JAAS configuration in the WebSphere configuration API security document takes precedence over that defined in the `wsjaas.conf` file. In other words, a configuration entry in `wsjaas.conf` will be overridden by an entry of the same alias name in the WebSphere configuration API security document.

Note: The Java Authentication and Authorization Service (JAAS) login configuration entries in the Security Center are propagated to the server run time when they are created, not when the configuration is saved. However, the deleted JAAS login configuration entries are not removed from the server run time. To remove the entries, save the new configuration, then stop and restart the server.

Configuration entry settings for Java Authentication and Authorization Service

Use this page to specify a list of Java Authentication and Authorization Service (JAAS) login configurations for the application code to use, including enterprise beans, Java ServerPages (JSP) files, servlets and resource adapters.

To view this administrative console page, click **Security** > **JAAS Configuration** > **Application Login Configuration**.

Read the JAAS documentation before you begin defining additional login modules for authenticating to the WebSphere Application Server security run time. You can define additional login configurations for your applications. However, if the WebSphere Application Server LoginModule (`com.ibm.ws.security.common.auth.module.WSLoginModuleImpl`) is not used or the LoginModule does not produce a credential that is recognized by WebSphere Application Server, then the WebSphere Application Server security run time cannot use the authenticated subject from these login configurations for an authorization check for resource access.

Note: You must invoke Java client programs that use Java Authentication and Authorization Service (JAAS) for authentication with a JAAS configuration file specified. The WebSphere product supplies the default JAAS configuration file, wsjaas_client.conf under the *install_root*`/properties` directory. This configuration file is set in the */install_root*`/bin/launchClient.bat` file as: `set JAAS_LOGIN_CONFIG=-Djava.security.auth.login.config=%WAS_HOME%\properties\wsjaas_client.conf`

If `launchClient.bat` file is not used to invoke Java client programs, make sure that the appropriate JAAS configuration file is passed to the Java virtual machine with the *-Djava.security.auth.login.config* flag.

ClientContainer:

Specifies the login configuration used by the client container application, which uses the CallbackHandler API defined in the client container deployment descriptor.

ClientContainer is the default login configuration for the WebSphere Application Server. Do not remove this default, as other applications that use it fail.

Default: ClientContainer

DefaultPrincipalMapping:

Specifies the login configuration used by Java 2 Connectors to map users to principals that are defined in the J2C Authentication Data Entries.

ClientContainer is the default login configuration for the WebSphere Application Server. Do not remove this default, as other applications that use it fail.

Default: ClientContainer

WSLogin:

Specifies whether all applications can use the WSLogin configuration to perform authentication for the WebSphere Application Server security run time.

This login configuration does not honor the CallbackHandler defined in the client container deployment descriptor. To use this functionality, use the ClientContainer login configuration.

The WSLogin configuration is the default login configuration for the WebSphere Application Server. Do not remove this default, as other applications that use it fail. This login configuration authenticates users for the WebSphere Application Server security run time. Use credentials from the authenticated subject returned from this login configurations as an authorization check for access to WebSphere Application Server resources.

Default: ClientContainer

System login configuration entry settings for Java Authentication and Authorization Service

Use this page to specify a list of Java Authentication and Authorization Service (JAAS) system login configurations.

To view this administrative console page, click **Security > JAAS Configuration > System logins**.

Read "Java Authentication and Authorization Service" on page 240 before you begin defining additional login modules for authenticating to the WebSphere Application Server security run time. Do not remove the following system login modules:

- RMI_INBOUND
- WEB_INBOUND
- DEFAULT
- RMI_OUTBOUND
- SWAM
- wssecurity.IDAssertion
- wssecurity.signature
- LTPA
- LTPA_WEB

RMI_INBOUND, WEB_INBOUND, DEFAULT:

Processes inbound login requests for Remote Method Invocation (RMI), Web applications, and most of the other login protocols. These login configurations are used by WebSphere Application Server Version 5.1.1

RMI_INBOUND

The RMI_INBOUND login configuration handles logins for inbound RMI requests. Typically, these logins are requests for authenticated access to EJB files. Also, these logins might be Java Management Extensions (JMX) requests when using the RMI connector.

WEB_INBOUND

The WEB_INBOUND login configuration handles logins for Web application requests, which includes servlets and JavaServer pages (JSP). This login configuration can interact with the output generated from a

Trust Association Interceptor (TAI), if configured. The Subject passed into the WEB_INBOUND login configuration might contain objects generated by the TAI.

DEFAULT
The DEFAULT login configuration handles the logins for inbound requests made by most of the other protocols and internal authentications.

These three login configurations can pass in the following callback information, which is handled by the login modules within these configurations. These callbacks are not passed in at the same time. However, the combination of these callbacks determines how WebSphere Application Server authenticates the user.

Callback
```
callbacks[0] = new javax.security.auth.callback.
NameCallback("Username: ");
```

Responsibility
Collects the user name provided during a login. This information can be the user name for the following types of logins:

- User name and password login, which is known as basic authentication.
- User name only for identity assertion.

Callback
```
callbacks[1] = new javax.security.auth.callback.
PasswordCallback("Password: ", false);
```

Responsibility
Collects the password provided during a login.

Callback
```
callbacks[2] = new com.ibm.websphere.security.auth.callback.
WSCredTokenCallbackImpl("Credential Token: ");
```

Responsibility
Collects the Lightweight Third Party Authentication (LTPA) token (or other token type) during a login. Typically, this information is present when a user name and password is not present.

Callback
```
callbacks[3] = new com.ibm.wsspi.security.auth.callback.
WSTokenHolderCallback("Authz Token List: ");
```

Responsibility
Collects the ArrayList of the TokenHolder objects that are returned from the call to the WSOpaqueTokenHelper. createTokenHolderListFromOpaqueToken () method using the Common Secure Interoperability version 2 (CSIv2) authorization token as input.

Restriction: This callback is present only when the **Security Attribute Propagation** option is enabled and this login is a propagation login. In a propagation login, (sufficient security attributes are propagated with the request to prevent having to access the user registry for additional attributes.

In system login configurations, WebSphere Application Server authenticates the user based upon the information collected by the callbacks. However, a custom login module does not need to act upon any of these callbacks. The following list explains the typical combinations of these callbacks:

- The `callbacks[0] = new javax.security.auth.callback.NameCallback("Username: ");` callback only

  This callback occurs for CSIv2 Identity Assertion; Web and CSIv2 X509 certificate logins; old-style Trust Association Interceptor logins, and so on. In Web and CSIv2 X509 certificate logins, WebSphere Application Server maps the certificate to a user name. This callback is used when by any login type that establishes trust using just the user name.
- Both the `callbacks[0] = new javax.security.auth.callback.NameCallback("Username: ");` callback and the `callbacks[1] = new javax.security.auth.callback.PasswordCallback("Password: ", false);` callbacks.

  This combination of callbacks is typical for basic authentication logins. Most user authentications occur using these two callbacks.
- The `callbacks[2] = new com.ibm.websphere.security.auth.callback.WSCredTokenCallbackImpl("Credential Token: ");` only

  This callback is used to validate a Lightweight Third Party Authentication (LTPA) token. This validation typically occurs during an single sign-on (SSO) or downstream login. Any time a request originates from a WebSphere Application Server, instead of a pure client, the LTPA token typically flows to the target server. For single signon (SSO), the LTPA token is received in the cookie and the token is used for login. If a custom login module needs the user name from an LTPA token, the module can use the following method to retrieve the uniqueID from the token:

  ```
  com.ibm.wsspi.security.token.WSSecurityPropagationHelper.
  validateLTPAToken(byte[])
  ```

  After retrieving the uniqueID, use the following method to get the user name:

  ```
  com.ibm.wsspi.security.token.WSSecurityPropagationHelper.
  getUserFromUniqueID(uniqueID)
  ```

  Important: Any time a custom login module is plugged in ahead of the WebSphere Application Server login modules and it changes the identity using the credential mapping services, it is important that this login module validates the LTPA token, if present. Calling the following method is sufficient to validate the trust in the LTPA token:

  ```
  com.ibm.wsspi.security.token.WSSecurityPropagationHelper.
  validateLTPAToken(byte[])
  ```

  The receiving server must have the same LTPA keys as the sending server in order for this to be successful. There is a possible security exposure if you do not validate this LTPA token, when present.
- A combination of any of the previously mentioned callbacks plus the `callbacks[3] = new com.ibm.wsspi.security.auth.callback.WSTokenHolderCallback("Authz Token List: ");` callback.

  This callback indicates that some propagated attributes have arrived at the server. The propagated attributes still require one of the following authentication methods:

- `callbacks[0] = new javax.security.auth.callback.NameCallback("Username: ");`
- `callbacks[1] = new javax.security.auth.callback.PasswordCallback("Password: ", false);`
- `callbacks[2] = new com.ibm.websphere.security.auth.callback.WSCredTokenCallbackImpl("Credential Token: ");`

If the attributes are added to the Subject from a pure client, then the NameCallback and PasswordCallback callbacks authenticate the information and the objects that are serialized in the token holder are added to the authenticated Subject.

If both CSIv2 Identity Assertion and propagation are enabled, WebSphere Application Server uses the NameCallback and the token holder, which contains all of the propagated attributes, to deserialize most of the objects. WebSphere Application Server uses the NameCallback only because trust is established with the servers that you indicate in the CSIv2 trusted server list. To specify trusted servers, click **Security > Authentication protocol > CSIv2 Inbound authentication**.

Custom serialization only needs to be handled by a custom login module. For more information, see "Security Attribute Propagation".

In addition to the callbacks defined previously, the WEB_INBOUND login configuration only can contain the following additional callbacks

Callback

```
callbacks[4] = new com.ibm.websphere.security.auth.callback.WSServletRequestCallback("HttpServletRequest: ");
```

Responsibility

Collects the HTTP servlet request object, if presented. This callback enables login modules to retrieve information from the HTTP request to use during a login.

Callback

```
callbacks[5] = new com.ibm.websphere.security.auth.callback.WSServletResponseCallback("HttpServletResponse: ");
```

Responsibility

Collects the HTTP servlet response object, if presented. This callback enables login modules to add information into the HTTP response as a result of the login. For example, login modules might add the SingleSignonCookie to the response.

Callback

```
callbacks[6] = new com.ibm.websphere.security.auth.callback.WSAppContextCallback("ApplicationContextCallback: ");
```

Responsibility

Collects the Web application context used during the login. This callback consists of a Hashtable, which contains the application name and the redirect Web address, if present.

The following login modules are pre-defined for the RMI_INBOUND, WEB_INBOUND, and DEFAULT system login configurations. You can add custom login modules before, between, or after any of these login modules, but you cannot remove these pre-defined login modules.

- `com.ibm.ws.security.server.lm.ltpaLoginModule`

This login module performs the primary login when attribute propagation is either enabled or disabled. A primary login uses normal authentication information such as a user ID and password; an LTPA token; or a trust association interceptor (TAI) and a certificate distinguished name (DN). If any of the following scenarios are true, this login module is not used and the `com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule` performs the primary login:

- The java.util.Hashtable object with the required user attributes is contained in the Subject.
- The java.util.Hashtable object with the required user attributes is present in the sharedState HashMap of the LoginContext.
- The WSTokenHolderCallback is present without a specified password. If a user name and a password are present with a WSTokenHolderCallback, which indicates propagated information, the request likely originates from either a pure client or a server from a different realm that mapped the existing identity to a user ID and password.

- `com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule`

  This login module performs the primary login using the normal authentication information if any of the following conditions are true:

  - A java.util.Hashtable object with required user attributes is contained in the Subject
  - A java.util.Hashtable object with required user attributes is present in the sharedState HashMap of the LoginContext
  - The WSTokenHolderCallback is present without a PasswordCallback.

  When the java.util.Hashtable object is present, the login module maps the object attributes into a valid Subject. When WSTokenHolderCallback is present, the login module deserializes the byte token objects and regenerates the serialized Subject contents. The java.util.Hashtable takes precedence over all of the other forms of login. Thus, be careful to avoid duplicating or overriding what WebSphere Application Server might have propagated previously. By specifying a java.util.Hashtable to take precedence over other authentication information, the custom login module must have already verified the LTPA token, if present, to establish sufficient trust. The custom login module can use the com.ibm.wsspi.security.token.WSSecurityPropagationHelper.validationLTPAToken(byte[]) method to validate the LTPA token present in the WSCredTokenCallback. Failure to validate the LTPA token presents a security risk.

  For more information on adding a Hashtable containing well-known and well-formed attributes used by WebSphere Application Server as sufficient login information, see ″Configuring inbound identity mapping″.

RMI_OUTBOUND:

Processes RMI requests that are sent outbound to another server when either the `com.ibm.CSI.rmiOutboundLoginEnabled` or the `com.ibm.CSIOutboundPropagationEnabled` properties are true.

These properties are set in the CSIv2 authentication panel. To access the panel, click **Security > Authentication protocol > CSIv2 Outbound authentication**. To set the `com.ibm.CSI.rmiOutboundLoginEnabled` property, select **Custom outbound mapping**. To set the `com.ibm.CSIOutboundPropagationEnabled` property, select the **Security attribute propagation** option.

This login configuration determines the security capabilities of the target server and its security domain. For example, if WebSphere Application Server Version

5.1.1 communicates with a version 5.x application server, then the version 5.1.1 application server sends the authentication information only, using an LTPA token, to the version 5.x application server. However, if WebSphere Application Server Version 5.1.1 communicates with a version 5.1.x application server, the authentication and authorization information is sent to the receiving application server if propagation is enabled at both the sending and receiving servers. When the application server sends both the authentication and authorization information downstream, it removes the need to re-access the user registry and look up the security attributes of the user for authorization purposes. Additionally, any custom objects added at the sending server should be present in the Subject at the downstream server.

The following callback is available to in the RMI_OUTBOUND login configuration. You can use the com.ibm.wsspi.security.csiv2.CSIv2PerformPolicy object returned by this callback to query the security policy for this particular outbound request. This query can help determine if the target realm is different than the current realm and if WebSphere Application Server must map the realm. For more information, see ″Configuring outbound mapping to a different target realm″.

Callback

```
callbacks[0] = new WSProtocolPolicyCallback("Protocol Policy
Callback: ");
```

Responsibility

Provides protocol-specific policy information for the login modules on this outbound invocation. This information is used to determine the level of security, including the target realm, target security requirements, and coalesced security requirements.

The following method obtains the CSIv2PerformPolicy from this specific login module:

```
csiv2PerformPolicy = (CSIv2PerformPolicy)
((WSProtocolPolicyCallback)callbacks[0]).getProtocolPolicy();
```

A different protocol other than RMI might have a different type of policy object.

The following login module is pre-defined in the RMI_OUTBOUND login configuration. You can add custom login modules before, between, or after any of these login modules, but you cannot remove these pre-defined login modules.

com.ibm.ws.security.lm.wsMapCSIv2OutboundLoginModule

Retrieves the following tokens and objects before creating an opaque byte that is sent to another server using the Common Secure Interoperability version 2 (CSIv2) authorization token layer:

- Forwardable com.ibm.wsspi.security.token.Token implementations from the Subject
- Serializable custom objects from the Subject
- Propagation tokens from the thread

You can use a custom login module prior to this login module to perform credential mapping. However, it is recommended that the login module change the contents of the Subject that is passed in during the login phase. If this recommendation is followed, the login modules processed after this login module act on the new Subject contents.

For more information, see ″Configuring outbound mapping to a different target realm″.

SWAM:

Processes login requests in a single server environment when SWAM is used as the authentication method.

Simple WebSphere Authentication Mechanism (SWAM) does not support forwardable credentials. When SWAM is the authentication method, WebSphere Application Server cannot send requests from server to server. In this case, you must use LTPA.

wssecurity.IDAssertion:

Processes login configuration requests for Web services security using identity assertion.

wssecurity.signature:

Processes login configuration requests for Web services security using digital signature validation.

LTPA_WEB:

Processes login requests used by the Web container such as servlets, JavaServer pages.

This login configuration is used by WebSphere Application Server Version 5.1. This login configuration was introduced in version 5.1 and is no longer used in version 5.1.1.

The `com.ibm.ws.security.web.AuthenLoginModule` login module is pre-defined in the LTPA login configuration. You can add custom login modules before or after this module in the LTPA_WEB login configuration.

The LTPA_WEB login configuration can process the HttpServletRequest object, the HttpServletResponse object, and the Web application name that are passed in using a callback handler. For more information, see ″Customizing a server-side Java Authentication and Authorization Service authentication and login configuration″ in the documentation.

LTPA:

Processes login requests that are not handled by the LTPA_WEB login configuration.

This login configuration is used by WebSphere Application Server Version 5.1 and previous versions.

The `com.ibm.ws.security.server.lm.ltpaLoginModule` login module is pre-defined in the LTPA login configuration. You can add custom login modules before or after this module in the LTPA login configuration. For more information, see ″Customizing a server-side Java Authentication and Authorization Service authentication and login configuration″ in the documentation.

Login module settings for Java Authentication and Authorization Service

Use this page to define the login module for a Java Authentication and Authorization Service (JAAS) login configuration.

5.1.1 You can define the JAAS login modules for application and system logins. To define these login module in the administrative console, use one of the following paths:

- Click **Security** > **JAAS Configuration** > **Application Logins** > *alias_name*. Under Additional Properties, click **JAAS Login Modules**.
- Click **Security** > **JAAS Configuration** > **System Logins** > *alias_name*. Under Additional Properties, click **JAAS Login Modules**.

Module Class Name:

Specifies the class name of the given login module.

Data type: String

Proxy class name:

Specifies the name of the proxy login module class.

The default login modules defined by the WebSphere product use a proxy LoginModule class, com.ibm.ws.security.common.auth.module.WSLoginModuleProxy. This proxy class loads the WebSphere login module with the thread context class loader and delegates all the operations to the *real* login module implementation. The real login module implementation is specified as the delegate option in the option configuration. The proxy class is needed because the Developer Kit application class loaders do not have visibility of the WebSphere product class loaders.

Data type: String

Authentication Strategy:

Specifies the authentication behavior as authentication proceeds down the list of login modules.

A JAAS authentication provider supplies the authentication strategy. In JAAS, an authentication strategy is implemented through the LoginModule interface.

Data type: String
Default: Required
Range: Required, Requisite, Sufficient and Optional

Specify additional options by clicking **Custom Properties** under Additional Properties. These name and value pairs are passed to the login modules during initialization. This process is one of the mechanisms used to passed information to login modules.

Module Order:

Specifies the order in which the Java Authentication and Authorization Service (JAAS) login modules are processed.

Click **Set Order** to change the processing order of the login modules.

Login module order settings for Java Authentication and Authorization Service

Use this page to specify the order in which WebSphere Application Server processes the login configuration modules.

You can specify the order of the login modules for application and system logins. To define these login modules in the administrative console, use one of the following paths:

- Click **Security > Application logins >** *alias*. Under Additional Properties, click **JAAS login modules > Set Order**.
- Click **Security > System logins >** *alias*. Under Additional Properties, click **JAAS login modules > Set Order**.

When you select one of the JAAS login module class names, you can move that class name up and down the list. After you press **OK** and save the changes, the new order is reflected on either the Application login configuration or System login configuration panel.

Application login configuration settings for Java Authentication and Authorization Service

Use this page to configure application login configurations.

To view this administrative console page, click **Security** > **JAAS Configuration** > **Application Logins** > *alias_name*.

Click **Apply** to save changes and to add the extra node name that precedes the original alias name. Clicking **OK** does not save the new changes in the `security.xml` file.

Alias:

Specifies the alias name of the application login.

Do not use the forward slash character (/) in the alias name when defining JAAS login configuration entries. The JAAS login configuration parser cannot process the forward slash character.

Data type: String

Java 2 Connector security

Java 2 Connector authentication data entries are used by resource adapters and Java database connectivity (JDBC) data sources. A Java 2 Connector authentication data entry contains authentication data.

The connector architecture defines a standard architecture for connecting the Java 2 Platform, Enterprise Edition (J2EE) to heterogeneous enterprise information systems (EIS). Examples of EIS include Enterprise Resource Planning (ERP), mainframe transaction processing (TP) and database systems.

The connector architecture enables an EIS vendor to provide a standard *resource adapter* for its EIS. A *resource adapter* is a system-level software driver that is used by a Java application to connect to an EIS. The resource adapter plugs into an application server and provides connectivity between the EIS, the application server, and the enterprise application. You must protect information in EIS from unauthorized access. The Java 2 Connector security architecture is designed to extend the end-to-end security model for J2EE-based applications to include integration with EISs. An application server and an EIS collaborate to ensure the proper authentication of a resource principal, which establishes a connection to an underlying EIS. The connector architecture identifies the following mechanisms as the commonly-supported authentication mechanisms:

- BasicPassword: Basic user-password-based authentication mechanism specific to an EIS
- Kerbv5: Kerberos Version 5-based authentication mechanism

WebSphere Application Server implementation of a Java 2 connection supports basic password authentication mechanisms.

The user ID and password for the target EIS is either supplied by applications or by the application server. WebSphere Application Server uses a Java Authentication and Authorization Service (JAAS) pluggable authentication mechanism to perform principal mapping to convert a WebSphere principal to a resource principal. WebSphere Application Server provides a DefaultPrincipalMapping LoginModule, which basically converts any authenticated principal to the pre-configured EIS resource principal and password. Subsequently, you can plug in a principal mapping LoginModule through the JAAS plug-in mechanism.

J2C mapping module configuration

When a Java 2 connection factory is configured for container-managed signon, WebSphere Application Server uses the configured principal mapping module to create a Subject instance that contains a user ID and a password for the target EIS.

Mapping modules are special JAAS login modules that provide principal and credential mapping functionality. You can define and configure custom mapping modules through the administrative console. Associated with the mapping module configuration is a set of user IDs and passwords that you can define in the security configuration with a specified alias name. The WebSphere Application Server run time passes the user ID, password and a reference of the connection factory manager to the configured mapping module to create a subject.

For more information about mapping module requirements, refer to the Javadoc of the WSDefaultPrincipalMapping class. For more detailed information about developing a mapping module, refer to the Developing your own Java 2 security mapping module article.

J2C mapping module programming reference

You can develop your own mapping module if your application requires more sophisticated mapping functions. You can use the WSSubject.getRunAsSubject() method to retrieve the subject that represents the identity of the current thread of execution. The identity of the current thread of execution is known as the RunAs identity. The RunAs subject typically contains a WSPrincipal in the principal set and a WSCredential in the public credential set. The subject instance that is created by your mapping module contains a Principal instance in the principals set and a PasswordCredential or GenericCredential instance in the set of private credentials.

Managing J2EE Connector Architecture authentication data entries

Java 2 Connector authentication data entries are used by resource adapters and Java database connectivity (JDBC) data sources. A Java 2 Connector authentication data entry contains authentication data, which contains the following information:

Alias An identifier used to identify the authenticated data entry. When configuring resource adapters or Java database connectivity (JDBC) data sources, the administrator can specify which authentication data to choose for the corresponding alias.

User ID
A user identity of the intended security domain. For example, if a particular authentication data entry is used to open a new connection to DB2, this entry contains a DB2 user identity.

Password
The password of the user identity is encoded in the configuration respository.

Description
A short text description.

This task creates and deletes Java 2 Connector (J2C) authentication data entries.

1. Delete a J2C authentication data entry.
   a. Click **Security** in the navigation tree, then click **JAAS Configuration** > **J2C Authentication Data**. The **J2C Authentication Data Entries** panel is displayed.
   b. Select the check boxes for the entries to delete and click **Delete**. Before deleting or removing an authentication data entry, make sure that it is not used or referenced by any resource adapter or JDBC data source. If the deleted authentication data entry is used or referenced by a resource, the application that uses the resource adapter or JDBC data source fails to connect to the resources.
2. Create a new J2C authentication data entry.
   a. Click **Security** in the navigation tree, then click **JAAS Configuration** > **J2C Authentication Data**. The **J2C Authentication Data Entries** panel is displayed.
   b. Click **New**.
   c. Enter a unique alias, a value user ID, a valid password, and a short description (optional).
   d. Click **OK** or **Apply**. No validation for the user ID and password is required.
   e. Click **Save**. For a Network Deployment installation, make sure that a file synchronized operation is performed to propagate the changes to other nodes.

A new J2C authentication data entry is created or an old entry is removed. The newly created entry is visible without restarting the application server process for use in the data source definition. But the entry is only in effect after the server is restarted. Specifically, the authentication data is loaded by an application server when starting an application and is shared among applications in the same application server.

If you create or update a data source that points to a newly created J2C authentication data alias, Test Connection fails to connect until you restart the deployment manager. After you restart the deployment manager, the J2C

authentication data is reflected in the run-time configuration. Any changes to the J2C authentication data fields require a deployment manager restart for the changes to take effect.

This step defines authentication data that you can share among resource adapters and JDBC data sources.

Use the authentication data entry defined in the resource adapters or JDBC data sources.

Java 2 Connector authentication data entry settings:

Use this page as a central place for administrators to define authentication data, which includes user identities and passwords. These values can reference authentication data entries by resource adapters, data sources, and other configurations that require authentication data using an alias.

You can display this page directly from the JAAS configuration page or from other pages for resources that use J2C authentication data entries. For example, to view this administrative page, you can click either **Security** > **JAAS Configuration** > **J2C Authentication Data Entries** or **Resources** > **WebSphere JMS Provider** > **WebSphere Queue Connection Factories** > *connection_factory* > **J2C Authentication Data Entries**.

Deleting authentication data entries: Be careful when deleting authentication data entries. If the deleted authentication data is used by other configurations, the initializing resources process fails.

Define a new authentication data entry by clicking **New**.

Alias:

Specifies the name of the authentication data entry.

Data type:	String
Units:	String
Default:	None

User ID:

Specifies the user identity.

Data type:	String

Description:

Specifies an optional description of the authentication data entry. For example, this authentication data entry is used to connect to DB2.

Data type:	String

Identity mapping

Identity mapping is a one-to-one mapping of a user identity between two servers to reflect the correct identity of the downstream server so that the proper

authorization decisions are made. Identity mapping is necessary when the integration of servers is needed, but the user registries are different and not shared between the systems.

In most cases, requests flow downstream between two servers that are part of the same security domain. In WebSphere Application Server, two servers that are members of the same cell are also members of the same security domain. In the same cell, the two servers have the same user registry and the same Lightweight Third Party Authentication (LTPA) keys for token encryption. These two commonalities ensure that the LTPA token (among other user attributes), which flows between the two servers, not only can be decrypted and validated, but also the user identity in the token can be mapped to attributes that are recognized by the authorization engine. The most reliable and recommended configuration involves two servers within the same cell. However, sometimes you need to integrate multiple systems that cannot use the same user registry. When the user registries are different between two servers, the security domain or realm of the target server does not match the security domain of the sending server.

In previous releases of WebSphere Application Server, the difference in user registries results in a NO_PERMISSION exception by the sending server due to a realm mismatch unless the *install_dir*/properties/wsserver.key file is configured with a many-to-one mapping of the target realm to a user ID and password. This configuration alternative still exists in WebSphere Application Server. However, in most cases, a one-to-one mapping is needed to keep the identity of the sender so that proper authorization decisions are made by downstream servers. Previous releases of WebSphere Application Server rejected the requests sent to target servers in a different realm due to security concerns. If you allow sensitive security and user information to be sent to a target server with a different realm that is not trusted, it might be possible for a rogue target server to intercept and record the security and user information it receives.

WebSphere Application Server now enables mapping to occur either before sending the request outbound or enables the existing security credentials to flow to the target server as-is with the knowledge that it is mapped inbound and with the specification that the target realm is trusted.

An alternative to mapping is to send the user identity without the token or password to a target server without actually mapping the identity. The use of the user identity is based on trust between the two servers. To do this alternative, use Common Secure Interoperability version 2 (CSIv2) identity assertion. This alternative feature, when enabled, sends just the X.509 certificate, principal name, or distinguished name (DN) based upon what was used by the original client to perform the initial authentication. During CSIv2 identity assertion, trust is established between the WebSphere Application Servers. The user identity must exist in the target user registry for identity assertion to work. This process can also enable interoperability between other Java 2 Platform, Enterprise Edition (J2EE) Version 1.3 and higher compliant application servers. When using identity assertion, if both the sending server and target servers have identity assertion configured, WebSphere Application Server always uses this method of authentication, even when both servers are in the same security domain. For more information on CSIv2 identity assertion, see “Identity assertion” on page 348.

When the user identity is not present in the user registry of the target server, identity mapping must occur either before the request is sent outbound or when the request comes inbound. This decision depends upon your environment and

requirements. However, it is typically easier to map the identity before the request is sent outbound because of the following reasons:

- You know the identity of the existing credential as it comes from the user registry of the sending server.
- You do not have to worry about sharing LTPA keys with the other target realm because you are not mapping the identity to LTPA credentials. Typically, you are mapping the identity to a user ID and password that is present in the user registry of the target realm.

When you do perform outbound mapping, in most cases, it is recommended that you use Secure Sockets Layer (SSL) to protect the integrity and confidentiality of the security information sent across the network. If LTPA keys are not shared between servers, an LTPA token cannot be validated at the inbound server. In this case, outbound mapping is necessary because the identity can not be determined at the inbound server to do inbound mapping. For more information, see "Configuring outbound mapping to a different target realm" on page 271.

When you need inbound mapping, potentially due to the mapping capabilities of the inbound server, you must ensure that both servers have the same LTPA keys so that you can get access to the user identity. Typically, in secure communications between servers, an LTPA token is passed into the WSCredTokenCallback of the inbound JAAS login configuration for the purposes of client authentication. A method is available that enables you to open the LTPA token, if valid, and get access to the user unique ID so that mapping can be performed. For more information, see "Configuring inbound identity mapping." In other cases, such as identity assertion, you might receive a user name in the NameCallback of the inbound login configuration that enables you to map the identity.

Configuring inbound identity mapping

For inbound identity mapping, it is recommend that you write a custom login module and configure WebSphere Application Server to run the login module first within the system login configurations. Consider the following steps when you write your custom login module:

1. Get the inbound user identity from the callbacks and map the identity, if necessary This step occurs in the login() method of the login module. A valid authentication has either or both of the following callbacks present: NameCallback and the WSCredTokenCallback. The following code sample shows you how to determine the user identity:

```
javax.security.auth.callback.Callback callbacks[] =
   new javax.security.auth.callback.Callback[3];
 callbacks[0] = new javax.security.auth.callback.NameCallback("");
 callbacks[1] = new javax.security.auth.callback.PasswordCallback
     ("Password: ", false);
 callbacks[2] = new com.ibm.websphere.security.auth.callback.
     WSCredTokenCallbackImpl("");
 callbacks[3] = new com.ibm.wsspi.security.auth.callback.
     WSTokenHolderCallback("");

 try
 {
  callbackHandler.handle(callbacks);
 }
 catch (Exception e)
```

```
{
 // Handles exceptions
 throw new WSLoginFailedException (e.getMessage(), e);
}

// Shows which callbacks contain information
boolean identitySwitched = false;
String uid = ((NameCallback) callbacks[0]).getName();
char password[] = ((PasswordCallback) callbacks[1]).getPassword();
byte[] credToken = ((WSCredTokenCallbackImpl) callbacks[2]).getCredToken();
java.util.List authzTokenList = ((WSTokenHolderCallback)
    callbacks[3]).getTokenHolderList();

if (credToken != null)
{
 try
 {
  String uniqueID = WSSecurityPropagationHelper.validateLTPAToken(credToken);
  String realm = WSSecurityPropagationHelper.getRealmFromUniqueID (uniqueID);
      // Now set the string to the UID so that you can use the result for either
      // mapping or logging in.
  uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);
 }
 catch (Exception e)
 {
  // Handles the exception
 }
}
else if (uid == null)
{
    // Throws an except if invalid authentication data exists.
    // You must have either UID or CredToken
 throw new WSLoginFailedException("invalid authentication data.");
}
else if (uid != null && password != null)
{
    // This is a typical authentication. You can choose to map this ID to
    // another ID or you can skip it and allow WebSphere Application Server
    // to login for you. When passwords are presented, be very careful to not
    // validate the password because this is the initial authentication.

 return true;
}

   // If desired, map this uid to something else and set the identitySwitched
   // boolean. If the identity was changed, clear the propagated attributes
   // below so they are not used incorrectly.
uid = myCustomMappingRoutine (uid);

   // Clear the propagated attributes because they no longer applicable to the
   // new identity
if (identitySwitched)
{
 ((WSTokenHolderCallback) callbacks[3]).setTokenHolderList(null);
}
```

2. Check to see if attribute propagation occurred and if the attributes for the user are already present when the identity remains the same. Check to see if the user attributes are already present from the sending server to avoid duplicate calls to the user registry lookup. To check for the user attributes, use a method on the WSTokenHolderCallback that analyzes the information present in the callback to determine if the information is sufficient for WebSphere Application Server to create a Subject. The following code sample checks for the user attributes:

   ```
   boolean requiresLogin =
   ((com.ibm.wsspi.security.auth.callback.WSTokenHolderCallback)
   callbacks[2]).requiresLogin();
   ```

   If sufficient attributes are not present to form the WSCredential and WSPrincipal objects needed to perform authorization, the previous code sample returns a true result. When the result is false, you can choose to discontinue processing as the necessary information exists to create the Subject without performing additional remote user registry calls.
3. Optional: Look up the required attributes from the user registry, put the attributes in hashtable, and add the hashtable to the shared state. If the identity is switched in this login module, you must complete the following steps:
   a. Create the hashtable of attributes as shown in the following example.
   b. Add the hashtable to shared state.

   If the identity is not switched, but the value of the `requiresLogin` code sample shown previously is true, you can create the hashtable of attributes. However, you are not required to create a hashtable in this situation as WebSphere Application Server handles the login for you. However, you might consider creating a hashtable to gather attributes in special cases where you are using your own special user registry. Creating a UserRegistry implementation, using a hashtable, and letting WebSphere Application Server gather the user attributes for you might be the easiest solution. The following table shows how to create a hashtable of user attributes:

   ```
   if (requiresLogin || identitySwitched)
    {
     // Retrives the default InitialContext for this server.
     javax.naming.InitialContext ctx = new javax.naming.InitialContext();

     // Retrieves the local UserRegistry implementation.
     com.ibm.websphere.security.UserRegistry reg = (com.ibm.websphere.
           security.UserRegistry)
     ctx.lookup("UserRegistry");

        // Retrieves the user registry uniqueID based on the uid specified
        // in the NameCallback.
     String uniqueid = reg.getUniqueUserId(uid);
      uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);

        // Retrieves the display name from the user registry based on the uniqueID.
     String securityName = reg.getUserSecurityName(uid);

        // Retrieves the groups associated with the uniqueID.
     java.util.List groupList = reg.getUniqueGroupIds(uid);

        // Creates the java.util.Hashtable with the information that you gathered
   ```

```
    // from the UserRegistry implementation.
  java.util.Hashtable hashtable = new java.util.Hashtable();
  hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
       WSCREDENTIAL_UNIQUEID, uniqueid);
     hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
       WSCREDENTIAL_SECURITYNAME, securityName);
  hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
       WSCREDENTIAL_GROUPS, groupList);

     // Adds a cache key that is used as part of the look up mechanism for
     // the created Subject. The cache key can be an object, but should have
     // an implemented toString() method. Make sure that the cacheKey contains
     // enough information to scope it to the user and any additional attributes
     // that you are using. If you do not specify this property the Subject is
     // scoped to the returned WSCREDENTIAL_UNIQUEID, by default.
  hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
        WSCREDENTIAL_CACHE_KEY, "myCustomAttribute" + uniqueid);
  // Adds the hashtable to the sharedState of the Subject.
  _sharedState.put(com.ibm.wsspi.security.token.AttributeNameConstants.
        WSCREDENTIAL_PROPERTIES_KEY, hashtable);
}
```

The following rules define in more detail how a hashtable login is performed. You must use a java.util.Hashtable object in either the Subject (public or private credential set) or shared state HashMap. The com.ibm.wsspi.security.token.AttributeNameConstants class defines the keys that contain the user information. If the hashtable object is put into the shared state of the login context using a custom login module that is listed prior to the Lightweight Third Party Authentication (LTPA) login module, the value of the java.util.Hashtable object is searched using the following key within the shared state hashMap:

Property
com.ibm.wsspi.security.cred.propertiesObject

Reference to the property
AttributeNameConstants.WSCREDENTIAL_PROPERTIES_KEY

Explanation
This key searches for the hashtable object that contains the required properties in sharedState of the login context.

Expected result
A java.util.Hashtable object.

If a java.util.Hashtable object is found either inside the Subject or within the sharedState area, verify that the following properties are present in the hashtable:

Property
com.ibm.wsspi.security.cred.uniqueId

Reference to the property
AttributeNameConstants.WSCREDENTIAL_UNIQUEID

Returns
java.util.String

Explanation
The value of the property must be a unique representation of the user. For the WebSphere Application Server default implementation, this

property represents the information that is stored in the application authorization table. The information is located in the application deployment descriptor after it is deployed and user-to-role mapping is performed. See the expected format examples if the user to role mapping is performed using a lookup to a WebSphere Application Server user registry implementation. If a third-party authorization provider overrides the user to role mapping, then the third-party authorization provider defines the format. To ensure compatibility with the WebSphere Application Server default implementation for the unique ID value, call the WebSphere Application Server `public String getUniqueUserId(String userSecurityName)` UserRegistry method.

Expected format examples

Realm	Format (uniqueUserId)
Lightweight Directory Access Protocol (LDAP)	`ldaphost.austin.ibm.com:389/cn=user,o=ibm,c=us`
Windows	`MYWINHOST/S-1-5-21-963918322-163748893-4247568029-500`
UNIX	`MYUNIXHOST/32`

The com.ibm.wsspi.security.cred.uniqueId property is required.

Property
com.ibm.wsspi.security.cred.securityName

Reference to the property
AttributeNameConstants. WSCREDENTIAL_ SECURITYNAME

Returns
java.util.String

Explanation
This property searches for the securityName of the authentication user. This name is commonly called the display name or short name. WebSphere Application Server uses the securityName attribute for the getRemoteUser(), getUserPrincipal() and getCallerPrincipal() application programming interfaces (APIs). To ensure compatibility with the WebSphere Application Server default implementation for the securityName value, call the WebSphere Application Server `public String getUserSecurityName(String uniqueUserId)` UserRegistry method.

Expected format examples

Realm	Format (uniqueUserId)
LDAP	user (*LDAP UID*)
Windows	user (*Windows username*)
UNIX	user (*UNIX username*)

The com.ibm.wsspi.security.cred.securityName property is required.

Property
com.ibm.wsspi.security.cred.groups

Reference to the property
AttributeNameConstants. WSCREDENTIAL_GROUPS

Returns
java.util.ArrayList

Explanation

This key searches for the ArrayList of realm-qualified groups to which this user belongs. The format of these groups is important as the groups are used by the WebSphere Application Server authorization engine for group-to-role mappings in the deployment descriptor. The format provided must match the format expected by the WebSphere Application Server default implementation. When you use a third-party authorization provider, you must use the format expected by the third-party provider. To ensure compatibility with the WebSphere Application Server default implementation for the unique group IDs value, call the WebSphere Application Server `public List getUniqueGroupIds(String uniqueUserId)` UserRegistry method.

Expected format examples for each group in the ArrayList

Realm	Format
LDAP	`ldap1.austin.ibm.com:389/cn=group1,o=ibm,c=us`
Windows	`MYWINREALM/S-1-5-32-544`
UNIX	`MY/S-1-5-32-544`

The com.ibm.wsspi.security.cred.groups property is not required. A user is not required to have associated groups.

Property

com.ibm.wsspi.security.cred.cacheKey

Reference to the property

AttributeNameConstants. WSCREDENTIAL_CACHE_KEY

Returns

java.lang.Object

Explanation

This key property can specify an Object that represents the unique properties of the login including the user-specific information and the user dynamic attributes that might affect uniqueness. For example, when the user logs in from location A, which might affect their access control, the cacheKey needs to include location A so that the Subject received is the correct Subject for the current location.

This com.ibm.wsspi.security.cred.cacheKey property is not required. When this property is not specified, the cache lookup is the value specified for WSCREDENTIAL_UNIQUEID. When this information is found in the java.util.Hashtable object, WebSphere Application Server creates a Subject similar to the Subject that goes through the normal login process (at least for LTPA). The new Subject contains a WSCredential object and a WSPrincipal object that is fully populated with the information found in the Hashtable object.

4. Add your custom login module into the RMI_INBOUND, WEB_INBOUND, and DEFAULT Java Authentication and Authorization Service (JAAS) system login configurations. Configure the RMI_INBOUND login configuration so that WebSphere Application Server loads your new custom login module first.
   a. Click **Security > JAAS Configuration > System logins > RMI_INBOUND**.
   b. Under Additional Properties, click **JAAS login modules > New** to add your login module to the RMI_INBOUND configuration.

c. Return to the JAAS login modules panel for RMI_INBOUND and click **Set order** to change the order that the login modules are loaded so that WebSphere Application Server loads your custom login module first.
d. Repeat the previous three steps for the WEB_INBOUND and DEFAULT login configurations.

This process configures identity mapping for an inbound request.

The "Example: Custom login module for inbound mapping" article shows a custom login module that creates a java.util.Hashtable based on the specified NameCallback. The java.util.Hashtable is added to the sharedState java.util.Map so that the WebSphere Application Server login modules can locate the information in the Hashtable.

Example: Custom login module for inbound mapping

This sample shows a custom login module that creates a java.util.Hashtable based on the specified NameCallback. The java.util.Hashtable is added to the sharedState java.util.Map so that the WebSphere Application Server login modules can locate the information in the Hashtable.

```
public customLoginModule()
{

public void initialize(Subject subject, CallbackHandler callbackHandler,
   Map sharedState, Map options)
{
 // (For more information on initialization, see
 //  "Custom login module development for a system login configuration" on page 67.)
 _sharedState = sharedState;
}

public boolean login() throws LoginException
{
 // (For more information on what to do during login, see
 //  "Custom login module development for a system login configuration" on page 67.)

   // Handles the WSTokenHolderCallback to see if this is an initial or
   // propagation login.
 javax.security.auth.callback.Callback callbacks[] =
     new javax.security.auth.callback.Callback[3];
 callbacks[0] = new javax.security.auth.callback.NameCallback("");
 callbacks[1] = new javax.security.auth.callback.PasswordCallback(
     "Password: ", false);
 callbacks[2] = new com.ibm.websphere.security.auth.callback.
     WSCredTokenCallbackImpl("");
 callbacks[3] = new com.ibm.wsspi.security.auth.callback.
     WSTokenHolderCallback("");

 try
 {
  callbackHandler.handle(callbacks);
 }
 catch (Exception e)
 {
  // Handles the exception
 }
```

```
// Determines which callbacks contain information
boolean identitySwitched = false;
String uid = ((NameCallback) callbacks[0]).getName();
char password[] = ((PasswordCallback) callbacks[1]).getPassword();
byte[] credToken = ((WSCredTokenCallbackImpl) callbacks[2]).getCredToken();
java.util.List authzTokenList = ((WSTokenHolderCallback) callbacks[3]).
    getTokenHolderList();

if (credToken != null)
{
 try
 {
  String uniqueID = WSSecurityPropagationHelper.validateLTPAToken(credToken);
  String realm = WSSecurityPropagationHelper.getRealmFromUniqueID (uniqueID);
      // Set the string to the UID so you can use the information to either
      // map or login.
  uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);
 }
 catch (Exception e)
 {
  // handle exception
 }
}
else if (uid == null)
{
 // Invalid authentication data. You must have either UID or CredToken
 throw new WSLoginFailedException("invalid authentication data.");
}
else if (uid != null && password != null)
{
    // This is a typical authentication. You can choose to map this ID to
    // another ID or you can skip it and allow WebSphere Application Server
    // to login for you. When passwords are presented, be very careful not to
    // validate the password because this is the initial authentication.

 return true;
}

 // If desired, map this uid to something else and set the identitySwitched
 // boolean. If the identity is changed, clear the propagated attributes below
 // so they are not used incorrectly.
uid = myCustomMappingRoutine (uid);

// Clear the propagated attributes because they no longer apply to the new identity
if (identitySwitched)
{
 ((WSTokenHolderCallback) callbacks[3]).setTokenHolderList(null);
}
boolean requiresLogin = ((com.ibm.wsspi.security.auth.callback.
    WSTokenHolderCallback) callbacks[2]).requiresLogin();

if (requiresLogin || identitySwitched)
{
 // Retrieves the default InitialContext for this server.
 javax.naming.InitialContext ctx = new javax.naming.InitialContext();
```

```
// Retrieves the local UserRegistry object.
com.ibm.websphere.security.UserRegistry reg =
     (com.ibm.websphere.security.UserRegistry) ctx.lookup("UserRegistry");

// Retrieves the registry uniqueID based on the uid that is specified
   // in the NameCallback.
String uniqueid = reg.getUniqueUserId(uid);
 uid = WSSecurityPropagationHelper.getUserFromUniqueID (uniqueID);

// Retrieves the display name from the user registry based on the uniqueID.
String securityName = reg.getUserSecurityName(uid);

// Retrieves the groups associated with this uniqueID.
java.util.List groupList = reg.getUniqueGroupIds(uid);

// Creates the java.util.Hashtable with the information that you gathered
   // from the UserRegistry.
java.util.Hashtable hashtable = new java.util.Hashtable();
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
     WSCREDENTIAL_UNIQUEID, uniqueid);
   hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
     WSCREDENTIAL_SECURITYNAME, securityName);
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
     WSCREDENTIAL_GROUPS, groupList);

// Adds a cache key that is used as part of the look up mechanism for
// the created Subject. The cache key can be an object, but should have
// an implemented toString() method. Make sure the cacheKey contains enough
// information to scope it to the user and any additional attributes you are
   // using. If you do not specify this property, the Subject is scoped to the
// WSCREDENTIAL_UNIQUEID returned, by default.
hashtable.put(com.ibm.wsspi.security.token.AttributeNameConstants.
     WSCREDENTIAL_CACHE_KEY, "myCustomAttribute" + uniqueid);
// Adds the hashtable to the sharedState of the Subject.
_sharedState.put(com.ibm.wsspi.security.token.AttributeNameConstants.
     WSCREDENTIAL_PROPERTIES_KEY, hashtable);
}
else if (requiresLogin == false)
{
 // For more information on this section, see
   // "Security attribute propagation" on page 276.
 // If you added a custom Token implementation, you can search through the
   // token holder list for it to deserialize.
 // Note: Any Java objects are automatically deserialized by
   // wsMapDefaultInboundLoginModule

 for (int i=0; i<authzTokenList.size(); i++)
 {
  if (authzTokenList[i].getName().equals("com.acme.MyCustomTokenImpl")
  {
   byte[] myTokenBytes = authzTokenList[i].getBytes();

         // Passes these bytes into the constructor of your implementation
         // class for deserialization.
   com.acme.MyCustomTokenImpl myTokenImpl =
```

```
            new com.acme.MyCustomTokenImpl(myTokenBytes);
    }
   }
  }
}

public boolean commit() throws LoginException
{
 // (For more information on what to do during a commit, see
  //   "Custom login module development for a system login configuration" on page 67.)

 // Not doing anything here for this specific example
}

// Defines your login module variables
com.ibm.wsspi.security.token.AuthorizationToken customAuthzToken = null;
com.ibm.wsspi.security.token.AuthenticationToken defaultAuthToken = null;
java.util.Map _sharedState = null;
}
```

Configuring outbound mapping to a different target realm

By default, when WebSphere Application Server makes an outbound request from one server to another server in a different security realm, the request is rejected. This request is rejected to protect against a rogue server reading potentially sensitive information if successfully impersonating the home of the object. The following alternatives are available to enable one server to send outbound requests to a target server in a different realm:

- Do not perform mapping, instead, allow the existing security information to flow to a trusted target server even if the target server resides in a different realm. To allow information to flow to a server in a different realm, complete the following steps in the administrative console:
  1. Click **Security > Authentication Protocol > CSIv2 Outbound authentication**.
  2. Specify the target realms in the **Trusted target realms** field. You can specify each trusted target realm separated by a pipe (|) character. For example, specify *server_name.domain:port_number* for a Lightweight Directory Access Protocol (LDAP) server or the machine name for Local OS. If you want to propagate security attributes to a different target realm, you must specify that target realm in the **Trusted target realms** field.
- Use the Java Authentication and Authorization Service (JAAS) WSLogin application login configuration to create a basic authentication Subject that contains the credentials of the new target realm. This configuration enables you to login with a realm, user ID, and password that are specific to the user registry of the target realm. You can provide the login information from within the Java 2 Platform, Enterprise Edition (J2EE) application that is making the outbound request or from within the RMI_OUTBOUND system login configuration. These two login options are described in the following information:
  1. Use the WSLogin application login configuration from within the J2EE application to login and get a Subject that contains the user ID and the password of the target realm. The application then can wrap the remote call with a WSSubject.doAs() call. For an example, see "Example: Using WSLogin to create a basic authentication subject" on page 273.
  2. Use the code sample in "Example: Using WSLogin to create a basic authentication subject" on page 273 from this plug point within the

RMI_OUTBOUND login configuration. Every outbound Remote Method Invocation (RMI) request passes through this login configuration when it is enabled. Complete the following steps to enable and plug in this login configuration:

a. Click **Security > Authentication Protocol > CSIv2 Outbound authentication**.

b. Select the **Custom outbound mapping** option. If the **Security Attribute Propagation** option is selected, then WebSphere Application Server is already using this login configuration and you do not need to enable custom outbound mapping.

c. Write a custom login module. For more information, see "Custom login module development for a system login configuration" on page 67.

   The "Example: Sample login configuration for RMI_OUTBOUND" on page 274 article shows a custom login module that determines whether the realm names match. In this example, the realm names do not match so WSLogin is used to create a basic authentication Subject based on custom mapping rules. The custom mapping rules are specific to the customer environment and must be implemented using a realm to user ID and password mapping utility.

d. Configure the RMI_OUTBOUND login configuration so that your new custom login module is first in the list.

   1) Click **Security > JAAS Configuration > System logins > RMI_OUTBOUND**.

   2) Under Additional Properties, click **JAAS login modules > New** to add your login module to the RMI_OUTBOUND configuration.

   3) Return to the JAAS login modules panel for RMI_OUTBOUND and click **Set order** to change the order that the login modules are loaded so that your custom login is loaded first.

- Add the use_realm_callback and use_appcontext_callback options to the outbound mapping module for WSLogin. To add these options, complete the following steps:

  1. Click **Security > JAAS Configuration > Application Logins > WSLogin**.
  2. Under Additional Properties, click **JAAS Login Modules > com.ibm.ws.security.common.auth.module.WSLoginModuleImpl**.
  3. Under Additional Properties, click **Custom Properties > New**.
  4. On the Custom Properties panel, enter `use_realm_callback` in the **Name** field and `true` in the **Value** field.
  5. Click **OK**.
  6. Click **New** to enter the second custom property.
  7. On the Custom Properties panel, enter `use_appcontext_callback` in the **Name** field and `true` in the **Value** field.
  8. Click **OK**.

  As a result of these custom property additions, the following changes are made to the `security.xml` file:

```
<entries xmi:id="JAASConfigurationEntry_2" alias="WSLogin">
 <loginModules xmi:id="JAASLoginModule_2"
  moduleClassName="com.ibm.ws.security.common.auth.module.proxy.WSLoginModuleProxy"
  authenticationStrategy="REQUIRED">
  <options xmi:id="Property_2" name="delegate"
   value="com.ibm.ws.security.common.auth.module.WSLoginModuleImpl"/>
```

```
    <options xmi:id="Property_3" name="use_realm_callback" value="true"/>
    <options xmi:id="Property_4" name="use_appcontext_callback" value="true"/>
   </loginModules>
  </entries>
```

Example: Using WSLogin to create a basic authentication subject

This example shows how to use the WSLogin application login configuration from within a Java 2 Platform, Enterprise Edition (J2EE) application to login and get a Subject that contains the user ID and the password of the target realm

```
 javax.security.auth.Subject subject = null;

try
{
  // Create a login context using the WSLogin login configuration and specify a
  // user ID, target realm, and password. Note: If the target_realm_name is the
  // same as the current realm, an authenticated Subject is created. However, if
  // the target_realm_name is different from the current realm, a basic
  // authentication Subject is created that is not validated. This unvalidated
  // Subject is created so that you can send a request to the different target
  // realm with valid security credentials for that realm.
  javax.security.auth.login.LoginContext ctx = new LoginContext("WSLogin",
   new WSCallbackHandlerImpl("userid", "target_realm_name", "password"));

  // Note: The following is an alternative that  validates the user ID and
  // password specified against the target realm. It will perform a remote call
  // to the target server and will return  true if the user ID and password are
  // valid and false if the user ID and password are invalid. If false is
  // returned, a WSLoginFailedException is thrown. You can catch that exception and
  // perform a retry or stop the request from flowing by allowing that exception to
  // surface out of this login.

  // ALTERNATIVE LOGIN CONTEXT THAT VALIDATES THE USER ID AND PASSWORD TO THE
  // TARGET REALM

  /****  currently remarked out ****
  java.util.Map appContext = new java.util.HashMap();
              appContext.put(javax.naming.Context.INITIAL_CONTEXT_FACTORY,
                             "com.ibm.websphere.naming.WsnInitialContextFactory");
              appContext.put(javax.naming.Context.PROVIDER_URL,
                             "corbaloc:iiop:target_host:2809");

  javax.security.auth.login.LoginContext ctx = new LoginContext("WSLogin",
   new WSCallbackHandlerImpl("userid", "target_realm_name", "password", appContext));
  **** currently remarked out  ****/

  // Starts the login
  ctx.login();

  // Gets the Subject from the context
  subject = ctx.getSubject();
 }
 catch (javax.security.auth.login.LoginException e)
 {
  throw new com.ibm.websphere.security.auth.WSLoginFailedException (e.getMessage(), e);
```

```
 }

 if (subject != null)
 {
  // Defines a privileged action that encapsulates your remote request.
java.security.PrivilegedAction myAction = java.security.PrivilegedAction()
  {
   public Object run()
   {
    // Assumes a proxy is already defined. This example method returns a String
    return proxy.remoteRequest();
   }
  });

  // Executes this action using the basic authentication Subject needed for
     // the target realm security requirements.
  String myResult = (String) com.ibm.websphere.security.auth.WSSubject.doAs
        (subject, myAction);
 }
```

Example: Sample login configuration for RMI_OUTBOUND

This example shows a sample login configuration for RMI_OUTBOUND that determines whether the realm names match between two servers.

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
     // (For more information on what to do during initialization, see
     // "Custom login module development for a system login configuration" on page 67.)
 }

 public boolean login() throws LoginException
 {
     // (For more information on what to do during login, see
     // "Custom login module development for a system login configuration" on page 67.)

  // Gets the WSProtocolPolicyCallback object
  Callback callbacks[] = new Callback[1];
   callbacks[0] = new com.ibm.wsspi.security.auth.callback.
          WSProtocolPolicyCallback("Protocol Policy Callback: ");

  try
  {
   callbackHandler.handle(callbacks);
  }
  catch (Exception e)
  {
   // Handles the exception
  }

     // Receives the RMI (CSIv2) policy object for checking the target realm
     // based upon information from the IOR.
     // Note: This object can be used to perform additional security checks.
     // See the Javadoc for more information.
```

```
 csiv2PerformPolicy = (CSIv2PerformPolicy) ((WSProtocolPolicyCallback)callbacks[0]).
       getProtocolPolicy();

 // Checks if the realms do not match. If they do not match, then login to
    // perform a mapping
 if (!csiv2PerformPolicy.getTargetSecurityName().equalsIgnoreCase(csiv2PerformPolicy.
        getCurrentSecurityName()))
 {
  try
  {
   // Do some custom realm -> user ID and password mapping
   MyBasicAuthDataObject myBasicAuthData = MyMappingLogin.lookup
         (csiv2PerformPolicy.getTargetSecurityName());

         // Creates the login context with basic authentication data gathered from
         // custom mapping
    javax.security.auth.login.LoginContext ctx = new LoginContext("WSLogin",
     new WSCallbackHandlerImpl(myBasicAuthData.userid,
       csiv2PerformPolicy.getTargetSecurityName(),
                   myBasicAuthData.password));

    // Starts the login
    ctx.login();

            // Gets the Subject from the context. This subject is used to replace
            // the passed-in Subject during the commit phase.
    basic_auth_subject = ctx.getSubject();
   }
   catch (javax.security.auth.login.LoginException e)
   {
    throw new com.ibm.websphere.security.auth.
              WSLoginFailedException (e.getMessage(), e);
   }
 }
}

public boolean commit() throws LoginException
{
    // (For more information on what to do during commit, see
    // "Custom login module development for a system login configuration" on page 67.)

 if (basic_auth_subject != null)
 {
      // Removes everything from the current Subject and adds everything from the
      // basic_auth_subject
  try
  {
   public final Subject basic_auth_subject_priv = basic_auth_subject;
         // Do this in a doPrivileged code block so that application code
         // does not need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.
            PrivilegedExceptionAction()
   {
    public Object run() throws WSLoginFailedException
    {
              // Removes everything user-specific from the current outbound
```

```
                // Subject. This a temporary Subject for this specific invocation
                // so you are not affecting the Subject set on the thread. You may
                // keep any custom objects that you want to propagate in the Subject.
                // This example removes everything and adds just the new stuff
                // back in.
            try
            {
             subject.getPublicCredentials().clear();
             subject.getPrivateCredentials().clear();
             subject.getPrincipals().clear();
            }
            catch (Exception e)
            {
             throw new WSLoginFailedException (e.getMessage(), e);
            }

                // Adds everything from basic_auth_subject into the login subject.
                // This completes the mapping to the new user.
            try
            {
             subject.getPublicCredentials().addAll(basic_auth_subject.
                         getPublicCredentials());
             subject.getPrivateCredentials().addAll(basic_auth_subject.
                         getPrivateCredentials());
             subject.getPrincipals().addAll(basic_auth_subject.
                         getPrincipals());
            }
            catch (Exception e)
            {
             throw new WSLoginFailedException (e.getMessage(), e);
            }

            return null;
           }
          });
         }
         catch (PrivilegedActionException e)
         {
          throw new WSLoginFailedException (e.getException().getMessage(),
                   e.getException());
         }
        }
       }

       // Defines your login module variables
       com.ibm.wsspi.security.csiv2.CSIv2PerformPolicy csiv2PerformPolicy = null;
       javax.security.auth.Subject basic_auth_subject = null;
      }
```

Security attribute propagation

Security attribute propagation enables WebSphere Application Server to transport security attributes (authenticated Subject contents and security context information) from one server to another in your configuration. WebSphere Application Server might obtain these security attributes from either an enterprise user registry, which queries static attributes, or a custom login module, which can query static or

dynamic attributes. Dynamic security attributes, which are custom in nature, might include the authentication strength used for the connection, the identity of the original caller, the location of the original caller, the IP address of the original caller, and so on.

Security attribute propagation provides propagation services using Java serialization for any objects contained in the Subject. However, Java must be able to serialize and de-serialize these objects. The Java programming language specifies the rules for how Java can serialize an object. Because there can be problems when dealing with different platforms and versions of software, WebSphere Application Server also offers a token framework that enables custom serialization functionality. The token framework has other benefits that include the ability to identify the uniqueness of the token. This uniqueness determines how the Subject gets cached and the purpose of the token. The token framework defines four marker token interfaces that enable the WebSphere Application Server run time to determine how to propagate the token.

Important: Any custom tokens that are used in this framework are not used by WebSphere Application Server for authorization or authentication. The framework serves as a way to notify WebSphere Application Server that you want these tokens propagated in a particular way. WebSphere Application Server handles the propagation details, but does not handle serialization or de-serialization of custom tokens. The serialization of custom tokens is handled by the token framework calling the getBytes() method on all forwardable tokens in the invocation Subject. The implementation of the getBytes() method determines whether the byte array is encoded or encrypted. The de-serialization of custom tokens is handled by a custom login module plugged into inbound system login configurations. The token byte array is found by iterating through the information provided in the WSTokenHolderCallback passed into the inbound login configuration.

When a request is being authenticated, a determination is made by the login modules whether this is an *initial login* or a *propagation login*. An initial login is the process of authenticating the user information, typically a user ID and password, and then calling the application programming interfaces (APIs) for the remote user registry to look up secure attributes that represent the user access rights. A propagation login is the process of validating the user information, typically an Lightweight Third Party Authentication (LTPA) token, and then deserializing a series of tokens that constitute both custom objects and token framework objects known to the WebSphere Application Server.

The following marker tokens are introduced in the framework:

Authorization token

The authorization token contains most of the authorization-related security attributes that are propagated. The default AuthorizationToken is used by the WebSphere Application Server authorization engine to make Java 2 Platform, Enterprise Edition (J2EE) authorization decisions. Service providers can use custom AuthorizationToken implementations to isolate their data in a different token; perform custom serialization and de-serialization; and make custom authorization decisions using the information in their token at the appropriate time. For information on how to use and implement this token type, see “Default AuthorizationToken” on page 300 and “Implementing a custom AuthorizationToken” on page 304.

Single signon (SSO) token

A custom SingleSignonToken added to the Subject is automatically added to the response as an HTTP cookie and contains the attributes sent back to Web browsers. The token interface getName() method together with the getVersion() method defines the cookie name. WebSphere Application Server defines a default SingleSignonToken with the LtpaToken name and version 2. The cookie name added is LtpaToken2. Do not add sensitive information, confidential information, or unencrypted data to the response cookie. It is also recommended that any time that you use cookies, use the Secure Sockets Layer (SSL) protocol to protect the request. Using an SSO token, Web users can authenticate once when accessing Web resources across multiple WebSphere Application Servers. A custom SSO token extends this functionality by adding custom processing to the single signon scenario. For more information on SSO tokens, see "Configuring single signon" on page 173. For information on how to use and implement this token type, see "Default SingleSignonToken" on page 314 and "Implementing a custom SingleSignonToken" on page 315.

Propagation token

The PropagationToken is not associated with the authenticated user thus it is not stored in the Subject. Instead, the PropagationToken is stored on the thread and follows the invocation wherever it goes. When a request is sent outbound to another server, the propagation tokens on that thread are sent with the request and are carried out by the target server. The attributes stored on the thread are propagated regardless of the Java 2 Platform, Enterprise Edition (J2EE) RunAs user switches. The default PropagationToken monitors and logs all user switches and host switches. You can add additional information to the default PropagationToken using the WSSecurityHelper application programming interfaces (APIs). To retrieve and set custom implementations of a propagation token, you can use the WSSecurityPropagationHelper class. For information on how to use and implement this token type, see "Default PropagationToken" on page 284 and "Implementing a custom PropagationToken" on page 290.

Authentication token

The AuthenticationToken flows to downstream servers and contains the identity of the user. This token type serves the same function as the Lightweight Third Party Authentication (LTPA) token in previous versions. Although this token type is typically reserved for internal WebSphere Application Server purposes, you can add this token to the Subject and the token is propagated using the getBytes() method of the token interface. A custom AuthenticationToken is used solely for the purpose of the service provider that adds it to the Subject. WebSphere Application Server do not use it for authentication purposes, because a default AuthenticationToken exists that is used for WebSphere Application Server authentication. This token type is available for the service provider to identify the purpose of the custom data to use the token to perform custom authentication decisions. For information on hot to use and implement this token type, see "Default AuthenticationToken" on page 328 and "Implementing a custom AuthenticationToken" on page 329.

Horizontal propagation versus downstream propagation

In WebSphere Application Server, both horizontal propagation, which is uses single signon for Web requests, and downstream propagation, which uses Remote Method Invocation over the Internet Inter-ORB Protocol (RMI/IIOP) to access enterprise beans, are available.

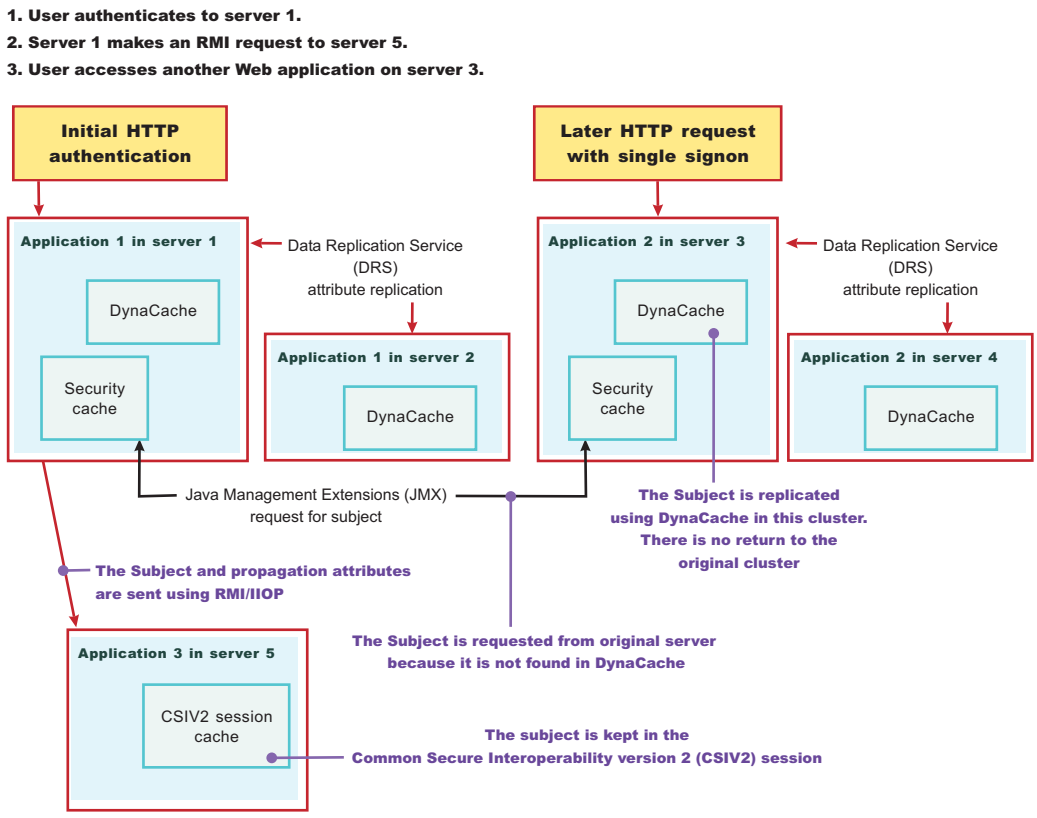
Horizontal propagation

In horizontal propagation, security attributes are propagated amongst front-end servers. The serialized security attributes, which are the Subject contents and the PropagationTokens, can contain both static and dynamic attributes. The single signon (SSO) token stores additional system-specific information that is needed for horizontal propagation. The information contained in the SSO token tells the receiving server where the originating server is located and how to communicate with that server. Additionally, the SSO token also contains the key to lookup the serialized attributes. In order to enable horizontal propagation, you must configure the single signon token and the Web inbound security attribute propagation features. You can configure both of these features using the administrative console by clicking **Security > Authentication Mechanisms > LTPA**. Under Additional Properties, click **Single signon (SSO)**. For more information, see "Enabling security attribute propagation" on page 282.

When front-end servers are configured and in the same distributed replication service (DRS) replication domain, the application server automatically propagates the serialized information to all of the servers within the same domain. In figure 1, application 1 is deployed on server 1 and server 2, and both servers are members of the same DRS replication domain. If a request originates from application 1 on server and then gets redirected to application 1 on server 2, the original login attributes are found on server 2 without additional remote requests. However, if the request originates from application 1 on either server 1 or server 2, but the request is redirected to application 2 on either server 1 or server 2, the serialized information is not found in the DRS cache because the servers are not configured in the same replication domain. As a result, a remote Java Management Extensions (JMX) request is sent back to the originating server that hosts application 1 to obtain the serialized information so that original login information is available to the application. By getting the serialized information using a single JMX remote call back to the originating server, the following benefits are realized:

- You gain the function of retrieving login information from the original server.
- You do not need to perform any remote user registry calls because the application server can regenerate the Subject from the serialized information. Without this ability, the application server might make 5 to 6 separate remote calls.

Figure 1



Performance implications for horizontal propagation

The performance implications of either the DRS or JMX remote call alternative for obtaining the original login attributes depends upon your environment. Horizontal propagation reduces many of the remote user registry calls in cases where these calls cause the most performance problems for an application. However, the de-serialization of these objects also might cause performance degradation, but this degradation might be less than the remote user registry calls. It is recommended that you test your environment with horizontal propagation enabled and disabled. In cases where you must use horizontal propagation for preserving original login attributes, test whether DRS or JMX provides better performance in your environment. Typically, it is recommended that you configure DRS both for failover and performance reasons. However, because DRS propagates the information to all of the servers in the same replication domain, whether the servers are accessed, , there may be a performance degradation if too many servers are in the same replication domain. In this case, either reduce the number of servers in the replication domain or do not configure the servers in a DRS replication domain. The later suggestion causes a JMX remote call to retrieve the attributes, when needed, which might be quicker overall.

Downstream propagation

In *downstream propagation*, a Subject is generated at the Web front-end server, either by a propagation login or a user registry login. WebSphere Application Server propagates the security information downstream for enterprise bean invocations when both Remote Method Invocation (RMI) outbound and inbound propagation is enabled.

Benefits of propagating security attributes

The security attribute propagation feature of WebSphere Application Server has the following benefits:

- Enables WebSphere Application Server to use the security attribute information for authentication and authorization purposes. The propagation of security attributes can eliminate the need for user registry calls at each remote hop along an invocation. Previous versions of WebSphere Application Server propagated only the user name of the authenticated user, but ignored other security attribute information that needed to be regenerated downstream using remote user registry calls. To accentuate the benefits of this new functionality, consider the following example:

  In previous releases, you might use a Reverse Proxy Server (RPS), such as WebSEAL, to authenticate the user, gather group information, and gather other security attributes. Prior to WebSphere Application Server Version 5.1.1, the application server used to accept only the identity of the authenticated user, but disregarded the additional security attribute information. To create a Java Authentication and Authorization Service (JAAS) Subject containing the needed WSCredential and WSPrincipal objects, WebSphere Application Server made 5 to 6 calls to the user registry. The WSCredential object contains various security information required to authorize a J2EE resource. The WSPrincipal object contains the realm name and the user that represents the principal for the Subject.

  In the current release of the application server, information obtained from the RPS can be used by WebSphere Application Server and propagated downstream to other server resources without additional calls to the user registry. The retaining of the security attribute information enables you to protect server resources properly by making appropriate authorization and trust-based decisions User switches that occur due to J2EE RunAs configurations do not cause the application server to lose the original caller information. This information is stored in the PropagationToken located on the running thread.
- Enables third-party providers to plug in custom tokens. The token interface contains a getBytes() method that enables the token implementation to define custom serialization, encryption methods, or both.
- Provides the ability to have multiple tokens of the same type within a Subject created by different providers. WebSphere Application Server can handle multiple tokens for the same purpose. For example, you might have multiple authorization tokens in the Subject and each token might have distinct authorization attributes that are generated by different providers.
- Provides the ability to have a unique ID for each token type that is used to formulate a more unique subject identifier than just the user name in cases where dynamic attributes might change the context of a user login. The token type has a getUniqueId() method that is used for returning a unique string for caching purposes. For example, you might need to propagate a location ID, which indicates the location from which the user logged into the system. This location ID can be generated during the original login using either an RPS or the WEB_INBOUND login configuration and added to the Subject prior to serialization. Other attributes might be added to the Subject as well and use a unique ID. All of the unique IDs must be considered for the uniqueness of the entire Subject. WebSphere Application Server has the ability to specify what is unique about the information in the subject, which might affect how the used access the Subject later.

Enabling security attribute propagation

The security attribute propagation feature of WebSphere Application Server enables you to send security attribute information regarding the original login to other servers using a token. To fully enable security attribute propagation, you must configure the single signon (SSO), CSIv2 inbound, and CSIv2 outbound panels in the WebSphere Application Server Administrative Console. You can enable just the portions of security attribute propagation relevant to your configuration. For example, you can enable Web propagation, which is propagation amongst front-end application servers, using either the push technique (DynaCache) or the pull technique (remote method to originating server). You also can choose whether to enable Remote Method Invocation (RMI) outbound and inbound propagation, which is commonly called downstream propagation. Typically both types of propagation are enabled for any given cell. In some cases, you might want to choose a different option for a specific application server using the server security panel within the specific application server settings. To access the server security panel in the administrative console, click **Servers > Application Servers > *server_name***. Under Additional properties, click **Server security > Server level security**.

Complete the following steps to configure WebSphere Application Server for security attribute propagation:

1. Access the WebSphere Application Server administrative console by typing http://*server_name*:9090/admin The administrative console address might differ if you have previously changed the port number.
2. Click **Security > Authentication Mechanisms > LTPA**. Under Additional Properties, click **Single Signon (SSO)**.
3. Optional: Select the **Interoperability Mode** option if you need to interoperate with servers that do not support security attribute propagation. Servers that do not support security attribute propagation receive the Lightweight Third Party Authentication (LTPA) token and the PropagationToken, but ignore the security attribute information that it does not understand.
4. Select the **Web inbound security attribute propagation** option. The **Web inbound security attribute propagation** option enables horizontal propagation, which allows the receiving SSO token to retrieve the login information from the original login server. If you do not enable this option, downstream propagation can occur if you enable the **Security Attribute Propagation** option on both the CSIv2 Inbound authentication and CSIv2 outbound authentication panels.

   Typically, you enable the **Web inbound security attribute propagation** option if you need to gather dynamic security attributes set at the original login server that cannot be regenerated at the new front-end server. This attributes include any custom attributes that might be set in the PropagationToken using the com.ibm.websphere.security.WSSecurityHelper application programming interfaces (APIs). You must determine whether enabling this option improves or degrades the performance of your system. While the option prevents some remote user registry calls, the deserialization and decryption of some tokens might impact performance. In some cases, propagation is faster especially if your user registry is the bottleneck of your topology. It is recommended that you measurement the performance of your environment using and not using this option. When you test the performance, it is recommended that you test in the operating environment of the typical production environment with the typical number of unique users accessing the system simultaneously.

5. Click **Security > Authentication Protocol > CSIv2 Inbound authentication**. The **Login configuration** field specifies `RMI_INBOUND` as the system login configuration used for inbound requests. To add custom Java Authentication and Authorization Service (JAAS) login modules, complete the following steps:
   a. Click **Security > JAAS Configuration > System Logins**. A list of the system login configurations is displayed. WebSphere Application Server provides the following pre-configured system login configurations: DEFAULT, LTPA, LTPA_WEB, RMI_INBOUND, RMI_OUTBOUND, SWAM, WEB_INBOUND, wssecurity.IDAssertion, and wssecurity.Signature. Do not delete these predefined configurations.
   b. Click the name of the login configuration that you want to modify.
   c. Under Additional Properties, click **JAAS Login Modules**. The JAAS Login Modules panel is displayed, which lists all of the login modules processed in the login configuration. Do not delete the required JAAS login modules. Instead, you can add custom login modules before or after the required login modules. If you add custom login modules, do not begin their names with com.ibm.ws.security.server because this prefix is reserved for WebSphere Application Server internal use.

      You can specify the order in which the login modules are processed by clicking **Set Order**.
6. Select the **Security Attribute Propagation** option on the CSIv2 Inbound authentication panel. When you select **Security Attribute Propagation**, the server advertises to other application servers that it can receive propagated security attributes from another server in the same realm over the Common Secure Interoperability version 2 (CSIv2) protocol.
7. Click **Security > Authentication protocol > CSIv2 Outbound authentication**. The CSIv2 outbound authentication panel is displayed. The **Login configuration** field specifies `RMI_OUTBOUND` as JAAS login configuration that is used for outbound configuration. You cannot change this login configuration. Instead, you can customize this login configuration by completing the substeps listed previously for CSIv2 Inbound authentication.
8. Optional: Select the **Custom Outbound Mapping** option if the **Security Attribute Propagation** option, on this same panel, is not selected and you want to use the RMI_OUTBOUND login configuration. If the **Custom Outbound Mapping** option nor the **Security Attribute Propagation** option is selected, WebSphere Application Server does not call the RMI_OUTBOUND login configuration. If you need to plug in a credential mapping login module, you must select the **Custom Outbound Mapping** option.
9. Optional: Select the **Security Attribute Propagation** option to enable outbound Subject and security context token propagation for the Remote Method Invocation (RMI) protocol. When you select this option, WebSphere Application Server serializes the Subject contents and the PropagationToken contents. After the contents are serialized, the server uses the Common Secure Interoperability version 2 (CSIv2) protocol to send the Subject and PropagationToken to the target servers that support security attribute propagation. If the receiving server does not support security attribute tokens, WebSphere Application Server sends the Lightweight Third Party Authentication (LTPA) token only.

   Important: WebSphere Application Server propagates only the objects within the Subject that it can serialize. The server propagates custom objects on a best-effort basis.

When **Security Attribute Propagation** is enabled, WebSphere Application Server adds marker tokens to the Subject to enable the target server to add additional attributes during the inbound login. During the commit phase of the login, the marker tokens and the Subject are marked as read-only and cannot be modified thereafter.

10. Optional: Specify trusted target realm names in the **Trusted Target Realms** field. By specifying these realm names, information can be sent to servers that reside outside the realm of the sending server to allow for inbound mapping to occur at these downstream servers. To perform outbound mapping to a realm different from the current realm, you must specify the realm in this field so that you can get to this point without the request being rejected due to a realm mismatch. If you need WebSphere Application Server to propagate security attributes to another realm when a request is sent, you must specify the realm name in the **Trusted Target Realms** field. Otherwise, the security attributes are not propagated to the unspecified realm. You can add multiple target realms by adding a pipe (|) delimiter between each entry.
11. Optional: Enable propagation for a pure client. For a pure client to propagate attributes added to the invocation Subject, you must add the following property to the `sas.client.props` file:

    ```
    com.ibm.CSI.rmiOutboundPropagationEnabled=true
    ```

After completing these steps, you have configured WebSphere Application Server to propagate security attributes to other servers. After you have configured WebSphere Application Server for security attribute propagation and need to disable this functionality, you can disable propagation for either the server level or the cell level. To disable security attribute propagation on the server level, click **Server > Application Servers >***server_name*. Under Additional Properties, click **Server security**. You can disable security attribute propagation for inbound requests by clicking **CSI Authentication > Inbound** under Additional Properties and deselecting **Security attribute propagation**. You can disable security attribute propagation for outbound requests by clicking **CSI Authentication > Outbound** under Additional Properties and deselecting **Security attribute propagation**. To disable security attribute propagation on the cell level, undo each of the steps that you completed to enable security attribute propagation in this task.

Default PropagationToken

A default PropagationToken is located on the thread of execution for applications and the security infrastructure to use. WebSphere Application Server propagates this default PropagationToken downstream and the token stays on the thread where the invocation lands at each hop. The data should be available from within the container of any resource where the PropagationToken lands. Remember that you must enable the propagation feature at each server where a request is sent in order for propagation to work. See “Enabling security attribute propagation” on page 282 to make sure that you have enabled security attribute propagation for all of the cells in your environment where you want propagation

There is a WSSecurityHelper class that has application programming interfaces (APIs) for accessing the PropagationToken attributes. This article documents the usage scenarios and includes examples. A close relationship exists between PropagationToken and the WorkArea feature. The main difference between these features is that after you add attributes to the PropagationToken, you cannot change the attributes. You cannot change these attributes so that the security run time can add auditable information and have that information remain there for the

life of the invocation. Any time that you add an attribute to a specific key, an ArrayList is stored to hold that attribute. Any new attribute added with the same key is added to the ArrayList. When you call getAttributes, the ArrayList is converted to a String[] and the order is preserved. The first element in the String[] is the first attribute added for that specific key.

In the default PropagationToken, a change flag is kept that logs any data changes to the token. These changes are tracked to enable WebSphere Application Server to know when to re-send the authentication information downstream so that the downstream server has those changes. Normally, Common Secure Interoperability Version 2 (CSIv2) maintains a session between servers for an authenticated client. If the PropagationToken changes, a new session is generated and subsequently a new authentication occurs. Frequent changes to the PropagationToken during a method causes frequent downstream calls. If you change the token prior to making many downstream calls, but you change the token between each downstream call, you might impact security performance.

Getting the server list from the default PropagationToken

Every time the PropagationToken is propagated and used to create the authenticated Subject, either horizontally or downstream, the name of the receiving application server is logged into the PropagationToken. The format of the host is ″Cell:Node:Server″, which provides you access to the cell name, node name, and server name of each application server that receives the invocation. The following code provides you with this list of names and can be called from a Java 2 Platform, Enterprise Edition (J2EE) application:

```
String[] server_list = null;

// If security is disabled on this application server, do not bother checking
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  // Gets the server_list string array
  server_list = com.ibm.websphere.security.WSSecurityHelper.getServerList();
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }

 if (server_list != null)
 {
  // print out each server in the list, server_list[0] is the first server
  for (int i=0; i<server_list.length; i++)
  {
   System.out.println(″Server[″ + i + ″] = ″ + server_list[i]);
  }
 }
}
```

The format of each server in the list is: *cell*:*node*:*server*. The output, for example, is:
`myManager:node1:server1`

Getting the caller list from the default PropagationToken

A default PropagationToken is generated any time an authenticated user is set on the thread of execution or any one tries to add attributes to the PropagationToken. Whenever an authenticated user is set on the thread, the user is logged in the default PropagationToken. There may be some pushing and popping of Subjects by the authorization code. At times, the same user might be logged in multiple times if the RunAs user is different from the caller. The following list provides the rules that are used to determine if a user added to the thread gets logged into the PropagationToken:

- The current Subject must be authenticated. For example, an unauthenticated Subject is not logged.
- The current authenticated Subject is logged if a Subject has not been previously logged.
- The current authenticated Subject is logged if the last authenticated Subject logged does not contain the same user.
- The current authenticated Subject is logged on each unique application server involved in the propagation process.

The following code sample shows how to use the getCallerList() API:

```
String[] caller_list = null;

// If security is disabled on this application server, do not check the caller list
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  // Gets the caller_list string array
  caller_list = com.ibm.websphere.security.WSSecurityHelper.getCallerList();
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }

 if (caller_list != null)
 {
  // Prints out each caller in the list, caller_list[0] is the first caller
  for (int i=0; i<caller_list.length;i++)
  {
   System.out.println("Caller[" + i + "] = " + caller_list[i]);
  }
 }
}
```

The format of each caller in the list is: *cell*:*node*:*server*:*realm*/*securityName*. The output, for example, is:
`myManager:node1:server1:ldap.austin.ibm.com:389/jsmith`.

Getting the first caller from the default PropagationToken

Whenever you want to know which authenticated caller started the request, you can call the getFirstCaller method and the caller list is parsed. However, this method returns the securityName of the caller only. If you need to know more

than the securityName, call the getCallerList() method and retrieve the first entry in the String[]. This entry provides the entire caller information. The following code sample retrieves the securityName of the first authenticated caller using the getFirstCaller() API:

```
String first_caller = null;

// If security is disabled on this application server, do not bother checking
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  // Gets the first caller
  first_caller = com.ibm.websphere.security.WSSecurityHelper.getFirstCaller();

  // Prints out the caller name
  System.out.println("First caller: " + first_caller);
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }
}
```

The output, for example, is: `jsmith`.

Getting the first host from the default PropagationToken

Whenever you want to know what the first application server is for this request, you can call the getFirstServer() method directly. The following code sample retrieves the name of the first application server using the getFirstServer() API:

```
String first_server = null;

// If security is disabled on this application server, do not bother checking
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  // Gets the first server
  first_server = com.ibm.websphere.security.WSSecurityHelper.getFirstServer();

  // Prints out the server name
  System.out.println("First server: " + first_server);
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }
}
```

The output, for example, is: `myManager:node1:server1`.

Adding custom attributes to the default PropagationToken

You can add custom attributes to the default PropagationToken for application usage. This token follows the request downstream so that the attributes are available when they are needed. When you use the default PropagationToken to add attributes, you must understand the following issues:

- When you add information to the PropagationToken, it affects CSIv2 session caching. Add information sparingly between remote requests.
- After you add information with a specific key, the information cannot be removed.
- You can add as many values to a specific key as your need. However, all of the values must be available from a returned String[] in the order they were added.
- The PropagationToken is available only on servers where propagation and security are enabled.
- The Java 2 Security javax.security.auth.AuthPermission wssecurity.addPropagationAttribute is needed to add attributes to the default PropagationToken.
- An application cannot use keys that begin with either com.ibm.websphere.security or com.ibm.wsspi.security. These prefixes are reserved for system usage.

The following code sample shows how to use the addPropagationAttribute API:

```
// If security is disabled on this application server,
    // do not check the status of server security
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  // Specifies the key and values
  String key = "mykey";
  String value1 = "value1";
  String value2 = "value2";

  // Sets key, value1
      com.ibm.websphere.security.WSSecurityHelper.
      addPropagationAttribute (key, value1);

  // Sets key, value2
  String[] previous_values = com.ibm.websphere.security.WSSecurityHelper.
         addPropagationAttribute (key, value2);

  // Note: previous_values should contain value1
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }
}
```

See Getting custom attributes from the default PropagationToken to retrieve attributes using the getPropagationAttributes application programming interface (API).

Getting custom attributes from the default PropagationToken

Custom attributes are added to the default PropagationToken using the addPropagationAttribute API. These attributes can be retrieved using the getPropagationAttributes API. This token follows the request downstream so the attributes are available when they are needed. When you use the default PropagationToken to retrieve attributes, you must understand the following issues.

- The PropagationToken is available only on servers where propagation and security are enabled.
- The Java 2 Security javax.security.auth.AuthPermission wssecurity.getPropagationAttributes is needed to retrieve attributes from the default PropagationToken.

The following code sample shows how to use the getPropagationAttributes API:

```
// If security is disabled on this application server, do not bother checking
if (com.ibm.websphere.security.WSSecurityHelper.isServerSecurityEnabled())
{
 try
 {
  String key = "mykey";
  String[] values = null;

  // Sets key, value1
      values = com.ibm.websphere.security.WSSecurityHelper.
      getPropagationAttributes (key);

  // Prints the values
  for (int i=0; i<values.length; i++)
  {
   System.out.println("Value[" + i + "] = " + values[i]);
  }
 }
 catch (Exception e)
 {
  // Performs normal exception handling for your application
 }
}
```

The output, for example, is:

```
Value[0] = value1
Value[1] = value2
```

See Adding custom attributes to the default PropagationToken to add attributes using the addPropagationAttributes API.

Changing the TokenFactory associated with the default PropagationToken

When WebSphere Application Server generates a default PropagationToken, the application server utilizes the TokenFactory class that is specified using the com.ibm.wsspi.security.token.propagationTokenFactory property. To modify this property using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.

The default TokenFactory specified for this property is called com.ibm.ws.security.ltpa.AuthzPropTokenFactory. This token factory encodes the data in the PropagationToken and does not encrypt the data. Because the PropagationToken typically flows over Common Secure Interoperability version 2 (CSIv2) using Secure Sockets Layer (SSL), there is no need to encrypt the token itself. However, if you need additional security for the PropagationToken, you can associate a different TokenFactory implementation with this property to get encryption. For example, if you choose to associate com.ibm.ws.security.ltpa.LTPAToken2Factory with this property, the token is AES encrypted. However, you need to weigh the performance impacts against your security needs. Adding sensitive information to the PropagationToken is a good reason to change the TokenFactory implementation to something that encrypts rather than just encodes.

If you want to perform your own signing and encryption of the default PropagationToken, you must implement the following classes:

- com.ibm.wsspi.security.ltpa.Token
- com.ibm.wsspi.security.ltpa.TokenFactory

Your TokenFactory implementation instantiates and validates your token implementation. You can choose to use the Lightweight Third Party Authentication (LTPA) keys passed into the initialize method of the TokenFactory or you can use your own keys. If you use your own keys, they must be the same everywhere in order to validate the tokens that are generated using those keys. See the Javadoc, available through a link on the front page of the information center, for more information on implementing your own custom TokenFactory. To associate your TokenFactory with the default PropagationToken, using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.
3. Locate the com.ibm.wsspi.security.token.propagationTokenFactory property and verify that the value of this property matches your custom TokenFactory implementation.
4. Verify that your implementation classes are put into the *install directory*/classes directory so that the WebSphere class loader can load the classes.

Implementing a custom PropagationToken

This task explains how you might create your own PropagationToken implementation, which is set on the thread of execution and propagated downstream. The default PropagationToken usually is sufficient for propagating attributes that are not user-specific. Consider writing your own implementation if you want to accomplish one of the following tasks:

- Isolate your attributes within your own implementation.
- Serialize the information using custom serialization. You must deserialize the bytes at the target and add that information back on the thread by plugging in a custom login module into the inbound system login configurations. This task also might include encryption and decryption.

To implement a custom Propagation token, you must complete the following steps:

1. Write a custom implementation of the PropagationToken interface. There are many different methods for implementing the PropagationToken interface.

However, make sure that the methods required by the PropagationToken interface and the token interface are fully implemented. After you implement this interface, you can place it in the *install_dir*/classes directory. Alternatively, you can place the class in any private directory . However, make sure that the WebSphere Application Server class loader can locate the class and that it is granted the appropriate permissions. You can add the Java archive (JAR) file or directory that contains this class into the server.policy file so that it has the necessary permissions that are needed by the server code.

Tip: All of the token types defined by the propagation framework have similar interfaces. Basically, the token types are marker interfaces that implement the com.ibm.wsspi.security.token.Token interface. This interface defines most of the methods. If you plan to implement more than one token type, consider creating an abstract class that implements the com.ibm.wsspi.security.token.Token interface. All of your token implementations, including the PropagationToken, might extend the abstract class and then most of the work is completed.

To see an implementation of PropagationToken, see "Example: com.ibm.wsspi.security.token.PropagationToken implementation" on page 292

2. Add and receive the custom PropagationToken during WebSphere Application Server logins This task is typically accomplished by adding a custom login module to the various application and system login configurations. You also can add the implementation from an application. However, in order to deserialize the information, you will need to plug in a custom login module, which is discussed in "Propagating a custom Java serializable object" on page 339. The WSSecurityPropagationHelper class has APIs that are used to set a PropagationToken on the thread and to retrieve it from the thread to make updates.

   The code sample in "Example: custom PropagationToken login module" on page 298 shows how to determine if the login is an initial login or a propagation login. The difference between these login types is whether the WSTokenHolderCallback contains propagation data. If the callback does not contain propagation data, initialize a new custom PropagationToken implementation and set it on the thread. If the callback contains propagation data, look for your specific custom PropagationToken TokenHolder instance, convert the byte[] back into your customer PropagationToken object, and set it back on the thread. The code sample shows both instances.

   You can add attributes any time your custom PropagationToken is added to the thread. If you add attributes between requests and the getUniqueId method changes, then the CSIv2 client session is invalidated so that it can send the new information downstream. Keep in mind that adding attributes between requests can affect performance. In many cases, this is the desired behavior so that downstream requests receive the new PropagationToken information.

   To add the custom PropagationToken to the thread, call WSSecurityPropagationHelper.addPropagationToken. This call requires the following Java 2 Security permission: WebSphereRuntimePerMission ″setPropagationToken″

3. Add your custom login module to WebSphere Application Server system login configurations that already contain the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule for receiving serialized versions of your custom propagation token Also, you can add this login module to any of the application logins where you might want to generate your custom PropagationToken on the thread during the login. Alternatively, you can generate the custom PropagationToken implementation

from within your application. However, to deserialize it, you need to add the implementation to the system login modules.

For information on how to add your custom login module to the existing login configurations, see "Custom login module development for a system login configuration" on page 67

After completing these steps, you have implemented a custom PropagationToken.

Example: com.ibm.wsspi.security.token.PropagationToken implementation

Use this file to see an example of a PropagationToken implementation. The following sample code does not extend an abstract class, but rather implements the com.ibm.wsspi.security.token.PropagationToken interface directly. You can implement the interface directly, but it might cause you to write duplicate code. However, you might choose to implement the interface directly if there are considerable differences between how you handle the various token implementations.

For information on how to implement a custom PropagationToken, see "Implementing a custom PropagationToken" on page 290.

```
package com.ibm.websphere.security.token;

import com.ibm.websphere.security.WSSecurityException;
import com.ibm.websphere.security.auth.WSLoginFailedException;
import com.ibm.wsspi.security.token.*;
import com.ibm.websphere.security.WebSphereRuntimePermission;
import java.io.ByteArrayOutputStream;
import java.io.ByteArrayInputStream;
import java.io.DataOutputStream;
import java.io.DataInputStream;
import java.io.ObjectOutputStream;
import java.io.ObjectInputStream;
import java.io.OutputStream;
import java.io.InputStream;
import java.util.ArrayList;

public class CustomPropagationTokenImpl implements com.ibm.wsspi.security.
   token.PropagationToken
{
 private java.util.Hashtable hashtable = new java.util.Hashtable();
 private byte[] tokenBytes = null;
   // 2 hours in millis, by default
  private static long expire_period_in_millis = 2*60*60*1000;
 private long counter = 0;

/**
 * The constructor that is used to create initial PropagationToken instance
 */

 public CustomAbstractTokenImpl ()
 {
  // set the token version
  addAttribute("version", "1");
  // set the token expiration
  addAttribute("expiration", new Long(System.currentTimeMillis() +
```

```
        expire_period_in_millis).toString());
 }

/**
 * The constructor that is used to deserialize the token bytes received
 * during a propagation login.
 */
 public CustomAbstractTokenImpl (byte[] token_bytes)
 {
  try
  {
       hashtable = (java.util.Hashtable) com.ibm.wsspi.security.token.
         WSOpaqueTokenHelper.deserialize(token_bytes);
  }
  catch (Exception e)
  {
   e.printStackTrace();
  }
 }

/**
 * Validates the token including expiration, signature, and so on.
 * @return boolean
 */

 public boolean isValid ()
 {
  long expiration = getExpiration();

  // if you set the expiration to 0, it's does not expire
  if (expiration != 0)
  {
   // return if this token is still valid
   long current_time = System.currentTimeMillis();

   boolean valid = ((current_time < expiration) ? true : false);
   System.out.println("isValid: returning " + valid);
   return valid;
  }
  else
  {
   System.out.println("isValid: returning true by default");
   return true;
  }
 }

/**
 * Gets the expiration as a long type.
 * @return long
 */
 public long getExpiration()
 {
  // get the expiration value from the hashtable
  String[] expiration = getAttributes("expiration");

  if (expiration != null && expiration[0] != null)
```

```
  {
   // expiration is the first element (should only be one)
   System.out.println("getExpiration: returning " + expiration[0]);
   return new Long(expiration[0]).longValue();
  }

  System.out.println("getExpiration: returning 0");
  return 0;
 }

/**
 * Returns if this token should be forwarded/propagated downstream.
 * @return boolean
 */
 public boolean isForwardable()
 {
     // You can choose whether your token gets propagated. In some cases
     // you might want the token to be local only.
  return true;
 }

/**
 * Gets the principal that this token belongs to. If this token is an
 * authorization token, this principal string must match the authentication
 * token principal string or the message is rejected.
 * @return String
 */
 public String getPrincipal()
 {
  // It is not necessary for the PropagtionToken to return a principal,
     // because it is not user-centric.
  return "";
 }

/**
 * Returns the unique identifier of the token based upon information that
 * the provider considers makes it a unique token. This identifier is used
 * for caching purposes and might be used in combination with other token
 * unique IDs that are part of the same Subject.
 *
 * This method should return null if you want the accessID of the user to
 * represent its uniqueness. This is the typical scenario.
 *
 * @return String
 */
 public String getUniqueID()
 {
     // If you want to propagate the changes to this token, change the
     // value that this unique ID returns whenever the token is changed.
     // Otherwise, CSIv2 uses an existing session when everything else is
     // the same. This getUniqueID ischecked by CSIv2 to determine the
     // session lookup.
  return counter;
 }

/**
```

```
 * Gets the bytes to be sent across the wire. The information in the byte[]
 * needs to be enough to recreate the Token object at the target server.
 * @return byte[]
 */
 public byte[] getBytes ()
 {
  if (hashtable != null)
  {
   try
   {
     // Do this if the object is set to read-only during login commit
     // because this guarantees that no new data is set.
    if (isReadOnly() && tokenBytes == null)
     tokenBytes = com.ibm.wsspi.security.token.WSOpaqueTokenHelper.
               serialize(hashtable);

     // You can deserialize this in the downstream login module using
         //  WSOpaqueTokenHelper.deserialize()
    return tokenBytes;
   }
   catch (Exception e)
   {
    e.printStackTrace();
    return null;
   }
  }

  System.out.println("getBytes: returning null");
  return null;
 }

/**
 * Gets the name of the token, which is used to identify the byte[] in the
 * protocol message.
 * @return String
 */
 public String getName()
 {
  return this.getClass().getName();
 }

/**
 * Gets the version of the token as an short type. This code also is used
 * to identify the byte[] in the protocol message.
 * @return short
 */
 public short getVersion()
 {
  String[] version = getAttributes("version");

  if (version != null && version[0] != null)
   return new Short(version[0]).shortValue();

  System.out.println("getVersion: returning default of 1");
  return 1;
    }
```

```
/**
 * When called, the token becomes irreversibly read-only. The implementation
 * needs to ensure that any setter methods check that this read-only flag has
 * been set.
 */
 public void setReadOnly()
 {
  addAttribute("readonly", "true");
 }

/**
 * Called internally to see if the token is readonly
 */
 private boolean isReadOnly()
 {
  String[] readonly = getAttributes("readonly");

  if (readonly != null && readonly[0] != null)
   return new Boolean(readonly[0]).booleanValue();

  System.out.println("isReadOnly: returning default of false");
  return false;
 }

/**
 * Gets the attribute value based on the named value.
 * @param String key
 * @return String[]
 */
 public String[] getAttributes(String key)
 {
  ArrayList array = (ArrayList) hashtable.get(key);

  if (array != null && array.size() > 0)
  {
   return (String[]) array.toArray(new String[0]);
  }

  return null;
 }

/**
 * Sets the attribute name and value pair. Returns the previous values set
 * for the key, or returns null if the value is not previously set.
 * @param String key
 * @param String value
 * @returns String[];
 */
 public String[] addAttribute(String key, String value)
 {
  // Gets the current value for the key
  ArrayList array = (ArrayList) hashtable.get(key);

  if (!isReadOnly())
  {
```

```
   // Increments the counter to change the uniqueID
   counter++;

   // Copies the ArrayList to a String[] as it currently exists
   String[] old_array = null;
   if (array != null && array.size() > 0)
    old_array = (String[]) array.toArray(new String[0]);

   // Allocates a new ArrayList if one was not found
   if (array == null)
    array = new ArrayList();

   // Adds the String to the current array list
   array.add(value);

   // Adds the current ArrayList to the Hashtable
   hashtable.put(key, array);

   // Returns the old array
   return old_array;
  }

  return (String[]) array.toArray(new String[0]);
 }


/**
 * Gets the list of all of the attribute names present in the token.
 * @return java.util.Enumeration
 */
 public java.util.Enumeration getAttributeNames()
 {
  return hashtable.keys();
 }

/**
 * Returns a deep clone of this token. This is typically used by the session
 * logic of the CSIv2 server to create a copy of the token as it exists in the
 * session.
 * @return Object
 */
 public Object clone()
 {
  com.ibm.websphere.security.token.CustomPropagationTokenImpl deep_clone =
   new com.ibm.websphere.security.token.CustomPropagationTokenImpl();

  java.util.Enumeration keys = getAttributeNames();

  while (keys.hasMoreElements())
  {
   String key = (String) keys.nextElement();

   String[] list = (String[]) getAttributes(key);

   for (int i=0; i<list.length; i++)
    deep_clone.addAttribute(key, list[i]);
```

```
  }

      return deep_clone;
 }
}
```

Example: custom PropagationToken login module

This file shows how to determine if the login is an initial login or a propagation login

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
         Map sharedState, Map options)
 {
  // (For more information on what to do during initialization, see
     // "Custom login module development for a system login configuration" on page 67.)
 }

 public boolean login() throws LoginException
 {
  // (For more information on what to do during login, see
     // "Custom login module development for a system login configuration" on page 67.)

  // Handles the WSTokenHolderCallback to see if this is an initial
     // or propagation login.
  Callback callbacks[] = new Callback[1];
  callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");

  try
  {
   callbackHandler.handle(callbacks);
  }
  catch (Exception e)
  {
   // handle exception
  }

  // Receives the ArrayList of TokenHolder objects (the serialized tokens)
  List authzTokenList = ((WSTokenHolderCallback) callbacks[0]).getTokenHolderList();

  if (authzTokenList != null)
  {
   // Iterates through the list looking for your custom token
   for (int i=0; i<authzTokenList.size(); i++)
   {
    TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

    // Looks for the name and version of your custom PropagationToken implementation
    if (tokenHolder.getName().equals("
              com.ibm.websphere.security.token.CustomPropagationTokenImpl") &&
        tokenHolder.getVersion() == 1)
    {
     // Passes the bytes into your custom PropagationToken constructor
            //  to deserialize
     customPropToken = new
```

```
    com.ibm.websphere.security.token.CustomPropagationTokenImpl(tokenHolder.
                getBytes());

   }
  }
 }
 else // This is not a propagation login. Create a new instance of
         // your PropagationToken implementation
 {
  // Adds a new custom propagation token. This is an initial login
  customPropToken = new com.ibm.websphere.security.token.CustomPropagationTokenImpl();

  // Adds any initial attributes
  if (customPropToken != null)
  {
   customPropToken.addAttribute("key1", "value1");
   customPropToken.addAttribute("key1", "value2");
   customPropToken.addAttribute("key2", "value1");
   customPropToken.addAttribute("key3", "something different");
  }
 }

 // Note: You can add the token to the thread during commit in case
    // something happens during the login.
}

public boolean commit() throws LoginException
{
 // For more information on what to do during commit, see
    // "Custom login module development for a system login configuration" on page 67
 if (customPropToken != null)
 {
  // Sets the propagation token on the thread
  try
  {

   System.out.println(tc, "*** ADDED MY CUSTOM PROPAGATION TOKEN TO THE THREAD ***");
   // Prints out the values in the deserialized propagation token
   java.util.Enumeration keys = customPropToken.getAttributeNames();
   while (keys.hasMoreElements())
   {
    String key = (String) keys.nextElement();
    String[] list = (String[]) customPropToken.getAttributes(key);
    for (int k=0; k<list.length; k++)
    System.out.println("Key/Value: " + key + "/" + list[k]);
   }

   // This sets it on the thread using getName() + getVersion() as the key
   com.ibm.wsspi.security.token.WSSecurityPropagationHelper.addPropagationToken(
             customPropToken);
  }
  catch (Exception e)
  {
   // Handles exception
  }
```

```
  // Now you can verify that you have set it properly by trying to get
      // it back from the thread and print the values.
  try
  {
   // This gets the PropagationToken from the thread using getName()
         // and getVersion() parameters.
   com.ibm.wsspi.security.token.PropagationToken tempPropagationToken =
    com.ibm.wsspi.security.token.WSSecurityPropagationHelper.getPropagationToken
     ("com.ibm.websphere.security.token.CustomPropagationTokenImpl", 1);

   if  (tempPropagationToken != null)
   {
    System.out.println(tc, "*** RECEIVED MY CUSTOM PROPAGATION
              TOKEN FROM THE THREAD ***");
    // Prints out the values in the deserialized propagation token
    java.util.Enumeration keys = tempPropagationToken.getAttributeNames();
    while (keys.hasMoreElements())
    {
     String key = (String) keys.nextElement();
     String[] list = (String[]) tempPropagationToken.getAttributes(key);
     for (int k=0; k<list.length; k++)
     System.out.println("Key/Value: " + key + "/" + list[k]);
    }
   }
  }
  catch (Exception e)
  {
   // Handles exception
  }
 }
}

// Defines your login module variables
com.ibm.wsspi.security.token.PropagationToken customPropToken = null;

}
```

Default AuthorizationToken

This article explains how WebSphere Application Server uses the default AuthorizationToken. Consider using the default AuthorizationToken when you are looking for a place to add string attributes that will get propagated downstream. However, make sure that the attributes that you add to the AuthorizationToken are specific to the user associated with the authenticated Subject. If they are not specific to a user, the attributes probably belong in the PropagationToken, which is also propagated with the request. For more information on the PropagationToken, see "Default PropagationToken" on page 284. To add attributes into the AuthorizationToken, you must plug in a custom login module into the various system login modules that are configured. Any login module configuration that has the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule implementation configured can receive propagated information and can generate propagation information that can be sent outbound to another server

If propagated attributes are not presented to the login configuration during an initial login, a default AuthorizationToken is created in the

wsMapDefaultInboundLoginModule after the login occurs in the ltpaLoginModule. A reference to the default AuthorizationToken can be obtained from the login() method using the sharedState hashmap. You must plug in the custom login module after the wsMapDefaultInboundLoginModule implementation for WebSphere Application Server to see the default AuthorizationToken..

For more information on the Java Authentication and Authorization Service (JAAS) programming model, see "Security: Resources for learning" on page 495.

Important: Whenever you plug in a custom login module into the WebSphere Application Server login infrastructure, you must ensure that the code is trusted. When you add the login module into the *install_dir*/classes directory, it has Java 2 Security AllPermissions. It is recommended that you add your login module and other infrastructure classes into a private directory. However, if you use a private directory, modify the $(WAS_INSTALL_ROOT)/properties/server.policy file so that the private directory, Java archive (JAR) file, or both have the permissions needed to execute the application programming interfaces (API) called from the login module. Because the login module might run after the application code on the call stack, you might consider adding a doPrivileged code block so that you do not need to add additional permissions to your applications.

The following sample code shows you how to obtain a reference to the default AuthorizationToken from the login() method, how to add attributes to the token, and how to read from the existing attributes that are used for authorization.

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
          Map sharedState, Map options)
 {
     // (For more information on initialization, see
     // "Custom login module development for a system login configuration" on page 67.)

  // Get a reference to the sharedState map that is passed in during initialization.
  _sharedState = sharedState;
 }

 public boolean login() throws LoginException
 {
     // (For more information on what to during login, see
     // "Custom login module development for a system login configuration" on page 67.)

  // Look for the default AuthorizationToken in the shared state
  defaultAuthzToken  = (com.ibm.wsspi.security.token.AuthorizationToken)
       sharedState.get
     (com.ibm.wsspi.security.auth.callback.Constants.WSAUTHZTOKEN_KEY);

  // Might not always have one of these generated. It depends on the login
     // configuration setup.
  if (defaultAuthzToken != null)
  {
   try
   {
```

```
// Add a custom attribute
defaultAuthzToken.addAttribute("key1", "value1");

// Determine all of the attributes and values that exist in the token.
java.util.Enumeration listOfAttributes = defaultAuthorizationToken.
          getAttributeNames();

while (listOfAttributes.hasMoreElements())
{
 String key = (String) listOfAttributes.nextElement();

 String[] values = (String[]) defaultAuthorizationToken.getAttributes (key);

 for (int i=0;  i<values.length; i++)
 {
  System.out.println ("Key: " + key + ", Value[" + i + "]: "
             + values[i]);
 }
}

// Read the existing uniqueID attribute.
String[]  uniqueID = defaultAuthzToken.getAttributes
  (com.ibm.wsspi.security.token.AttributeNameConstants.
           WSCREDENTIAL_UNIQUEID);

 // Getthe uniqueID from the String[]
 String unique_id = (uniqueID != null &&
            uniqueID[0] != null) ? uniqueID[0] : "";

// Read the existing expiration attribute.
String[]  expiration = defaultAuthzToken.getAttributes
  (com.ibm.wsspi.security.token.AttributeNameConstants.
           WSCREDENTIAL_EXPIRATION);

 // An example of getting a long expiration value from the string array.
 long expire_time = 0;
 if (expiration != null && expiration[0] != null)
  expire_time = Long.parseLong(expiration[0]);

// Read the existing display name attribute.
String[]  securityName = defaultAuthzToken.getAttributes
  (com.ibm.wsspi.security.token.AttributeNameConstants.
           WSCREDENTIAL_SECURITYNAME);

 // Get the display name from the String[]
 String display_name = (securityName != null &&
            securityName[0] != null) ? securityName[0] : "";


// Read the existing long securityName attribute.
String[]  longSecurityName = defaultAuthzToken.getAttributes
 (com.ibm.wsspi.security.token.AttributeNameConstants.
         WSCREDENTIAL_LONGSECURITYNAME);

// Get the long security name from the String[]
String long_security_name = (longSecurityName != null &&
```

```
            longSecurityName[0] != null) ? longSecurityName[0] : "";


    // Read the existing group attribute.
    String[]  groupList = defaultAuthzToken.getAttributes
      (com.ibm.wsspi.security.token.AttributeNameConstants.
               WSCREDENTIAL_GROUPS);

    // Get the groups from the String[]
    ArrayList groups = new ArrayList();
    if (groupList != null)
    {
     for (int i=0; i<groupList.length; i++)
     {
      System.out.println ("group[" + i + "] = " + groupList[i]);
      groups.add(groupList[i]);
     }
    }
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }

 }

 public boolean commit() throws LoginException
 {
  // (For more information on what to do during commit, see
     // "Custom login module development for a system login configuration" on page 67.)

 }

 private java.util.Map _sharedState = null;
 private com.ibm.wsspi.security.token.AuthorizationToken defaultAuthzToken = null;
}
```

Changing the TokenFactory associated with the default AuthorizationToken

When WebSphere Application Server generates a default AuthorizationToken, the application server utilizes the TokenFactory class that is specified using the com.ibm.wsspi.security.token.authorizationTokenFactory property. To modify this property using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.

The default TokenFactory that used is called com.ibm.ws.security.ltpa.AuthzPropTokenFactory. This token factory encodes the data, but does not encrypt the data in the AuthorizationToken. Because the AuthorizationToken typically flows over Common Secure Interoperability version 2 (CSIv2) using Secure Sockets Layer (SSL), there is no need to encrypt the token itself. However, if you need addition security for the AuthorizationToken, you can associate a different TokenFactory implementation with this property to get encryption. For example, if you associate

com.ibm.ws.security.ltpa.LTPAToken2Factory with this property, the token uses AES encryption. However, you need to weigh the performance impacts against your security needs. Adding sensitive information to the AuthorizationToken is one reason to change the TokenFactory implementation to something that encrypts rather than just encodes.

If you want to perform your own signing and encryption of the default AuthorizationToken you must implement the following classes:

- com.ibm.wsspi.security.ltpa.Token
- com.ibm.wsspi.security.ltpa.TokenFactory

Your TokenFactory implementation instantiates and validates your token implementation. You can use the Lightweight Third Party Authentication (LTPA) keys that are passed into the initialize method of the TokenFactory or you can use your own keys. If you use your own keys, they must be the same everywhere in order to validate the tokens that are generated using those keys. See the Javadoc, available through a link on the front page of the information center, for more information on implementing your own custom TokenFactory. To associate your TokenFactory with the default AuthorizationToken, using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.
3. Locate the com.ibm.wsspi.security.token.authorizationTokenFactory property and verify that the value of this property matches your custom TokenFactory implementation.
4. Verify that your implementation classes are put into the *install directory*/classes directory so that the WebSphere class loader can load the classes.

Implementing a custom AuthorizationToken

This task explains how you might create your own AuthorizationToken implementation, which is set in the login Subject and propagated downstream. The default AuthorizationToken usually is sufficient for propagating attributes that are user-specific. Consider writing your own implementation if you want to accomplish one of the following tasks:

- Isolate your attributes within your own implementation.
- Serialize the information using custom serialization. You must deserialize the bytes at the target and add that information back on the thread. This task also might include encryption and decryption.
- Affect the overall uniqueness of the Subject using the getUniqueID() API.

To implement a custom authorization token, you must complete the following steps:

1. Write a custom implementation of the AuthorizationToken interface. There are many different methods for implementing the AuthorizationToken interface. However, make sure that the methods required by the AuthorizationToken interface and the token interface are fully implemented. After you implement this interface, you can place it in the *install_dir*/classes directory. Alternatively, you can place the class in any private directory . However, make sure that the WebSphere Application Server class loader can locate the class and that it is granted the appropriate permissions. You can add the Java archive

(JAR) file or directory that contains this class into the `server.policy` file so that it has the necessary permissions that are needed by the server code.

Tip: All of the token types defined by the propagation framework have similar interfaces. Basically, the token types are marker interfaces that implement the com.ibm.wsspi.security.token.Token interface. This interface defines most of the methods. If you plan to implement more than one token type, consider creating an abstract class that implements the com.ibm.wsspi.security.token.Token interface. All of your token implementations, including the AuthorizationToken, might extend the abstract class and then most of the work is completed.

To see an implementation of AuthorizationToken, see "Example: com.ibm.wsspi.security.token.AuthorizationToken implementation" on page 306

2. Add and receive the custom AuthorizationToken during WebSphere Application Server logins This task is typically accomplished by adding a custom login module to the various application and system login configurations. However, in order to deserialize the information, you must plug in a custom login module, which is discussed in "Propagating a custom Java serializable object" on page 339. After the object is instantiated in the login module, you can the object to the Subject during the commit() method.

   If you only want to add information to the Subject to get propagated, see "Propagating a custom Java serializable object" on page 339. If you want to ensure that the information is propagated, want to do you own custom serialization, or want to specify the uniqueness for Subject caching purposes, then consider writing your own AuthorizationToken implementation.

   The code sample in "Example: custom AuthorizationToken login module" on page 312 shows how to determine if the login is an initial login or a propagation login. The difference between these login types is whether the WSTokenHolderCallback contains propagation data. If the callback does not contain propagation data, initialize a new custom AuthorizationToken implementation and set it into the Subject. If the callback contains propagation data, look for your specific custom AuthorizationToken TokenHolder instance, convert the byte[] back into your custom AuthorizationToken object, and set it back into the Subject. The code sample shows both instances.

   You can make your AuthorizationToken read-only in the commit phase of the login module. If you do not make the token read-only, then attributes can be added within your applications.

3. Add your custom login module to WebSphere Application Server system login configurations that already contain the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule for receiving serialized versions of your custom authorization token

   Because this login module relies on information in the sharedState added by the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule, add this login module after com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule. For information on how to add your custom login module to the existing login configurations, see "Custom login module development for a system login configuration" on page 67

After completing these steps, you have implemented a custom AuthorizationToken.

Example: com.ibm.wsspi.security.token.AuthorizationToken implementation

Use this file to see an example of a AuthorizationToken implementation. The following sample code does not extend an abstract class, but rather implements the com.ibm.wsspi.security.token.AuthorizationToken interface directly. You can implement the interface directly, but it might cause you to write duplicate code. However, you might choose to implement the interface directly if there are considerable differences between how you handle the various token implementations.

For information on how to implement a custom AuthorizationToken, see "Implementing a custom AuthorizationToken" on page 304.

```
package com.ibm.websphere.security.token;

import com.ibm.websphere.security.WSSecurityException;
import com.ibm.websphere.security.auth.WSLoginFailedException;
import com.ibm.wsspi.security.token.*;
import com.ibm.websphere.security.WebSphereRuntimePermission;
import java.io.ByteArrayOutputStream;
import java.io.ByteArrayInputStream;
import java.io.DataOutputStream;
import java.io.DataInputStream;
import java.io.ObjectOutputStream;
import java.io.ObjectInputStream;
import java.io.OutputStream;
import java.io.InputStream;
import java.util.ArrayList;

public class CustomAuthorizationTokenImpl implements com.ibm.wsspi.security.
   token.AuthorizationToken
{
 private java.util.Hashtable hashtable = new java.util.Hashtable();
 private byte[] tokenBytes = null;
 private static long expire_period_in_millis = 2*60*60*1000;
  // 2 hours in millis, by default

/**
 * Constructor used to create initial AuthorizationToken instance
 */

 public CustomAuthorizationTokenImpl (String principal)
 {
  // Sets the principal in the token
  addAttribute("principal", principal);
  // Sets the token version
  addAttribute("version", "1");
  // Sets the token expiration
  addAttribute("expiration", new Long(System.currentTimeMillis() +
        expire_period_in_millis).toString());
 }

/**
 * Constructor used to deserialize the token bytes received during a
 * propagation login.
 */
```

```
public CustomAuthorizationTokenImpl (byte[] token_bytes)
{
 try
 {
  hashtable = (java.util.Hashtable) com.ibm.wsspi.security.token.
          WSOpaqueTokenHelper.deserialize(token_bytes);
 }
 catch (Exception e)
 {
  e.printStackTrace();
 }
}

/**
 * Validates the token including expiration, signature, and so on.
 * @return boolean
 */

 public boolean isValid ()
 {
  long expiration = getExpiration();

  // if you set the expiration to 0, it does not expire
  if (expiration != 0)
  {
   // return if this token is still valid
   long current_time = System.currentTimeMillis();

   boolean valid = ((current_time < expiration) ? true : false);
   System.out.println("isValid: returning " + valid);
   return valid;
  }
  else
  {
   System.out.println("isValid: returning true by default");
   return true;
  }
 }

/**
 * Gets the expiration as a long.
 * @return long
 */
 public long getExpiration()
 {
  // Gets the expiration value from the hashtable
  String[] expiration = getAttributes("expiration");

  if (expiration != null && expiration[0] != null)
  {
   // The expiration is the first element. There should be only one expiration.
   System.out.println("getExpiration: returning " + expiration[0]);
   return new Long(expiration[0]).longValue();
  }

  System.out.println("getExpiration: returning 0");
```

```
 return 0;
 }

/**
 * Returns if this token should be forwarded/propagated downstream.
 * @return boolean
 */
 public boolean isForwardable()
 {
  // You can choose whether your token gets propagated. In some cases,
     // you might want it to be local only.
  return true;
 }

/**
 * Gets the principal that this Token belongs to. If this is an authorization token,
 * this principal string must match the authentication token principal string or the
 * message will be rejected.
 * @return String
 */
 public String getPrincipal()
 {
  // this might be any combination of attributes
  String[] principal = getAttributes("principal");

  if (principal != null && principal[0] != null)
  {
   return principal[0];
  }

  System.out.println("getExpiration: returning null");
  return null;
 }

/**
 * Returns a unique identifier of the token based upon the information that provider
 * considers makes this a unique token. This will be used for caching purposes
 * and might be used in combination with other token unique IDs that are part of
 * the same Subject.
 *
 * This method should return null if you want the accessID of the user to represent
 * uniqueness.  This is the typical scenario.
 *
 * @return String
 */
 public String getUniqueID()
 {
  // if you don't want to affect the cache lookup, just return NULL here.
  // return null;

  String cacheKeyForThisToken = "dynamic attributes";

  // if you do want to affect the cache lookup, return a string of
     // attributes that you want factored into the lookup.
  return cacheKeyForThisToken;
 }
```

```
/**
 * Gets the bytes to be sent across the wire. The information in the byte[]
 * needs to be enough to recreate the Token object at the target server.
 * @return byte[]
 */
 public byte[] getBytes ()
 {
  if (hashtable != null)
  {
   try
   {
    // Do this if the object is set to read-only during login commit,
    // because this makes sure that no new data gets set.
    if (isReadOnly() && tokenBytes == null)
     tokenBytes = com.ibm.wsspi.security.token.WSOpaqueTokenHelper.
                serialize(hashtable);

    // You can deserialize this in the downstream login module using
          // WSOpaqueTokenHelper.deserialize()
    return tokenBytes;
   }
   catch (Exception e)
   {
    e.printStackTrace();
    return null;
   }
  }

  System.out.println("getBytes: returning null");
  return null;
 }

/**
 * Gets the name of the token used to identify the byte[] in the protocol message.
 * @return String
 */
 public String getName()
 {
  return this.getClass().getName();
 }

/**
 * Gets the version of the token as an short. This also is used to identify the
 * byte[] in the protocol message.
 * @return short
 */
 public short getVersion()
 {
  String[] version = getAttributes("version");

  if (version != null && version[0] != null)
   return new Short(version[0]).shortValue();

  System.out.println("getVersion: returning default of 1");
  return 1;
```

```
    }

/**
 * When called, the token becomes irreversibly read-only. The implementation
 * needs to ensure that any setter methods check that this flag has been set.
 */
 public void setReadOnly()
 {
  addAttribute("readonly", "true");
 }

/**
 * Called internally to see if the token is read-only
 */
 private boolean isReadOnly()
 {
  String[] readonly = getAttributes("readonly");

  if (readonly != null && readonly[0] != null)
   return new Boolean(readonly[0]).booleanValue();

  System.out.println("isReadOnly: returning default of false");
  return false;
 }

/**
 * Gets the attribute value based on the named value.
 * @param String key
 * @return String[]
 */
 public String[] getAttributes(String key)
 {
  ArrayList array = (ArrayList) hashtable.get(key);

  if (array != null && array.size() > 0)
  {
   return (String[]) array.toArray(new String[0]);
  }

  return null;
 }

/**
 * Sets the attribute name and value pair. Returns the previous values set for key,
 * or null if not previously set.
 * @param String key
 * @param String value
 * @returns String[];
 */
 public String[] addAttribute(String key, String value)
 {
  // Gets the current value for the key
  ArrayList array = (ArrayList) hashtable.get(key);

  if (!isReadOnly())
  {
```

```
   // Copies the ArrayList to a String[] as it currently exists
   String[] old_array = null;
   if (array != null && array.size() > 0)
    old_array = (String[]) array.toArray(new String[0]);

   // Allocates a new ArrayList if one was not found
   if (array == null)
    array = new ArrayList();

   // Adds the String to the current array list
   array.add(value);

   // Adds the current ArrayList to the Hashtable
   hashtable.put(key, array);

   // Returns the old array
   return old_array;
  }

  return (String[]) array.toArray(new String[0]);
 }


/**
 * Gets the list of all attribute names present in the token.
 * @return java.util.Enumeration
 */
 public java.util.Enumeration getAttributeNames()
 {
  return hashtable.keys();
 }

/**
 * Returns a deep copying of this token, if necessary.
 * @return Object
 */
 public Object clone()
 {
  com.ibm.websphere.security.token.CustomAuthorizationTokenImpl deep_clone =
   new com.ibm.websphere.security.token.CustomAuthorizationTokenImpl();

  java.util.Enumeration keys = getAttributeNames();

  while (keys.hasMoreElements())
  {
   String key = (String) keys.nextElement();

   String[] list = (String[]) getAttributes(key);

   for (int i=0; i<list.length; i++)
    deep_clone.addAttribute(key, list[i]);
  }

      return deep_clone;
 }
}
```

Example: custom AuthorizationToken login module

This file shows how to determine if the login is an initial login or a propagation login

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
     // (For more information on  what to do during initialization, see
     // "Custom login module development for a system login configuration" on page 67.)
  _sharedState = sharedState;
 }

 public boolean login() throws LoginException
 {
     // (For more information on what do during login, see
     // "Custom login module development for a system login configuration" on page 67.)

  // Handles the WSTokenHolderCallback to see if this is an initial or
     // propagation login.
  Callback callbacks[] = new Callback[1];
  callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");

  try
  {
   callbackHandler.handle(callbacks);
  }
  catch (Exception e)
  {
   // Handles exception
  }

  // Receives the ArrayList of TokenHolder objects (the serialized tokens)
  List authzTokenList = ((WSTokenHolderCallback) callbacks[0]).getTokenHolderList();

  if (authzTokenList != null)
  {
   // Iterates through the list looking for your custom token
   for (int i=0; i
   for (int i=0; i<authzTokenList.size(); i++)
   {
    TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

          // Looks for the name and version of your custom AuthorizationToken
          // implementation
    if (tokenHolder.getName().equals("com.ibm.websphere.security.token.
             CustomAuthorizationTokenImpl") &&
        tokenHolder.getVersion() == 1)
    {
           // Passes the bytes into your custom AuthorizationToken constructor
           // to deserialize
     customAuthzToken = new
      com.ibm.websphere.security.token.CustomAuthorizationTokenImpl(
                  tokenHolder.getBytes());
```

```
  }
 }
}
else
   // This is not a propagation login. Create a new instance of your
   // AuthorizationToken implementation
{
     // Gets the prinicpal from the default AuthenticationToken. This must match
     // all tokens.
 defaultAuthToken = (com.ibm.wsspi.security.token.AuthenticationToken)
  sharedState.get(com.ibm.wsspi.security.auth.callback.Constants.WSAUTHTOKEN_KEY);
 String principal = defaultAuthToken.getPrincipal();

     // Adds a new custom authorization token. This is an initial login. Pass the
     // principal into the constructor
 customAuthzToken = new com.ibm.websphere.security.token.
        CustomAuthorizationTokenImpl(principal);

 // Adds any initial attributes
 if (customAuthzToken != null)
 {
  customAuthzToken.addAttribute("key1", "value1");
  customAuthzToken.addAttribute("key1", "value2");
  customAuthzToken.addAttribute("key2", "value1");
  customAuthzToken.addAttribute("key3", "something different");
 }
}

   // Note: You can add the token to the Subject during commit in case something
   // happens during the login.
}

public boolean commit() throws LoginException
{
   // (For more information on what to do during a commit, see
   // "Custom login module development for a system login configuration" on page 67.)

 if (customAut  // (hzToken != null)
 {
  // sSets the customAuthzToken token into the Subject
  try
  {
   public final AuthorizationToken customAuthzTokenPriv = customAuthzToken;
         // Do this in a doPrivileged code block so that application code does not
         // need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
   {
    public Object run()
    {
     try
     {
                 // Adds the custom authorization token if it is not null
                 //  and not already in the Subject
                              if ((customAuthzTokenPriv != null) &&
        (!subject.getPrivateCredentials().contains(customAuthzTokenPriv)))
      {
```

```
        subject.getPrivateCredentials().add(customAuthzTokenPriv);
       }
      }
      catch (Exception e)
      {
       throw new WSLoginFailedException (e.getMessage(), e);
      }

      return null;
     }
    });
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }
 }

 // Defines your login module variables
 com.ibm.wsspi.security.token.AuthorizationToken customAuthzToken = null;
 com.ibm.wsspi.security.token.AuthenticationToken defaultAuthToken = null;
 java.util.Map _sharedState = null;
}
```

Default SingleSignonToken

Do not use the default SingleSignonToken in service provider code. This default token is used by the WebSphere Application Server run-time code only. There are size limitations for this token when it is added as an HTTP cookie. If you need to create an HTTP cookie using this token framework, you can implement a custom SingleSignonToken. To implement a custom SingleSignonToken, see "Implementing a custom SingleSignonToken" on page 315 for more information.

Changing the TokenFactory associated with the default SingleSignonToken

When default SingleSignonToken is generated, the application server utilizes the TokenFactory class that is specified using the com.ibm.wsspi.security.token.singleSignonTokenFactory property. To modify this property using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.

The default TokenFactory specified for this property is called com.ibm.ws.security.ltpa.LTPAToken2Factory. This token factory creates an SSO token called LtpaToken2, which WebSphere Application Server uses for propagation. This TokenFactory uses the AES/CBC/PKCS5Padding cipher. If you change this TokenFactory, you lose the interoperability with any servers running a version of WebSphere Application Server prior to version 5.1.1 that use the default TokenFactory. Only servers running WebSphere Application Server Version 5.1.1 with propagation enabled are aware of the LtpaToken2 cookie. However, this is not a problem if all of your application servers use WebSphere Application Server Version 5.1.1 and all of your servers use your new TokenFactory.

If you need to perform your own signing and encryption of the default SingleSignonToken, you must implement the following classes:

- com.ibm.wsspi.security.ltpa.Token
- com.ibm.wsspi.security.ltpa.TokenFactory

Your TokenFactory implementation instantiates (createToken) and validates (validateTokenBytes) your token implementation. You can use the LTPA keys passed into the initialize method of the TokenFactory or you can use your own keys. If you use your own keys, they must be the same everywhere in order to validate the tokens that are generated using those keys. See the Javadoc, available through a link on the front page of the information center, for more information on implementing your own custom TokenFactory. To associate your TokenFactory with the default SingleSignonToken using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.
3. Locate the com.ibm.wsspi.security.token.singleSignonTokenFactory property and verify that the value of this property matches your custom TokenFactory implementation.
4. Verify that your implementation classes are put into the *install directory*/classes directory so that the WebSphere class loader can load the classes.

Implementing a custom SingleSignonToken

This task explains how to create your own SingleSignonToken implementation, which is set in the login Subject and added to the HTTP response as an HTTP cookie. The cookie name is the concatenation of the SingleSignonToken.getName() application programming interface (API) and the SingleSignonToken.getVersion() API. There is no delimiter. When you add a SingleSignonToken to the Subject, it also gets propagated horizontally and downstream in case the Subject is used for other Web requests. You must deserialize your custom SingleSignonToken when you receive it from a propagation login. Consider writing your own implementation if you want to accomplish one of the following:

- Isolate your attributes within your own implementation.
- Serialize the information using custom serialization. It is recommended that you encrypt the information because it is out to the HTTP response and is available on the Internet. You must deserialize or decrypt the bytes at the target and add that information back into the Subject.
- Affect the overall uniqueness of the Subject using the getUniqueID() API

To implement a custom SingleSignonToken, you must complete the following steps:

1. Write a custom implementation of the SingleSignonToken interface.

   There are many different methods for implementing the SingleSignonToken interface. However, make sure that the methods required by the SingleSignonToken interface and the token interface are fully implemented. After you implement this interface, you can place it in the *install_dir*/classes directory. Alternatively, you can place the class in any private directory . However, make sure that the WebSphere Application Server class loader can locate the class and that it is granted the appropriate permissions. You can add

the Java archive (JAR) file or directory that contains this class into the `server.policy` file so that it has the necessary permissions that are needed by the server code.

Tip: All of the token types defined by the propagation framework have similar interfaces. Basically, the token types are marker interfaces that implement the com.ibm.wsspi.security.token.Token interface. This interface defines most of the methods. If you plan to implement more than one token type, consider creating an abstract class that implements the com.ibm.wsspi.security.token.Token interface. All of your token implementations, including the SingleSignonToken, might extend the abstract class and then most of the work is completed.

To see an implementation of the SingleSignonToken, see "Example: com.ibm.wsspi.security.token.SingleSignonToken implementation" on page 317

2. Add and receive the custom SingleSignonToken during WebSphere Application Server logins. This task is typically accomplished by adding a custom login module to the various application and system login configurations. However, in order to deserialize the information, you will need to plug in a custom login module, which is discussed in a subsequent step. After the object is instantiated in the login module, you can add it to the Subject during the commit() method.

   The code sample in "Example: custom SingleSignonToken login module" on page 323 shows how to determine if the login is an initial login or a propagation login. The difference is whether the WSTokenHolderCallback contains propagation data. If the token does not contain propagation data, initialize a new custom SingleSignonToken implementation and set it into the Subject. Also, look for the HTTP cookie from the HTTP request if the HTTP request object is available in the callback. You can get your custom SingleSignonToken both from a horizontal propagation login and from the HTTP request. However, it is recommended that you make the token available in both places because then the information arrives at any front-end application server even if that server that does not support propagation.

   You can make your SingleSignonToken read-only in the commit phase of the login module. If you make the token read-only, additional attributes cannot be added within your applications.

   Restriction:

   - HTTP cookies have a size limitation so do not add too much data to this token.
   - The WebSphere Application Server run time does not handle cookies that it does not generate, so this cookie is not used by the run time.
   - The SingleSignonToken object, when in the Subject, does affect the cache lookup of the Subject if you return something in the getUniqueID() method.

3. Get the HTTP cookie from the HTTP request object during login or from an application. The sample code, found in "Example: HTTP cookie retrieval" on page 325 shows how you can retrieve the HTTP cookie from the HTTP request, decode the cookieso that it is back to your original bytes, and create your custom SingleSignonToken object from the bytes.
4. Add your custom login module to WebSphere Application Server system login configurations that already contain the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule for receiving serialized versions of your custom propagation token Because this login module relies on information in the sharedState added by the

com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule, add this login module after com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule.

For information on adding your custom login module into the existing login configurations, see "Custom login module development for a system login configuration" on page 67

After completing these steps, you have implemented a custom AuthorizationToken.

Example: com.ibm.wsspi.security.token.SingleSignonToken implementation

Use this file to see an example of a SingleSignon implementation. The following sample code does not extend an abstract class, but rather implements the com.ibm.wsspi.security.token.SingleSignonToken interface directly. You can implement the interface directly, but it might cause you to write duplicate code. However, you might choose to implement the interface directly if there are considerable differences between how you handle the various token implementations.

For information on how to implement a custom SingleSignonToken, see "Implementing a custom SingleSignonToken" on page 315.

```
package com.ibm.websphere.security.token;

import com.ibm.websphere.security.WSSecurityException;
import com.ibm.websphere.security.auth.WSLoginFailedException;
import com.ibm.wsspi.security.token.*;
import com.ibm.websphere.security.WebSphereRuntimePermission;
import java.io.ByteArrayOutputStream;
import java.io.ByteArrayInputStream;
import java.io.DataOutputStream;
import java.io.DataInputStream;
import java.io.ObjectOutputStream;
import java.io.ObjectInputStream;
import java.io.OutputStream;
import java.io.InputStream;
import java.util.ArrayList;

public class CustomSingleSignonTokenImpl implements com.ibm.wsspi.security.
   token.SingleSignonToken
{
 private java.util.Hashtable hashtable = new java.util.Hashtable();
 private byte[] tokenBytes = null;
   // 2 hours in millis, by default
 private static long expire_period_in_millis = 2*60*60*1000;

/**
 * Constructor used to create initial SingleSignonToken instance
 */

 public CustomSingleSignonTokenImpl (String principal)
 {
  // set the principal in the token
  addAttribute("principal", principal);
  // set the token version
  addAttribute("version", "1");
```

```
 // set the token expiration
 addAttribute("expiration", new Long(System.currentTimeMillis() +
       expire_period_in_millis).toString());
}

/**
 * Constructor used to deserialize the token bytes received during a propagation login.
 */
public CustomSingleSignonTokenImpl (byte[] token_bytes)
{
 try
 {
  // you should implement a decryption algorithm to decrypt the cookie bytes
  hashtable = (java.util.Hashtable) some_decryption_algorithm (token_bytes);
 }
 catch (Exception e)
 {
  e.printStackTrace();
 }
}

/**
 * Validates the token including expiration, signature, and so on.
 * @return boolean
 */

public boolean isValid ()
{
 long expiration = getExpiration();

 // if you set the expiration to 0, it's does not expire
 if (expiration != 0)
 {
  // return if this token is still valid
  long current_time = System.currentTimeMillis();

  boolean valid = ((current_time < expiration) ? true : false);
  System.out.println("isValid: returning " + valid);
  return valid;
 }
 else
 {
  System.out.println("isValid: returning true by default");
  return true;
 }
}

/**
 * Gets the expiration as a long.
 * @return long
 */
public long getExpiration()
{
 // get the expiration value from the hashtable
 String[] expiration = getAttributes("expiration");
```

```
 if (expiration != null && expiration[0] != null)
 {
  // expiration will always be the first element (should only be one)
  System.out.println("getExpiration: returning " + expiration[0]);
  return new Long(expiration[0]).longValue();
 }

 System.out.println("getExpiration: returning 0");
 return 0;
}

/**
 * Returns if this token should be forwarded/propagated downstream.
 * @return boolean
 */
public boolean isForwardable()
{
 // You can choose whether your token gets propagated or not, in some cases
    // you might want it to be local only.
 return true;
}

/**
 * Gets the principal that this Token belongs to. If this is an authorization token,
 * this principal string must match the authentication token principal string or the
 * message will be rejected.
 * @return String
 */
public String getPrincipal()
{
 // this could be any combination of attributes
 String[] principal = getAttributes("principal");

 if (principal != null && principal[0] != null)
 {
  return principal[0];
 }

 System.out.println("getExpiration: returning null");
 return null;
}

/**
 * Returns a unique identifier of the token based upon information the provider
 * considers makes this a unique token.  This will be used for caching purposes
 * and may be used in combination with outher token unique IDs that are part of
 * the same Subject.
 *
 * This method should return null if you want the accessID of the user to represent
 * uniqueness.  This is the typical scenario.
 *
 * @return String
 */
public String getUniqueID()
{
 // this could be any combination of attributes
```

```
 return getPrincipal();
}

/**
 * Gets the bytes to be sent across the wire.  The information in the byte[]
 * needs to be enough to recreate the Token object at the target server.
 * @return byte[]
 */
public byte[] getBytes ()
{
 if (hashtable != null)
 {
  try
  {
   // do this if the object is set read-only during login commit,
   // since this guarantees no new data gets set.
   if (isReadOnly() && tokenBytes == null)
    tokenBytes = some_encryption_algorithm (hashtable);

   // you can deserialize the tokenBytes using a similiar decryption algorithm.
   return tokenBytes;
  }
  catch (Exception e)
  {
   e.printStackTrace();
   return null;
  }
 }

 System.out.println("getBytes: returning null");
 return null;
}

/**
 * Gets the name of the token, used to identify the byte[] in the protocol message.
 * @return String
 */
public String getName()
{
 return "myCookieName";
}

/**
 * Gets the version of the token as an short.  This is also used to identify the
 * byte[] in the protocol message.
 * @return short
 */
public short getVersion()
{
 String[] version = getAttributes("version");

 if (version != null && version[0] != null)
  return new Short(version[0]).shortValue();

 System.out.println("getVersion: returning default of 1");
 return 1;
```

```
    }

/**
 * When called, the token becomes irreversibly read-only.  The implementation
 * needs to ensure any setter methods check that this has been set.
 */
 public void setReadOnly()
 {
  addAttribute("readonly", "true");
 }

/**
 * Called internally to see if the token is readonly
 */
 private boolean isReadOnly()
 {
  String[] readonly = getAttributes("readonly");

  if (readonly != null && readonly[0] != null)
   return new Boolean(readonly[0]).booleanValue();

  System.out.println("isReadOnly: returning default of false");
  return false;
 }

/**
 * Gets the attribute value based on the named value.
 * @param String key
 * @return String[]
 */
 public String[] getAttributes(String key)
 {
  ArrayList array = (ArrayList) hashtable.get(key);

  if (array != null && array.size() > 0)
  {
   return (String[]) array.toArray(new String[0]);
  }

  return null;
 }

/**
 * Sets the attribute name/value pair.  Returns the previous values set for key,
 * or null if not previously set.
 * @param String key
 * @param String value
 * @returns String[];
 */
 public String[] addAttribute(String key, String value)
 {
  // get the current value for the key
  ArrayList array = (ArrayList) hashtable.get(key);

  if (!isReadOnly())
  {
```

```
    // copy the ArrayList to a String[] as it currently exists
    String[] old_array = null;
    if (array != null && array.size() > 0)
     old_array = (String[]) array.toArray(new String[0]);

    // allocate a new ArrayList if one was not found
    if (array == null)
     array = new ArrayList();

    // add the String to the current array list
    array.add(value);

    // add the current ArrayList to the Hashtable
    hashtable.put(key, array);

    // return the old array
    return old_array;
   }

   return (String[]) array.toArray(new String[0]);
  }


 /**
  * Gets the List of all attribute names present in the token.
  * @return java.util.Enumeration
  */
  public java.util.Enumeration getAttributeNames()
  {
   return hashtable.keys();
  }

 /**
  * Returns a deep copying of this token, if necessary.
  * @return Object
  */
  public Object clone()
  {
   com.ibm.websphere.security.token.CustomSingleSignonImpl deep_clone =
    new com.ibm.websphere.security.token.CustomSingleSignonTokenImpl();

   java.util.Enumeration keys = getAttributeNames();

   while (keys.hasMoreElements())
   {
    String key = (String) keys.nextElement();

    String[] list = (String[]) getAttributes(key);

    for (int i=0; i<list.length; i++)
     deep_clone.addAttribute(key, list[i]);
   }

       return deep_clone;
  }
 }
```

Example: custom SingleSignonToken login module

This file shows how to determine if the login is an initial login or a propagation login

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
     // (For more information on initialization, see
     // "Custom login module development for a system login configuration" on page 67.)
  _sharedState = sharedState;
 }

 public boolean login() throws LoginException
 {
     // (For more information on what to do during login, see
     // "Custom login module development for a system login configuration" on page 67.)

     // Handles the WSTokenHolderCallback to see if this is an initial or
     // propagation login.
  Callback callbacks[] = new Callback[1];
  callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");

  try
  {
   callbackHandler.handle(callbacks);
  }
  catch (Exception e)
  {
   // handle exception
  }

  // Receives the ArrayList of TokenHolder objects (the serialized tokens)
  List authzTokenList = ((WSTokenHolderCallback) callbacks[0]).getTokenHolderList();

  if (authzTokenList != null)
  {
   // iterate through the list looking for your custom token
   for (int i=0; i
   for (int i=0; i<authzTokenList.size(); i++)
   {
    TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

    // Looks for the name and version of your custom SingleSignonToken
          // implementation
    if (tokenHolder.getName().equals("myCookieName")
              && tokenHolder.getVersion() == 1)
    {
     // Passes the bytes into your custom SingleSignonToken constructor
            // to deserialize
     customSSOToken = new
      com.ibm.websphere.security.token.CustomSingleSignonTokenImpl
                  (tokenHolder.getBytes());

    }
```

```
 }
}
else
        // This is not a propagation login. Create a new instance of your
        // SingleSignonToken implementation
{
     // Gets the principal from the default SingleSignonToken. This principal
     //  must match all tokens.
 defaultAuthToken = (com.ibm.wsspi.security.token.AuthenticationToken)
  sharedState.get(com.ibm.wsspi.security.auth.callback.Constants.WSAUTHTOKEN_KEY);
 String principal = defaultAuthToken.getPrincipal();

 // Adds a new custom single signon (SSO) token. This is an initial login.
     //  Pass the principal into the constructor
 customSSOToken = new com.ibm.websphere.security.token.
         CustomSingleSignonTokenImpl(principal);

 // add any initial attributes
 if (customSSOToken != null)
 {
  customSSOToken.addAttribute("key1", "value1");
  customSSOToken.addAttribute("key1", "value2");
  customSSOToken.addAttribute("key2", "value1");
  customSSOToken.addAttribute("key3", "something different");
 }
}

    // Note: You can add the token to the Subject during commit in case something
    // happens during the login.
}

public boolean commit() throws LoginException
{
    // (For more information on what to do during commit, see
    // "Custom login module development for a system login configuration" on page 67.)

 if (customSSOToken != null)
 {
  // Sets the customSSOToken token into the Subject
  try
  {
   public final SingleSignonToken customSSOTokenPriv = customSSOToken;
         // Do this in a doPrivileged code block so that application code does not
         // need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
   {
    public Object run()
    {
     try
     {
      // Adds the custom SSO token if it is not null and
                //  not already in the Subject
                              if ((customSSOTokenPriv != null) &&
        (!subject.getPrivateCredentials().
                          contains(customSSOTokenPriv)))
      {
```

```
        subject.getPrivateCredentials().
                      add(customSSOTokenPriv);
       }
      }
      catch (Exception e)
      {
       throw new WSLoginFailedException (e.getMessage(), e);
      }

      return null;
     }
    });
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }
 }

 // Defines your login module variables
 com.ibm.wsspi.security.token.SingleSignonToken customSSOToken = null;
 com.ibm.wsspi.security.token.AuthenticationToken defaultAuthToken = null;
 java.util.Map _sharedState = null;
}
```

Example: HTTP cookie retrieval

Use this file to see an example of how to retrieve a cookie from an HTTP request, decode the cookie so that it is back to your original byes, and create your custom SingleSignonToken object from the bytes. This example shows how to complete these steps from a login module. However, you also can complete these steps using a servlet.

For information on how to implement a custom SingleSignonToken, see "Implementing a custom SingleSignonToken" on page 315.

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
     // (For more information on what to do during initialization, see
     // "Custom login module development for a system login configuration" on page 67.)
  _sharedState = sharedState;
 }

 public boolean login() throws LoginException
 {
     // (For more information on what to do during login, see
     // "Custom login module development for a system login configuration" on page 67.)

     // Handles the WSTokenHolderCallback to see if this is an initial
     // or propagation login.
  Callback callbacks[] = new Callback[2];
  callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");
  callbacks[1] = new WSServletRequestCallback("HttpServletRequest: ");
```

```
try
{
 callbackHandler.handle(callbacks);
}
catch (Exception e)
{
 // Handles the exception
}

// receive the ArrayList of TokenHolder objects (the serialized tokens)
List authzTokenList = ((WSTokenHolderCallback) callbacks[0]).getTokenHolderList();
javax.servlet.http.HttpServletRequest request =
       ((WSServletRequestCallback) callbacks[1]).getHttpServletRequest();

if (request != null)
{

 // Checks if the cookie is present
 javax.servlet.http.Cookie[] cookies = request.getCookies();
 String[] cookieStrings = getCookieValues (cookies, "myCookeName1");

 if (cookieStrings != null)
 {
  String cookieVal = null;
  for (int n=0;n<cookieStrings.length;n++)
  {
   cookieVal = cookieStrings[n];
   if (cookieVal.length()>0)
   {
             // Removes the cookie encoding from the cookie to get
             // your custom bytes
    byte[] cookieBytes =
     com.ibm.websphere.security.WSSecurityHelper.
                   convertCookieStringToBytes(cookieVal);
    customSSOToken =
     new com.ibm.websphere.security.token.
                   CustomSingleSignonTokenImpl(cookieBytes);

             // Now that you have your cookie from the request,
             // you can do something with it here, or add it
             // to the Subject in the commit() method for use later.
    if (debug || tc.isDebugEnabled())
    {
     Systen.out.println("*** GOT MY CUSTOM SSO TOKEN FROM
                   THE REQUEST ***");
    }
   }
  }
 }
}

public boolean commit() throws LoginException
{
```

```
    // (For more information on what to during a commit, see
    // "Custom login module development for a system login configuration" on page 67.)

 if (customSSOToken != null)
 {
  // Sets the customSSOToken token into the Subject
  try
  {
   public final SingleSignonToken customSSOTokenPriv = customSSOToken;
         // Do this in a doPrivileged code block so that application code does not
         // need to add additional permissions
   java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
   {
    public Object run()
    {
     try
     {
                 // Add the custom SSO token if it is not null and not
                 // already in the Subject
                                 if ((customSSOTokenPriv != null) &&
        (!subject.getPrivateCredentials().
                       contains(customSSOTokenPriv)))
      {
       subject.getPrivateCredentials().add(customSSOTokenPriv);
      }
     }
     catch (Exception e)
     {
      throw new WSLoginFailedException (e.getMessage(), e);
     }

     return null;
    }
   });
  }
  catch (Exception e)
  {
   throw new WSLoginFailedException (e.getMessage(), e);
  }
 }
}

// Private method to get the specific cookie from the request
private String[] getCookieValues (Cookie[] cookies, String hdrName)
{
 Vector retValues = new Vector();
 int numMatches=0;
 if (cookies != null)
 {
  for (int i = 0; i < cookies.length; ++i)
  {
   if (hdrName.equals(cookies[i].getName()))
   {
    retValues.add(cookies[i].getValue());
    numMatches++;
    System.out.println(cookies[i].getValue());
```

```
    }
   }
  }

  if (retValues.size()>0)
   return (String[]) retValues.toArray(new String[numMatches]);
  else
   return null;
 }

 // Defines your login module variables
 com.ibm.wsspi.security.token.SingleSignonToken customSSOToken = null;
 com.ibm.wsspi.security.token.AuthenticationToken defaultAuthToken = null;
 java.util.Map _sharedState = null;
}
```

Default AuthenticationToken

Do not use the default AuthenticationToken in service provider code. This default token is used by the WebSphere Application Server run-time code only and is authentication mechanism specific. Any modifications to this token by service provider code can potentially cause interoperability problems. If you need to create an authentication token for custom usage, see "Implementing a custom AuthenticationToken" on page 329 for more information.

Changing the TokenFactory associated with the default AuthenticationToken

When WebSphere Application Server generates a default AuthenticationToken, the application server utilizes the TokenFactory class that is specified using the com.ibm.wsspi.security.token.authenticationTokenFactory property. To modify this property using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.

The default TokenFactory specified for this property is called com.ibm.ws.security.ltpa.LTPATokenFactory. The LTPATokenFactory uses the DESede/ECB/PKCS5Padding cipher. This token factory creates an interoperable Lightweight Third Party Authentication (LTPA) token. If you change this TokenFactory, you lose the interoperability with any servers running a version of WebSphere Application Server prior to version 5.1.1 and any other servers that do not support the new TokenFactory implementation. However, this is not a problem if all of your application servers use WebSphere Application Server Version 5.1.1 and all of your servers use your new TokenFactory.

If you associate com.ibm.ws.security.ltpa.LTPAToken2Factory with the com.ibm.wsspi.security.token.authenticationTokenFactory property, the token is AES encrypted. However, you need to weigh the performance against your security needs. By doing this, you might add additional attributes to the AuthenticationToken in the Subject during a login that are available downstream.

If you need to perform your own signing and encryption of the default AuthenticationToken, you must implement the following classes:

- com.ibm.wsspi.security.ltpa.Token
- com.ibm.wsspi.security.ltpa.TokenFactory

Your TokenFactory implementation instantiates (createToken) and validates (validateTokenBytes) your token implementation. You can use the LTPA keys passed into the initialize method of the TokenFactory or you can use your own keys. If you use your own keys, they must be the same everywhere in order to validate the tokens that are generated using those keys. See the Javadoc, available through a link on the front page of the information center, for more information on implementing your own custom TokenFactory. To associate your TokenFactory with the default AuthenticationToken using the administrative console, complete the following steps:

1. Click **Security > Global Security**.
2. Under Additional properties, click **Custom properties**.
3. Locate the com.ibm.wsspi.security.token.authenticationTokenFactory property and verify that the value of this property matches your custom TokenFactory implementation.
4. Verify that your implementation classes are put into the *install directory*/classes directory so that the WebSphere class loader can load the classes.

Implementing a custom AuthenticationToken

This task explains how you might create your own AuthenticationToken implementation, which is set in the login Subject and propagated downstream. This implementation enables you to specify an authentication token that can be used by a custom login module or application. Consider writing your own implementation if you want to accomplish one of the following tasks:

- Isolate your attributes within your own implementation.
- Serialize the information using custom serialization. You must deserialize the bytes at the target and add that information back on the thread. This task also might include encryption and decryption.
- Affect the overall uniqueness of the Subject using the getUniqueID() API.

Important: Custom AuthenticationToken implementations are not used by the security run time in WebSphere Application Server to enforce authentication. WebSphere Application Security run time uses this token in the following situations only:

- Call the getBytes() method for serialization
- Call the getForwardable() method to determine whether to serialize the AuthenticationToken.
- Call the getUniqueId() method for uniqueness
- Call the getName() and the getVersion() methods for adding serialized bytes to the TokenHolder that is sent downstream

All of the other uses are custom implementations.

To implement a custom authentication token, you must complete the following steps:

1. Write a custom implementation of the AuthenticationToken interface. There are many different methods for implementing the AuthenticationToken interface. However, make sure that the methods required by the AuthenticationToken interface and the token interface are fully implemented. After you implement this interface, you can place it in the *install_dir*/classes directory. Alternatively, you can place the class in any private directory. However, make sure that the WebSphere Application Server class loader can locate the class and

that it is granted the appropriate permissions. You can add the Java archive (JAR) file or directory that contains this class into the `server.policy` file so that it has the necessary permissions that are needed by the server code.

Tip: All of the token types defined by the propagation framework have similar interfaces. Basically, the token types are marker interfaces that implement the com.ibm.wsspi.security.token.Token interface. This interface defines most of the methods. If you plan to implement more than one token type, consider creating an abstract class that implements the com.ibm.wsspi.security.token.Token interface. All of your token implementations, including the AuthenticationToken, might extend the abstract class and then most of the work is completed.

To see an implementation of AuthenticationToken, see "Example: com.ibm.wsspi.security.token.AuthorizationToken implementation" on page 306

2. Add and receive the custom AuthenticationToken during WebSphere Application Server logins This task is typically accomplished by adding a custom login module to the various application and system login configurations. However, in order to deserialize the information, you must plug in a custom login module. After the object is instantiated in the login module, you can the object to the Subject during the commit() method.

   If you only want to add information to the Subject to get propagated, see "Propagating a custom Java serializable object" on page 339. If you want to ensure that the information is propagated, if you want to do your own custom serialization, or if you want to specify the uniqueness for Subject caching purposes, then consider writing your own AuthenticationToken implementation.

   The code sample in "Example: custom AuthenticationToken login module" on page 337 shows how to determine if the login is an initial login or a propagation login. The difference between these login types is whether the WSTokenHolderCallback contains propagation data. If the callback does not contain propagation data, initialize a new custom AuthenticationToken implementation and set it into the Subject. If the callback contains propagation data, look for your specific custom AuthenticationToken TokenHolder instance, convert the byte[] back into your custom AuthenticationToken object, and set it back into the Subject. The code sample shows both instances.

   You can make your AuthenticationToken read-only in the commit phase of the login module. If you do not make the token read-only, then attributes can be added within your applications.

3. Add your custom login module to WebSphere Application Server system login configurations that already contain the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule for receiving serialized versions of your custom authorization token

   Because this login module relies on information in the sharedState added by the com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule, add this login module after com.ibm.ws.security.server.lm.wsMapDefaultInboundLoginModule. For information on how to add your custom login module to the existing login configurations, see "Custom login module development for a system login configuration" on page 67

After completing these steps, you have implemented a custom AuthenticationToken.

Example: com.ibm.wsspi.security.token.AuthenticationToken implementation

Use this file to see an example of a AuthenticationToken implementation. The following sample code does not extend an abstract class, but rather implements the com.ibm.wsspi.security.token.AuthenticationToken interface directly. You can implement the interface directly, but it might cause you to write duplicate code. However, you might choose to implement the interface directly if there are considerable differences between how you handle the various token implementations.

For information on how to implement a custom AuthenticationToken, see "Implementing a custom AuthenticationToken" on page 329.

```
package com.ibm.websphere.security.token;

import com.ibm.websphere.security.WSSecurityException;
import com.ibm.websphere.security.auth.WSLoginFailedException;
import com.ibm.wsspi.security.token.*;
import com.ibm.websphere.security.WebSphereRuntimePermission;
import java.io.ByteArrayOutputStream;
import java.io.ByteArrayInputStream;
import java.io.DataOutputStream;
import java.io.DataInputStream;
import java.io.ObjectOutputStream;
import java.io.ObjectInputStream;
import java.io.OutputStream;
import java.io.InputStream;
import java.util.ArrayList;

public class CustomAuthenticationTokenImpl implements com.ibm.wsspi.security.
   token.AuthenticationToken
{
 private java.util.Hashtable hashtable = new java.util.Hashtable();
 private byte[] tokenBytes = null;
  // 2 hours in millis, by default
   private static long expire_period_in_millis = 2*60*60*1000;
 private String oidName = "your_oid_name";
  // This string can really be anything if you do not want to use an OID.

/**
 * Constructor used to create initial AuthenticationToken instance
 */
 public CustomAuthenticationTokenImpl (String principal)
 {
  // Sets the principal in the token
  addAttribute("principal", principal);
  // Sets the token version
  addAttribute("version", "1");
  // Sets the token expiration
  addAttribute("expiration", new Long(System.currentTimeMillis()
        + expire_period_in_millis).toString());
 }

/**
 * Constructor used to deserialize the token bytes received during a
 * propagation login.
```

```
 */
 public CustomAuthenticationTokenImpl (byte[] token_bytes)
 {
  try
  {
       // The data in token_bytes should be signed and encrypted if the
       // hashtable is acting as an authentication token.
   hashtable = (java.util.Hashtable) custom_decryption_algorithm (token_bytes);
  }
  catch (Exception e)
  {
   e.printStackTrace();
  }
 }

/**
 * Validates the token including expiration, signature, and so on.
 * @return boolean
 */

 public boolean isValid ()
 {
  long expiration = getExpiration();

  // If you set the expiration to 0, the token does not expire
  if (expiration != 0)
  {
   // Returns a response that identifies whether this token is still valid
   long current_time = System.currentTimeMillis();

   boolean valid = ((current_time < expiration) ? true : false);
   System.out.println("isValid: returning " + valid);
   return valid;
  }
  else
  {
   System.out.println("isValid: returning true by default");
   return true;
  }
 }

/**
 * Gets the expiration as a long type.
 * @return long
 */
 public long getExpiration()
 {
  // Gets the expiration value from the hashtable
  String[] expiration = getAttributes("expiration");

  if (expiration != null && expiration[0] != null)
  {
   // The expiration is the first element and there should only be one expiration
   System.out.println("getExpiration: returning " + expiration[0]);
   return new Long(expiration[0]).longValue();
  }
```

```
 System.out.println("getExpiration: returning 0");
 return 0;
}

/**
 * Returns if this token should be forwarded/propagated downstream.
 * @return boolean
 */
public boolean isForwardable()
{
    // You can choose whether your token gets propagated. In some cases
    // you might want it to be local only.
 return true;
}

/**
 * Gets the principal to which this token belongs. If this is an
 * authorization token, this principal string must match the
 * authentication token principal string or the message is rejected.
 * @return String
 */
public String getPrincipal()
{
 // This value might be any combination of attributes
 String[] principal = getAttributes("principal");

 if (principal != null && principal[0] != null)
 {
  return principal[0];
 }

 System.out.println("getExpiration: returning null");
 return null;
}

/**
 * Returns a unique identifier of the token based upon information the provider
 * considers makes this a unique token. This identifier is used for caching purposes
 * and can be used in combination with other token unique IDs that are part of
 * the same Subject.
 *
 * This method should return null if you want the accessID of the user to represent
 * uniqueness.  This is the typical scenario.
 *
 * @return String
 */
public String getUniqueID()
{
    // If you do not want to affect the cache lookup, just return NULL here.
    return null;

 String cacheKeyForThisToken = "dynamic attributes";

    // If you do want to affect the cache lookup, return a string of
    // attributes that you want factored into the lookup.
```

```
 return cacheKeyForThisToken;
}

/**
 * Gets the bytes to be sent across the wire. The information in the byte[]
 * needs to be enough to recreate the token object at the target server.
 * @return byte[]
 */
public byte[] getBytes ()
{
 if (hashtable != null)
 {
  try
  {
         // Do this if the object is set read-only during login commit
         // because this ensures that new data is not set.
   if (isReadOnly() && tokenBytes == null)
    tokenBytes = custom_encryption_algorithm (hashtable);

   return tokenBytes;
  }
  catch (Exception e)
  {
   e.printStackTrace();
   return null;
  }
 }

 System.out.println("getBytes: returning null");
 return null;
}

/**
 * Gets the name of the token, which is used to identify the byte[] in the
 * protocol message.
 * @return String
 */
public String getName()
{
 return oidName;
}

/**
 * Gets the version of the token as an short type.  This also is used
 * to identify the byte[] in the protocol message.
 * @return short
 */
public short getVersion()
{
 String[] version = getAttributes("version");

 if (version != null && version[0] != null)
  return new Short(version[0]).shortValue();

 System.out.println("getVersion: returning default of 1");
 return 1;
```

```
    }

/**
 * When called, the token becomes irreversibly read-only.  The implementation
 * needs to ensure that any set methods check that this state has been set.
 */
 public void setReadOnly()
 {
  addAttribute("readonly", "true");
 }

/**
 * Called internally to see if the token is read-only
 */
 private boolean isReadOnly()
 {
  String[] readonly = getAttributes("readonly");

  if (readonly != null && readonly[0] != null)
   return new Boolean(readonly[0]).booleanValue();

  System.out.println("isReadOnly: returning default of false");
  return false;
 }

/**
 * Gets the attribute value based on the named value.
 * @param String key
 * @return String[]
 */
 public String[] getAttributes(String key)
 {
  ArrayList array = (ArrayList) hashtable.get(key);

  if (array != null && array.size() > 0)
  {
   return (String[]) array.toArray(new String[0]);
  }

  return null;
 }

/**
 * Sets the attribute name/value pair.  Returns the previous values set for key,
 * or null if not previously set.
 * @param String key
 * @param String value
 * @returns String[];
 */
 public String[] addAttribute(String key, String value)
 {
  // Gets the current value for the key
  ArrayList array = (ArrayList) hashtable.get(key);

  if (!isReadOnly())
  {
```

```
    // Copies the ArrayList to a String[] as it currently exists
    String[] old_array = null;
    if (array != null && array.size() > 0)
     old_array = (String[]) array.toArray(new String[0]);

    // Allocates a new ArrayList if one was not found
    if (array == null)
     array = new ArrayList();

    // Adds the String to the current array list
    array.add(value);

    // Adds the current ArrayList to the Hashtable
    hashtable.put(key, array);

    // Returns the old array
    return old_array;
   }

   return (String[]) array.toArray(new String[0]);
  }


 /**
  * Gets the list of all attribute names present in the token.
  * @return java.util.Enumeration
  */
  public java.util.Enumeration getAttributeNames()
  {
   return hashtable.keys();
  }

 /**
  * Returns a deep copying of this token, if necessary.
  * @return Object
  */
  public Object clone()
  {
   com.ibm.wsspi.security.token.AuthenticationToken deep_clone =
    new com.ibm.websphere.security.token.CustomAuthenticationTokenImpl();

   java.util.Enumeration keys = getAttributeNames();

   while (keys.hasMoreElements())
   {
    String key = (String) keys.nextElement();

    String[] list = (String[]) getAttributes(key);

    for (int i=0; i<list.length; i++)
     deep_clone.addAttribute(key, list[i]);
   }

       return deep_clone;
  }
```

```
/**
 * This method returns true if this token is storing a user ID and password
 * instead of a token.
 * @return boolean
 */
 public boolean isBasicAuth()
 {
  return false;
 }
}
```

Example: custom AuthenticationToken login module

This file shows how to determine if the login is an initial login or a propagation login

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
    Map sharedState, Map options)
 {
   // (For more information on what to do during initialization, see
   // "Custom login module development for a system login configuration" on page 67.)
  _sharedState = sharedState;
 }

 public boolean login() throws LoginException
 {
   // (For information on what to do during login, see
   // "Custom login module development for a system login configuration" on page 67.)

  // Handles the WSTokenHolderCallback to see if this is an initial or
     // propagation login.
  Callback callbacks[] = new Callback[1];
  callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");

  try
  {
   callbackHandler.handle(callbacks);
  }
  catch (Exception e)
  {
   // Handles exception
  }

  // Receives the ArrayList of TokenHolder objects (the serialized tokens)
  List authzTokenList = ((WSTokenHolderCallback) callbacks[0]).getTokenHolderList();

  if (authzTokenList != null)
  {
   // Iterates through the list looking for your custom token
   for (int i=0; i<authzTokenList.size(); i++)
   {
    TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

          // Looks for the name and version of your custom AuthenticationToken
          // implementation
```

```
   if (tokenHolder.getName().equals("your_oid_name") && tokenHolder.getVersion() == 1)
   {
           // Passes the bytes into your custom AuthenticationToken constructor
           // to deserialize
    customAuthzToken = new
     com.ibm.websphere.security.token.
              CustomAuthenticationTokenImpl(tokenHolder.getBytes());

   }
  }
 }
 else
        // This is not a propagation login. Create a new instance of your
        // AuthenticationToken implementation
 {
      //  Gets the principal from the default AuthenticationToken. This principal
      //  should match all default tokens.
      //  Note: WebSphere Application Server run time only enforces this for
      //  default tokens. Thus, you can choose
      //  to do this for custom tokens, but it is not required.
  defaultAuthToken = (com.ibm.wsspi.security.token.AuthenticationToken)
   sharedState.get(com.ibm.wsspi.security.auth.callback.Constants.WSAUTHTOKEN_KEY);
  String principal = defaultAuthToken.getPrincipal();

     // Adds a new custom authentication token. This is an initial login. Pass
     // the principal into the constructor
  customAuthToken = new com.ibm.websphere.security.token.
        CustomAuthenticationTokenImpl(principal);

  // Adds any initial attributes
  if (customAuthToken != null)
  {
   customAuthToken.addAttribute("key1", "value1");
   customAuthToken.addAttribute("key1", "value2");
   customAuthToken.addAttribute("key2", "value1");
   customAuthToken.addAttribute("key3", "something different");
  }
 }

    // Note: You can add the token to the Subject during commit in case
    // something happens during the login.
}

public boolean commit() throws LoginException
{
  // (For more information on what do during commit, see
  // "Custom login module development for a system login configuration" on page 67.)

 if (customAuthToken != null)
 {
  // Sets the customAuthToken token into the Subject
  try
  {
   private final AuthenticationToken customAuthTokenPriv = customAuthToken;
        // Do this in a doPrivileged code block so that application code does
        // not need to add additional permissions
```

```
    java.security.AccessController.doPrivileged(new java.security.PrivilegedAction()
    {
     public Object run()
     {
      try
      {
                  // Adds the custom Authentication token if it is not
                  // null and not already in the Subject
                               if ((customAuthTokenPriv != null) &&
         (!subject.getPrivateCredentials().
                         contains(customAuthTokenPriv)))
       {
        subject.getPrivateCredentials().add(customAuthTokenPriv);
       }
      }
      catch (Exception e)
      {
       throw new WSLoginFailedException (e.getMessage(), e);
      }

      return null;
     }
    });
   }
   catch (Exception e)
   {
    throw new WSLoginFailedException (e.getMessage(), e);
   }
  }
 }

 // Defines your login module variables
 com.ibm.wsspi.security.token.AuthenticationToken customAuthToken = null;
 com.ibm.wsspi.security.token.AuthenticationToken defaultAuthToken = null;
 java.util.Map _sharedState = null;
}
```

Propagating a custom Java serializable object

Prior to completing this task, verify that security propagation is enabled in the administrative console.

With security attribute propagation enabled, you can propagate data either horizontally with single signon (SSO) enabled or downstream using Common Secure Interoperability version 2 (CSIv2). When a login occurs, either through an application login configuration or a system login configuration, a custom login module can be plugged in to add Java serializable objects into the Subject during login. This document describes how to add an object into the Subject from a login module and describes other infrastructure considerations to make sure that the Java object gets propagated.

1. Add your custom Java object into the Subject from a custom login module There is a two phase process for each Java Authentication and Authorization Service (JAAS) login module. WebSphere Application Server completes the following processes for each login module present in the configuration:

login() method
In this step, the login configuration callbacks are analyzed, if necessary, and the new objects or credentials are created.

commit() method
In this step, the objects or credentials that are created during login are added into the Subject.

After a custom Java object is added into the Subject, WebSphere Application Server serializes the object, deserializes the object, and adds the object back into the Subject downstream. However, there are some requirements for this process to occur successfully. For more information on the JAAS programming model, see the JAAS information provided in "Security: Resources for learning" on page 495.

Important: Whenever you plug in a custom login module into the login infrastructure of WebSphere Application Server, make sure that the code is trusted. When you add the login module into the *install_root*/classes directory, the login module has Java 2 Security AllPermissions. It is recommended that you add your login module and other infrastructure classes into any private directory. However, you must modify the *install_root*/properties/server.policy file to make sure that your private directory, Java archive (JAR) file, or both have the permissions need to execute the application programming interfaces (API) that are called from the login module. Because the login module might be executed after the application code on the call stack, you might add doPrivileged code so that you do not need to add additional properties to your applications.

The following code sample shows how to add doPrivileged:

```
public customLoginModule()
{
 public void initialize(Subject subject, CallbackHandler callbackHandler,
     Map sharedState, Map options)
 {
  // (For more information on what to do during initialization, see
  // "Custom login module development for a system login configuration" on page 67.)
 }

 public boolean login() throws LoginException
 {
  // (For more information on what to do during login phase, see
  // "Custom login module development for a system login configuration" on page 67.)

     // Construct callback for the WSTokenHolderCallback so that you
     // can determine if
     // your custom object has propagated
    Callback callbacks[] = new Callback[1];
    callbacks[0] = new WSTokenHolderCallback("Authz Token List: ");

    try
    {
         _callbackHandler.handle(callbacks);
    }
    catch (Exception e)
    {
```

```
   throw new LoginException (e.getLocalizedMessage());
   }

   // Checks to see if any information is propagated into this login
   List authzTokenList = ((WSTokenHolderCallback) callbacks[1]).
           getTokenHolderList();

   if (authzTokenList != null)
   {
       for (int i = 0; i< authzTokenList.size(); i++)
            {
           TokenHolder tokenHolder = (TokenHolder)authzTokenList.get(i);

                 //  Look for your custom object. Make sure you use
                 //  "startsWith"because there is some data appended
                 //  to the end of the name indicating in which Subject
                 //  Set it belongs. Example from getName():
                 //  "com.acme.CustomObject (1)". The class name is
                 //  generated at the sending side by calling the
                 //  object.getClass().getName() method. If this object
                 //  is deserialized by WebSphere Application Server,
                 //  then return it and you do not need to add it here.
                 //  Otherwise, you can add it below.
                 //  Note: If your class appears in this list and does
                 //  not use custom serialization (for example, an
                 //  implementation of the Token interface described in
                 //  the Propagation Token Framework), then WebSphere
                 //  Application  Server automatically deserializes the
                 //  Java object for you. You might just return here if
                 //  it is found in the list.

           if (tokenHolder.getName().startsWith("com.acme.CustomObject"))
         return true;
       }
   }
      //  If you get to this point, then your custom object has not propagated
       myCustomObject = new com.acme.CustomObject();
       myCustomObject.put("mykey", "mydata");
}

public boolean commit() throws LoginException
{
 // (For more information on what to do during the commit phase, see
 // "Custom login module development for a system login configuration" on page 67.)

 try
 {
      // Assigns a reference to a final variable so it can be used in
      // the doPrivileged block
  final com.acme.CustomObject myCustomObjectFinal = myCustomObject;
  // Prevents your applications from needing a JAAS getPrivateCredential
      // permission.
  java.security.AccessController.doPrivileged(new java.security.
          PrivilegedExceptionAction()
  {
   public Object run() throws java.lang.Exception
```

```
    {
            // Try not to add a null object to the Subject or an object
            // that already exists.
     if (myCustomObjectFinal != null && !subject.getPrivateCredentials().
                contains(myCustomObjectFinal))
     {
               // This call requires a special Java 2 Security permission,
               // see the JAAS Javadoc.
      subject.getPrivateCredentials().add(myCustomObjectFinal);
     }
     return null;
    }
   });
  }
  catch (java.security.PrivilegedActionException e)
  {
   // Wraps the exception in a WSLoginFailedException
   java.lang.Throwable myException = e.getException();
   throw new WSLoginFailedException (myException.getMessage(), myException);
  }
 }

 // Defines your login module variables
 com.acme.CustomObject myCustomObject = null;
}
```

2. Verify that your custom Java class implements the `java.io.Serializable` interface. An object that is added to the Subject must be serializable if you want the object to propagate. For example, the object must implement the `java.io.Serializable` interface. If the object is not serializable, the request does not fail, but the object does not propagate. To make sure that an object added to the Subject is propagated, implement one of the token interfaces defined in the "Security attribute propagation" on page 276 article or add attributes to one of the following existing default token implementations:

   AuthorizationToken
   Add attributes if they are user-specific. For more information, see "Default AuthorizationToken" on page 300.

   PropagationToken
   Add attributes that are specific to an invocation. For more information, see "Default PropagationToken" on page 284

   If you are careful adding custom objects and follow all the steps to make sure that WebSphere Application Server can serialize and deserialize the object at each hop, then it is sufficient to use custom Java objects only.
3. Verify that your custom Java class exists on all of the systems that might receive the request When you add a custom object into the Subject and expect WebSphere Application Server to propagate the object, make sure the class definition for that custom object exists in the *install_root*/`classes` directory on all of the nodes where serialization or deserialization might occur. Also, verify that the Java class versions are the same.
4. Verify that your custom login module is configured in all of the login configurations used in your environment where you would need to add your custom object during a login. Any login configuration that interacts with WebSphere Application Server generates a Subject that might be propagated outbound for an EJB request. If you want WebSphere Application Server to

propagate a custom object in all cases, make sure that the custom login module is added to every login configuration that is used in your environment. For more information, see "Custom login module development for a system login configuration" on page 67.

5. Verify that security attribute propagation is enabled on all of the downstream servers that receive the propagated information When an EJB request is sent to a downstream server and security attribute propagation is disabled on that server, only the authentication token is sent for backwards compatibility. Therefore, you must review the configuration to verify that propagation is enabled in all of the cells that might receive requests. There are several places in the administrative console that you must check to make sure propagation is fully enabled. For more information, see "Enabling security attribute propagation" on page 282.
6. Add any custom objects to the propagation exclude list that you do not want to propagate. You can configure a property to exclude the propagation of objects that match specific class names, package names, or both. For example, you can have a custom object that is related to a specific process. If the object is propagated, it does not contain valid information. You must tell WebSphere Application Server not to propagate this object. Complete the following instructions to specify the object in the propagation exclude list using the administrative console:
   a. Click **Security > Global Security >**.
   b. Under Additional Properties, click **Custom Properties > New**.
   c. Add `com.ibm.ws.security.propagationExcludeList` in the **Name** field.
   d. Add the name of the custom object in the **Value** field. You can add a list of custom objects to the propagation exclude list separated by a colon. For example, you might enter `com.acme.CustomLocalObject:com.acme.private.*`. You can enter a class name such as `com.acme.CustomLocalObject` or a package name such as `com.acme.private.*`. In this example, WebSphere Application Server does not propagate any class that equals `com.acme.CustomLocalObject` or begins with `com.acme.private.`.

      Although you can add custom objects to the propagation exclude list, you must be aware of a side effect. WebSphere Application Server stores the opaque token, or the serialized Subject contents, in a local cache for the life of the single signon (SSO) token. The life of the SSO token, which has a default of two hours, is configured in the SSO properties on the administrative console. The information that is added to the opaque token only includes the objects not in the exclude list. If your authentication cache does not match your SSO token timeout, you might get a Subject on the local server that is regenerated from the opaque token but does not contain the objects on the exclude list. The authentication cache, which has a default of ten minutes, is configured on the Global Security panel on the administrative console. It is recommended that you make your authentication cache timeout value equal to the SSO token timeout so that the Subject contents are consistent locally.

As a result of this task, custom Java serializable objects are propagated horizontally or downstream. For more information on the differences between horizontal and downstream propagation, see "Security attribute propagation" on page 276.

Authentication protocol for EJB security

In WebSphere Application Server Version 5, two authentication protocols are available to choose from: Secure Authentication Service (SAS) and Common Secure

Interoperability Version 2 (CSIv2). SAS is the authentication protocol used by all previous releases of WebSphere Application Server and is maintained for backwards compatibility. The Object Management Group (OMG) has defined a new authentication protocol, called CSIv2, so that vendors can interoperate securely. CSIv2 is implemented in WebSphere Application Server with more features than SAS and is considered the strategic protocol.

Invoking EJB methods in a secure WebSphere Application Server environment requires an authentication protocol to determine the level of security and the type of authentication, which occur between any given client and server for each request. It is the job of the authentication protocol during a method invocation to merge the server authentication requirements (determined by the object Interoperable Object Reference (IOR)) with the client authentication requirements (determined by the client configuration) and come up with an authentication policy specific to that client and server pair.

The authentication policy makes the following decisions, among others, which are all based on the client and server configurations:
- What kind of connection can you make to this server--SSL or TCP/IP?
- If Secure Sockets Layer (SSL) is chosen, how strong is the encryption of the data?
- If SSL is chosen, do you authenticate the client using client certificates?
- Do you authenticate the client with a user ID and password? Does an existing credential exist?
- Do you assert the client identity to downstream servers?
- Given the configuration of the client and server, can a secure request proceed?

You can configure both protocols (SAS and CSIv2) to work simultaneously. If a server supports both protocols, it exports an IOR containing tagged components describing the configuration for SAS and CSIv2. If a client supports both protocols, it reads tagged components for both CSIv2 and SAS. If the client supports both and the server supports both, CSIv2 is used. However, if the server supports SAS (for example, it is a previous WebSphere Application Server release) and the client supports both, the client chooses SAS for this request, since the SAS protocol is what both have in common. Choose a protocol by specifying the `com.ibm.CSI.protocol` property on the client side and configuring through the administrative console on the server side. More details are included in the SAS and CSIv2 properties articles.

Common Secure Interoperability Specification, Version 2

The Common Secure Interoperability Specification, Version 2 (CSIv2) defines the Security Attribute Service (SAS) that enables interoperable authentication, delegation and privileges. The CSIv2 SAS and SAS protocols are entirely different. The CSIv2SAS protocol is a subcomponent of CSIv2 that supports SSL and interoperability with the EJB Specification, Version 2.0.

Security Attribute Service

The Common Secure Interoperability Specification, Version 2 Security Attribute Service (CSIv2 SAS) protocol is designed to exchange its protocol elements in the service context of a General Inter-ORB Protocol (GIOP) request and reply messages that are communicated over a connection-based transport. The protocol is intended for use in environments where transport layer security, such as that available through Secure Sockets Layer (SSL) and Transport Layer Security (TLS), is used to provide message protection (that is, integrity and or confidentiality) and

server-to-client authentication. The protocol provides client authentication, delegation, and privilege functionality that might be applied to overcome corresponding deficiencies in an underlying transport. The CSIv2 SAS protocol facilitates interoperability by serving as the higher-level protocol under which secure transports can be unified.

Connection and request interceptors

The authentication protocols used by WebSphere Application Server are add-on Interoperable Inter-ORB Protocol (IIOP) services. IIOP is a request-and-reply communications protocol used to send messages between two Object Request Brokers (ORBs). For each request made by a client ORB to a server ORB, an associated reply is made by the server ORB back to the client ORB. Prior to any request flowing, a connection between the client ORB and the server ORB must be established over the TCP/IP transport (SSL is a secure version of TCP/IP). The client ORB invokes the authentication protocol client connection interceptor, which is used to read the tagged components in the IOR of the object located on the server. As mentioned previously, this is where the authentication policy is established for the request. Given the authentication policy (a coalescing of the server configuration with the client configuration), the strength of the connection is returned to the ORB. The ORB makes the appropriate connection, usually over SSL.

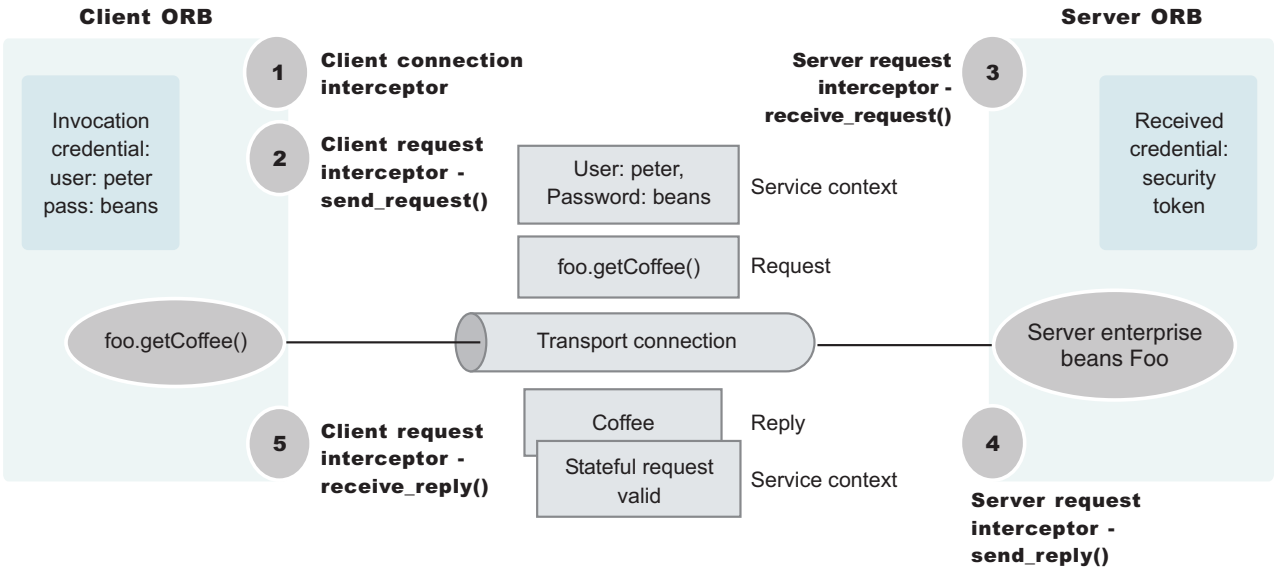
After the connection is established, the client ORB invokes the authentication protocol client request interceptor, which is used to send security information other than what is established by the transport. The security information includes the user ID and password token (authenticated by the server), an authentication mechanism-specific token (validated by the server), or an identity assertion token. Identity assertion is a way for one server to trust another server without the need to reauthenticate or revalidate the originating client. However, some work is required for the server to trust the upstream server. This additional security information is sent with the message in a *service context*. A service context has a registered identifier so that the server ORB can identify which protocol is sending the information. The fact that a service context contains a unique identity is another way for WebSphere Application Server to support both SAS and CSIv2 simultaneously because both protocols have different service context IDs. After the client request interceptor finishes adding the service context to the message, the message is sent to the server ORB.

When the message is received by the server ORB, the ORB invokes the authentication protocol server request interceptor. This interceptor looks for the service context ID known by the protocol. When both SAS and CSIv2 are supported by a server, two different server request interceptors are invoked and both interceptors look for different service context IDs. However, only one finds a service context for any given request. When the server request interceptor finds a service context, it reads the information in the service context. A method is invoked to the security server to authenticate or validate client identity. The security server either rejects the information or returns a credential. A credential contains additional information about the client, retrieved from the user registry so that authorization can make the appropriate decision. Authorization is the process of determining if the user can invoke the request based on the roles applied to the method and the roles given to the user. If the request is rejected by the security server, a reply is sent back to the client without ever invoking the business method.

If a service context is not found by the CSIv2 server request interceptor, the interceptor then looks at the transport connection to see if a client certificate chain was sent. This is done when SSL client authentication is configured between the client and server. If a client certificate chain is found, the distinguished name (DN) is extracted from the certificate and is used to map to an identity in the user registry. If the user registry is Lightweight Directory Access Protocol (LDAP), the search filters defined in the LDAP registry configuration determine how the certificate maps to an entry in the registry. If the user registry is local OS, the first attribute of the distinguished name (DN) maps to the user ID of the registry. This attribute is typically the common name. If the certificate does not map, no credential is created and the request is rejected. When invalid security information is presented, the method request is rejected and a NO_PERMISSION exception is sent back with the reply. However, when no security information is presented, an unauthenticated credential is created for the request and the authorization engine determines if the method gets invoked or not. For an unauthenticated credential to invoke an Enterprise JavaBean (EJB) method, either no security roles are defined for the method or a special **Everyone** role is defined for the method.

When the method invocation is completed in the EJB container, the server request interceptor is invoked again to complete server authentication and a new reply service context is created to inform the client request interceptor of the outcome. This process is typically for making the request *stateful*. When a stateful request is made, only the first request between a client and server requires that security information is sent. All subsequent method requests need to send a unique context ID only so that the server can look up the credential stored in a session table. The context ID is unique within the connection between a client and server.

Finally, the method request cycle is completed by the client request interceptor receiving a reply from the server with a reply service context providing information so the client side stateful context ID can be confirmed and reused. Specifying a stateful client is done through the property com.ibm.CSI.performStateful (true/false). Specifying a stateful server is done through the administrative console configuration.



. Authentication protocol flow

Authentication policy for each request

The authentication policy of a given request determines the security protection between a client and a server. A client or server authentication protocol configuration can describe required features, supported features and non-supported features. When a client requires a feature, it can only talk to servers that either require or support that feature. When a server requires a feature, it can only talk to clients that either require or support that feature. When a client supports a feature, it can talk to a server that supports or requires that feature, but can also talk to servers that do not support the feature. When a server supports a feature, it can talk to a client that supports or requires the feature, but can also talk to clients that do not support the feature (or chose not to support the feature).

For example, for a client to support client certificate authentication, some setup is required to either generate a self-signed certificate or to get one from a certificate authority (CA). Some clients might not need to complete these actions, therefore, you can configure this feature as `not supported`. By making this decision, the client cannot communicate with a secure server requiring client certificate authentication. Instead, this client can choose to use the user ID and password as the method of authenticating itself to the server.

Typically, supporting a feature is the most common way of configuring features. It is also the most successful during run time because it is more forgiving than requiring a feature. Knowing how secure servers are configured in your domain,

you can choose the right combination for the client to ensure successful method invocations and still get the most security. If you know that all of your servers support both client certificate and user ID and password authentication for the client, you might want to require one and not support the other. If both the user ID and password and the client certificate are supported on the client and server, both are performed but user ID and password take precedence at the server. This action is based on the CSIv2 specification requirements.

Common Secure Interoperability Version 2 features

The following Common Secure Interoperability Version 2 (CSIv2) features are available in IBM WebSphere Application Server: SSL client certificate authentication, message layer authentication, and identity assertion.

5.1.1 In WebSphere Application Server, the security attribute propagation feature is also available.

- SSL Client Certificate authentication.

  An additional way to authenticate a client to a server using SSL client authentication.
- Message Layer Authentication.

  Authenticates credential information and sends that information across the network so that a receiving server can interpret it.
- Identity Assertion.

  Supports a downstream server in accepting the client identity established on an upstream server, without having to reauthenticate. The downstream server trusts the upstream server.
- 5.1.1 Security attribute propagation

  Supports the use of the authorization token to propagate serialized Subject contents and PropagationToken contents with the request. You can propagate these objects using a pure client or a server login that adds custom objects to the Subject. Propagating security attributes prevents downstream logins from having to make UserRegistry calls to look up these attributes.

Identity assertion

Identity assertion is the invocation credential that is asserted to the downstream server.

When a client authenticates to a server, the received credential is set. When authorization checks the credential to determine whether access is permitted, it also sets the *invocation* credential so that if the EJB method calls another EJB method located on other servers, the invocation credential can be the identity used to invoke the downstream method. Depending on the RunAs mode for the enterprise beans, the invocation credential is set as the originating client identity, the server identity, or a specified different identity. Regardless of the identity that is set, when identity assertion is enabled, it is the invocation credential that is asserted to the downstream server.

The invocation credential identity is sent to the downstream server in an identity token. In addition, the sending server identity, including the password or token, is sent in the client authentication token when basic authentication is enabled. The sending server identity is sent through a Secure Sockets Layer (SSL) client certification authentication when client certificate authentication is enabled. Basic authentication takes precedence over client certificate authentication. Both tokens are needed by the receiving server to accept the asserted identity. The receiving server completes the following actions to accept the asserted identity:

- The server determines whether the sending server identity, sent with a basic authentication token or with a SSL client certificate, is on the trusted principal list of the receiving server. The server determines whether the sending server can send an identity token to the receiving server.
- After it is determined that the sending server is on the trusted list, the server authenticates the sending server to verify its identity.
- The server is authenticated by comparing the user ID and password from the sending server to the receiving server, or it might require a real authenticated call. If the credentials of the sending server are authenticated and on the trusted principal list, then the server proceeds to evaluate the identity token.

Evaluation of the identity token consists of the following four identity formats that exist in an identity token:
- Principal name
- Distinguished name
- Certificate chain
- Anonymous identity

The product servers that receive authentication information typically support all four identity types. The sending server decides which one is chosen, based on how the original client authenticated. The existing type depends on how the client originally authenticates to the sending server. For example, if the client uses Secure Sockets Layer (SSL) client authentication to authenticate to the sending server, then the identity token sent to the downstream server contains the certificate chain. This information is important because it permits the receiving server to perform its own certificate chain mapping. It enables more interoperability with other vendors and platforms.

After the identity format is understood and parsed, the identity maps to a credential. For an ITTPrincipal identity token, this identity maps one-to-one with the user ID fields. For an ITTDistinguishedName identity token, the mapping depends on the user registry. For Lightweight Directory Access Protocol (LDAP), the configured search filter determines how the mapping occurs. For LocalOS, the first attribute of the distinguished name (DN), which is typically the same as the common name, maps to the user ID of the registry. For an ITTCertChain identity token, see the section, Map certificates to users for details on how this action is performed for the LDAP user registry. For LocalOS, the first attribute of the DN in the certificate is used to map to the user ID in the registry.

Some user registry methods are called to gather additional credential information used by authorization. In a stateful server, this action completes once for the sending server and receiving server pair where the identity tokens are the same. Subsequent requests are made through a session ID.

Identity assertion is only available using the Common Secure Interoperability Version 2 (CSIv2) protocol.

Message layer authentication

Defines the credential information and sends that information across the network so that a receiving server can interpret it.

When you send authentication information across the network using a token (whether the token is a user ID and password token, that is, Generic Security Services Username Password (GSSUP), or a mechanism-specific format token,

Lightweight Third Party Authentication (LTPA), for example), the transmission is considered message layer authentication because the data is sent along with the message inside a service context.

A pure Java client uses basic authentication (GSSUP) as the authentication mechanism to establish client identity. However, a servlet can use either basic authentication (GSSUP) or the authentication mechanism of the server (LTPA) to send security information in the message layer. Use LTPA by authenticating or mapping the basic authentication credentials to the security mechanism of the server.

The security token contained in a token-based credential is authentication mechanism-specific. That is, the way the token is interpreted is only known by the authentication mechanism. Therefore, each authentication mechanism has an object ID (OID) representing it. The OID and the client token are sent to the server, so that the server knows which mechanism to use when reading and validating the token. The following list contains the OIDs for each mechanism:

BasicAuth (GSSUP): oid:2.23.130.1.1.1
LTPA: oid:1.3.18.0.2.30.2
SWAM: No OID because it is not forwardable

On the server, the authentication mechanisms can interpret the token and create a credential, or they can authenticate basic authentication data from the client, and create a credential. Either way, the created credential is the *received* credential that the authorization check uses to determine if the user has access to invoke the method. You can specify the authentication mechanism by using the com.ibm.CORBA.authenticationTarget property on the client side. (Basic authentication is currently the only valid value.) You can configure the server through the administrative console.

While this property tells you which authentication mechanism to use, you also need to specify whether you want to perform authentication over the message layer (that is, get a `BasicAuth or token-based` credential). To complete this task, specify the com.ibm.CSI.performClientAuthenticationRequired (**True** or **False**) and com.ibm.CSI.performClientAuthenticationSupported (**True** or **False**) properties. Indicating that client authentication is required implies that it must be done for every request. Indicating that the authentication mechanism is supported implies that it might be done but is not required. For some servers, this option is appropriate if no resources are protected. In most cases it is a best practice to indicate that this mechanism is supported so that client authentication is performed if both the client and server support it. Client authentication it is not performed when communicating with certain servers that do not want security, yet the method requests still succeed.

Configuring authentication retries

Situations occur where you want a prompt to reappear if you entered your user ID and password incorrectly or you want a method to retry when a particular error occurs back at the client. If you can correct the error by information at the client side, the system automatically performs a retry without the client seeing the failure, if the system is configured appropriately.

Some of these errors include:
- Entering an invalid user ID and password
- Having an expired credential on the server

- Failing to find the stateful session on the server

By default, authentication retries are enabled and perform three retries before returning the error to the client. The property used to enable or disable authentication retries is com.ibm.CORBA.authenticationRetryEnabled (**True** or **False**). The property used to specify the number of retry attempts is com.ibm.CORBA.authenticationRetryCount.

Immediate validating of a basic authentication login

In WebSphere Application Server Version 5, a new behavior is defined during request_login for a BasicAuth login. In prior releases, a BasicAuth login takes the user ID and password entered through the loginSource method and creates a BasicAuth credential. If the user ID or password is invalid, the client program does not find out until the first method request is attempted. When the user ID or password is specified during a prompt or programmatic login, the user ID and password are authenticated by default with the security server, with a `True` or `False` being returned as the result. If `False`, an `org.omg.SecurityLevel2.LoginFailed` exception is returned to the client indicating the user ID and password are invalid. If `True`, then the BasicAuth credential is returned to the caller of the request_login. To disable this feature on the pure client, specify `com.ibm.CORBA.validateBasicAuth=false`. By default this feature is set to `True`. On the server side, specify this property in the security dynamic properties.

Secure Sockets Layer client certificate authentication

An additional way to authenticate a client to a server is using Secure Sockets Layer (SSL) client authentication.

Using SSL client authentication is another way of authenticating a client to a server. This form of authentication does not occur at the message layer as described previously (using a user ID and password or tokens). This authentication occurs during the connection handshake using SSL certificates. When the client is configured with a personal certificate in the SSL keystore file, which indicates that SSL client authentication is desired and the server supports SSL client authentication, the following actions occur to establish the identity on the client side.

Using SSL client authentication is another way of authenticating a client to a server. This form of authentication does not occur at the message layer as described previously (using a user ID and password or tokens). This authentication occurs during the connection handshake using SSL certificates. When the client is configured with a personal certificate in the SSL keystore or keyring file, which indicates that SSL client authentication is desired and the server supports SSL client authentication, the following actions occur to establish the identity on the client side.

When a method request is invoked in the client code to a remote enterprise bean, the Object Request Broker (ORB) invokes the client connection interceptor to establish a connection with the server. Because the configuration specifies SSL, and SSL client authentication, the connection type is SSL and the SSL handshake sends the client certificate to the server to validate. If the client certificate does not validate, the connection is not established and an exception is sent back to the client code where the method is invoked, which indicates the failure. If the client certificate is validated, then a connection opens between the client and the server.

The ORB proceeds to call the client request interceptor, which might be busy.

If basic authentication is also configured, for example, then the user might be prompted for a user ID and password. Because this action is not necessary, disable this option in the configuration if the SSL certificate is the desired identity against which to invoke the method. If no message layer security exists, then no security context is created and associated with the request.

After the server receives the request, the server-side request interceptor checks for a security context. Because the server does not find a service context, it checks the server socket for a client certificate chain that contains the client identity. In this case, the server finds the certificate chain from the client. The identity in the certificate chain is valid because the connection was made. To create a credential, map the identity from the certificate to the user registry. This action is done differently based on the type of authentication mechanism. Mapping a certificate to a credential is done differently based on the user registry type.

See the, Map certificates to users article, for details on how this mapping is performed for the Lightweight Directory Access Protocol (LDAP) user registry. For local OS, the first attribute of the distinguished name (DN) in the certificate is used to map to the user ID in the registry.

One benefit of SSL client certificate authentication is that it optimizes authentication performance, because an SSL connection is typically created anyway. The extra overhead of sending the client certificate is minimal. While the client-side request interceptor performs no activity, the server side request interceptor maps the certificate to a credential. One disadvantage to this type of authentication is the complexity of setting up the keystore file on each client system.

To enable SSL client certificate authentication on the client side, you must enable the properties, such as SSL. This action is completed using the following two properties:
- com.ibm.CSI.performTransportAssocSSLTLSRequired (true or false)
- com.ibm.CSI.performTransportAssocSSLTLSSupported (true or false)

Indicating SSL is required implies that every request must generate an SSL connection key. If a server does not support SSL, then the request fails. After you enable SSL by either supporting it or requiring it, you can enable some of the SSL features.

To enable SSL client authentication, you can specify the following two properties:
- com.ibm.CSI.performTLClientAuthenticationRequired (true or false)
- com.ibm.CSI.performTLClientAuthenticationSupported (true or false)

The TL means *transport layer*. If you indicate that SSL client authentication is required, then you only limit the ability to communicate with servers that support SSL client authentication. For a server to support SSL client authentication, that server must have similarly configured properties through the administrative console, and have an SSL listener port that is open to handle mutual authentication handshakes. Configuration of server properties are done through the administrative console.

SSL client certificate authentication from a Java client is only available using the Common Secure Interoperability Version 2 (CSIv2) protocol.

Supported IBM protocols: Secure Authentication Service and Common Secure Interoperability Version 2

There are two authentication protocols supported by IBM. Secure Authentication Service (SAS) (z/SAS on the z/OS platform) is the authentication protocol used by all previous releases of the WebSphere Application Server product. Common Secure Interoperability Version 2 (CSIv2) is implemented in WebSphere Application Server, Version 5 and is considered the strategic protocol.

You can configure both protocols to work simultaneously. If a server supports both protocols, it exports an IOR containing tagged components describing the configuration for SAS and CSIv2. If a client supports both protocols, it reads tagged components for both CSIv2 and SAS. If the client and the server support both protocols, CSIv2 is used. However, if the server supports SAS (for example, it is a previous WebSphere Application Server release) and the client supports both protocols, the client chooses SAS for this request. Choose a protocol using the `com.ibm.CSI.protocol` property on the client side and configure this protocol through the GUI on the server side.

You can configure both protocols to work simultaneously. If a server supports both protocols, it exports an IOR containing tagged components describing the configuration for z/SAS and CSIv2. If a client supports both protocols, it reads tagged components for both CSIv2 and z/SAS. If the client and the server support both protocols, CSIv2 is used. However, if the server supports z/SAS (for example, it is a previous WebSphere Application Server release) and the client supports both protocols, the client chooses z/SAS for this request. CSIv2 is considered enabled on the client with the existence of the `com.ibm.CORBA.ConfigURL java` property. If the property is not specified or the property does not exist, CSIv2 is not enabled.

Configuring Common Secure Interoperability Version 2 and Security Authentication Service authentication protocols

1. Determine how to configure security inbound and outbound at each point in your infrastructure.

   For example, you might have a Java client communicating with an Enterprise JavaBean (EJB) application server, which in turn communicates to a downstream EJB application server. The Java client utilizes the `sas.client.props` file to configure outbound security (pure clients only need to configure outbound security). The upstream EJB application server configures inbound security to handle the right type of authentication from the Java client. The upstream EJB application server utilizes the outbound security configuration when going to the downstream EJB application server.

   This type of authentication might be different than what you expect from the Java client into the upstream EJB application server. Security might be tighter between the pure client and the first EJB server, depending on your infrastructure. The downstream EJB server utilizes the inbound security configuration to accept requests from the upstream EJB server. These two servers require similar configuration options as well. If the downstream EJB application server communicates to other downstream servers, then the outbound security might require a special configuration.
2. Specify the type of authentication. By default, authentication using a user ID and password is performed. Both Java client certificate authentication and identity assertion are disabled by default. If you want this type of basic authentication performed at every tier, use the CSIv2 authentication protocol configuration as is. However, if you have any special requirements where some

servers authenticate differently from other servers, then consider how to configure CSIv2 to take advantage of its features.

3. Configure clients and servers. Configuring a pure Java client is done through the `sas.client.props` file where properties are modified. Configuring servers is always done from the administrative console, either from the Security navigation for cell-level configurations or from the application server Server security for server-level configurations. If you want some servers to authenticate differently from others, modify some of the server level configurations. When you modify the server-level configurations, you are overriding the cell-level configurations.

Common Secure Interoperability Version 2 and Security Authentication Service client configuration

A secure Java client requires configuration properties to determine how to perform security with a server. These configuration properties are typically put into a properties file somewhere on the client machine and referenced by specifying the following system property on the command line of the Java client. The syntax of this property accepts a valid URL with the protocol type, `file`.

```
-Dcom.ibm.CORBA.ConfigURL=file:/C:/WebSphere/AppServer/properties/sas.client.props
```

A secure Java client requires configuration properties to determine how to perform security with a server. These configuration properties are typically put into a properties file somewhere on the client system and referenced by specifying the following system property on the command line of the Java client. The syntax of this property accepts a valid URL with the protocol type, `file`.

```
-Dcom.ibm.CORBA.ConfigURL=file:/WebSphere/V5R0M0/AppServer/sas.client.props
```

When this file is processed by the object request broker (ORB), security can be enabled between the Java client and the target server. If any syntax problems exist with the ConfigURL property and the `sas.client.props` file is not found, the Java client proceeds to connect insecurely. Errors display indicating the failure to read the ConfigURL property. Typically the problem is related to having two slashes after `file`, which is invalid.

When this file is processed by the object request broker (ORB), security can be enabled between the Java client and the target server. If there are any problems with the client properties file or there is no match with the server security, the Java client examines the server securities for non-Common Secure Interoperability Version 2 (CSIv2) securities that might be available. If there is no match with the old, non-CSIv2 securities either, the Java client attempts a nonsecure connection.

The following properties are used to configure the SAS and CSIv2 authentication protocols:

- "Security Authentication Service and Common Secure Interoperability Version 2 authentication protocol common settings for a client configuration" on page 355
- "CSIv2 authentication protocol client settings" on page 358
- "Security Authentication Service Authentication Protocol client settings" on page 361

The following properties are used to configure the CSIv2 authentication protocol:

- "Security Authentication Service and Common Secure Interoperability Version 2 authentication protocol common settings for a client configuration" on page 355
- "CSIv2 authentication protocol client settings" on page 358

Security Authentication Service and Common Secure Interoperability Version 2 authentication protocol common settings for a client configuration: Use the following settings in the *install_dir*\properties\sas.client.props file to configure Security Authentication Service (SAS) and Common Secure Interoperability Version 2 (CSIv2) clients.

com.ibm.CORBA.securityEnabled:

Use to determine if security is enabled for the client process.

Data type:	Boolean
Default:	True
Valid values:	True or False

com.ibm.CSI.protocol:

Use to determine which authentication protocols are active.

The client can configure protocols of ibm, csiv2 or both as active. The only possible values for an authentication protocol are ibm, csiv2 and both. Do not use sas for the value of an authentication protocol. This restriction applies to both client and server configurations. The following list provides information about using each of these protocol options:

ibm Use this authentication protocol option when you are communicating with WebSphere Application Server version 4.x or previous version servers.

csiv2 Use this authentication protocol option when you are communicating with WebSphere Application Server Version 5 or later servers because the SAS interceptors are not loaded and running for each method request.

both Use this authentication protocol option for interoperability between WebSphere Application Server Version 4.x or previous version servers and WebSphere Application Server Version 5 or later servers. Typically, specifying both provides greater interoperability with other servers.

Data type:	String
Default:	Both
Valid values:	ibm, csiv2, both

com.ibm.CORBA.authenticationTarget:

Use to determine the type of authentication mechanism for sending security information from the client to the server.

If basic authentication is specified, the user ID and password are sent to the server. Using the SSL transport with this type of authentication is recommended because otherwise the password is not encrypted. The target server must support the specified authenticationTarget.

If you specify Lightweight Third Party Authentication (LTPA), then LTPA must be the mechanism configured at the server for a method request to proceed securely.

Data type:	String
Default:	BasicAuth
Valid values:	BasicAuth, LTPA

com.ibm.CORBA.validateBasicAuth:

Use to determine if the user ID and password get validated immediately after the login data is entered when the authenticationTarget property is set to `BasicAuth`.

In past releases, BasicAuth logins only validated with the initial method request. During the first request, the user ID and password is sent to the server. This is the first time that the client can notice an error, if the user ID or password is incorrect. The validateBasicAuth method is specified and the validation of the user ID and password occurs immediately to the security server.

For performance reasons, you might want to disable this property if it is not desirable to verify the user ID and password immediately. If the client program can wait, it is better to have the initial method request flow to the user ID and password. However, program logic might not be as simple because of error handling considerations.

Data type:	Boolean
Default:	True
Valid values:	True or False

com.ibm.CORBA.authenticationRetryEnabled:

Use to specify that a failed login attempt is retried. This property determines if a retry occurs for other errors, such as stateful sessions that are not found on a server or validation failures at the server because of an expiring credential.

The minor code in the exception that is returned to a client determines which errors are retried. The number of retry attempts is dependent upon the property com.ibm.CORBA.authenticationRetryCount.

Data type:	Boolean
Default:	True
Valid values:	True or False

com.ibm.CORBA.authenticationRetryCount:

Use to specify the number of retries that occur until either a successful authentication occurs or the maximum retry value is reached.

When the maximum retry value is reached, the authentication exception is returned to the client.

Data type:	Integer
Default:	3
Range:	1-10

com.ibm.CORBA.loginSource:

Use to specify how the request interceptor attempts to log in if it does not find an invocation credential already set.

This property is only valid if message layer authentication occurs. If only transport layer authentication occurs, this property is ignored. When specifying properties, the following two additional properties need to be defined:

- **com.ibm.CORBA.loginUserid**
- **com.ibm.CORBA.loginPassword**

When performing a programmatic login, it is not necessary to specify `none` as the login source. Unless you want the request to fail, do not set a credential as the invocation credential during a method request.

Data type:	String
Default:	Prompt
Valid values:	prompt, key file, stdin, none, properties

com.ibm.CORBA.loginUserid:

Use to specify the user ID when a properties login is configured and message layer authentication occurs.

This property is only valid when `com.ibm.CORBA.loginSource=properties`. Also, set the `com.ibm.CORBA.loginPassword` property.

Data type:	String
Range:	Any string appropriate for a user ID in the configured user registry of the server.

com.ibm.CORBA.loginPassword:

Use to specify the password when a properties login is configured and message layer authentication occurs.

This property is only valid when `com.ibm.CORBA.loginSource=properties`. Also, set the com.ibm.CORBA.loginUserid property.

Data type:	String
Range:	Any string appropriate for a password in the configured user registry of the server

com.ibm.CORBA.keyFileName:

Use to specify the key file that is used to log in.

A key file is a file that contains a list of realm, user ID, and password combinations that a client uses to log into multiple realms. The realm used is the one found in the Interoperable Object Reference (IOR) for the current method request. The value of this property is used when `com.ibm.CORBA.loginSource=key file` is used.

Data type:	String
Default:	`C:/WebSphere/AppServer/properties/wsserver.key`
Range:	Any fully qualified path and file name of a WebSphere Application Server key file

com.ibm.CORBA.loginTimeout:

Use to specify the length in time that the login prompt stays available before it is considered a failed login.

Data type:	Integer
Units:	Seconds
Default:	300 (5 minute intervals)
Range:	0 - 600 (10 minute intervals)

CSIv2 authentication protocol client settings: In addition to the properties that are valid for both Security Authentication Service (SAS) and Common Secure Interoperability Version 2 (CSIv2), this page documents the properties that are valid for the CSIv2 protocol only.

com.ibm.CSI.performStateful:

Used to determine if the CSIv2 protocol maintains stateful sessions between a client and server after the initial secure association (authentication between a particular client and server).

For performance reasons, it is beneficial to enable this property. Considerations for disabling this property include troubleshooting an authentication protocol session-related problem.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performClientAuthenticationSupported:

Use to determine if message layer client authentication is supported.

When supported, message layer client authentication is performed when communicating with any server that supports or requires the authentication. Message layer client authentication involves transmitting either a user ID and password or a token from an already authenticated credential. If the authenticationTarget property is BasicAuth, the user ID and password are transmitted to the target server. If the authenticationTarget password is a token-based mechanism such as Lightweight Third Party Authentication (LTPA) or Kerberos, then the credential token is transmitted to the server after authenticating the user ID and password directly to the security server.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performClientAuthenticationRequired:

Use to determine if message layer client authentication is required.

When required, message layer client authentication must occur when communicating with any server. If transport layer client authentication is also enabled, both authentications are performed, but message layer client authentication takes precedence at the server.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performTransportAssocSSLTLSSupported:

Use to determine if Secure Sockets Layer (SSL) is supported.

When SSL is supported, this client causes either SSL or TCP/IP to communicate with a server. If SSL is not supported, then the client must communicate over TCP/IP to the server. Supporting SSL is recommended so that any sensitive information is encrypted and digitally signed. When the associated com.ibm.CSI.performTransportAssocSSLTLSRequired property is enabled (set to `true`), this property is ignored. In this case, SSL is always required.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performTransportAssocSSLTLSRequired:

Use to determine if SSL is required.

When SSL is required, this client must use SSL to communicate to a server. If SSL is not supported by a server, this client does not attempt a connection to that server. When this property is enabled, the associated com.ibm.CSI.performTransportAssocSSLTLSSupported property is ignored.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performTLClientAuthenticationSupported:

Use to determine if transport layer client authentication is supported.

When performing client authentication using SSL, the client key file must have a personal certificate configured. Without a personal certificate, the client cannot authenticate to the server over SSL. If the personal certificate is a self-signed certificate, the server must contain the public key of the client in the server trust file. If the personal certificate is a Certificate Authority (CA) granted certificate, the server must contain the root public key of the CA in the server trust file. This property is only valid when SSL is supported or required. If the associated com.ibm.CSI.performTLClientAuthenticationRequired property is enabled, this property is ignored.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performTLClientAuthenticationRequired:

Use to determine if transport layer client authentication is required.

If required, every secure socket opened between a client and server authenticates using SSL mutual authentication. When performing client authentication using SSL, the client key file must have a personal certificate configured. Without a personal certificate, the client cannot authenticate to the server over SSL.

If the personal certificate is a self-signed certificate, the server must contain the public key of the client in the server trust file. If the personal certificate is a certificate authority (CA) granted certificate, the server must contain the root public key of the CA in the server trust file. When this property is specified, the associated `com.ibm.CSI.performTLClientAuthenticationSupported` property is ignored.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performMessageConfidentialitySupported:

Use to determine if 128-bit ciphers are supported to make SSL connections.

If a target server does not support 128-bit ciphers, you can make a connection at a lower encryption strength. This property is only valid when SSL is enabled.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performMessageConfidentialityRequired:

Use to determine if 128-bit ciphers must be used to make SSL connections.

If a target server does not support 128-bit ciphers, a connection to that server fails. This property is only valid when SSL is enabled. When this property is enabled, the associated `com.ibm.CSI.performMessageConfidentialitySupported` property is ignored.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performMessageIntegritySupported:

Use to determine if 40-bit ciphers are supported to make SSL connections.

If a target server does not support 40-bit ciphers, you can make a connection using only digital signing ciphers. This property is only valid when SSL is enabled. This property is ignored if the associated com.ibm.CSI.performMessageIntegrityRequired property is enabled.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.performMessageIntegrityRequired:

Use to determine if 40-bit ciphers must be used to make SSL connections.

If a target server does not support 40-bit ciphers, a connection to that server fails. This property is only valid when SSL is enabled. When this property is enabled, the associated `com.ibm.CSI.performMessageIntegritySupported` property is ignored.

Data type:	Boolean
Default:	True
Range:	True or False

com.ibm.CSI.rmiOutboundPropagationEnabled: Enables the propagation of custom objects that are added to the Subject. On a pure client, add this property to the sas.client.props file. For more information, see ″Security Attribute Propagation″.

Security Authentication Service Authentication Protocol client settings:

In addition to those properties which are valid for both Security Authentication Service (SAS) and Common Secure Interoperability Version 2 (CSIv2), this article documents properties which are valid only for the SAS authentication protocol.

com.ibm.CORBA.standardPerformQOPModels:

Specifies the strength of the ciphers when making an SSL connection.

Data type:	String
Default:	High
Range	Low, Medium, High

Configuring Common Secure Interoperability Version 2 inbound authentication

Inbound authentication refers to the configuration that determines the type of accepted authentication for inbound requests. This authentication is advertised in the Interoperable Object Reference (IOR) that the client retrieves from the name server.

1. Start the administrative console. Click **Security > Authentication Protocol > CSI Inbound Authentication**.
2. Consider the following three layers of security:
   - Identity assertion (attribute layer).

     When selected, this server accepts identity tokens from upstream servers. If the server receives an identity token, the identity is taken from an originating client. For example, the identity is in the same form that the originating client presented to the first server. An upstream server sends the identity of the originating client. The format of the identity can be either a principal name, a distinguished name, or a certificate chain. In some cases, the identity is anonymous. It is important to trust the upstream server that sends the identity token because the identity is authenticating on this server. Trust of the upstream server is established either using Secure Sockets Layer (SSL) client certificate authentication or basic authentication. You must select one of the two layers of authentication in both inbound and outbound authentication when you choose identity assertion. The server ID is sent in the client authentication token with the identity token. The server ID is checked against the trusted server ID list. If the server ID is on the trusted

server list, the server ID is authenticated. If the server ID is valid, then the identity token identity is put into a credential and used for authorization of the request.

- User ID and password (message layer).

  This type of authentication is the most typical. The user ID and password or authenticated token is sent from a pure client or from an upstream server. However, the upstream server can not be a z/OS server because z/OS does not support a user ID or password from a server acting as a client. Usually, a token is sent from an upstream server and a user ID and password are sent from a client (including a servlet). When a user ID and password are received at the server, they are authenticated with the user registry. When a token is received at the server level, the token is validated to determine whether it has been tampered with or has expired.
- Secure Sockets Layer client certificate authentication (transport layer).

  This type of authentication typically occurs from pure clients using the certificate identity and from servers trusting the upstream server. Usually, when a server delegates an identity to a downstream server, the identity comes from either the message layer (a client authentication token) or the attribute layer (an identity token), not from the transport layer, through the client certificate authentication.

  A client has an SSL client certificate stored in the keystore file of the client configuration. When SSL client authentication is enabled on this server, the server requests that the client send the SSL client certificate when the connection is established. The certificate chain is available on the socket whenever a request is sent to the server. The server request interceptor gets the certificate chain from the socket and maps this certificate chain to a user in the registry. This type of authentication is optimal for communicating directly from a client to a server. However, when you have to go downstream, the identity typically flows over the message layer or through identity assertion.

3. Consider the following points when deciding what type of authentication to accept:
   - A server can receive multiple layers simultaneously, so an order of precedence rule decides which identity to use. The identity assertion layer has the highest priority, the message layer follows, and the transport layer has the lowest priority. The SSL client certificate authentication is used when it is the only layer provided. If the message layer and the transport layer are provided, the message layer is used to establish the identity for authorization. The identity assertion layer is used to establish precedence when provided.
   - Does this server usually receive requests from a client, from a server or both? If the server always receives requests from a client, identity assertion is not needed. You can then choose either the message layer, the transport layer, or both. You also can decide when authentication is required or just supported. To select a layer as required, the sending client must supply this layer, or the request is rejected. However, if the layer is only supported, the layer might not be supplied.
   - What kind of client identity is supplied? If the client identity is client certificates authentication and you want the certificate chain to flow downstream so that it maps to the downstream server user registries, then identity assertion is the appropriate choice. Identity assertion preserves the format of the originating client. If the originating client authenticated with a user ID and password, then a principal identity is sent. If authentication is done with a certificate, then the certificate chain is sent. In some cases, if the

client authenticated with a token and a Lightweight Directory Access Protocol (LDAP) server is the user registry, then a distinguished name (DN) is sent.

4. Configure a trusted server list.

   When identity assertion is selected for inbound requests, insert a pipe-separated (|) list of server administrator IDs to which this server can support identity token submission. For backwards compatibility, you can still use a comma-delimited list. However, if the server ID is a Distinguished Name (DN), then you must use a pipe-delimited (|) list as a comma delimiter does not work.

   If you choose to support any server sending an identity token, you can enter an asterisk (*) in this field. This action is called *presumed trust*. In this case, use SSL client certificate authentication between servers to establish the trust.

5. Configure session management. You can choose either *stateful* or *stateless* security. Performance is optimum when choosing stateful sessions. The first method request between a client and server is authenticated. All subsequent requests (or until the credential token expires) reuse the session information, including the credential. A client sends a context ID for subsequent requests. The context ID is scoped to the connection for uniqueness.

When you finish configuring this panel, you have configured most of the information that a client coalesces when determining what to send to this server. A client or server outbound configuration with this server inbound configuration, determines the security that is applied. When you know what clients send, the configuration is simple. However, if you have a diverse set of clients with differing security requirements, your server considers various layers of authentication.

For an enterprise bean server, the authentication choice is usually either identity assertion or message layer because you want the identity of the originating client delegated downstream. You cannot easily delegate a client certificate using an SSL connection. It is acceptable to enable the transport layer because additional server security, as the additional client certificate portion of the SSL handshake, adds some overhead to the overall SSL connection establishment.

After you determine which type of authentication data this server might receive, you can determine what to select for outbound security. Refer to the article, Configuring Common Secure Interoperability Version 2 outbound authentication.

Common Secure Interoperability inbound authentication settings:

Use this page to specify the features that a server supports for a client accessing its resources.

To view this administrative console page, click **Security** > **Authentication Protocol** > **CSI Inbound Authentication**.

Use CSI inbound authentication settings for configuring the type of authentication information contained in an incoming request or transport.

Authentication features include three layers of authentication that you can use simultaneously:

- **Transport layer**. The transport layer, which is the lowest layer, might contain a Secure Sockets Layer (SSL) client certificate as the identity.
- **Message layer**. The message layer might contain a user ID and password or an expirable authenticated token.

- **Attribute layer**. The attribute layer might contain an identity token, which is an identity from an upstream server that already is authenticated. The identity layer has the highest priority, followed by the message layer, and then the transport layer. If a client sends all three, only the identity layer is used. The only way to use the SSL client certificate as the identity is if it is the only information presented during the request. The client picks up the Interoperable Object Reference (IOR) from the name space and reads the values from the tagged component to determine what the server needs for security.

Basic Authentication:

Specifies that basic authentication occurs over the message layer.

In the message layer, basic authentication (user ID and password) takes place. This type of authentication typically involves sending a user ID and a password from the client to the server for authentication.

This authentication also involves delegating a credential token from an already authenticated credential, provided the credential type is forwardable (for example, Lightweight Third Party Authentication (LTPA)).

If you specify **Basic Authentication** and LTPA is the configured authentication protocol, user name, password, and LTPA tokens are accepted.a

When you select **Basic Authentication**, decide whether it is Required or Supported. Selecting Required, indicates that only clients configured to authenticate to this server through the message layer can invoke requests on the server. Selecting Supported, indicates that this server accepts basic authentication. However, other methods of authentication can occur if configured and anonymous requests are accepted. Select **Never** to indicate that the server is not configured to accept message layer authentication from any client.

Data type: String

Client Certificate Authentication:

Specifies that authentication occurs when the initial connection is made between the client and the server during a method request.

In the transport layer, Secure Sockets Layer (SSL) client certificate authentication takes place. In the message layer, basic authentication (user ID and password) is performed. Client certificate authentication typically performs better than message layer authentication, but requires some additional setup steps. These additional steps involve verifying that the server has the signer certificate of each client to which it is connected. If the client uses a certificate authority (CA) to create its personal certificate, then you only need the CA root certificate in the server signer section of the SSL trust file.

When the certificate is authenticated to a Lightweight Directory Access Protocol (LDAP) user registry, the distinguished name (DN) is mapped based on the filter specified when configuring LDAP.

When the certificate is authenticated to a LocalOS user registry, the first attribute of the DN in the certificate (typically the common name) is mapped to the user ID in the registry. The identity from client certificates is used only if no other layer of authentication is presented to the server.

When you select **Client Certificate Authentication**, decide whether it is Required or Supported. When You select **Required**, only clients that are configured to authenticate to this server through SSL client certificates can invoke requests on the server. When you select **Supported**, this server accepts SSL client certificate authentication, however, other methods of authentication can occur (if configured) and anonymous requests are accepted. When you select **Never**, this server is not configured to accept client certificate authentication from any client.

Data type String

Identity Assertion:

Specifies that identity assertion is a way to assert identities from one server to another during a downstream Enterprise JavaBean (EJB) invocation.

Identity assertion is performed in the attribute layer and is only applicable on servers. The principal determined at the server is based on precedence rules. If identity assertion is performed, the identity is always derived from the attribute. If basic authentication is performed without identity assertion, the identity is always derived from the message layer. Finally, if SSL client certificate authentication is performed without either basic authentication, or identity assertion, then the identity is derived from the transport layer.

The identity asserted is the invocation credential that is determined by the RunAs mode for the enterprise bean. If the RunAs mode is Client, the identity is the client identity. If the RunAs mode is System, the identity is the server identity. If the RunAs mode is Specified, the identity is the one specified. The receiving server receives the identity in an identity token and also receives the sending server identity in a client authentication token. The receiving server validates the sending server identity as a trusted identity through the Trusted Server IDs entry box. Enter a list of pipe-separated (|) principal names, for example, `serverid1|serverid2|serverid3`.

When authenticating to a LocalOS user registry, all identity token types map to the user ID field of the active user registry. For an ITTPrincipal identity token, this token maps one-to-one with the user ID fields. For an ITTDistinguishedName identity token, the value from the first equal sign is mapped to the user ID field. For an ITTCertChain identity token, the value from the first equal sign of the distinguished name is mapped to the user ID field.

When authenticating to an LDAP user registry, the LDAP filters determine how an identity of type ITTCertChain and ITTDistinguishedName get mapped to the registry. If the token type is ITTPrincipal, then the principal gets mapped to the UID field in the LDAP registry.

Data type: String

Trusted servers:

Specifies a pipe-separated (|) list of trusted server IDs, which are trusted to perform identity assertion to this server. For example, `serverid1|serverid2|serverid3`. WebSphere Application Server supports the comma (,) character as the list delimiter for backwards compatibility. WebSphere Application Server checks the comma character when the pipe character fails to find a valid trusted server ID.

Use this list to quickly decide whether a server is trusted. Even if the server is on the list, the sending server must still authenticate with the receiving server to accept the identity token of the sending server.

Data type String

Stateful:

Specifies stateful sessions that are used mostly for performance improvements.

The first contact between a client and server must fully authenticate. However, all subsequent contacts with valid sessions reuse the security information. The client passes a context ID to the server, and the ID is used to look up the session. The context ID is scoped to the connection, which guarantees uniqueness. Whenever the security session is invalid and the authentication retry is enabled (it is by default), the client-side security interceptor invalidates the client-side session and resubmits the request without user awareness. This situation might occur if the session does not exist on the server (the server failed and resumed operation). When this value is disabled, every method invocation must re-authenticate.

Data type String

Login configuration:

Specifies the type of system login configuration used for inbound authentication.

You can add custom login modules by clicking **Security > JAAS configuration > System login**.

Security attribute propagation:

Specifies whether to support security attribute propagation during login requests. When you select this option, WebSphere Application Server retains additional information about the login request, such as the authentication strength used, and retains the identity and location of the request originator.

Verify that you are using Lightweight Third Party Authentication (LTPA) as your authentication mechanism. LTPA is the only authentication mechanism supported when you enable the security attribute propagation feature. To configure LTPA, click **Security > Authentication mechanisms > LTPA**.

If you do not select this option, WebSphere Application Server does not accept any additional login information to propagate to downstream servers.

Configuring Common Secure Interoperability Version 2 outbound authentication

Outbound authentication refers to the configuration that determines the type of authentication performed for outbound requests to downstream servers. Several *layers* or *methods* of authentication can occur. The downstream server inbound authentication configuration must support at least one choice made in this server outbound authentication configuration. If nothing is supported, the request might go outbound as `unauthenticated`. This situation does not create a security problem because the authorization run time is responsible for preventing access to protected resources. However, if you choose to prevent an unauthenticated credential to go

outbound, you might want to designate one of the authentication layers as `required`, rather than `supported`. If a downstream server does not support authentication, then when authentication is required, the method request fails to go outbound.

The following choices are available in the Common Secure Interoperability Version 2 (CSIv2) Outbound Authentication panel. Remember that you are not required to complete these steps in the displayed order. Rather, these steps are provided to help you understand your choices for configuring outbound authentication.

1. Select **Identity Assertion** (attribute layer). When selected, this server submits an identity token to a downstream server, if the downstream server supports identity assertion. When an originating client authenticates to this server, the authentication information supplied is preserved in the outbound identity token. If the client authenticating to this server uses client certificate authentication, then the identity token format is a certificate chain, containing the exact client certificate chain on the socket. The same scenario is true for other mechanisms of authentication. Read theIdentity Assertion article for more information.
2. Select **User ID** and **Password** (message layer). This type of authentication is the most typical. The user ID and password (if BasicAuth credential) or authenticated token (if authenticated credential) are sent outbound to the downstream server if the downstream server supports message layer authentication in the inbound authentication panel. Refer to the Message Layer Authentication article for more information.
3. Select **SSL Client certificate authentication** (transport layer). The main reason to enable outbound Secure Sockets Layer (SSL) client authentication from one server to a downstream server is to create a trusted environment between those servers. For delegating client credentials, use one of the two layers mentioned previously. However, you might want to create SSL personal certificates for all the servers in your domain, and only trust those servers in your SSL truststore file. No other servers or clients can connect to the servers in your domain, except at the tiers where you want them. This process can protect your enterprise bean servers from access by anything other than your servlet servers. Refer to the SSL Client Certificate Authentication article for more information.

   A server can send multiple layers simultaneously, therefore, an order of precedence rule decides which identity to use. The identity assertion layer has the highest priority, the message layer follows, and the transport layer has the lowest priority. SSL client certificates are only used as the identity for invoking method requests, when that is the only layer provided. SSL client certificates are useful for trust purposes, even if the identity is not used for the request. If only the message layer and transport layer are provided, the message layer is used to establish the identity for authorization. If the identity assertion layer is provided (regardless of what is provided), then the identity from the identity token is always used by the authorization engine as the identity for that request.

Configuring session management:

You can choose either *stateful* or *stateless* security. Performance is optimum when choosing stateful sessions. The first method request between this server and the downstream server is authenticated. All subsequent requests reuse the session information, including the credential. A *unique session entry* is defined as the combination of a unique client authentication token and an identity token, scoped to the connection.

When you finish configuring this panel, you configured the information that this server uses to make decisions about the type of authentication to perform with downstream servers. If the downstream server is configured not to support the outbound configuration of the server, the following exception likely occurs:

```
Exception received: org.omg.CORBA.INITIALIZE:
JSAS1477W: SECURITY CLIENT/SERVER CONFIG MISMATCH:  The client security
configuration (sas.client.props or outbound settings in GUI) does not
support the server security configuration for the following reasons:
ERROR 1: JSAS0607E: The client requires SSL Confidentiality but the server
does not support it.
ERROR 2: JSAS0610E: The server requires SSL Integrity but the client does
not support it.
ERROR 3: JSAS0612E: The client requires client (e.g., userid/password or token),
but the server does not support it.
minor code: 0  completed: No
        at com.ibm.ISecurityLocalObjectBaseL13Impl.SecurityConnectionInterceptor.
getConnectionKey(SecurityConnectionInterceptor.java:1770)
        at com.ibm.ws.orbimpl.transport.WSTransport.getConnection(Unknown Source)
        at com.ibm.rmi.iiop.TransportManager.get(TransportManager.java:79)
        at com.ibm.rmi.iiop.GIOPImpl.locate(GIOPImpl.java:167)
        at com.ibm.CORBA.iiop.ClientDelegate._createRequest(ClientDelegate.java:2088)
        at com.ibm.CORBA.iiop.ClientDelegate.createRequest(ClientDelegate.java:1264)
        at com.ibm.CORBA.iiop.ClientDelegate.createRequest(ClientDelegate.java:1177)
        at com.ibm.CORBA.iiop.ClientDelegate.request(ClientDelegate.java:1726)
        at org.omg.CORBA.portable.ObjectImpl._request(ObjectImpl.java:245)
        at com.ibm.WsnOptimizedNaming._NamingContextStub.get_compatibility_level
(Unknown Source)
        at com.ibm.websphere.naming.DumpNameSpace.getIdlLevel(DumpNameSpace.java:300)
        at com.ibm.websphere.naming.DumpNameSpace.getStartingContext
(DumpNameSpace.java:329)
        at com.ibm.websphere.naming.DumpNameSpace.main(DumpNameSpace.java:268)
        at java.lang.reflect.Method.invoke(Native Method)
        at com.ibm.ws.bootstrap.WSLauncher.main(WSLauncher.java:163)
```

The reasons for the mismatch are explained in the exception. You can make the corrections when you configure the outbound configuration for this server, or when you configure the inbound configuration of the downstream server. If multiple reasons exist for a failure, the reasons are explained as message text in the exception.

Typically, the outbound authentication configuration is for an upstream server to communicate with a downstream server. Most likely, the upstream server is a servlet server and the downstream server is an EJB server. On a servlet server, the client authentication performed to access the servlet can be one of many different types of authentication, including client certificate and basic authentication. When receiving basic authentication data, whether through a prompt login or a form based login, the basic authentication information is typically authenticated to form a credential of the mechanism type that is supported by the server, such as Lightweight Third Party Authentication (LTPA) or LocalOS. When LTPA is the mechanism, a forwardable token exists in the credential. Choose the message layer (BasicAuth) authentication to propagate the client credentials. If the credential was created using a certificate login and you want to preserve sending the certificate downstream, you might decide to go outbound with identity assertion.

Save the configuration and restart the server for the changes to take effect.

Common Secure Interoperability outbound authentication settings:

Use this page to specify the features that a server supports when acting as a client to another downstream server.

To view this administrative console page, click **Security > Authentication Protocol > CSI Outbound Authentication**.

Authentication features include three layers of authentication that you can use simultaneously:

Basic Authentication:

Specifies whether to send a user ID and a password from the client to the server for authentication.

This type of authentication occurs over the message layer. Basic authentication also involves delegating a credential token from an already authenticated credential, provided the credential type is forwardable (for example, Lightweight Third Party Authentication (LTPA)). Basic authentication refers to any authentication over the message layer and indicates user ID and password as well as token-based authentication.

Select **Basic Authentication** and determine whether this authentication method is required or supported. Select **Required** to indicate that when the server goes outbound to downstream servers, the downstream server must support basic authentication for this server to connect. Select **Supported** to indicate that this server might or might not perform basic authentication to a downstream server. Other methods of authentication can occur if configured. Select **Never** to indicate that this server never sends a message layer token outbound to a downstream server. If the downstream server requires basic authentication, then the connection is not attempted.

Data type: String

Client Certificate Authentication:

Specifies whether a client certificate from the configured keystore file is used to authenticate to the server when the SSL connection is made between this server and a downstream server (provided that the downstream server supports client certificate authentication).

Typically, client certificate authentication has a higher performance than message layer authentication, but requires some additional setup steps. These additional steps include verifying that this server has a personal certificate and that the downstream server has the signer certificate of this server.

If you select client certificate authentication, decide whether it is required or supported. Select **Required** to indicate that this server can only connect to downstream servers with client certificate authentication also configured. Select **Supported** to indicate that this server performs client certificate authentication with any downstream server, but might not use client certificate authentication depending on whether it is supported by the downstream server. Select **Never** to indicate that this client does not perform client certificate authentication to any downstream server. This limitation prevents access to any downstream server that requires client certificate authentication.

Data type: String

Identity Assertion:

Specifies whether to assert identities from one server to another during a downstream enterprise bean invocation.

The identity asserted is the invocation credential that is determined by the RunAs mode for the enterprise bean. If the RunAs mode is Client, the identity is the client identity. If the RunAs mode is System, the identity is the server identity. If the RunAs mode is Specified, the identity is the identity specified. The receiving server receives the identity in an identity token and also receives the sending server identity in a client authentication token. The receiving server validates the identity of the sending server to ensure a trusted identity.

When specifying identity assertion on the CSIv2 Authentication Outbound panel, you must also select basic authentication as supported or required on the CSIv2 Authentication Outbound panel. The server identity can then be submitted with the identity token, so that the receiving server can *trust* the sending server. Without specifying basic authentication as supported or required, trust is not established and the identity assertion fails.

Data type: String

Stateful:

Specifies whether to reuse security information during authentication. This option is usually used to increase performance.

The first contact between a client and server must fully authenticate. However, all subsequent contacts with valid sessions, reuse the security information. The client passes a context ID to the server, and that ID is used to look up the session. The context ID is scoped to the connection, which guarantees uniqueness. Whenever the security session is invalid and if authentication retry is enabled (it is enabled by default), the client-side security interceptor invalidates the client-side session and resubmits the request transparently. For example, if the session does not exist on the server; the server fails and resumes operation.

When this value is disabled, every method invocation must re-authenticate.

Data type: String

Login configuration:

Specifies the type of system login configuration used for outbound authentication.

You can add custom login modules before or after this login module by clicking **Security > JAAS configuration > System login**.

Custom outbound mapping:

Enables the use of custom RMI outbound login modules.

The custom login module maps or performs other functions before the pre-defined RMI outbound call. To declare a custom outbound mapping, click **Security > JAAS Configuration > System Logins > New**.

Security attribute propagation:

Enables WebSphere Application Server to propagate the Subject and the security content token to other application servers using the Remote Method Invocation (RMI) protocol.

Verify that you are using Lightweight Third Party Authentication (LTPA) as your authentication mechanism. LTPA is the only authentication mechanism supported when you enable the security attribute propagation feature. To configure LTPA, click **Security > Authentication mechanisms > LTPA**.

If you do not select this check box, WebSphere Application Server does not propagate any additional login information to downstream servers. However, if you select this check box, the outbound login configuration is invoked.

Trusted target realms:

Specifies a list of trusted target realms, separated by a pipe (|), that differ from the current realm.

Prior to WebSphere Application Server, Version 5.1.1, if the current realm does not match the target realm, the authentication request is not sent outbound to other application servers.

Configuring inbound transports

Inbound transports refer to the types of listener ports and their attributes that are opened to receive requests for this server. Both Common Secure Interoperability Specification, Version 2 (CSIv2) and Secure Authentication Service (SAS) have the ability to configure the transport. However, the following differences between the two protocols exist:

- CSIv2 is much more flexible than SAS, which requires Secure Sockets Layer (SSL); CSIv2 does not require SSL.
- SAS does not support SSL client certificate authentication, while CSIv2 does.
- CSIv2 can require SSL connections, while SAS only supports SSL connections.
- SAS always has two listener ports open: TCP/IP and SSL.
- CSIv2 can have as few as one listener port and as many as three listener ports. You can open one port for just TCP/IP or when SSL is required. You can open two ports when SSL is supported, and open three ports when SSL and SSL client certificate authentication is supported.

Complete the following steps to configure the Inbound Transport panels in the administrative console:

1. Click **Security** > **Authentication Protocol** > **CSIv2 Inbound Transport** to select the type of transport and the SSL settings. By selecting the type of transport, as noted previously, you choose which listener ports you want to open. In addition, you disable the SSL client certificate authentication feature if you choose TCP/IP as the transport.
2. Select the SSL settings that correspond to an SSL transport. These SSL settings are defined in the **Security** > **SSL** panel and define the SSL configuration including the keyring, security level, ciphers, and so on.
3. Consider fixing the listener ports that you configured.

You complete this action in a different panel, but this is the time to think about it. Most end points are managed at a single location, which is why they do not appear in the Inbound Transport panels. Managing end points at a single location helps you decrease the number of conflicts in your configuration when you assign the end points. The location for SSL end points is at each server. The following port names are defined in the End Points panel and are used for object request broker (ORB) security:

- CSIV2_SSL_MUTUALAUTH_LISTENER_ADDRESS - CSIv2 Client Authentication SSL Port
- CSIV2_SSL_SERVERAUTH_LISTENER_ADDRESS - CSIv2 SSL Port
- SAS_SSL_SERVERAUTH_LISTENER_ADDRESS - SAS SSL Port
- ORB_LISTENER_PORT - TCP/IP Port

For an application server, click **Servers** > **Application Servers** > *server_name*. Under Additional Properties, click **End Points**. The End Points panel is displayed for the specified server.

For an application server, click **Servers** > **Application Servers** > *server_name* **> End Points**.

The Object Request Broker (ORB) on WebSphere Application Server uses a listener port for Remote Method Invocation over the Internet Inter-ORB Protocol (RMI/IIOP) communications, which is generally not specified and selected dynamically during run time. If you are working with a firewall, you must specify a static port for the ORB listener and open that port on the firewall so that communication can pass through the specified port. The endPoint property for setting the ORB listener port is: ORB_LISTENER_ADDRESS.

Complete the following steps using the administrative console to specify the ORB_LISTENER_ADDRESS port or ports.

a. Click **Servers > Application Servers >** *server_name*.
b. Click **End Points > New** under Additional Properties.
c. Select **ORB_LISTENER_ADDRESS** from the End Point Name field in the Configuration panel.
d. Enter the IP address, the fully qualified DNS host name, or the DNS host name by itself in the Host field. For example, if the host name is `myhost`, the fully qualified DNS name can be `myhost.myco.com` and the IP address can be `155.123.88.201`.
e. Enter the port number in the Port field. The port number specifies the port for which the service is configured to accept client requests. The port value is used in conjunction with the host name. Using the previous example, the port number might be 9000.

4. Click **Security** > **Authentication Protocol** > **SAS Inbound** to select the SSL settings used for inbound requests from SAS clients. Remember that the SAS protocol is used to interoperate with previous releases. When configuring the key store and trust store files in the SSL configuration, these files need the right information for interoperating with previous releases of WebSphere Application Server. For example, a previous release has a different trust store file than the Version 5 release. If you use the Version 5 key store file, add the signer to the trust store file of the previous release for those clients connecting to this server.

The inbound transport configuration is complete.

With this configuration, you can configure a different transport for inbound security versus outbound security. For example, if the application server is the first server used by users, the security configuration might be more secure. When

requests go to back-end enterprise bean servers, you might lessen the security for performance reasons when you go outbound. With this flexibility you can design the right transport infrastructure to meet your needs.

When you finish configuring security, perform the following steps to save, synchronize, and restart the servers:
1. Click **Save** in the administrative console to save any modifications to the configuration.
2. Stop and restart all servers, when synchronized.

Common Secure Interoperability transport inbound settings:

Use this page to specify which listener ports to open and which Secure Sockets Layer (SSL) settings to use. These specifications determine which transport a client or upstream server uses to communicate with this server for incoming requests.

To view this administrative console page, click **Security** > **Authentication Protocol** > **CSI Inbound Transport**.

Transport:

Specifies whether client processes connect to the server using one of its connected transports.

You can choose to use either Secure Sockets Layer (SSL), TCP/IP or both as the inbound transport that a server supports. If you specify TCP/IP, the server only supports TCP/IP and cannot accept SSL connections. If you specify SSL Supported, this server can support either TCP/IP or SSL connections. If you specify SSL-Required, then any server communicating with this one must use SSL.

If you specify SSL-Supported or SSL-Required, decide which set of SSL configuration settings you want to use for the inbound configuration. This decision determines which key file and trust file are used for inbound connections to this server.

By default, SSL ports for Common Secure Interoperability Version 2 (CSIv2) and Security Authentication Service (SAS) are dynamically generated. In cases where you need to fix the SSL ports on application servers, click **Servers** > **Application Servers** > *server_name* > **End Points**. Provide a fixed port number for the following port or ports. A zero port number indicates that a dynamic assignment is made at run time.

CSIV2_SSL_MUTUALAUTH_LISTENER_ADDRESS
CSIV2_SSL_SERVERAUTH_LISTENER_ADDRESS
SAS_SSL_SERVERAUTH_LISTENER_ADDRESS
- **TCP/IP**: Only a TCP/IP listener port is opened and all requests inbound do not have SSL protection.
- **SSL-Supported**: Both a TCP/IP and SSL listener port are opened and most requests come inbound by SSL.
- **SSL-Required**: Only an SSL listener port is opened, and all requests come through SSL connections. If you choose **SSL-Required**, you must also choose **CSI** as the active authentication protocol. If you choose **CSI and SAS**, SAS requires an open TCP/IP socket for some special requests.

Default: SSL-Supported
Range: TCP/IP, SSL Required, SSL-Supported

SSL settings:

Specifies a list of predefined SSL settings to choose from for inbound connections. These settings are configured at the SSL Repertoire panel.

Data type:	String
Default:	DefaultSSLSettings
Range:	Any SSL settings configured in the SSL Configuration Repertoire

Secure Authentication Service transport inbound settings:

Use this page to specify transport settings for connections that are accepted by this server using the Secure Authentication Service (SAS) authentication protocol. The SAS protocol is used to communicate securely to enterprise beans with previous releases of the WebSphere Application Server.

To view this administrative console page, click **Security > Authentication Protocol > SAS Inbound Transport**.

SSL Settings:

Specifies a list of predefined SSL settings to choose from for inbound connections. These settings are configured at the SSL Repertoire panel.

Data type:	String
Default:	DefaultSSLSettings

Configuring outbound transports

Outbound transports refers to the transport used to connect to a downstream server. When you configure the outbound transport, consider the transports that the downstream servers support. If you are considering Secure Sockets Layer (SSL), also consider including the signers of the downstream servers in this server truststore file for the handshake to succeed. When you select an SSL configuration, that configuration points to keystore and truststore files that contain the necessary signers. If you configured client certificate authentication for this server in the **Security** > **Authentication Protocols** > **CSIv2 Outbound Authentication** panel, then the downstream servers contain the signer certificate belonging to the server personal certificate.

Complete the following steps to configure the Outbound Transport panels.

1. Select the type of transport and the SSL settings by clicking **Security** > **Authentication Protocol** > **CSIv2 Outbound Transport** panel. By selecting the type of transport, you are choosing the transport to use when connecting to downstream servers. The downstream servers support the transport that you choose. If you choose **SSL-Supported**, the transport used is negotiated during the connection. If both the client and server support SSL, always choose **SSL-Supported** unless the request is considered a special request that does not require SSL, such as if an object request broker (ORB) is a request.
2. Pick the SSL settings that correspond to an SSL transport. Click **Security** > **SSL**. This panel includes the SSL configuration of keystore files, truststore files, file formats, security levels, ciphers, cryptographic token selections, and so on. Verify that the truststore file in the selected SSL configuration contains the

signers for any downstream servers. Also, verify that the downstream servers contain the server signer certificates when outbound client certificate authentication is used.

3. Select the SSL settings used for outbound requests to downstream Secure Authentication Service (SAS) servers. Click **Security** > **Authentication Protocol** > **SAS Outbound**. Remember that the SAS protocol allows interoperability with previous releases. When configuring the keystore and truststore files in the SSL configuration, these files have the correct information for interoperating with previous releases of WebSphere Application Server. For example, a previous release has a different personal certificate than the Version 5 release. If you use the keystore file from the Version 5.0 release, you must add the signer to the truststore file of the previous release. Also, you must extract the signer for the Version 5.0 release and import that signer into the truststore file of the previous release.

The outbound transport configuration is complete.

With this configuration you can configure a different transport for inbound security versus outbound security. For example, if the application server is the first server used by end users, the security configuration might be more secure. When requests go to back-end enterprise beans servers, you might consider less security for performance reasons when you go outbound. With this flexibility you can design a transport infrastructure that meets your needs.

When you finish configuring security, perform the following steps to save, synchronize, and restart the servers.

- Click **Save** in the administrative console to save any modifications to the configuration.
- Stop and restart all servers, after synchronization.

Common secure interoperability transport outbound settings:

Use this page to specify which transports and Secure Sockets Layer (SSL) settings this server uses when communicating with downstream servers for outbound requests.

To view this administrative console page, click **Security > Authentication Protocol > CSI Outbound Transport**.

Transport:

Specifies whether the client processes connect to the server using one of the server-connected transports.

You can choose to use either SSL, TCP/IP or Both as the outbound transport which a server supports. If you specify **TCP/IP**, the server only supports TCP/IP and cannot initiate SSL connections with downstream servers. If you specify SSL Supported, this server can initiate either TCP/IP or SSL connections. If you specify SSL Required, then this server must use SSL to initiate connections to downstream servers. When you do specify SSL, decide which set of SSL configuration settings you want to use for the outbound configuration.

This decision determines which key file and trust file to use for outbound connections to downstream servers.

For example, consider the following options:

TCP/IP
This server opens TCP/IP connections with downstream servers only.
SSL Supported
This server opens SSL connections with any downstream servers that support them, and TCP/IP connections with any downstream servers that do not support these SSL connections.
SSL Required
This server always opens SSL connections with downstream servers.

Default:	SSL-Supported
Range:	TCP/IP, SSL-Required, SSL-Supported

SSL settings:

Specifies a list of predefined SSL settings for outbound connections. These settings are configured at the SSL Configuration Repertoires panel.

Data type:	String
Default:	DefaultSSLSettings
Range:	Any SSL settings configured in the SSL Configuration Repertoires panel

Secure Authentication Service transport outbound settings:

Use this page to specify transport settings for connections that are accepted by this server using the Secure Authentication Service (SAS) authentication protocol. Use the SAS protocol to communicate securely to enterprise beans with previous releases of WebSphere Application Server.

To view this administrative console page, click **Security** > **Authentication Protocol** > **SAS Outbound Transport**.

SSL Settings:

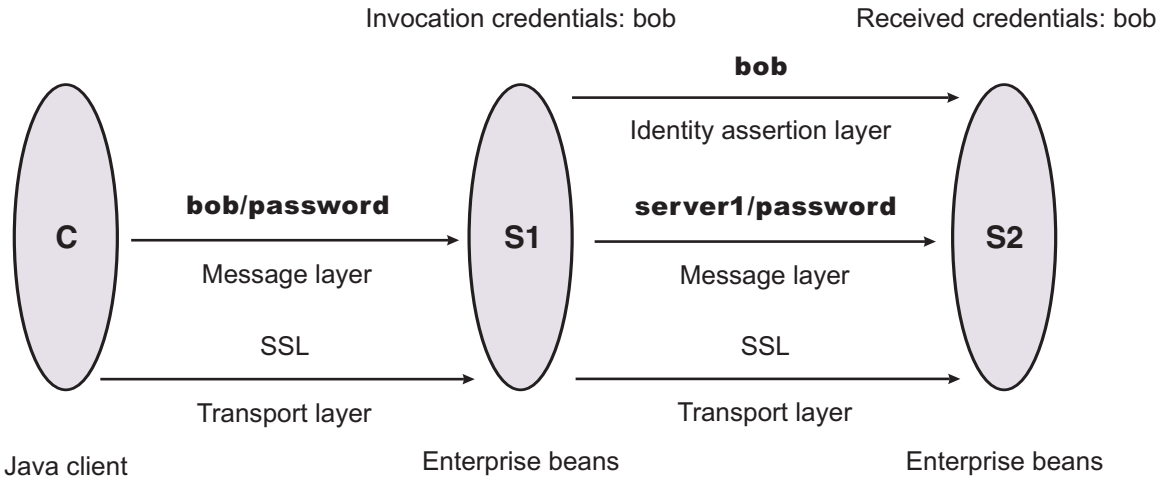
Specifies a list of predefined Secure Sockets Layer (SSL) settings to choose from for outbound connections. These settings are configured at the SSL Repertoire panel.

Data type:	String
Default:	DefaultSSLSettings

Example: Common Secure Interoperability Version 2 scenarios

The articles included in this section are intended to demonstrate how to configure specific Common Secure Interoperability Version 2 (CSIv2) configuration examples.

Scenario 1: Basic authentication and identity assertion:



This example presents a pure Java client, C, that accesses a secure enterprise bean on server, S1, through user ″bob.″ The enterprise bean code on S1 accesses another enterprise bean on server, S2. This configuration uses identity assertion to propagate the identity of ″bob″ to the downstream server, S2. S2 trusts that ″bob″ already is authenticated by S1 because it trusts S1. To gain this trust, the identity of S1 also flows to S2 simultaneously and S2 validates the identity by checking the trustedPrincipalList to verify that it is a valid server principal. S2 also authenticates S1. The following steps take you through the configuration of C, S1, and S2.

Configuring client, C

Client C requires message layer authentication with a Secure Sockets Layer (SSL) transport. To accomplish this task:

1. Point the client to the `sas.client.props` file using the `com.ibm.CORBA.ConfigURL=file:/C:/was/properties/sas.client.props` property.

   All further configuration involves setting properties within this file.
2. Enable SSL.

   In this case, SSL is supported but not required:
   `com.ibm.CSI.performTransportAssocSSLTLSSupported=true,`
   `com.ibm.CSI.performTransportAssocSSLTLSRequired=false`
3. Enable client authentication at the message layer.

   In this case, client authentication is supported but not required:
   `com.ibm.CSI.performClientAuthenticationRequired=false,`
   `com.ibm.CSI.performClientAuthenticationSupported=true`
4. Use all of the remaining defaults in the `sas.client.props` file.

Configuring server, S1

In the administrative console, server S1 is configured for incoming requests to support message layer client authentication and incoming connections to support SSL without client certificate authentication. Server S1 is configured for outgoing requests to support identity assertion.

1. Configure S1 for incoming connections.
   a. Disable identity assertion.
   b. Enable user ID and password authentication.
   c. Enable SSL.

d. Disable SSL client certificate authentication.

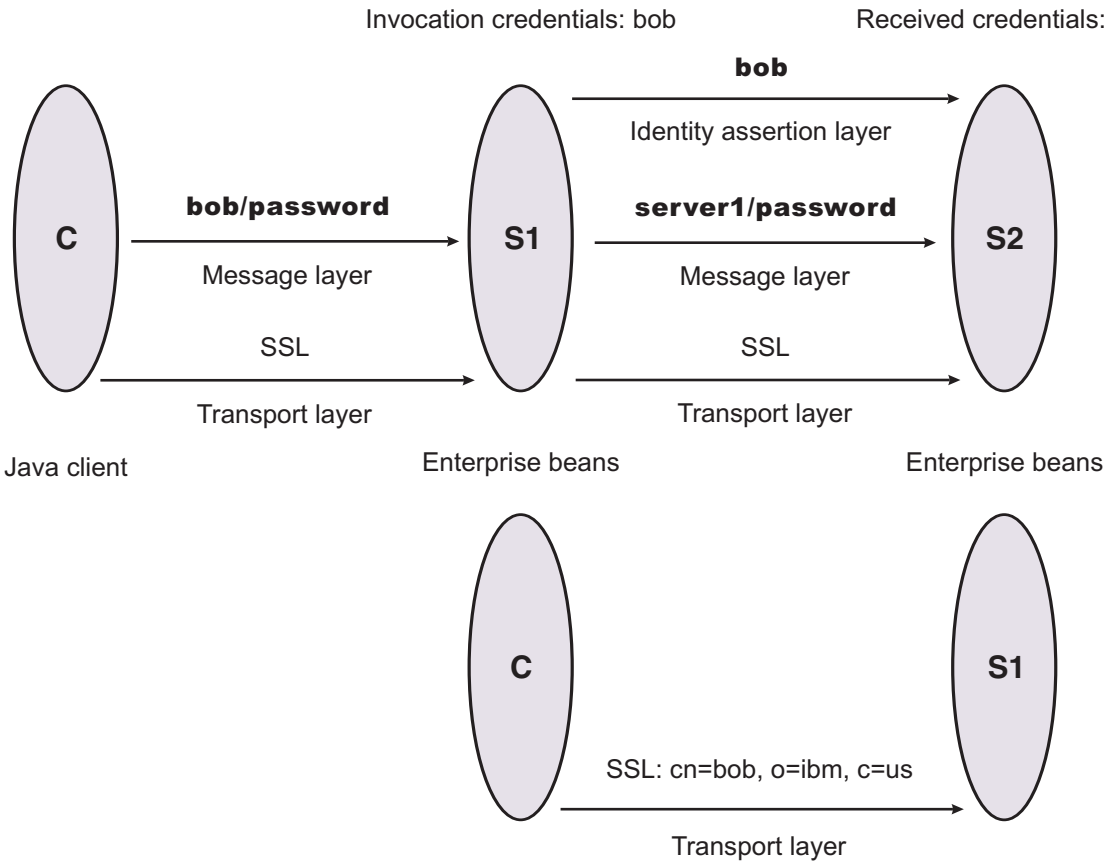
2. Configure S1 for outgoing connections.
   a. Enable identity assertion.
   b. Disable user ID and password authentication.
   c. Enable SSL.
   d. Disable SSL client certificate authentication.

Configuring server, S2

In the administrative console, server S2 is configured for incoming requests to support identity assertion and to accept SSL connections. Complete the following steps to configure incoming connections. Configuration for outgoing requests and connections are not relevant for this scenario.

1. Enable identity assertion.
2. Disable user ID and password authentication.
3. Enable SSL.
4. Disable SSL client authentication.

Scenario 2: Basic authentication, identity assertion and client certificates:



This scenario is the same as Scenario 1, except for the interaction from client C2 to server S2. Therefore, the configuration of Scenario 1 still is valid, but you have to modify server S2 slightly and add a configuration for client C2. The configuration is not modified for C1 or S1.

Configuring client C2

Client C2 requires transport layer authentication (Secure Sockets Layer (SSL) client certificates). To configure transport layer authentication:

1. Point the client to the `sas.client.props` file using the `com.ibm.CORBA.ConfigURL=file:/C:/was/properties/sas.client.props` property.

   All further configuration involves setting properties within this file.
2. Enable SSL.

   In this case, SSL is supported but not required:

   ```
   com.ibm.CSI.performTransportAssocSSLTLSSupported=true,
   com.ibm.CSI.performTransportAssocSSLTLSRequired=false
   ```
3. Disable client authentication at the message layer.

   ```
   com.ibm.CSI.performClientAuthenticationRequired=false,
   com.ibm.CSI.performClientAuthenticationSupported=false
   ```
4. Enable client authentication at the transport layer where it is supported, but not required:

   ```
   com.ibm.CSI.performTLClientAuthenticationRequired=false,
   com.ibm.CSI.performTLClientAuthenticationSupported=true
   ```

Configuring server, S2

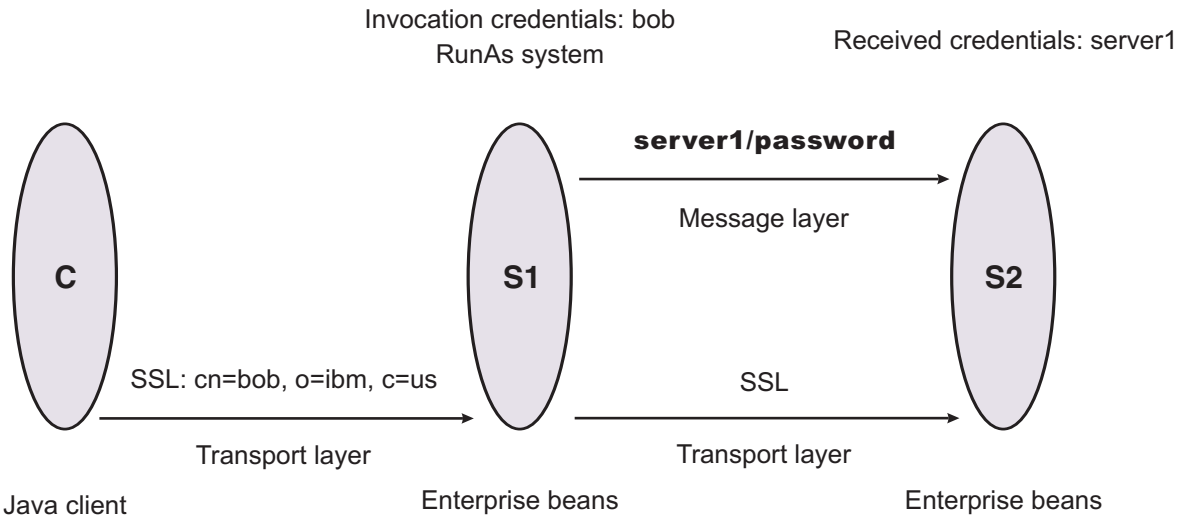
In the administrative console, server S2 is configured for incoming requests to SSL client authentication and identity assertion. Configuration for outgoing requests is not relevant for this scenario.

1. Enable identity assertion.
2. Disable user ID and password authentication.
3. Enable SSL.
4. Enable SSL client authentication.

You can mix and match these configuration options. However, there is a precedence to which authentication features become the identity in the received credential:

1. Identity assertion
2. Message layer client authentication (basic authentication or token)
3. Transport layer client authentication (SSL certificates)

Scenario 3: Client certificate authentication and RunAs system:



This example presents a pure Java client, C, accessing a secure enterprise bean on S1. C authenticates to S1 using Secure Sockets Layer (SSL) client certificates. S1 maps the common name of the distinguished name (DN) in the certificate to a user in the local registry. The user in this case is `bob`. The enterprise bean code on S1 accesses another enterprise bean on S2. Because the RunAs mode is `system`, the invocation credential is set as server1 for any outbound requests.

Configuring C

C requires transport layer authentication (SSL client certificates):

1. Point the client to the `sas.client.props` file using the `com.ibm.CORBA.ConfigURL=file:/C:/was/properties/sas.client.props` property.

   All further configuration involves setting properties within this file.
2. Enable SSL.

   In this case, SSL is supported but not required: `com.ibm.CSI.performTransportAssocSSLTLSSupported=true`, `com.ibm.CSI.performTransportAssocSSLTLSRequired=false`
3. Disable client authentication at the message layer:`com.ibm.CSI.performClientAuthenticationRequired=false`, `com.ibm.CSI.performClientAuthenticationSupported=false`
4. Enable client authentication at the transport layer. It is supported, but not required: `com.ibm.CSI.performTLClientAuthenticationRequired=false`, `com.ibm.CSI.performTLClientAuthenticationSupported=true`

Configuring S1

In the administrative console, S1 is configured for incoming connections to support SSL with client certificate authentication. The S1 server is configured for outgoing requests to support message layer client authentication.

1. Configure S1 for incoming connections:
   a. Disable identity assertion.
   b. Disable user ID and password authentication.
   c. Enable SSL.
   d. Enable SSL client certificate authentication.

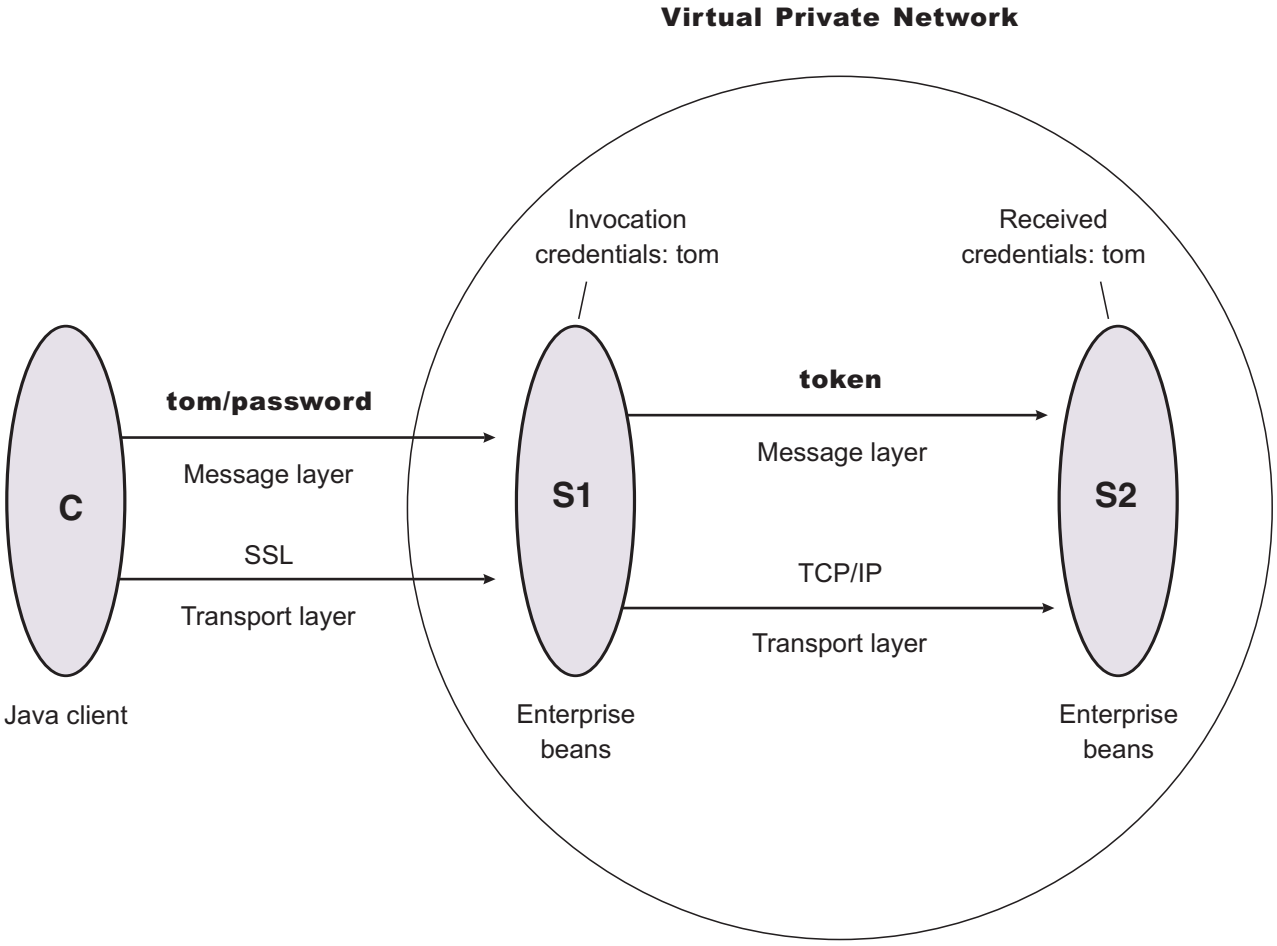
2. Configure S1 for outgoing connections:
   a. Disable identity assertion.
   b. Disable user ID and password authentication.
   c. Enable SSL.
   d. Enable SSL client certificate authentication.

Configuring S2

In the administrative console, the S2 server is configured for incoming requests to support message layer authentication over SSL. Configuration for outgoing requests is not relevant for this scenario.

1. Disable identity assertion.
2. Enable user ID and password authentication.
3. Enable SSL.
4. Disable SSL client authentication.

Scenario 4: TCP/IP transport using a Virtual Private Network:



This scenario illustrates the ability to choose TCP/IP as the transport when it is appropriate. In some cases, when two servers are on the same Virtual Private Network (VPN), it can be appropriate to select TCP/IP as the transport for performance reasons because the VPN already encrypts the message.

Configuring C

C requires message layer authentication with an SSL transport:

1. Point the client to the `sas.client.props` file using the `com.ibm.CORBA.ConfigURL=file:/C:/was/properties/sas.client.props` property. All further configuration involves setting properties within this file.
2. Enable SSL. In this case, SSL is supported but not required: `com.ibm.CSI.performTransportAssocSSLTLSSupported=true`, `com.ibm.CSI.performTransportAssocSSLTLSRequired=false`
3. Enable client authentication at the message layer. In this case, client authentication is supported but not required: `com.ibm.CSI.performClientAuthenticationRequired=false`, `com.ibm.CSI.performClientAuthenticationSupported=true`
4. Use the remaining defaults in the `sas.client.props` file.

Configuring the S1 server

In the administrative console, the S1 server is configured for incoming requests to support message layer client authentication and incoming connections to support SSL without client certificate authentication. The S1 server is configured for outgoing requests to support identity assertion.

1. Configure S1 for incoming connections:
   a. Disable identity assertion.
   b. Enable user ID and password authentication.
   c. Enable SSL.
   d. Disable SSL client certificate authentication.
2. Configure S1 for outgoing connections:
   a. Disable identity assertion.
   b. Enable user ID and password authentication.
   c. Disable SSL.

It is possible to enable SSL for inbound connections and disable SSL for outbound connections. The same is true in reverse.

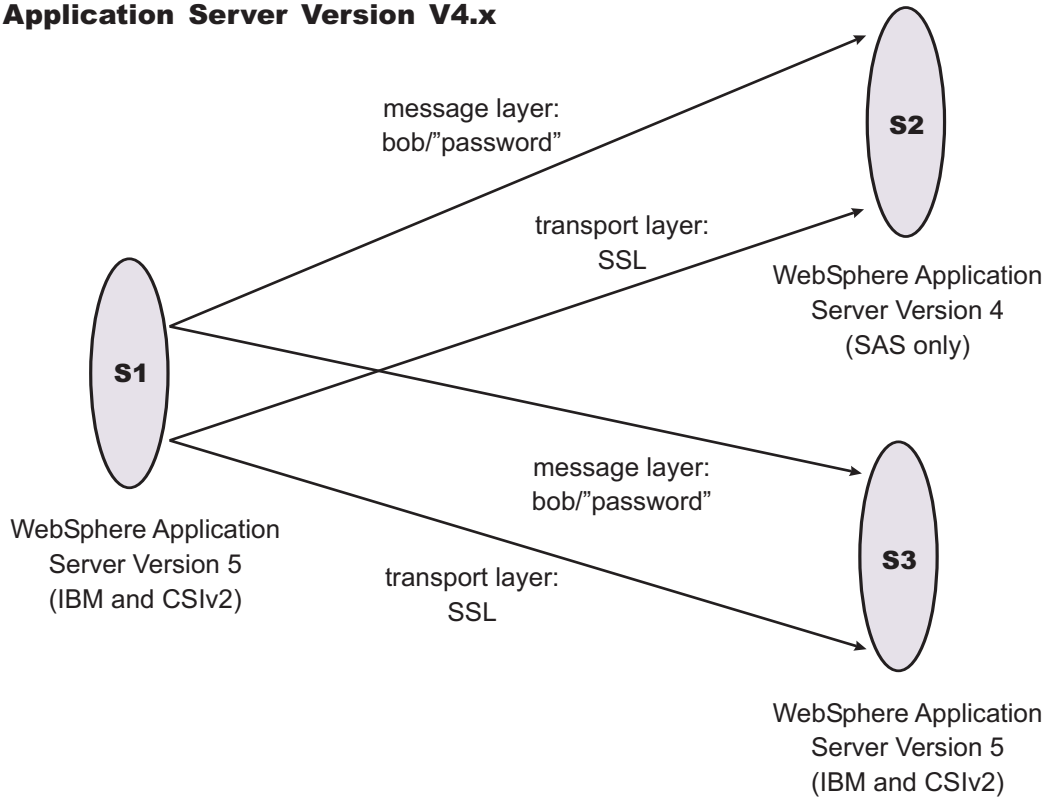
Configuring the S2 server

In the administrative console, the S2 server is configured for incoming requests to support identity assertion and to accept SSL connections. Configuration for outgoing requests and connections are not relevant for this scenario.

1. Disable identity assertion.
2. Enable user ID and password authentication.
3. Disable SSL.

Scenario 5: Interoperability with WebSphere Application Server Version:

Interoperability with WebSphere Application Server Version V4.x



The purpose of this scenario is to show how secure interoperability can occur between different releases simultaneously while using multiple authentication protocols (Security Authentication Service (SAS) and Common Secure Interoperability Version 2 (CSIv2)). For WebSphere Application Server Version 5 to communicate with a WebSphere Application Server Version 4, Version 5 server must support either IBM or BOTH as the protocol choice. By choosing BOTH, the Version 5 server also can communicate with other Version 5 servers that support CSI. If the only servers in your security domain are version 5, it is recommended that you choose CSI as the protocol because this prevents the IBM interceptors from loading. However, a chance exists that any server has to communicate with a previous release of WebSphere Application Server, select the protocol choice of BOTH.

Configuring the S1 server

The S1 server requires message layer authentication with an SSL transport. The protocol for the S1 server must be BOTH. Configuration for incoming requests for the S1 server is not relevant for this scenario. To configure the S1 server for outgoing connections:

1. Disable identity assertion.
2. Enable user ID and password authentication.
3. Enable Secure Sockets Layer (SSL).
4. Disable SSL client certificate authentication.
5. Set authentication protocol to BOTH in the global security settings.

Configuring the S2 server

All previous releases of WebSphere Application Server support the SAS authentication protocol only. No special configuration steps are needed other than enabling global security on the server (S2).

Configuring the S3 server

In the administrative console, the S3 server is configured for incoming requests to support message layer authentication and to accept SSL connections. Configuration for outgoing requests and connections are not relevant for this scenario.

1. Enable identity assertion.
2. Disable user ID and password authentication.
3. Enable SSL.
4. Disable SSL client authentication.
5. Set authentication protocol to either CSI or BOTH.

Secure Sockets Layer

The Secure Sockets Layer (SSL) protocol provides transport layer security: authenticity, integrity, and confidentiality, for a secure connection between a client and server in the WebSphere Application Server. The protocol runs above TCP/IP and below application protocols such as Hypertext Transfer Protocol (HTTP), Lightweight Directory Access Protocol (LDAP), and Internet Inter-ORB Protocol (IIOP), and provides trust and privacy for the transport data.

Depending upon the SSL configurations of both the client and server, various levels of trust, data integrity, and privacy can be established. Understanding the basic operation of SSL is very important to proper configuration and to achieve the desired protection level for both client and application data.

Some of the security features provided by SSL are data encryption to prevent the exposure of sensitive information while data flows across the wire. Data signing prevents unauthorized modification of data while data flows across the wire. Client and server authentication ensures that you talk to the appropriate person or machine. SSL can be effective in securing an enterprise environment.

SSL is used by multiple components within WebSphere Application Server to provide trust and privacy. These components are the built-in HTTP transport, the Object Request Broker (ORB), and the secure LDAP client.

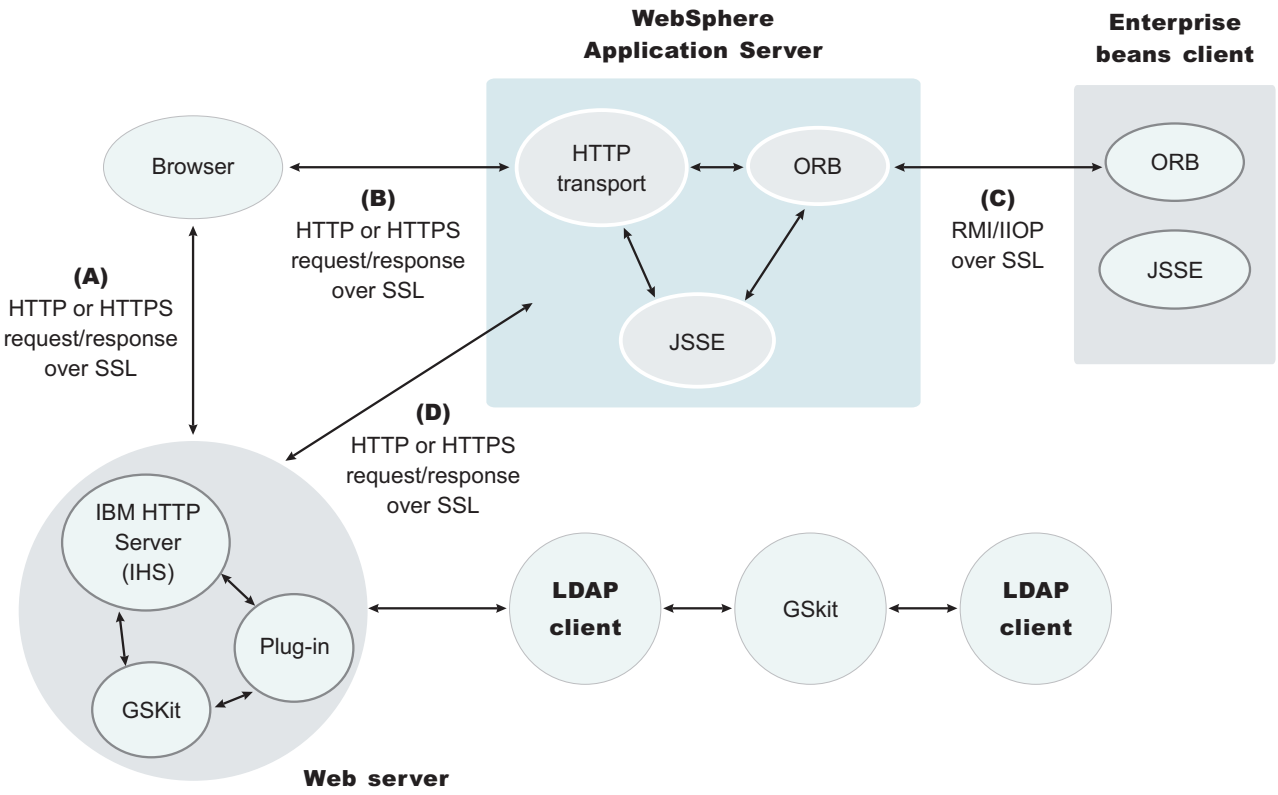


Figure 2. SSL and WebSphere Application Server

In this figure:

- The built-in HTTP transport in a WebSphere Application Server accepts HTTP requests over SSL from a Web client like a browser.
- The Object Request Broker used in WebSphere Application Server can perform Internet Inter-ORB Protocol (IIOP) over SSL to secure the message.
- The secure LDAP client uses LDAP over SSL to securely connect to an LDAP user registry and is present only when LDAP is configured as the user registry.

WebSphere Application Server and the IBMJSSE provider

The SSL implementation used by the WebSphere Application Server is IBM Java Secure Sockets Extension (IBMJSSE). The IBMJSSE provider contains a reference implementation supporting SSL and Transport Layer Security (TLS) protocols and an application programming interface (API) framework. The IBMJSSE provider also comes with a standard provider, which supplies Rivest Shamir Adleman (RSA) support for the signature-related JCA features of the Java 2 platform, common SSL and TLS cipher suites, hardware cryptographic token device, X.509-based key and trust managers, and PKCS12 implementation for a JCA *keystore*. A graphical tool called Key Management Tool (iKeyman) also is provided to manage digital certificates. With this tool, you can create a new key database or a test digital certificate, add certificate authority (CA) roots to the database, copy certificates from one database to another, as well as request and receive a digital certificate from a CA.

Configuring the JSSE provider is very similar to configuring most other SSL implementations (for example, GSKit); however, a couple of differences are worth noting.

- The JSSE provider support both signer and personal certificate storage in an SSL key file, but it also supports a separate file called a *trust file*. A trust file can contain only signer certificates. You can put all of your personal certificates in an SSL key file and your signer certificates in a trust file. This might be desirable, for example, if you have an inexpensive hardware cryptographic device with only enough memory to hold a personal certificate. In this case, the key file refers to the hardware device and the trust file to a file on disk containing all of the signer certificates.
- The JSSE provider does not recognize the proprietary SSL key file format, which is used by the plug-in (*.kdb* files). Instead, the JSSE provider recognizes standard file formats such as Java Key Store (JKS). SSL key files might not be shared between the plug-in and application server. Furthermore, a different implementation of the key management utility must be used to manage application server key and trust files.

Certain limitations exist with the Java Secure Socket Extension (JSSE) provider:
- Customer code using JSSE and Java Cryptography Extension (JCE) APIs must reside within a WebSphere Application Server environment. This restriction includes applications deployed in WebSphere Application Server and client applications in the J2EE application client environment.
- Only `com.ibm.crypto.provider.IBMJCE`, `com.ibm.jsse.IBMJSSEProvider`, `com.ibm.security.cert.IBMCertPath`, and `com.ibm.crypto.pkcs11.provider.IBMPKCS11` are provided as the cryptography package providers.
- Interoperability of the IBM JSSE implementation with other SSL implementations by vendors is limited to tested implementations. The tested implementations include Microsoft Internet Information Services (IIS), BEA WebLogic Server, IBM AIX, and IBM AS/400.
- Hardware token support is limited to supported cryptographic token devices. .

Tested for SSL clients	Tested for SSL clients or servers
IBM Security Kit Smartcard	IBM 4758-23
GemPlus Smartcards	IBM 4758-23
Rainbow iKey 1000/2000(USB ″Smartcard″ device)	IBM 4758-23

- The SSL protocol of Version 2.0 is not supported. In addition, the JSSE and JCE APIs are not supported with Java applet applications.

WebSphere Application Server and the Federal Information Processing Standards for Java Secure Socket Extension and Java Cryptography Extension providers

The Federal Information Processing Standards (FIPS)-approved Java Secure Socket Extension (JSSE) and Java Cryptography Extension (JCE) providers are optional in WebSphere Application Server. By default, the FIPS-approved JSSE and JCE providers are disabled. When these providers are enabled, WebSphere Application Server uses FIPS-approved cryptographic algorithms in the IBMJSSEFIPS and IBMJCEFIPS provider packages only.

Important: The IBMJSSEFIPS and IBMJCEFIPS modules are undergoing FIPS 140-2 certification. For more information on the FIPS certification process and to check the status of the IBM submission, see the Cryptographic Module Validation Program FIPS 140-1 and FIPS 140-2 Pre-validation List Web site.

Authenticity

Authenticity of client and server identities during a Secure Sockets Layer (SSL) connection is validated by both communicating parties using public key cryptography or asymmetric cryptography, to prove the claimed identity from each other.

Public key cryptography is a cryptographic method that uses public and private keys to encrypt and decrypt messages. The public key is distributed as a public key certificate while the private key is kept private. The public key is also a cryptographic inverse of the private key. Well known public key cryptographic algorithms such as the Rivest Shamir Adleman (RSA) algorithm and Diffie-Hellman (DH) algorithm are supported in the WebSphere Application Server.

Public key certificates are either issued by a trusted organization like a certificate authority (CA) or extracted from a self-signed personal certificate by using the IBM Key Management Tool (iKeyman). A self-signed certificate is less secure and is not recommended for use in a production environment.

The public key certificate includes the following information:
- Issuer of the certificate
- Expiration date
- Subject that the certificate represents
- Public key belonging to the subject
- Signature by the issuer

You can link multiple key certificates into a certificate chain. In a certificate chain, the client is always first, while the certificate for a root CA is last. In between, each certificate belongs to the authority that issued the previous one.

During the Secure Sockets Layer (SSL) connection, a digital signature is also applied to avoid forged keys. The digital signature is an encrypted hash and cannot be reversed. It is very useful for validating the public keys.

SSL supports reciprocal authentication between the client and the server. This process is optional during the handshake. By default, a WebSphere Application Server client always authenticates its server during the SSL connection. For further protection, you can configure a WebSphere Application Server for client authentication.

Refer to the Transport Layer Security (TLS) specification at http://www.ietf.org/rfc/rfc2246.txt for further information.

Confidentiality

Secure Sockets Layer (SSL) uses private or secret key cryptography or symmetric cryptography to support message confidentiality or privacy. After an initial handshake (a negotiation process by message exchange), the client and server decide on a secret key and a cipher suite. Between the communicating parties, each message encryption and decryption using the secret key occurs based on the cipher suite.

Private key cryptography requires the two communicating parties to use the same key for encryption and decryption. Both parties must have the key and keep the key private. Well known secret key cryptographic algorithms include the Data Encryption Standard (DES), triple-strength DES (3DES), and Rivest Cipher 4 (RC4), which are all supported in WebSphere Application Server. These algorithms provide excellent security and quick encryption.

A cryptographic algorithm is a *cipher*, while a set of ciphers is a *cipher suite*. A cipher suite is a combination of cryptographic parameters that define the security algorithms and the key sizes used for authentication, key agreement, encryption strength and integrity protection.

The following cipher suites are supported in WebSphere Application Server:
- SSL_RSA_WITH_RC4_128_MD5
- SSL_RSA_WITH_RC4_128_SHA
- 5.1.1 SSL_RSA_WITH_AES_128_CBC_SHA
- 5.1.1 SSL_RSA_WITH_AES_256_CBC_SHA
- SSL_RSA_FIPS_WITH_DES_CBC_SHA
- SSL_RSA_WITH_3DES_EDE_CBC_SHA
- SSL_RSA_FIPS_WITH_3DES_EDE_CBC_SHA
- 5.1.1 SSL_DHE_RSA_WITH_AES_128_CBC_SHA
- 5.1.1 SSL_DHE_RSA_WITH_AES_256_CBC_SHA
- SSL_DHE_RSA_WITH_DES_CBC_SHA
- SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA
- 5.1.1 SSL_DHE_DSS_WITH_AES_128_CBC_SHA
- 5.1.1 SSL_DHE_DSS_WITH_AES_256_CBC_SHA
- 5.1.1 SSL_DHE_DSS_WITH_RC4_128_SHA
- SSL_DHE_DSS_WITH_DES_CBC_SHA
- SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA
- SSL_RSA_EXPORT_WITH_RC4_40_MD5
- SSL_RSA_EXPORT_WITH_DES40_CBC_SHA
- SSL_RSA_EXPORT_WITH_RC2_CBC_40_MD5
- SSL_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA
- SSL_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA
- SSL_RSA_WITH_NULL_MD5
- SSL_RSA_WITH_NULL_SHA
- 5.1.1 SSL_DH_anon_WITH_AES_128_CBC_SHA *
- 5.1.1 SSL_DH_anon_WITH_AES_256_CBC_SHA *
- SSL_DH_anon_WITH_RC4_128_MD5 *
- SSL_DH_anon_WITH_DES_CBC_SHA *
- SSL_DH_anon_WITH_3DES_EDE_CBC_SHA *
- SSL_DH_anon_EXPORT_WITH_RC4_40_MD5 *
- SSL_DH_anon_EXPORT_WITH_DES40_CBC_SHA *

Important: * Although anonymous cipher suites are enabled, the IBM Java Secure Sockets Extension (JSSE) client trust manager does not allow anonymous cipher suites. The default implementation can be overwritten by providing your own trust manager that allows anonymous cipher suites.

All of the previously mentioned cipher suites provide data integrity protection by using hash algorithms like `MD5` and `SHA-1`. The cipher suite names ending with `_SHA` indicate that the `SHA-1` algorithm is used. SHA-1 is considered a stronger hash, while MD5 provides better performance.

The `SSL_DH_anon_xxx` cipher suites (for example, those cipher suites that begin with `SSL_DH_anon_`, where, `anon` is *anonymous*) are not enabled on the product client side. Because the JSSE client trust manager does not support anonymous connections, the JSSE client must always establish trust in the server. However, the `SSL_DH_anon_xxx` cipher suites are enabled on the server side to support another type of client connection. That client might not require trust in the server. These cipher suites are vulnerable to *man-in-the-middle* attacks and are strongly

discouraged. In a *man-in-the-middle* attack, an attacker is able to intercept and potentially modify communications between two parties without either party being cognizant of the attack.

Where:

Name	Description
SSL	Secure Sockets Layer
RSA	• Public key algorithm developed by Rivest, Shamir and Adleman • Requires RSA or DSS key exchange
DH	• Diffie-Hellman public key algorithm • Server certificate contains the Diffie-Hellman parameters signed by the certificate authority (CA)
DHE	• Ephemeral Diffie-Hellman public key algorithm • Diffie-Hellman parameters are signed by a DSS or RSA certificate, which is signed by the certificate authority (CA)
DSS	Digital Signature Standard, using the Digital Signature Algorithm for digital signatures
DES	• Data Encryption Standard, an symmetric encryption algorithm • Block cipher • Performance cost is high when using software without the support of a hardware cryptographic device
3DES	• Triple DES, increasing the security of DES by encrypting three times with different keys • Strongest of the ciphers • Performance cost is very high when using software without the support of a hardware cryptographic device support
RC4	• A stream cipher designed for RSA • Variable key-size stream cipher with key length from 40 bits to 128 bits
EDE	Encrypt-decrypt-encrypt for the triple DES algorithm
CBC	• Cipher block chaining • A mode in which every plain text block encrypted with the block cipher is first exclusive-ORed with the previous ciphertext block
128	128-bit key size
40	40-bit key size
EXPORT	Exportable
MD5	• Secure hashing function that converts an arbitrarily long data stream into a digest of fixed size • Produces 128-bit hash

Name	Description
SHA	• Secure Hash Algorithm, same as SHA-1 • Produces 160-bit hash
anon	For anonymous connections
NULL	No encryption
WITH	The cryptographic algorithm is defined after this key word

Refer to the Transport Layer Security (TLS) specification at http://www.ietf.org/rfc/rfc2246.txt for further information.

Integrity

Secure Sockets Layer (SSL) uses a cryptographic hash function similar to checksum, to ensure data integrity in transit. Use the cryptographic hash function to detect accidental alterations in the data. This function does not require a cryptographic key. After a cryptographic hash is created, the hash is encrypted with a secret key. The private key belonging to the sender encrypts the hash for the digital signature of the message.

When secret key information is included with the cryptographic hash, the resulting hash is known as a *Key-Hashing Message Authentication Code* (HMAC) value. HMAC is a mechanism for message authentication that uses cryptographic hash functions. Use this mechanism with any iterative cryptographic hash function, in combination with a secret shared key.

In the product, both well known *one-way* hash algorithms, MD5 and SHA-1, are supported. One-way hash is an algorithm that converts processing data into a string of bits known as a *hash value* or a *message digest*. *One-way* means that it is extremely difficult to turn the fixed string back into the original data. The following explanation includes both the MD5 and SHA-1 *one-way* hash algorithms:

- MD5 is a hash algorithm designed for a 32-bit machine. It takes a message of arbitrary length as input and produces a 128-bit hash value as output. Although this process is less secure than SHA-1, MD5 provides better performance.
- SHA-1 is a secure hash algorithm specified in the Secure Hash Standard. It is designed to produce a 160-bit hash. Although it is slightly slower than MD5, the larger message digest makes it more secure against attacks like *brute-force collision*.

Refer to the Transport Layer Security (TLS) specification at http://www.ietf.org/rfc/rfc2246.txt for further information.

Configuring Secure Sockets Layer

Secure Sockets Layer (SSL) is used by multiple components within WebSphere Application Server to provide trust and privacy. These components are the built-in HTTP Transport, the Object Request Broker (ORB) (for client and server) and the secure Lightweight Directory Access Protocol (LDAP) client. Configuring SSL is different between client and server with WebSphere Application Server .

1. Configure the client (JSSE). Use the `sas.client.props` file located in the `${install_root}/properties` directory. The `sas.client.props` file is a configuration file that contains lists of property-value pairs, using the syntax <*property*> = <*value*>. The property names are case sensitive, but the values are not; the values are converted to lowercase when the file is read. By default, the

sas.client.props file is located in the `properties` directory under the *install_root* of your WebSphere Application Server installation. Specify the following properties for an SSL connection:

- com.ibm.ssl.protocol
- com.ibm.ssl.keyStoreType
- com.ibm.ssl.keyStore
- com.ibm.ssl.keyStorePassword
- com.ibm.ssl.trustStoreType
- com.ibm.ssl.trustStore
- com.ibm.ssl.trustStorePassword
- com.ibm.ssl.enabledCipherSuites
- com.ibm.ssl.contextProvider
- com.ibm.ssl.keyStoreServerAlias
- com.ibm.ssl.keyStoreClientAlias
- For the Secure Authentication Services (SAS) authentication protocol only: com.ibm.CORBA.standardPerformQOPModels
- For the cryptographic token device:
  - com.ibm.ssl.tokenType
  - com.ibm.ssl.tokenLibraryFile
  - com.ibm.ssl.tokenPassword

Note: Although WebSphere Application Server supports the IBM Federal Information Processing Standard-approved Java Secure Socket Extension (IBMJSSEFIPS), IBMJSSEFIPS is not supported on the HP-UX platform.

2. Configure the server. Use the administrative console to configure an application server that makes SSL connections. To start the administrative console, specify the following Web address: http://*server_hostname*:9090/admin.
3. Create an SSL configuration repertoires alias or entry. You can select the alias later when a component is configured for SSL support. An SSL configuration repertoires entry contains the following fields:
   - Typical configuration settings:
     - Alias
     - Key file name
     - Key file password
     - Key file format
     - Trust file name
     - Trust file password
     - Trust file format
     - Client authentication
     - Security level
     - Cipher suites
   - For the cryptographic token device:
     - Cryptographic token (Create the alias first so you can configure these fields).
       - Token type
       - Library file
       - Password
   - For additional Java properties:
     - Custom properties (Create the alias first so you can configure these fields).
       - `com.ibm.ssl.contextProvider`
       - `com.ibm.ssl.protocol`

Note: WebSphere Application Server contains IBM Developer Kit for Java Technology Edition Version 1.4.x , which includes changes from IBM

Developer Kit for Java Technology Edition Version 1.3. See Changes to IBM Developer Kit for Java Technology Edition Version 1.4.x for more information.

Configuring Secure Sockets Layer for Web client authentication

To enable client-side certificate-based authentication, you must modify the authentication method defined on the J2EE Web module that you want to manage. The Web module might already be configured to use the basic challenge authentication method. In this case, modify the challenge type to `client certificate`.

This functionality is delivered to the WebSphere Application Server administrator in the Assembly Toolkit. However, developers can use the WebSphere Application Server Studio Application Development environment to achieve the same result.

1. Launch the Assembly Toolkit. This step can be done either before an enterprise application archive `.ear` file is deployed into the WebSphere Application Server or after deployment into the product. The latter option is discouraged in a production environment because it involves opening the expanded archive correlating to the enterprise application archive, found in the `installedApps` directory.
2. Locate and expand the Web module package under the application for which you wish to enable the client-side certificate authentication method.
3. Select the appropriate Web application, and switch to the **Advanced** tab. Modify the authentication method to client certificate. The realm name is the scope of the login operation and is the same for all participating resources.
4. Click **OK**, and save the changes you made with Assembly Toolkit.
5. Stop and restart the associated application server containing the resource, so that the security modification is included in the run time. Complete this action if the modification was made to a resource that already is deployed in the WebSphere Application Server.

Now your enterprise application prompts the user for proof of identity with a certificate.

The Web server must also be configured to request a client certificate. If the Web server is external, refer to the appropriate configuration documentation. If the Web server is the Web container transport (for example, 9043) within WebSphere Application Server, verify that the **client authentication** flag is selected in the referenced SSL configuration.

Refer to the Map certificates to users article to determine how a certificate is authenticated within the product.

Configuring Secure Sockets Layer for the Lightweight Directory Access Protocol client

This topic describes how to establish a Secure Sockets Layer (SSL) connection between WebSphere Application Server and a Lightweight Directory Access Protocol (LDAP) server. This page provides an overview. Refer to the linked pages for more details. To understand SSL concepts, refer to “Secure Sockets Layer” on page 384.

Setting up an SSL connection between WebSphere Application Server and an LDAP server requires the following steps:

1. Set up an LDAP server with users. The server configured in this example is IBM Directory Server. Other servers are configured differently. Refer to the documentation of the directory server you are using for details on SSL enablement. For a product-supported LDAP directory server, see the "Supported directory services" on page 209 article.
2. Configure certificates for the LDAP server using the key management utility (iKeyman) that is shipped with the IBM HTTP Server product.
3. Click **Key Database File > New**.
4. Type `LDAPkey.kdb` as the file name and a proper path.
5. Click **Personal Certificates > New Self-Signed Certificate**. The **Create New Self-Signed Certificate** panel is displayed. Type the following information in the fields and click **OK**:
   Key Label
   `LDAP_Cert`
   Common Name
   droplet.austin.ibm.com

   This common name is the host name where the WebSphere Application Server plug-in runs.
   Organization
   `ibm`
   Country
   `US`
6. Return to the Personal Certificates panel and click **Extract Certificate**.
7. Click the **Base64-encoded ASCII data** data type. Type `LDAP_cert.arm` as the file name and a proper path. Click **OK**.
8. Enable SSL on the LDAP server:
   a. Copy the `LDAPkey.kdb`, `LDAPkey.sth`, `LDAPkey.rdb`, and `LDAPkey.crl` files created previously to the LDAP server system, for example, the `\Program Files\IBM\LDAP\ssl\` directory.
   b. Open the LDAP Web administrator from a browser (http://secnt3.austin.ibm.com/ldap, for example). IBM HTTP Server is running on `secnt3`.
   c. Click **SSL properties** to open the SSL Settings window.
   d. Click **SSL On** > **Server Authentication** and type an SSL port (`636`, for example) and a full path to the `LDAPkey.kdb` file.
   e. Click **Apply**, and restart the LDAP server.
9. Manage certificates for WebSphere Application Server using the default SSL key files.
   a. Open the *`install_root`*`\etc\DummyServerTrustFile.jks` file using the key management utility that shipped with WebSphere Application Server. The password is `WebAS`.
   b. Click **Personal Certificates > Import**. The **Import Key** panel is displayed. Specify `LDAP_cert.arm` for the file name. Complete this step for all the servers including the deployment manager.
10. Establish a connection between the WebSphere Application Server and the LDAP server.
    a. In the administrative console, click **User Registry > LDAP User Registry > LDAP Settings**. Fill in the **Server ID**, **Server Password**, **Type**, **Host**, **Port**, and **Base Distinguished Name** fields. Select the **SSL Enabled** check box. The port is the one that the LDAP server is using for SSL (636, for example). Click **Apply**.

b. Click **Authentication Mechanisms > LTPA > Single SignOn (SSO)**. Type in a domain name (`austin.ibm.com`, for example). Click **Apply**.

11. Enable global security.
    a. Click **Security > Global Security**. Select the **Enabled** check box. Choose **LTPA** as the active authentication mechanism and **LDAP** as the active user registry. Click **Apply** and **Save**.

       Note: Verify that the security level for the LDAP server is set to HIGH. The default security level is HIGH (128-bit).

    b. Check the *LDAP_install_root*`\etc\slapd32.conf` file; verify that the ibm-slapdSSLCipherSpecs parameter has the value, 15360, instead of 12288.
    c. Restart the servers. Restarting the servers ensures that the security settings are synchronized between the deployment manager and the application servers.

You can test the configuration by accessing https://*fully_qualified_host_name*:9443/snoop. You are presented with a login challenge.

This test can be beneficial when using LDAP as your user registry. Sensitive information can flow between the WebSphere Application Server and the LDAP server, including passwords. Using SSL to encrypt the data protects this sensitive information.

1. If you are enabling security, make sure that you complete the remaining steps. As the final step, validate this configuration by clicking **OK** or **Apply** in the Global Security panel. Refer to the "Configuring global security" on page 137 article for detailed steps on enabling global security.
2. For changes in this panel to become effective, save, stop, and start all WebSphere Application Servers (cells, nodes and all the application servers).
3. After the server starts up, go through all the security-related tasks (getting users, getting groups, and so on) to make sure that the changes to the filters are functioning.

Configuring IBM HTTP Server for secure sockets layer mutual authentication

IBM HTTP Server supports Secure Sockets Layer (SSL) Version 2 and Version 3 and Transport Layer Security (TLS) Version 1. IBM HTTP Server is based on the Apache Web server, but for SSL configuration it requires the IBM-supplied SSL modules, rather than the OpenSSL modules. This document describes configuration of IBM HTTP Server, although it is possible to use another supported Web server.

SSL is disabled by default and it is necessary to modify a configuration file and generate a server-side certificate using the key management utility (iKeyman) provided with IBM HTTP Server to enable SSL.

1. For a single server, enable SSL on IBM HTTP Server (port 443,for example).
2. To set up certificates complete the following: Start the key management utility by clicking **Start > Programs > IBM HTTP Server > Start Key Management Utility**. Refer to Requesting a CA-signed personal certificate, Creating a certificate signing request (CSR), Receiving a CA-signed personal certificate, and Extracting a public certificate for use in a truststore file
3. Create a key database and click **Key Database File > New**.
4. Type a file name, `serverkey.kdb`, for example, and the location path. Click **OK**.

5. Type a password, select the **Stash the password to a file** check box and click **OK**.
6. Obtain a personal certificate for IBM HTTP Server: Click **Personal Certificate Requests** in the key management utility menu. Click **New**. The **Create New Key and Certificate Request** panel appears. Complete the following information:
   Key label
   `Server_Cert`
   Common name
   droplet.austin.ibm.com
   Organization
   `IBM`
   Country
   `US`
   File name
   `Server_certreq.arm`

   The Verisign Test CA Root Certificate is in the set of signer certificates shipped with the IKeyMan for IBM HTTP Server.
7. Go to URL `http://www.verisign.com`, click **Get Free Trial SSL ID**. Complete the profile information, click **Submit**, and click **Continue** twice.
8. Use your favorite text editor to edit the request file `Server_certreq.arm`, and copy the entire contents of the file into the browser request panel. Click **Continue**. VeriSign displays the Personal Certificate in the browser.
9. Copy and paste this certificate into a file, for example `Server_Cert.arm`. Click **Personal Certificate** from the menu in the key management utility. Click **Receive**. Specify the file name, `Server_Cert.arm`, and click **OK**. Close the `serverkey.kdb` file.
10. To allow IBM HTTP Server to support HTTPS, port 443, for example, enable SSL on IBM HTTP Server. Modify the configuration file of IBM HTTP Server, `IHS_HOME/conf/httpd.conf`. You also can enable SSL can be enabled through the IBM HTTP Server administrative console also. Open the file `IHS_HOME/conf/httpd.conf` and then add the following lines above the line `Alias /IBMWebAS/ "install_root/web"`:

    ```
    LoadModule  ibm_ssl_module   modules/IBMModuleSSL128.dll
    install_root/bin/mod_ibm_app_server_http.dll
    Listen 443
    VirtualHost  droplet.austin.ibm.com:443
    ServerName  droplet.austin.ibm.com
    DocumentRoot  install_root\htdocs
    SSLEnable
    #SSLClientAuth  required
    SSLDisable
    Keyfile IHS_HOME/serverkey.kdb
    ```

    Note: Change the host name and the path for the key file accordingly. Modify the Web server to support client certificates by uncommenting the SSLClientAuth directive shown in the `httpd.conf` file.

    SSLClientAuth required
11. Restart IBM HTTP Server.

12. Test SSL between a browser and IBM HTTP Server. For more information on the default IBM HTTP Server port number, see Port number settings in WebSphere Application Server versions.
13. Follow the prompts to select a personal certificate if the SSLClientAuth directive is set to required.
14. To enable the application server to communicate with IBM HTTP Server using port 443, add the host alias on the default_host. Click **Environment** > **Virtual Hosts** > *default host* > **Host Aliases** > **New**. Enter the following information in the appropriate fields:
    Host name
    *
    Port type
    443
15. Click **Apply** and **Save** to write to the `security.xml` file.
16. Click **Update Web Server Plugin**, and then click **OK**.
17. Restart WebSphere Application Server.
18. Test your connection.

You can connect to the Snoop servlet.

Enable Secure Sockets Layer communication between IBM HTTP Server and the WebSphere Application Server.

Configuring the IBM HTTP Server for distributed platforms and the Web server plug-in for Secure Sockets Layer

This section documents the configuration necessary to instantiate a secure connection between the Web server plug-in and the internal HTTP transport in the WebSphere Application Server Web container on a distributed platform. By default, this connection is not secure, even when global security is enabled. This document discusses the configuration for the IBM HTTP Server; however, the Web server related configuration in this situation is not specific to any distributed platform Web server.

1. Create a self-signed certificate for the Web server plug-in. The Web server plug-in requires a key ring file to store its own private and public key files and to store the public certificate from the Web container key file. The following steps are required to generate a self-signed certificate for the Web server plug-in.
   a. Create a directory on the Web server host for storing the key ring file referenced by the plug-in and associated files, for example: `IHS_install_root\conf\keys`.
   b. Launch the key management utility (iKeyman) packaged with the IBM HTTP Server.
   c. From the iKeyman menu, click **Key Database File** > **New**.
   d. Enter the following settings:
      Key database file
      CMS Key Database File
      File name
      WASplugin.kdb
      Location
      C:\http1324\conf\keys\(or file of your choice)
   e. Click **OK**.

f. Set the password of your choice at the password prompt. Select the **Stash the Password to a File** check box to save the password to a stash file. This action allows the plug-in to use the password, which provides access to the certificates contained in the key database.

g. From the iKeyman menu, click **Create > New Self-Signed Certificate** to create a new self-signed certificate key pair. Specify the following options. Optionally, you can choose to complete all of the remaining fields.
Key label
`WASplugin`
Version
`X509 V3`
Key size
`1024`
Common name
`droplet.austin.ibm.com`
Organization
`IBM`
Country
`US`
Validity period
`365`

h. Click **OK**.

i. Extract the public self-signed certificate key: this key is used later by the embedded HTTP server peer to authenticate connections originating from the plug-in.

j. Click **Personal Certificates** in the menu and select the `WASplugin` certificate that you just created.

k. Click **Extract Certificate**. Extract the certificate to a file:
Data type
`Base64-encoded ASCII data`
Certificate file name
`WASpluginPubCert.arm`
Location
`C:\http1324\conf\keys` (or directory of your choice)

l. Click **OK**.

m. Close the key database and exit the iKeyman when you finish.

2. Generate a self-signed certificate for the Web container.

a. Launch the JKS capable iKeyman version located the product `/bin` directory.

b. Click **Key Database File > New** from the iKeyman menu.

c. Enter the following settings:
Key database file
`JKS`
File name
`WASWebContainer.jks`
Location
`C:\WebSphere\AppServer\etc\` (or directory of your choice)

d. Click **OK**.

e. Enter the password of your choice at the password prompt window.

f. Click **Create > New Self-Signed Certificate** from the iKeyman menu. The following values were used in this example:
Key Label
`WASWebContainer`

Version
X509 V3
Key size
1024
Common name
droplet.austin.ibm.com
Organization
IBM
Country
US
Validity Period
365

g. Click **OK**.

h. Extract the public self-signed certificate key: this key is used later by the Web server plug-in peer to authenticate connections originating from the embedded HTTP server in the product.

i. Click **Personal Certificates** from the list. Select the **WASWebContainer** certificate that you just created. Click **Extract Certificate**. Extract the certificate to a file:
Data type
Base64-encoded ASCII data
Certificate file name
WASWebContainerPubCert.arm
Location
C:\WebSphere\AppServer\etc\

j. Click **OK**.

k. Close the database and exit the key management utility.

3. Exchange the public certificates.

a. Copy the WASpluginPubCert.arm file from the Web server machine to the WebSphere Application Server machine. The source directory in this case is C:\http1324\conf\keys, while the destination is C:\WebSphere\Appserver\etc.

b. Copy the WASWebContainerPubCert.arm file from the product machine to the Web server machine. The source directory in this case is C:\WebSphere\Appserver\etc, while the destination is C:\http1324\conf\keys.

4. Import the certificate into the Web server plug-in key file.

a. On the Web server machine, launch the key management utility that supports the CMS key database format.

b. From the iKeyman menu, click **Key Database File > Open** and select the previously created key database file: WASplugin.kdb.

c. In the password prompt window, enter the password. Click **OK**.

d. Click **Signer Certificates** from the list and click **Add**. This action imports the public certificate previously extracted from the embedded HTTP server (Web container) keystore file.
Data type
Base64-encoded ASCII data
Certificate file name
WASWebContainerPubCert.arm
Location
C:\WebSphere\Appserver\etc\

e. Click **OK**. You are prompted for a label name that represents the trusted signer public certificate.

f. Enter a label for the certificate: `WASWebContainer`.

g. Close the key database and exit IKeyman when you finish.

5. Import the certificate into the Web container keystore file.

a. On the WebSphere Application Server machine, launch the JKS capable iKeyman version, located in the product `/bin` directory.

b. From the iKeyman menu, select **Key Database File > Open**. Select the previously created `WASWebContainer.jks` file.

c. In the password prompt window, enter the password. Click **OK**.

d. Click **Signer Certificates** from the list. Click **Add**. This action imports the public certificate previously extracted from the embedded HTTP server (Web container) keystore file.
Data type
`Base64-encoded ASCII data`
Certificate file name
`WASpluginPubCert.arm`
Location
`C:\WebSphere\Appserver\etc\`

e. Click **OK**. You are prompted for a label name that represents the trusted signer public certificate.

f. Enter a label for the certificate: `WASplugin`.

g. Close the key database and exit iKeyman when you finish.

6. Modify the Web server plug-in file. In a production environment, add the secure transport definition, port 9443, to the `plugin-cfg.xml` file. For example, your modified `plugin-key.kdb` file contains the following lines:

```
<Transport Hostname="hpws07" Port="9080" Protocol="http"/>
<Transport Hostname="hpws07" Port="9443" Protocol="https"/>
```

After you verify that the proper `plugin-key.kdb` and `plugin-key.sth` files exist on the Web server, modify the `plugin-cfg.xml` file that resides on the Web server. You must specify the local path to both the `plugin-key.kdb` and `plugin-key.sth` files in the `plugin-cfg.xml` file. For more information, see plugin-cfg.xml file and Situations requiring manual editing of the plug-in configuration.

Important: If you manually edit the `plugin-cfg.xml` file and an automatic regeneration of the file occurs, you must replace your manual edits.

7. Modify the Web container to support SSL. To complete the configuration between Web server plug-in and Web container, modify the WebSphere Application Server Web container to use the previously created self-signed certificates.

a. Start the WebSphere Application Server administrative console.

b. Click **Security > SSL Configuration Repertoires**.

c. Click **New** to create a new entry in the repertoire. Provide the following values to complete the form:
Alias `WebContainerSSLSettings`
Key file name
`C:\WebSphere\Appserver\etc\WASWebContainer.jks`
Key file password
<key_file_password>

Key file format
JKS
Trust file name
C:\WebSphere\Appserver\etc\WASWebContainer.jks
Trust file password
<trust_file_password>
Trust file format
JKS
Client authentication
Security level
HIGH

d. Click **OK**.

e. If you want mutual SSL between the two parties, select the **Client Authentication** check box.

f. Save the configuration in the administrative console.

g. Click **Servers > Application Servers**, *server_name*, in this example, server1.

h. Click the Web container located in the server navigation tree.

i. Click **HTTP Transport** located in the Web container navigation tree.

j. Select the entry for the transfer you want to secure. Click the item under the **Host** column. Select the asterisk (*), in this case, in the line of port **9443**.

k. On the configuration panel, select the **Enable SSL** check box. Click the desired SSL entry from the SSL repertoire list. In this example, the WebContainerSSLSettings.

l. Click **OK**.

8. Test the secure connection. Test the secure connection by accessing a Web application on the WebSphere Application Server using port 9443. For example, https://droplet.austin.ibm.com:9443/snoop.

9. Import the correct certificate with public and private keys into the browser to test the secured connection, when client-side certification is required.

a. Launch the iKeyman utility that supports the CMS key database file, on the Web server machine.

b. Open the key file for the plug-in, C:\http1324\conf\keys\WASplugin.kdb. Provide the password when prompted.

c. Click **WASplugin certificate**, located under the Personal Certificates. Click **Export**.

d. Save the certificate in PKCS12 format to a file, for example C:\http1324\conf\keys\WASplugin.p12 . Provide a password to secure the PKCS12 certificate file.

e. Close the key file and exit iKeyman.

f. Copy the saved WASplugin.p12 file to the client machine from where you access the product server.

g. Import the PKCS12 file into your browser. Then, access https://*your_server_address*:9443/snoop.

h. The browser asks which personal certificate to use for the connection. Select the certificate, and continue connecting.

i. Once the browser test with direct product access is successful, test the connection through the Web server using port 9443. For example, https://*your_server_address*:9443/snoop.

The IBM HTTP Server plug-in and the internal Web server are configured for SSL.

Enabling Secure Sockets Layer (SSL) communication between the IBM HTTP Server plug-in and the embedded HTTP server (Web container) in the WebSphere Application Server.

Configuring Secure Sockets Layer for Java client authentication

WebSphere Application Server supports Java client authentication using a digital certificate when the client attempts to make a Secure Sockets Layer (SSL) connection. The authentication occurs during an SSL handshake. The SSL handshake is a series of messages exchanged over the SSL protocol to negotiate for connection-specific protection. During the handshake, the secure server requests the client to send back a certificate or certificate chain for the authentication.

To configure SSL for Java client authentication, consider the following questions:

- Have you enabled security with your WebSphere Application Server? Refer to Configuring global security for more details.
- Have you configured Common Secure Interoperability (CSI) authentication protocol for your target application server? Refer to "Configuring global security" on page 137 for more details.

  Note: The Security Authentication Service (SAS) authentication protocol does not support Java client authentication with SSL transport.
- Have you configured your server to support secure transport for the inbound CSI authentication protocol?
- Have you configured your server to support client authentication at the transport layer for the inbound CSI authentication protocol?
- If you are using a self-signed personal certificate, have you exported the public certificate from your client application Java keystore file or cryptographic token device?
- If you are using a certificate authority (CA)-signed personal certificate, have you received the root certificate of the CA?
- If you are using a self-signed personal certificate, have you imported the public certificate into your target Java truststore file as a signer certificate?
- If you are using a CA-signed (certificate authority) personal certificate, have you imported the CA root certificate into your target Java trust store file as a signer certificate?
- Does the common name (CN) specified in your personal certificate name exist in your configured user registry?

If you answer yes to all of these questions, you can configure SSL for Java client authentication.

Note: Java client authentication using digital certificates is supported only by the Common Secure Interoperability Version 2 (CSIv2) authentication protocol.

1. "Configuring Common Secure Interoperability Version 2 for Secure Sockets Layer client authentication" on page 402.
2. "Adding keystore files" on page 403.
3. "Adding truststore files" on page 403.
4. Save changes.
5. Restart the server if you have configured the server.

A secure client connects to a secure Internet InterORB Protocol (IIOP) server that requires client authentication at the transport layer.

If a connection problem occurs, you can set a Java property, `javax.net.debug=true`, before you run your client or your server to generate debugging information. See

"Troubleshooting security configurations" on page 479 for further information about how to debug an IBM JSSE problem.

Configuring Common Secure Interoperability Version 2 for Secure Sockets Layer client authentication:

Configure the Secure Sockets Layer (SSL) client authentication using the `sas.client.props` configuration file or the administrative console. To configure a Java client application, use the `sas.client.props` configuration file. By default, the `sas.client.props` file is located in the `properties` directory under the *<install_root>* of your WebSphere Application Server installation.

To configure a WebSphere Application Server, use the administrative console. To start the administrative console, specify URL: `http://<server host_name>:9090/admin`.

To configure a Java client application, complete the following steps, which explain how to edit the `sas.client.props file`.

1. To require SSL client authentication, set property `com.ibm.CSI.performTLClientAuthenticationRequired=true`. Do not set this property unless you know your target server also supports SSL client authentication for the inbound CSI authentication protocol.
2. To support SSL client authentication, set the property `com.ibm.CSI.performTLClientAuthenticationSupported=true`.
3. To specify the CSI protocol, set the property `com.ibm.CSI.protocol=csiv2`.
4. To match the SSL protocol configured with your server, set the property, `com.ibm.ssl.protocol`, accordingly.
5. Specify the com.ibm.CORBA.ConfigURL property with the fully qualified path of your Java property file when you run your application. For example, `-Dcom.ibm.CORBA.ConfigURL=file:/c:/WebSphere/AppServer/properties/sas.client.props`

To configure a WebSphere Application Server, complete the following steps

1. Start the administrative console.
2. Expand **Security** > **Authentication Protocol**.
3. Click **CSIv2 Inbound Authentication**.
4. Select **Supported** or **Required** for Client Certificate Authentication.
5. Click **OK**.
6. If you selected **Required** in step 4, configure the CSIv2 outbound authentication as well to support the client certificate authentication. Otherwise, you can skip this step. Click **CSIv2 Outbound Authentication** and select either **Supported** or **Required** for Client Certificate Authentication.
7. Click **CSIv2 Outbound Transport**. Select an SSL setting from the SSLSettings list for keystore, truststore, cryptographic token, SSL protocol, and ciphers use. Create an alias from the SSL Configuration Repertoires panel for an SSL setting. Update the SSL setting selected in CSIv2 Inbound Transport accordingly.
8. Save your configuration.
9. Restart the server for the changes to become effective.

Client authentication using digital certificates is performed during SSL connection.

A secure client connects using SSL to a secure Internet InterORB Protocol (IIOP) server with client authentication at the transport layer.

Specify the keystore and truststore files in your configuration.

Adding keystore files:

A keystore file contains both public keys and private keys. Public keys are stored as signer certificates while private keys are stored in the personal certificates. In WebSphere Application Server, adding keystore files to the configuration is different between client and server. For the client, a keystore file is added to a property file like `sas.client.props`. For the server, a keystore file is added through the WebSphere Application Server administrative console.

Before you add the keystore file to your configuration, consider the following questions:
- Is a self-signed or a certificate authority (CA)-signed personal certificate created in the keystore file?
- If you configure client authentication using digital certificates, is the public key of the signed personal certificate imported as a signer certificate into the server truststore file?

1. Add a keystore file into a client configuration by editing the `sas.client.props` file and setting the following properties:
   - **com.ibm.ssl.keyStoreType** for the keystore format. Range: JKS (default), PKCS12KS, JCEK.
   - **com.ibm.ssl.keyStore** for a fully qualified path to the keystore file. The keystore file contains private keys and sometimes public keys.
   - **com.ibm.ssl.keyStorePassword** for the password to access the keystore file.
2. Add a keystore file into a server configuration:
   a. Start the WebSphere administrative console by specifying: http://*server_hostname*:9090/admin.
   b. Click **Security > SSL Configuration Repertoires**.
   c. Create a new Secure Sockets Layer (SSL) setting alias if one does not exist.
   d. Select the alias that you want to add into the keystore file.
   e. Type in the Key File Name for the path of the keystore file.
   f. Type in the Key File Password for the password to access the keystore file.
   g. Select the **Key File Format** for the keystore type. Range: JKS (default), PKCS12KS, or JCEK.
   h. Click **OK** and **Save** to save the configuration.

The SSL configuration alias now has a valid keystore file for an SSL connection.

Note: If the Cryptographic Token field is selected and you only want to use cryptographic tokens for your keystore file, leave the Key File Name field and the Key File Password field blank.
- SSL connection for Internet InterORB Protocol (IIOP)
- SSL connection for Lightweight Directory Access Protocol (LDAP)
- SSL connection for Hypertext Transfer Protocol (HTTP)

Adding truststore files:

A *truststore file* is a key database file that contains public keys. The public key is stored as a signer certificate. The keys are used for a variety of purposes, including authentication and data integrity. In WebSphere Application Server, adding truststore files to the configuration is different between client and server. For the

client, a truststore file is added to a property file, like `sas.client.props`. For the server, a truststore file is added through the WebSphere Application Server administrative console.

Before you add the truststore file to your configuration, ask the following questions:

- If you configure for client authentication using digital certificate, has the public key of the client personal certificate been imported as a signer certificate into the server truststore file?
- Does the truststore file contain all the required signer certificates with respect to the keystore files of the target servers?

1. Add a truststore file into a client configuration, by editing the `sas.client.props` file and setting the following properties:
   - **com.ibm.ssl.trustStoreType** for the truststore format. Range: JKS (default), PKCS12KS, JCEK, JCERACFKS. Use JCERACFKS if you are using a RACF key ring as the truststore.
   - **com.ibm.ssl.trustStore** for a fully qualified path to the truststore file. The truststore file contains the public keys.
   - **com.ibm.ssl.trustStorePassword** for the password to access the truststore file. The com.ibm.ssl.trustStorePassword property should be set to `password` if you are using a RACF key ring as a trust store.
2. Add a truststore file into a server configuration:
   a. Start the WebSphere administrative console by specifying : http://*server_host_name*:9090/admin.
   b. Click **Security > SSL**.
   c. Create a new Secure Sockets Layer (SSL) setting alias if one does not exist.
   d. Select the alias that you want to add into the truststore file.
   e. Type the Trust File Password for the password to access the truststore file. Type `password` if you are using a RACF key ring for the trust store.
   f. Select the Trust File Format for the truststore type. JKS (Default), PKCS12KS, JCEK.
   g. Click **OK** and **Save** to save the configuration.

The SSL configuration alias now contains a valid truststore file for an SSL connection.

- SSL connection for Internet InterORB Protocol (IIOP)
- SSL connection for Lightweight Directory Access Protocol (LDAP)
- SSL connection for Hypertext Transfer Protocol (HTTP)

Secure Sockets Layer configuration repertoire settings

Use this page to define a new Secure Sockets Layer (SSL) alias. Using the SSL configuration repertoire, administrators can define any number of SSL settings to use in configuring the Hypertext Transfer Protocol with SSL (HTTPS), Internet InterORB Protocol with SSL (IIOPS) or Lightweight Directory Access Protocol with SSL (LDAPS) connections. You can pick one of the SSL settings defined here from any location within the administrative console that supports SSL connections. This flexibility simplifies the SSL configuration process because you can reuse many of these SSL configurations by specifying the alias in multiple places.

To view this administrative console page, click **Security** > **SSL**.

Click **New** to create a new SSL Configuration Repertoire alias.

Click **Delete** to remove an SSL Configuration Repertoire alias. If an SSL configuration alias is referenced in the configuration and is deleted here, then an SSL connection fails when the deleted alias is accessed.

Alias:

Specifies the name of the specific SSL setting.

Type:

Specifies the type of repertoire configured for the alias listed.

The value is either SSSL for System Secure Sockets Layer repertoire or JSSE for Java Secure Sockets Extension repertoire.

Repertoire settings:

Use this page to configure the repertoire settings for the server.

To view this administrative console page, click **Security > SSL >***alias_name*.

Alias:

Specifies the name of the specific SSL setting

Data type: String

Key File Name:

Specifies the fully qualified path to the SSL key file that contains public keys and private keys.

You can create an SSL key file with the key management utility, or this file can correspond to a hardware device if one is available. In either case, this option indicates the source for personal certificates and for signer certificates unless a trust file is specified. The default SSL key files, `DummyClientKeyFile.jks` and `DummyServerKeyFile.jks`, contais a self-signed personal test certificate expiring on March 17, 2005. The test certificate is only intended for use in a test environment. The default SSL key files should never be used in a production environment because the private keys are the same on all the WebSphere Application Server installations. Refer to the Managing certificates article for information about creating and managing digital certificates for your WebSphere Application Server domain.

Data type: String

Key File Password:

Specifies the password for accessing the SSL key file.

Data type: String

Key File Format:

Specifies the format of the SSL key file.

Data type: String
Default: JKS
Range: JKS, JCEK, PKCS12

Trust File Name:

Specifies the fully qualified path to a trust file containing the public keys.

You can create a trust file with the key management utility included in the WebSphere *bin* directory. Using the key management utility from Global Security Kit (GSKit) (another SSL implementation) does not work with the Java Secure Socket Extension (JSSE) implementation.

Unlike the SSL key file, no personal certificates are referenced; only signer certificates are retrieved. The default SSL trust files, `DummyClientTrustFile.jks` and `DummyServerTrustFile.jks`, contain multiple test public keys as signer certificates that can expire. The public key for the WebSphere Application Server Version 4.0 test certificates expires on January 15, 2004, and the public key for the WebSphere Application Server Version 5 test certificates and WebSphere Application Server CORBA C++ client expires on March 17, 2005. The test certificate is only intended for use in a test environment.

If a trust file is not specified but the SSL key file is specified, then the SSL key file is used for retrieval of signer certificates as well as personal certificates.

Data type: String

Trust File Password:

Specifies the password for accessing the SSL trust file.

Data type: String

Trust File Format:

Specifies the format of the SSL trust file.

Data type: String
Default: JKS
Range: JKS, JCEK, PKCS12

Client Authentication:

Specifies whether to request a certificate from the client for authentication purposes when making a connection.

This attribute is only valid when used by the Web container HTTP transport.

When performing client authentication with the Internet InterORB Protocol (IIOP) for EJB requests, click **Security** > **Authentication Protocol** > **CSIv2 Inbound** or **Outbound Authentication** from the left navigation pane of the administrative console. Click **SSL Client Certificate Authentication** to enable it for these requests.

Data type: Boolean
Default: Disabled
Range: Enabled or Disabled

Security Level:

Specifies whether the server selects from a preconfigured set of security levels.

Data type: Valid values include Low, Medium or High.
- Low specifies only digital signing ciphers (no encryption)
- Medium specifies only 40-bit ciphers (including digital signing)
- High specifies only 128-bit ciphers (including digital signing).

To specify all ciphers or any particular range, you can set the com.ibm.ssl.enabledCipherSuites property.

See the SSL documentation for more information.

Default: High
Range: Low, Medium, or High

Cipher Suites:

Specifies a list of supported cipher suites that can be selected during the SSL handshake. If you select cipher suites individually here, you override the cipher suites set in the Security Level field.

Data type:
Default:
Range:

Cryptographic Token:

Specifies whether the server enables or disables cryptographic hardware and software support. The SOAP connector does not use hardware cryptography.

Data type: Boolean
Default: Disabled
Range: Enabled or Disabled

Provider:

Refers to a package that supplies a concrete implementation of a subset of the cryptography aspects of the Java Security API.

If you select the first button, select a provider from the menu.

WebSphere Application Server has the IBMJSSE predefined provider.

WebSphere Application Server has the IBMJSSE predefined provider and the IBMJSSEFIPS predefined provider. IBMJSSEFIPS is a version of the IBMJSSE

provider that is undergoing Federal Information Processing Standard (FIPS) certification. If you select the second option, enter a custom provider. For a custom provider, you first must enter the cipher suites through Custom Properties under Additional Properties, Cipher suites and protocol values depend on the Provider.

Data type	integer
Default	100
Range	1 to 86400

Protocol:

Specifies the SSL protocol that is used.

If you are using a FIPS-approved JSSE such as IBMJSSEFIPS, you must select a TLS protocol. Because the FIPS-approved JSSE providers are not backwards-compatible, a server that uses the TLS protocol cannot communicate with a client that uses an SSL protocol.

Secure Sockets Layer settings for custom properties:

Use this page to configure additional Secure Sockets Layer (SSL) settings for a defined alias.

To view this administrative console page, click **Security** > **SSL** > *alias_name* > **Custom properties**.

Custom Properties:

Specifies the name-value pairs that you can use to configure additional SSL settings beyond those available in the `com.ibm.ssl.protocol` administrative interface.

This value is the SSL protocol used (including its version). The possible values are SSL, SSLv2, SSLv3, TLS, or TLSv1. The default value, SSL, is backward-compatible with the other SSL protocols.

com.ibm.ssl.keyStoreProvider
The name of the key store provider to use. Specify one of the security providers listed in your `java.security` file, which has a keystore implementation. The default value is IBMJCE.

com.ibm.ssl.keyManager
The name of the key management algorithm to use. Specify any key management algorithm that is implemented by one of the security providers listed in your `java.security` file. The default value is IbmX509.

com.ibm.ssl.trustStoreProvider
The name of the trust store provider to use. Specify one of the security providers listed in your `java.security` file, which has a truststore implementation. The default value is IBMJCE.

com.ibm.ssl.trustManager
The name of the trust management algorithm to use. Specify any trust management algorithm that is implemented by one of the security providers listed in your `java.security` file. The default value is IbmX509.

com.ibm.ssl.trustStoreType
The type or format of the truststore file. The possible values are JKS, PKCS12, JCEK. The default value is JKS.

com.ibm.ssl.enabledCipherSuites
The list of cipher suites to enable. By default, this is not set and the set of

cipher suites used is determined by the value of the security level (high, medium, or low). A cipher suite is a combination of cryptographic algorithms used for an SSL connection. Enter a space-separated list of any of the following cipher suites:
- SSL_RSA_WITH_RC4_128_MD5
- SSL_RSA_WITH_RC4_128_SHA
- SSL_RSA_WITH_DES_CBC_SHA
- SSL_RSA_WITH_3DES_EDE_CBC_SHA
- SSL_DHE_RSA_WITH_DES_CBC_SHA
- SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA
- SSL_DHE_DSS_WITH_DES_CBC_SHA
- SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA
- SSL_RSA_EXPORT_WITH_RC4_40_MD5
- SSL_RSA_EXPORT_WITH_DES40_CBC_SHA
- SSL_RSA_EXPORT_WITH_RC2_CBC_40_MD5
- SSL_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA
- SSL_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA
- SSL_RSA_WITH_NULL_MD5
- SSL_RSA_WITH_NULL_SHA
- SSL_DH_anon_WITH_RC4_128_MD5
- SSL_DH_anon_WITH_DES_CBC_SHA
- SSL_DH_anon_WITH_3DES_EDE_CBC_SHA
- SSL_DH_anon_EXPORT_WITH_RC4_40_MD5
- SSL_DH_anon_EXPORT_WITH_DES40_CBC_SHA

Data type: String

Cryptographic token:

Specifies information about the cryptographic tokens related to SSL support.

A cryptographic token is a hardware or software device that has a built-in keystore implementation. Document the exact values for the following fields in the found in the literature of your supported cryptographic device.

Creating a Secure Sockets Layer repertoire configuration entry

The first step in configuring Secure Sockets Layer (SSL) is to define an SSL configuration repertoire. A *repertoire* contains the details necessary for building an SSL connection, such as the location of the key files, their type and the available ciphers. WebSphere Application Server provides a default repertoire called DefaultSSLSettings. To view this page in the administrative console, click **Security > SSL** to see the list of SSL repertoire settings.

The appropriate repertoire is referenced during the configuration of a service that sends and receives requests encrypted using SSL, such as the Web and enterprise beans containers. If an SSL configuration alias is referenced elsewhere, but the alias is deleted from the SSL Configuration Repertoires panel, the SSL connection fails if the deleted alias is accessed.

With the SSL configuration repertoire, administrators can define SSL settings to use for making Hypertext Transfer Protocol with SSL (HTTPS), Internet InterORB Protocol with SSL (IIOPS) or Lightweight Directory Access Protocol with SSL (LDAPS) connections. You can pick one of the SSL settings defined here from any location within the administrative console, which supports SSL connections. This

selection simplifies the SSL configuration process because you can reuse many of these SSL configurations by specifying the alias in multiple places.

1. From the SSL Configuration Repertoire window, click **New**.
2. Enter the information needed to access the key file.
   a. Type the name of the key file, which must include the fully qualified path to the key file, in the Key File Name field.
   b. Type the password needed to access the key file in the Key File Password field.
   c. Select the format of the key file from the Key File Format menu.
3. Enter the information needed to access the trust file.
   a. Type the name of the trust file, which must include the fully qualified path to the trust file, in the Trust File Name field.
   b. Type the password needed to access the trust file in the Trust File Password field.
   c. Select the format of the trust file from the Trust File Format menu.
4. Select the **Client Authentication** option if this configuration supports client authentication. This selection only affects HTTP and LDAP requests.
5. Select the appropriate security level from the Security Level menu. Valid values are low, medium, and high. Low specifies digital signing ciphers only (no encryption), medium specifies 40-bit ciphers only (including digital signing), high specifies 128-bit ciphers only (including digital signing).

   If you are using a Federal Information Processing Standards (FIPS)-supported Java Secure Socket Extension (JSSE), you must select **High** from the Security Level menu.
6. Select a cipher suite from the Cipher Suites menu. If you chose a cipher suite, WebSphere Application Server uses this selection to override the security level setting.
7. Select the **Cryptographic Token** check box if hardware or software cryptographic support is available. See "Configuring to use cryptographic tokens" on page 434 for details regarding cryptographic support.
8. Indicate which JSSE provider you are using by either selecting **IBMJSSE** or **IBMJSSEFIPS** from the menu, or by typing the name of the provider. WebSphere Application Server includes the IBMJSSE JSSE provider and the IBMJSSEFIPS JSSE provider.

   Use IBMJSSEFIPS only if you are using the Transport Layer Security (TLS) protocol and not the Secure Sockets Layer (SSL) protocol. See "Configuring Federal Information Processing Standard Java Secure Socket Extension files" on page 411 for more information

   On the HP-UX platform, WebSphere Application Server uses the Sun JSSE framework and provider. The Sun JSSE framework is not pluggable for export control reasons. The lack of pluggability within the Sun JSSE framework prohibits WebSphere Application Server from using the IBMJSSE or the IBMJSSEFIPS provider. The Sun JSSE framework is part of the core IBM Developer Kit for HP-UX, Java Technology Edition, Version 1.4.x, which is located in the `java/jre/lib/jsse.jar` file. For more information, see "Changes to IBM Developer Kit for Java Technology Edition Version 1.4.x" on page 430. Configure the JSSE provider as a custom provider.

   If you are not using the predefined providers, configure the custom provider by clicking **Apply**, then **Custom Properties > New** in the Additional Properties section. After the custom provider is configured, return to the SSL Configuration Repertoires window and continue with these instructions.

9. Select an SSL or TLS protocol version. If you are using a FIPS-approved JSSE, you must select a TLS protocol version.
10. Click **Apply** to apply the changes.
11. If no errors occur, save the changes to the master configuration and restart the WebSphere Application Server. For more information on the FIPS certification process and to check the status of the IBM submission, see the Cryptographic Module Validation Program FIPS 140-1 and FIPS 140-2 Pre-validation List Web site.

You included additional SSL configuration repertoires with the default DefaultSSLSettings repertoire.

The appropriate repertoire is referenced during the configuration of a service that sends and receives requests encrypted using SSL, such as the Web and enterprise bean containers, and Lightweight Directory Access Protocol (LDAP) servers.

For the changes to take effect, restart the server after saving the configuration.

Configuring Federal Information Processing Standard Java Secure Socket Extension files

The Federal Information Processing Standard (FIPS)-approved Java Secure Socket Extension (JSSE) provider has increased data encryption capabilities. FIPS-approved JSEE providers support Data Encryption Standard (DES) or Triple DES with at least 56-bits of encryption. Although this additional encryption capability is available, you must use Transport Layer Security (TLS) and not Secure Sockets Layer (SSL) as FIPS-approved JSSE files are not backwards-compatible and SSL is not FIPS-approved. If the server uses TLS, a client using SSL cannot communicate with the server. Thus, use FIPS-approved JSSE providers if your servers and clients are using WebSphere Application Server, Version 5.0.2 or later as this version supports FIPS.

Attention: The IBMJSSEFIPS and IBMJCEFIPS underwent FIPS 140-2 certification. For more information on the FIPS certification process, see the Cryptographic Module Validation Program FIPS 140-1 and FIPS 140-2 Pre-validation List Web site.

If you create your own encryption configurations and enable FIPS, you must add a FIPS-approved JSSE to all of your server and client configurations.

Important: Although WebSphere Application Server supports the IBM Federal Information Processing Standard-approved Java Secure Socket Extension (IBMJSSEFIPS), IBMJSSEFIPS is not supported on the HP-UX platform.

To configure the WebSphere Application Server to use IBMJSSEFIPS and IBMJCEFIPS providers, complete the following steps using the administrative console:

1. Click **Security > Global Security**.
2. Select the **Use FIPS** check box and click **OK**. IBMJCEFIPS is enabled. However, IBMJSSEFIPS is not configured until you complete the remaining steps.
3. Click **Security > SSL**.
4. Click the name of your SSL configuration or click **New** to create a new configuration. For more information on SSL configurations, see "Creating a Secure Sockets Layer repertoire configuration entry" on page 409.

5. Select **High** from the Security Level menu. This action sets the encryption strength to 56-bits and higher.
6. Indicate which JSSE FIPS provider to use. Do one of the following actions:
   - Select **IBMJSSEFIPS** from the Provider menu and select Predefined JSSE provider. For a list of providers that were previously configured, click **Custom Properties** under Additional Properties.
   - Type the name of your custom JSSE FIPS provider and select Custom JSSE provider. To create a custom JSSE FIPS provider, click **Custom Properties > New** under Additional Properties. After configuring your custom FIPS-approved provider, return to the SSL Configuration Repertoires panel for your SSL configuration and enter the name in the Provider field.
7. Select the **TLS** or **TLSV1** option from the Protocol menu. To use a FIPS-approved JSSE, you must choose either the **TLS** or **TLSV1** option. SSL protocol is not FIPS-approved. After you select the protocol, the corresponding custom property value is updated for com.ibm.ssl.protocol. You can view this updated property value under Custom Properties after you click **Apply** or **OK**.
8. Click **OK**.
9. If you have a Java client that must access enterprise beans, modify the *install_dir*/properties/sas.client.props file to comment out the SSL protocol and add the Transport Layer Security (TLS) protocol. To change the protocol to TLS, make the following changes to the *install_dir*/properties/sas.client.props file:

   ```
   #com.ibm.ssl.protocol=SSL
   com.ibm.ssl.protocol=TLS
   ```

10. If the server uses a FIPS-approved provider for the CSIv2/SAS protocol, add IBMJSSEFIPS as the contextProvider and TLS as the protocol to the *install_dir*/properties/sas.client.props file on the application client. In the *install_dir*/properties/sas.client.props file, add the following information:

    ```
    com.ibm.ssl.contextProvider=IBMJSSEFIPS
    com.ibm.ssl.protocol=TLS
    ```

11. If the server-side SOAP connector configuration uses a FIPS-approved IBMJSSEFIPS provider, add com.ibm.fips.jsse.JSSESocketFactory as the provider and IBMJSSEFIPS as the contextProvider in the *install_dir*/properties/soap.client.props file on the administrative client. In the *install_dir*/properties/soap.client.props file, add the following information:

    ```
    ssl.SocketFactory.provider=com.ibm.fips.jsse.JSSESocketFactory
    com.ibm.ssl.contextProvider=IBMJSSEFIPS
    ```

12. Verify that a FIPS-approved configuration is specified correctly throughout the administrative console. Verify the configuration settings in the following panels:
    - Click **Servers > Application Servers >** *server_name*. Under Additional properties, click **Administration Services > JMX Connectors > SOAPConnector > Custom Properties >sslConfig**.
    - Click **Servers > Application Servers >** *server_name*. Under Additional properties, click **Web Container > HTTP Transport**.
    - Click **Environment > Virtual Hosts >** *host_name*. Under Additional properties, click **Host Aliases >** <*alias_name*>.

- Click **Applications > Enterprise Applications >***application_name*. Under Additional properties, click **Map virtual hosts for web modules**.
- Click **Security > User Registries > LDAP**.
- Click **Enterprise Applications >** *application_name*. Under Related Items, click **Web Module >***URI_file_name* **> Web Services: Client Security Bindings**. Verify the configuration settings listed under **HTTP Basic Authentication** and **HTTP SSL Authentication**.

After completing these steps, a FIPS-approved JSSE provides increased encryption capabilities. However, when you use FIPS-approved providers, consider the following points:

- By default, Microsoft Internet Explorer Version 5.5 might not have TLS enabled. To enable TLS, open the Internet Explorer browser and click **Tools > Internet Options**. On the **Advanced** tab, select the **Use TLS 1.0** checkbox.
- Netscape Version 4.7.x and earlier versions might not support TLS.
- IBM Directory Server Version 4.1 and earlier versions do not support TLS.
- If you select **IBMJSSEFIPS** from the Provider menu before changing the Security Level to `High` and the Protocol menu to `TLS` or `TLSV1`, WebSphere Application Server changes the Security Level and Protocol menu options automatically. However, if you change the Provider menu option from IBMJSSEFIPS to IBMJSSE, you must manually change the Protocol option to the correct setting. The setting does not change automatically because IBMJSSE supports both SSL and TLS.
- If you have an administrative client that uses a SOAP connector and you enable FIPS, add the following lines to the *`install_dir`*`/properties/soap.client.props` file:

  ssl.SocketFactory.provider=com.ibm.fips.jsse.JSSESocketFactory
  com.ibm.ssl.contextProvider=IBMJSSEFIPS
- When you select the **Use FIPS** check box on the **Security > Global Security** panel, the LTPA token format is not backwards-compatible with prior releases of WebSphere Application Server. However, you can continue to use the LTPA keys configured using a previous version of WebSpere Application Server.

Attention: If you select **USE FIPS** on the Global Security panel and select an SSL configuration on the SSL Configuration Repertoires panel, the following error message is displayed at the top of the Global Security panel:

```
The security policy is set to use only FIPS-approved cryptographic
algorithms. However at least one SSL configuration may not be using a
FIPS-approved JSSE provider. FIPS-approved cryptographic algorithms
may not be used in those cases.
```

Attention: If you use the FIPS-approved JSSE provided with WebSphere Application Server, you must choose **IBMJSSEFIPS** from the Provider menu on the SSL Configuration Repertoires panel. Otherwise, the following message is displayed at the top of the panel:

```
"Use FIPS" is enabled, but the SSL provider is not IBMJSSEFIPS.
FIPS approved cryptographic algorithms may not be used.
```

Digital certificates

Certificates provide a way of authenticating users. Instead of requiring each participant in an application to authenticate every user, third-party authentication relies on the use of digital certificates.

A digital certificate is equivalent to an electronic ID card. It serves two purposes:
- Establishes the identity of the owner of the certificate
- Distributes the owner's public key

Certificates are issued by trusted parties, called *certificate authorities* (CAs). These authorities can be commercial ventures or they can be local entities, depending on the requirements of your application. Regardless, the CA is trusted to adequately authenticate users before issuing certificates. A CA issues certificates with digital signatures. When a user presents a certificate, the recipient of the certificate validates it by using the digital signature. If the digital signature validates the certificate, the certificate is recognized as intact and authentic. Participants in an application only need to validate certificates; they do not need to authenticate users. The fact that a user can present a valid certificate proves that the CA has authenticated the user. The descriptor, *trusted third-party*, indicates that the system relies on the trustworthiness of the CAs.

Contents of a digital certificate

A certificate contains several pieces of information, including information about the owner of the certificate and the issuing CA. Specifically, a certificate includes:
- The distinguished name (DN) of the owner. A DN is a unique identifier, a fully qualified name including not only the common name (CN) of the owner but the owner's organization and other distinguishing information.
- The public key of the owner.
- The date on which the certificate was issued.
- The date on which the certificate expires.
- The distinguished name of the issuing CA.
- The digital signature of the issuing CA. (The message-digest function is run over all the preceding fields.)

The core idea of a certificate is that a CA takes the owner's public key, signs the public key with its own private key, and returns the information to the owner as a certificate. When the owner distributes the certificate to another party, it signs the certificate with its private key. The receiver can extract the certificate (containing the CA signature) with the owner's public key. By using the CA public key and the CA signature on the extracted certificate, the receiver can validate the CA signature. If it is valid, the public key used to extract the certificate is recognized as good. The owner signature is then validated, and if the validation succeeds, the owner is successfully authenticated to the receiver.

The additional information in a certificate helps an application decide whether to honor the certificate. With the expiration date, the application can determine if the certificate is still valid. With the name of the issuing CA, the application can check that the CA is considered trustworthy by the site.

A process that uses certificates must provide its personal certificate, the one containing its public key, and the certificate of the CA that signed its certificate, called a *signer certificate*. In cases where chains of trust are established, several signer certificates can be involved.

Requesting certificates

To get a certificate, send a certificate request to the CA. The certificate request includes:
- The distinguished name of the owner (the user for whom the certificate is requested).

- The public key of the owner.
- The digital signature of the owner.

The message-digest function is run over all these fields.

The CA verifies the signature with the public key in the request to ensure that the request is intact and authentic. The CA then authenticates the owner. Exactly what the authentication consists of depends on a prior agreement between the CA and the requesting organization. If the owner in the request is successfully authenticated, the CA issues a certificate for that owner.

Using certificates: Chain of trust and self-signed certificate

To verify the digital signature on a certificate, you must have the public key of the issuing CA. Because public keys are distributed in certificates, you must have a certificate for the issuing CA that is signed by the issuer. One CA can certify other CAs, so a chain of CAs can issue certificates for other CAs, all of whose public keys you need. Eventually, you reach a root CA that issues itself a self-signed certificate. To validate a user's certificate, you need certificates for all intervening participants, back to the root CA. Then you have the public keys you need to validate each certificate, including the user's.

A self-signed certificate contains the public key of the issuer and is signed with the private key. The digital signature is validated like any other, and if the certificate is valid, the public key it contains is used to check the validity of other certificates issued by the CA. However, anyone can generate a self-signed certificate. In fact, you can probably generate self-signed certificates for testing purposes before installing production certificates. The fact that a self-signed certificate contains a valid public key does not mean that the issuer is really a trusted certificate authority. To ensure that self-signed certificates are generated by trusted CAs, such certificates must be distributed by secure means (hand-delivered on floppy disks, downloaded from secure sites, and so on).

Applications that use certificates store these certificates in a *keystore* file. This file typically contains the necessary personal certificates, its signing certificates, and its private key. The private key is used by the application to create digital signatures. Servers always have personal certificates in their keystore files. A client requires a personal certificate only if the client must authenticate to the server when mutual authentication is enabled.

To allow a client to authenticate to a server, a server keystore file contains the private key and the certificate of the server and the certificates of its CA. A client truststore file must contain the signer certificates of the CAs of each server to which the client must authenticate.

If mutual authentication is needed, the client keystore file must contain the client private key and certificate. The server truststore file requires a copy of the certificate of the client CA.

Digital signatures:

A *digital signature* is a number attached to a document. For example, in an authentication system that uses public-key encryption, digital signatures are used to sign certificates.

This signature establishes the following information:

- The integrity of the message: Is the message intact? That is, has the message been modified between the time it was digitally signed and now?
- The identity of the signer of the message: Is the message authentic? That is, was the message actually signed by the user who claims to have signed it?

A digital signature is created in two steps. The first step distills the document into a large number. This number is the *digest code* or *fingerprint*. The digest code is then encrypted, resulting in the digital signature. The digital signature is appended to the document from which the digest code was generated.

Several options are available for generating the digest code. WebSphere Application Server supports the MD5 message digest function and the SHA1 secure hash algorithm, but these procedures reduce a message to a number. This process is not encryption, but a sophisticated checksum. The message cannot regenerate from the resulting digest code. The crucial aspect of distilling the document to a number is that if the message changes, even in a trivial way, a different digest code results. When the recipient gets a message and verifies the digest code by recomputing it, any changes in the document result in a mismatch between the stated and the computed digest codes.

To stop someone from intercepting a message, changing it, recomputing the digest code, and retransmitting the modified message and code, you need a way to verify the digest code as well. To verify the digest code, reverse the use of the public and private keys. For private communication, it makes no sense to encrypt messages with your private key; these keys can be decrypted by anyone with your public key. This technique can be useful for proving that a message came from you. No one can create it because no one else has your private key. If some meaningful message results from decrypting a document by using someone's public key, the decryption process verifies that the holder of the corresponding private key did encrypt the message.

The second step in creating a digital signature takes advantage of this reverse application of public and private keys. After a digest code is computed for a document, the digest code is encrypted with the sender's private key. The result is the digital signature, which is attached to the end of the message.

When the message is received, the recipient follows these steps to verify the signature:
1. Recomputes the digest code for the message.
2. Decrypts the signature by using the sender's public key. This decryption yields the original digest code for the message.
3. Compares the original and recomputed digest codes. If these codes match, the message is both intact and authentic. If not, something has changed and the message is not to be trusted.

Public key cryptography:

All encryption systems rely on the concept of a key. A key is the basis for a transformation, usually mathematical, of an ordinary message into an unreadable message. For centuries, most encryption systems have relied on what is called private-key encryption. Only within the last 30 years has a challenge to private-key encryption appeared: public-key encryption.

Private key encryption

Private-key encryption systems use a single key that is shared between the sender and the receiver. Both must have the key; the sender encrypts the message by using the key, and the receiver decrypts the message with the same key. Both must keep the key private to keep their communication private. This kind of encryption has characteristics that make it unsuitable for widespread, general use:

- Private key encryption requires a key for every pair of individuals who need to communicate privately. The necessary number of keys rises dramatically as the number of participants increases.
- The fact that keys must be shared between pairs of communicators means the keys must somehow be distributed to the participants. The need to transmit secret keys makes them vulnerable to theft.
- Participants can communicate only by prior arrangement. There is no way to send a usable encrypted message to someone spontaneously. You and the other participant must make arrangements to communicate by sharing keys.

Private-key encryption is also called *symmetric encryption*, because the same key is used to encrypt and decrypt the message.

Public key encryption

Public-key encryption uses a pair of mathematically related keys. A message encrypted with the first key must be decrypted with the second key, and a message encrypted with the second key must be decrypted with the first key.

Each participant in a public-key system has a pair of keys. The private key is kept secret. The other key is distributed to anyone who wants it; this key is the public key.

To send an encrypted message to you, the sender encrypts the message by using your public key. When you receive the message, you decrypt it by using your private key. To send a message to someone, you encrypt the message by using the recipient's public key. The message can be decrypted with the recipient's private key only. This kind of encryption has characteristics that make it very suitable for general use:

- Public-key encryption requires only two keys per participant. The increase in the total number of keys is less dramatic as the number of participants increases, compared to private-key encryption.
- The need for secrecy is more easily met. Only the private key needs to be kept private and because it does not need to be shared, the private key is less vulnerable to theft in transmission than the shared key in a private-key system.
- Public keys can be published, which eliminates the need for prior sharing of a secret key before communication. Anyone who knows your public key can use it to send you a message that only you can read.

Public-key encryption is also called *asymmetric encryption*, because the same key cannot be used to encrypt and decrypt the message. Instead, one key of a pair is used to undo the work of the other. WebSphere Application Server uses the Rivest Shamir Adleman (RSA) public and private key-encryption algorithm.

With private-key encryption, you have to be careful of stolen or intercepted keys. In public-key encryption, where anyone can create a key pair and publish the public key, the challenge is in verifying that the owner of the public key is really the person you think it is. Nothing prevents a user from creating a key pair and publishing the public key under a false name. The listed owner of the public key

cannot read messages encrypted with that key because the owner does not have the private key. If the creator of the false public key can intercept these messages, that person can decrypt and read messages intended for someone else. To counteract the potential for forged keys, public-key systems provide mechanisms for validating public keys and other information with digital signatures and digital certificates.

Managing digital certificates

Secure Sockets Layer (SSL) connections rely on the existence of *digital certificates*. A digital certificate reveals information about its owner, including their identity. During the initialization of an SSL connection, the server must present its certificate to the client for the client to determine the server identity. The client can also present the server with its own certificate for the server to determine the client identity. SSL is therefore, a means of propagating identity between components. Refer to "Configuring Secure Sockets Layer" on page 390 and "Creating a Secure Sockets Layer repertoire configuration entry" on page 409.

A client can trust the contents of a certificate if that certificate is digitally signed by a trusted third party. A Certificate Authority (CA) acts as a trusted third party and signs certificates on the basis of its knowledge of the certificate requestor. Complete the following steps to manage digital certificates using either the key management utility (iKeyman) or the keytool utility:

- Use the supplied key management utility. Refer to "Starting the key management utility (iKeyman)" on page 421. There are two options for creating a new certificate.
  - Request that a CA generates the certificates on your behalf. The CA creates a new certificate, digitally signs it, and delivers it to the requester. Popular Web browsers are preconfigured to trust certificates that are signed by certain CAs. No further client configuration is necessary for a client to connect to the server through an SSL connection. Therefore, CA signed certificates are useful where configuration for each and every client that accesses the server is impractical. Refer to "Requesting certificate authority-signed personal certificates" on page 423, "Creating certificate signing requests" on page 424, "Receiving certificate authority-signed personal certificates" on page 425, and "Extracting public certificates for truststore files" on page 426.
  - Generate a self-signed certificate. This option might be the quickest and require the fewest details to create the certificate. However, the certificate is not signed by a CA. Any client that connects to this server over an SSL connection needs configuration to trust the signer of this certificate. Therefore, self-signed certificates are only useful when you can configure each of the clients to trust the certificate. It is possible in some cases to present a self-signed certificate to an untrusting client. In some Web browsers, when the certificate is received and does not match any of those listed in the client trust file, a prompt appears asking if the certificate should be trusted for the connection and added to the trust file. Refer to "Creating a keystore file" on page 422, "Creating truststore files" on page 426, "Adding keystore files" on page 403, "Adding truststore files" on page 403, "Creating self-signed personal certificates" on page 422, and "Importing signer certificates" on page 427.

  You must configure the server side options. The WebSphere Application Server stores the keystore information in the repository and the keystore files are referred to in the `security.xml` file. Therefore, complete all server-side configuration through the administration console. For Java clients, refer to "Configuring Secure Sockets Layer for Java client authentication" on page 401.

- Use the command line Java utility called *keytool*. With keytool, you can create a private and public self-signed certificate key pair. For this example, the first user is *cn=rocaj*.
  1. Specify **RSA** for the private key to ensure that the *MD5 with RSA* signature algorithm is used. Not all Web browsers support the *DSA* cryptograph algorithm, which is the default when RSA is not specified. Set a password of at least six characters to protect the private key. Finally, specify the keystore file and keystore password (the option is storepass):

     ```
     ${WAS_HOME}/java/bin/keytool -genkey -keyalg RSA -dname "cn=rocaj, ou=users,
     u=uk, DC=internetchaos, DC=com" -alias rocaj -keypass websphere -keystore
     testkeyring.jks -storepass websphere
     ```

     The previous three lines of code belong on one line, but were split onto three lines due to the width of the page.

     The keytool utility creates the key store called testkeyring.jks.
  2. Create the second private and public self-signed certificate key pair in the same manner for the user *cn=amorv*.

     ```
     ${WAS_HOME}/java/bin/keytool -genkey -keyalg RSA -dname "cn=amorv, ou=users,
     ou=uk, DC=internetchaos, DC=com" -alias amorv -keypass websphere -keystore
     testkeyring.jks -storepass websphere
     ```

     The previous three lines of code belong on one line, but were split onto three lines due to the width of the page.

     Now the keystore *testkeyring.jks* contains two self-signed certificates with the owner being the same as the issuer for each certificate.
  3. Verify the integrity and authenticity of the certificates by getting each certificate signed by the certificate authority.
     a. Generate the Certificate Signing Request, CSR-1 (for the first user cn=rocaj).

        ```
        ${WAS_HOME}/java/bin/keytool -v certreq -alias rocaj -file rocajReq.csr
        -keypass websphere -keystore testkeyring.jks -storepass websphere
        ```

        The previous two lines of code belong on one line, but were split onto two lines due to the width of the page.
     b. On UNIX-based platforms, remove the end of line characters (^M) from the certificate signing request. To remove the end of line characters, type the following command:

        ```
        cat rocajReq.csr |tr -d "\r"
        ```
     c. Generate the CSR-2 (for the second user cn=amorv).

        ```
        ${WAS_HOME}/java/bin/keytool -v -certreq -alias amorv  -file amorvReq.csr
        -keypass websphere -keystore testkeyring.jks -storepass websphere
        ```

        The previous two lines of code belong on one line, but were split onto two lines due to the width of the page.
     d. On UNIX-based platforms, remove the end of line characters (^M) from the certificate signing request. To remove the end of line characters, type the following command:

        ```
        cat amoryReq.csr |tr -d "\r"
        ```
  4. Use the free Test SSL certificate program offered by Thawte Consulting to sign the Certificate Signing Requests (CSRs) for this example. In each case, select the **Custom Cert** option and set the certificate format to use the

default for your kind of certificate. The example also selects the **Generate an X.509v3 Certificate** option and saves the two resulting files as *rocajRes.arm* and *amorvRes.arm*, respectively.

5. Import the CA trusted root certificate into the keystore. Copy and paste the Thawte test root certificate in BASE64-encoded ASCII data format to a file called *ThawteTestCA.arm*. Add the test root CA certificate into the keystore file with the following command:

   ```
   ${WAS_HOME}/java/bin/keytool -import -alias "Thawte Test CA Root"
   -file ThawteTestCA.arm -keystore testkeyring.jks -storepass websphere
   ```

   The previous two lines of code belong on one line, but were split onto two lines due to the width of the page.

6. Import the two certificate responses from the CA into the keystore file using the same alias name that was first given to the self-signed certificates. In this example, these alias names are *rocaj* and *amorv* respectively. Using an alternative alias name generates a new signer certificate and not a personal certificate chain.
   - Import the certificate response -1 (for the first user cn=rocaj).

     ```
     ${WAS_HOME}/java/bin/keytool -import -trustcacerts -alias rocaj
     -file rocajRec.arm -keystore testkeyring.jks  -storepass websphere.
     Certificate reply was installed in keystore
     ```

     The previous three lines of code belong on one line, but were split onto three lines due to the width of the page.
   - Import the certificate response -2 (for the second user cn=amorv).

     ```
     ${WAS_HOME}/java/bin/keytool -import -trustcacerts -alias amorv
     -file amorvRec.arm -keystore testkeyring.jks -storepass websphere.
     Certificate  reply was installed in keystore
     ```

     The previous three lines of code belong on one line, but were split onto three lines due to the width of the page.

7. Launch the JSSE ikeyman utility, which supports the PKCS12 format and the private key exporting associated with any certificate (the public key is also exported).
8. Open the *testkeyring.jks* keystore file and select the first certificate from the **Personal Certificates** menu.
9. Click **Export** and name the file, *rocajprivate.p12*. Export the second personal certificate and name it *amorvprivate.p12*.
10. Verify that the same root certificate of the authenticating CA is installed as a trusted authority in the browser.
11. To install either of the personal certificates into Netscape Communicator, click **Communicator > Tools > Security Info > Certificates > Yours**. Use the **Import a Certificate** option.
12. Enter a password or PIN for the communicator certificate database, when you attempt to import the certificate. Enter the password used when first initializing your certificate database. Enter the password protecting the PKCS#12 certificate file, as set when you exported the personal private and public certificate key pair in iKeyman.
13. Click **Verify** to check integrity and validity of the certificate. If you did not install the root CA certificate, your certificate fails the verification.
14. Verify that you modified your Web server to support client side certificate requests.

15. Go to the following URL: `https://server_name/snoop`; the Web browser prompts you to select a personal certificate when accessing a resource protected by the *SSLClientAuth* directive.
16. Select the HTTPS information displayed by the snoop servlet; you see the certificate SubjectDN matching the following: **Subject: CN=amorv, OU=users, OU=uk, DC=internetchaos, DC=com**.

- Refer to "Creating a Secure Sockets Layer repertoire configuration entry" on page 409 to create a new SSL definition entry for WebSphere Application Server using the administrative console. Once a keystore file is configured, either by creating a self-signed certificate or by creating a certificate request and importing the reply, you can configure WebSphere Application Server to use the certificates. The product uses the certificates to establish a secure connection with a client through SSL.
- Set up the appropriate components to use the newly-defined SSL configuration. To ensure a secure connection, configure some non-WebSphere components, such as a Web server. A digital certificate is created for each component. The WebSphere Application Server owns a certificate and the Web server owns another certificate. Refer to "Configuring IBM HTTP Server for secure sockets layer mutual authentication" on page 394.

Setting up SSL communication between the Web browser and WebSphere Application Server. Using digital signatures, you can communicate securely from the Web browser through the Web server to WebSphere Application Server.

Once you finish configuring security, perform the following steps to save, synchronize, and restart the servers:
1. Click **Save** in the administrative console to save any modifications to the configuration.
2. Synchronize the configuration with all node agents (Network Deployment only).
3. Once synchronized, stop all servers and restart them.

Starting the key management utility (iKeyman):

It is recommended to read the documentation located in the http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information.

WebSphere Application Server provides a graphical tool, the key management utility (iKeyman), for managing keys and certificates. With the key management utility, you can:
- Create a new key database
- Create a self-signed digital certificate
- Add certificate authority (CA) roots to the key database as a signer certificate
- Request and receive a digital certificate from a CA

To start the key management utility, complete the following steps:
1. Move to the *install_root*`/bin directory`.
2. Issue one of the following commands:
   - On Windows systems, `ikeyman.bat`
   - On UNIX systems, `ikeyman.sh`

A graphical user interface of the key management utility appears.

Manage keys and digital certificates.

Creating a keystore file:

The keystore file is a key database file that contains both public keys and private keys. Public keys are stored as signer certificates while private keys are stored in the personal certificates. The keys are used for a variety of purposes, including authentication and data integrity. You can use both the key management utility (iKeyman) and the keytool utility to create keystore files.

Read the documentation located at http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip for further information.

1. Start the iKeyman utility, if it is not already running.
2. Open a new key database file by clicking **Key Database File > New** from the menu bar.
3. Select the Key Database Type: JKS (default), PKCS12, and JCEKS. This is the *key file format* (or the value of `com.ibm.ssl.keyStoreType` property in the `sas.client.props` file) when you configure the SSL setting for your application.
4. Type in the file name and location. The full path of this key database file is used as the *key file name* (or the value of the `com.ibm.ssl.keyStore` property in the `sas.client.props` file) when you configure the SSL setting for your application.
5. Click **OK** to continue.
6. Then, type in password to restrict access to the file. This password is used as the *key file password* (or the value of `com.ibm.ssl.keyStorePassword` property in the `sas.client.props` file) when you configure the SSL setting for your application. Do not set an expiration date on the password or save the password to a file; you must then reset the password when it expires or protect the password file. This password is used only to release the information stored by the key management utility during run time.
7. Click **OK** to continue. The tool displays all of the available default signer certificates. These certificates are the public keys of the most common certificate authorities (CAs). You can add, view or delete signer certificates from this panel.

A new SSL keystore file is created.

Prepare keystore files for an SSL connection.

Specify the keystore file in the configuration of WebSphere Application Server. Create a truststore if one does not yet exist.

Creating self-signed personal certificates:

A self-signed personal certificate is a temporary digital certificate you issue to yourself, acting as the certificate authority (CA). Creating a self-signed certificate creates a private key and a public key within the key database file. The self-signed certificate is created in a keystore file and it is useful when you develop and test your application. You can also create a self-signed personal certificate from your cryptographic token device.

If you want to create a self-signed certificate for a keystore, you must have already created the keystore file. You can later extract the public key and add the key as a signer certificate to other truststore files.

Read the documentation in the http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information about how to create a self-signed personal certificate within a key database file.

1. Start the key management utility, if it is not already running.
2. Click **New Self-Signed** from the tool bar or click **Create > New Self-Signed Certificate**.
3. Select the **X509** version and the key size that suits your application.
4. Enter the appropriate information for your self-signed certificate:
   Key Label
   Give the certificate a key label, which is used to uniquely identify the certificate within the keystore file. If you have only one certificate in each keystore file, you can assign any value to the label. However, it is good practice to use a unique label related to the server name.
   Common Name
   Enter the common name. This name is the primary, universal identity for the certificate; it should uniquely identify the principal that it represents. In a WebSphere environment, certificates frequently represent server principals, and the common convention is to use common names of the form *host_name* and *server_name*. The common name must be valid in the configured user registry for the secured WebSphere environment.
   Organization
   Enter the name of your organization.
   Optional fields
   Enter the organization unit (a department or division), location (city), state and province (if applicable), zip code (if applicable), and select the two-letter identifier of the country in which the server belongs. For a self-signed certificate, these fields are optional. However, commercial CAs might require them.
   Validity period
   Specify the lifetime of the certificate in days, or accept the default.
5. Click **OK**.

Your key database file now contains a self-signed personal certificate.

Create a self-signed test certificate for testing purposes.

If you need a test certificate signed by a certificate authority, follow the procedure in Creating a certification request.

Requesting certificate authority-signed personal certificates:

In a production environment, use a personal certificate signed by a certificate authority (CA). The principal or the owner of the CA-signed personal certificate is authenticated by a CA when the CA signs the principal certificate. Since the certificate authorities (CAs) keep their private keys secure, the signed certificate is more trustworthy than a self-signed certificate. Certificate authorities are entities that issue valid certificates for other entities. Well-known CAs include VeriSign, Entrust, and GTE CyberTrust. You can request a test certificate or a production certificate from some of the CAs like VeriSign.

The authentication process by a CA can take time. Commercial CAs often require up to a week to complete their authentication process. Even on-site CAs can take

several minutes, if not hours, or even days, to complete their authentication process. Therefore, you must plan for the certificates that you need.

Considering the following points when you plan for the CA-signed certificate:
- On the certificate signing request that you send to the CA, specify the common name for the certificate. The common name is the primary, universal identity for the certificate. It should uniquely identify the principal that it represents. Verify that the common name is valid in the configured user registry for the WebSphere domain.
- Check the formating of the address fields that your CA requires when planning the address for a certificate request.

1. Create and send a certificate signing request (CSR) to the CA.
2. Visit the CA Web site and follow the instructions to request a test or production certificate.

Once the request is accepted, the certificate authority verifies your identity and finally issues a signed certificate to you. The certificate is usually sent through e-mail.

Request a production certificate from a trusted CA for the production WebSphere Application Server environment.

Once you receive the e-mail from the CA, follow the instructions to store your signed certificate as a file. Receive or store the certificate into the keystore file as a personal certificate.

Creating certificate signing requests:

To obtain a certificate from a certificate authority, submit a certificate signing request (CSR) using the key management utility (iKeyman). You can request either production or test certificates from a CA with a CSR. With the key management utility, generating a certificate signing request also generates a private key for the application for which the certificate is requested. The private key remains in the application keystore file, so it stays private. The public key is included in the certificate requested.

Read the file *install_root*/web/docs/ikeyman/ikmuserguide.pdf for further information about how to create a certificate signing request from a key database file.

1. Start the key management utility, if it is not already running.
2. Open the key database file from which you want to generate the request.
3. Type the password and click **OK**.
4. Click **Create > New Certificate Request**. The Create New Key and Certificate Request window displays.
5. Type a **Key Label**, a **Common Name**, and **Organization**; and select a Country. For the remaining fields, accept the default value, type a value, or select new values. The common name must be valid in the configured user registry for the secured WebSphere environment.
6. Type in a name for the file, such as `certreq.arm`.
7. Click **OK** to complete.
8. Optional: On UNIX-based platforms, remove the end of line characters (^M) from the certificate signing request. To remove the end of line characters, type the following command:

```
cat certreq.arm |tr -d "\r" > new_certreq.arm
```

9. Send the certreq.arm file to the certificate authority (CA) following the instructions from the CA Web site for requesting a new certificate.

The Personal Certificate Requests list shows the key label of the new digital certificate request you just created. Send the file to a CA to request a new digital certificate, or cut and paste the request into the request forms of the CA Web site.

You need to request a certificate authority-signed digital certificate for your secure WebSphere domain.

Once you submit the certificate signing request, wait for the CA to accept the request. After the CA has verified your identity, it sends back the signed certificate usually through e-mail. Receive the signed certificate back to the keystore file from which you generated the CSR.

Receiving certificate authority-signed personal certificates:

Once the certificate signing request (CSR) is accepted, a certificate authority (CA) processes the request and verifies your identity. Once approved, the CA sends the signed certificate back through e-mail. Store the signed certificate in a keystore database file. This procedure describes how to receive the CA-signed certificate into a keystore file using the key management utility (iKeyman). You use this utility the same way for both test certificates and production certificates. The primary difference between the two certificate types is the amount of time it takes for the CA to authenticate the principal your certificate represents. Test certificates are authenticated automatically based on some simple edit checks and returned to you within a few hours. Production certificates may take several days or a week to authenticate and return to you. If the CSR request is made for the cryptographic token, the certificate must be received into that token. If the request is made for the secondary key database of the token, the certificate must be received into that database.

Receive the signed certificate from the CA through e-mail. Follow the instructions from the CA to store the certificate into a file. Read the http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information about how to receive a personal certificate into a key database file from the CA.

1. Start IKeyman, if it is not already running.
2. Open the key database file from which you generated the request.
3. Type the password and click **OK**.
4. Select **Personal Certificates** from the pull-down list.
5. Click **Receive**.
6. Click **Data type** and select the data type of the new digital certificate, such as Base64-encoded ASCII data. Select the data type that matches the CA-signed certificate. If the CA sends the certificate as part of an E-mail message, you may first need to cut and paste the certificate into a separate file.
7. Type the certificate file name and location for the new digital certificate, or click **Browse** to locate the CA-signed certificate.
8. Click **OK**.
9. Type a label for the new digital certificate and click **OK**.

The personal certificate list now displays the label you just gave for the new CA-signed certificate.

Needs digital certificate to support SSL for security over the WebSphere domain.

Once the CA-signed certificate is successfully received, you can extract or export the public key of the certificate to a file for distribution to the network.

Extracting public certificates for truststore files:

Use this procedure to extract a public certificate, which includes its public key, from a keystore file. If a target truststore file already contains the signer certificate of the certificate authority (CA) that signed the certificate, you do not need to extract and add the certificate to the target truststore file. However, in general, you need to complete this procedure for a self-signed certificate.

Extracting a certificate from one keystore file and adding it to a truststore file is not the same as exporting the certificate and then importing it. Exporting a certificate copies all the certificate information, including its private key, and is normally only used if you want to copy a personal certificate into another keystore file as a personal certificate.

If a certificate is self-signed, extract the certificate and its public key from the keystore file and add it to the target truststore file.

If a certificate is CA-signed, verify that the CA certificate used to sign the certificate is listed as a signer certificate in the target truststore file. The keystore file must already exist and contain the certificate to be extracted.

Read the
http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information about how to extract a public certificate from a key database file.

1. Start the key management utility (iKeyman), if it is not already running.
2. Open the keystore file from which the public certificate will be extracted.
3. Select **Personal Certificates**.
4. Click **Extract Certificate**.
5. Click **Base64-encoded ASCII data** under Data type.
6. Enter the **Certificate File Name** and **Location**.
7. Click **OK** to export the public certificate into the specified file.

A certificate file that contains the public key of the signed personal certificate is now available for the target truststore file.

Prepare truststore files for distributing the public keys to support the secure WebSphere domain using Secure Sockets Layer (SSL).

Once the keystore and truststore files are ready, make them accessible by specifying them in your client and server configurations.

Creating truststore files:

A truststore file is a key database file that contains the public keys for target servers. The public key is stored as a signer certificate. If the target uses a self-signed certificate, extract the public certificate from the server keystore file. Add the extracted certificate into the truststore file as a signer certificate. For a

commercial certificate authority (CA), the CA root certificate is added. The truststore file can be a more publicly accessible key database file that contains all the trusted certificates.

Read the documentation located at http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip for further information.

1. Start the key management utility (iKeyman), if it is not already running.
2. Open a new key database file by clicking **Key Database File > New** from the menu bar.
3. Click the **Key Database Type**: `JKS(Default)`, `PKCS12`, and `JCEKS`. The key database type is the *trust file format* (or the value of the `com.ibm.ssl.trustStoreType` property in the `sas.client.props` file) when you configure the SSL setting for your application.
4. Type in the file name and location. The full path of this key database file is used as the *trust file name* (or the value of `com.ibm.ssl.trustStore` property in the `sas.client.props`) when you configure the SSL setting for your application.
5. Click **OK** to continue.
6. Type in a password to restrict access to the file. This password is used as the *trust file password* (or the value of the `com.ibm.ssl.trustStorePassword` property in the `sas.client.props` file) when you configure the SSL setting for your application. Do not set an expiration date on the password or save the password to a file. You must reset the password when it expires or protect the password file. This password is used only to release the information stored by the key management utility during run time.
7. Click **OK** to continue. The tool now displays all of the available default signer certificates. These are the public keys of the most common CAs. You can add, view or delete signer certificates from this screen.

A new SSL truststore file is created.

Prepare truststore files for an SSL connection.

Specify the truststore file in the configuration of WebSphere Application Server. Create a keystore file if one does not exist.

Importing signer certificates:

A *signer certificate* is the trusted certificate entry that is usually in a truststore file. You can import a certificate authority (CA) root certificate from the CA, or a public certificate from the self-signed personal certificate of the target into your truststore file, as a signer certificate.

Read the documentation located in http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information.

1. Start the key management utility (iKeyman), if it is not already running.
2. Open the truststore file. The Password Prompt window displays.
3. Type the password and click **OK**.
4. Select **Signer Certificates** from the menu.
5. Click **Add**.
6. Click **Data type** and select a data type, such as Base64-encoded ASCII data. This data type must match the data type of the importing certificate.

7. Type a certificate file name and location for the CA root digital certificate or click **Browse** to select the name and location.
8. Click **OK**.
9. Type a label for the importing certificate.
10. Click **OK**.

The **Signer Certificates** field now displays the label of the signer certificate you just added.

Receive a CA root certificate or the public key from your secure target.

Map certificates to users:

Client-side certificates support access to secured resources from Web or Java clients. A client presents an X.509-compliant digital certificate to perform mutual authentication with a single sockets layer-enabled server. The product security run time attempts to map the certificate to a known user in the associated Lightweight Directory Access Protocol (LDAP) directory. If the certificate successfully maps to a user, then the holder of the certificate is regarded as the user in the registry and is authorized as this user.

After the single sockets layer-enabled server gets the client certificate, the server needs to map the certificate to a user. WebSphere Application Server supports two techniques for mapping certificates to entries in LDAP registries:
- By exact distinguished name
- By matching attributes in the certificate to attributes of LDAP entries

1. Map by exact distinguished name (DN).

   This approach attempts to map the distinguished name (DN) associated with the **Subject** field in the certificate to an entry in the LDAP directory. If the mapping is successful, the user is authenticated and is authorized according to the privileges granted to the identity in the LDAP directory.

   The mapping is case insensitive. For example, the following two DNs match on a case-insensitive comparison:

   ```
   "cn=Smith, ou=NewUnit, o=NewCompany, c=us"
   "cn=smith, ou=newunit, o=NewCompany, c=US"
   ```

   If a match is found, authentication succeeds; if no match is found, authentication fails.
2. Map by filtering certificate attributes.

   This approach maps certificate attributes to attributes of entries in an LDAP directory. For example, you can specify that the common name (CN) attribute of the **Subject** field in the certificate must match the uid attribute of your LDAP entry. If the mapping is successful, the user is authenticated and is authorized according to the privileges granted to the identity in the LDAP directory.

   If you are matching the Subject CN field in the certificate to the uid attribute of the LDAP entry, a certificate with the Subject DN `"cn=Smith, ou=NewUnit, o=NewCompany, c=us"` matches an LDAP user entry with uid=Smith.

   To use this mapping technique, you must request certificate mapping and set up the certificate filter in the administrative console.

This specification extracts the CN field from the Subject attribute in the certificate (`Smith`) and creates a filter (user ID = `Smith`) from it. The LDAP directory is searched for a user entry that matches the filter. If an entry matches the filter, authentication succeeds.

Note: The search and match of the LDAP directory are based in part on how your LDAP directory is configured.

Troubleshooting secure sockets layer interoperability

The Secure Sockets Layer (SSL) protocol provides transport layer security: authenticity, integrity, and confidentiality, for a secure connection between a client and server in the WebSphere Application Server.

The following topics are addressed in this article:

- Secure Sockets Layer Interoperability issues might occur between different releases of WebSphere Application Server
- Interoperability issue might occur between WebSphere Application Server for z/OS and WebSphere Application Server when Secure Sockets Layer is supported, but not required

Secure Sockets Layer Interoperability issues might occur with default key files and trust store files

Symptom

In WebSphere Application Server Version 5.1, the secure sockets later protocol fails when you use the default key files and trust files between version 5.1 and previous releases of the server. For example, when you add a version 5.0.x node to the deployment manager on WebSphere Application Server Network Deployment Version 5.1.x that has security enabled, errors similar to the following might occur:

```
com.ibm.websphere.management.exception.ConnectorException:
ADMC0016E: Cannot create SOAP Connector port 8879
```

or

```
javax.net.ssl.SSLHandShakeException: unknown certificate;
```

Explanation

WebSphere Application Server Version 5.1 creates a dummy certificate with a later expiration date. In previous versions of WebSphere Application Server, the signer of the certificate does not exist in the trust files. Because the signer is missing, certificate errors occur when attempting to establish secure sockets layer (SSL) connections between WebSphere Application Server Version 5.1 and previous releases of the server.

Recommended response

Copy the dummy key files and trust files provided with WebSphere Application Server Version 5.1 into the previous releases for test interoperability. However, do not use these dummy certificates, key stores, or trust stores in a production environment. These dummy certificates are widely used and thus considered insecure for a production environment.

When you apply an interim fix, the installer overwrites these files. An update to the Java keystore (JKS) files for WebSphere Application Server Version 4.x and 5.0.x is available. For version 4.x servers, see APAR

PQ77261. For version 5.0.x servers, see APAR PQ77264. Both of these APARs are available through the WebSphere Application Server support Web site.

Interoperability issue might occur between WebSphere Application Server for z/OS and WebSphere Application Server when Secure Sockets Layer is supported, but not required

Symptom

An interoperability issue exists between WebSphere Application Server for z/OS and WebSphere Application Server when Secure Sockets Layer is supported, but not required.

Explanation

WebSphere Application Server sets an integrity required flag for the Common Secure Interoperability Version 2 (CSIv2) inbound configuration to true, by default, because Secure Sockets Layer (SSL) requires integrity at a minimum. However, WebSphere Application Server for z/OS interprets this flag as an SSL requirement.

Recommended response

In the `security.xml` file for WebSphere Application Server (not WebSphere Application Server for z/OS), change the following line from:

```
<CSI xmi:id="IIOPSecurityProtocol_1066667906706">
    <claims xmi:type="orb.securityprotocol:CommonSecureInterop"
    xmi:id="CommonSecureInterop_1066667906706" stateful="true">
            ...
        <requiredQOP xmi:type="orb.securityprotocol:TransportQOP"
        xmi:id="TransportQOP_1066667906706" establishTrustInClient="false"
        enableProtection="false" confidentiality="false" integrity="true"/>
            ...
    </claims>
```

to

```
<CSI xmi:id="IIOPSecurityProtocol_1066667906706">
    <claims xmi:type="orb.securityprotocol:CommonSecureInterop"
    xmi:id="CommonSecureInterop_1066667906706" stateful="true">
            ...
        <requiredQOP xmi:type="orb.securityprotocol:TransportQOP"
        xmi:id="TransportQOP_1066667906706" establishTrustInClient="false"
        enableProtection="false" confidentiality="false" integrity="false"/>
            ...
    </claims>
```

You also can make the previous change using the WebSphere Application Server administrative scripting commands.

Changes to IBM Developer Kit for Java Technology Edition Version 1.4.x

WebSphere Application Server, Version 5.1 includes the IBM Developer Kit, Java Technology Edition Version 1.4.x, which contains changes to the IBM Developer Kit, Java Technology Edition Version 1.3.x. This document is intended to assist application developers and system administrators in understanding the changes.

Security packaging changes in IBM Developer Kit, Java Technology Edition Version 1.4.x

In IBM Developer Kit, Java Technology Edition Version 1.4.x, many of the security technologies have been included in the core of the IBM Developer Kit, Java Technology Edition Version 1.4.x. Because of the packaging changes, we are supporting specific `java.security` configurations for each platform. This document discusses the impact these `java.security` configuration changes have on each platform.

Security providers for the Windows, Linux, and AIX platforms

The Windows, Linux, and AIX platforms use all of the IBM security provider implementations, which is similar to how IBM Developer Kit, Java Technology Edition Version 1.3.x shipped. Because the security technologies in IBM Developer Kit, Java Technology Edition Version 1.3.x, were not part of the core, these technologies were shipped in the `java/jre/lib/ext` directory and provided more flexibility in implementing the technologies.

The following list shows the providers and sequence of how these providers are supported on the Windows, Linux, and AIX platforms. Add any additional providers at the end of this list of providers.

5.1.1 Only those JSSE providers configured by WebSphere Application Server are supported

```
security.provider.1=com.ibm.crypto.provider.IBMJCE
security.provider.2=com.ibm.jsse.IBMJSSEProvider
security.provider.3=com.ibm.security.jgss.IBMJGSSProvider
security.provider.4=com.ibm.security.cert.IBMCertPath
security.provider.5=com.ibm.crypto.pkcs11.provider.IBMPKCS11
```

Security providers for the Sun Solaris environment

In the Sun Solaris environment, by default, we are using the IBM JSSE framework classes. These classes enable you to plug-in the IBMJSSE and IBMJSSEFIPS providers. The following list shows the default provider lists for the Sun Solaris environment. Add any additional providers to the end of this list. 5.1.1

```
security.provider.1=com.ibm.security.cert.IBMCertPath
security.provider.2=com.ibm.security.jgss.IBMJGSSProvider
security.provider.3=sun.security.provider.Sun
security.provider.4=com.ibm.crypto.provider.IBMJCE
security.provider.5=com.ibm.jsse.IBMJSSEProvider
# security.provider.6=com.ibm.crypto.pkcs11.provider.IBMPKCS11
```

Security providers for the HP-UX platform

On the HP-UX platform, you must use the SunJSSE and the SunJCE providers due to license restrictions. The IBMJSSE and IBMJSSEFIPS providers are not supported on the HP-UX platform because of a lack of flexibility in plugging into the Sun JSSE framework. Any code that specifically uses the IBMJSSE provider within Java Secure Socket Extension (JSSE) getInstance methods does not work on the HP-UX platform. To get the default provider, you can call `getInstance`

methods without explicitly specifying the provider. The following provider list must be used in the `java.security` file on the HP-UX platform. Add additional providers after those listed in the following list.

Attention: Some functions that worked using the IBMJSSE provider might not work using the SunJSSE provider including hardware cryptographic token configurations and certificate alias selection.

5.1.1

```
security.provider.1=com.ibm.security.cert.IBMCertPath
security.provider.2=com.ibm.security.jgss.IBMJGSSProvider
security.provider.3=sun.security.provider.Sun
security.provider.4=com.ibm.crypto.provider.IBMJCE
security.provider.5=com.ibm.jsse.IBMJSSEProvider
# security.provider.6=com.ibm.crypto.pkcs11.provider.IBMPKCS11
```

Changes to the CertPath API package name

In IBM Developer Kit, Java Technology Edition Version 1.3.x, the package for CertPath APIs was javax.security.cert.*. However, in IBM Developer Kit, Java Technology Edition Version 1.4.x, the package has changed to java.security.cert.*. While your applications might still work using javax.security.cert.* due to the oldcertpath.jar packaged in `${WAS_INSTALL_ROOT}/java/jre/lib/ext/oldcertpath.jar` file, change your applications to use the new package name for CertPath from this point forward. In this release, either package name should work, but it is recommended that you use the correct package, which is java.security.cert.*.

Known problems with IBM Developer Kit, Java Technology Edition Version 1.4.x

For a list of known problems with the various platforms related to the IBM Developer Kit, Java Technology Edition Version 1.4.x changes, please review the release notes for WebSphere Application Server, Version 5.1.

Cryptographic token support

A *cryptographic token* is a hardware or software device with a built-in key store implementation. The cryptographic device is used to manage certificates stored on the cryptographic tokens (also known as *smartcards*).

Both cryptographic accelerators, where the cryptographic hardware device has no persistent key storage, and secure cryptographic hardware, where a cryptographic token generates and securely stores the private key used for Secure Sockets Layer (SSL) key exchange, are supported in the product.

The following token types are supported:
- PKCS#7
- PKCS#11
- PKCS#12
- MSCAPI (only on Windows platforms)

Cryptographic token support is limited to tested devices. These devices include support tested for SSL clients:
- IBM Security Kit Smartcard
- GemPlus Smartcards
- Rainbow iKey 1000/2000(USB ″Smartcard″ device)

Cryptographic token support has also been tested for the following SSL clients and servers:
- IBM 4758-23
- nCipher nForce
- Rainbow Cryptoswift
- Eracom CSA8000

WebSphere Application Server uses IBMJSSE to support cryptographic token devices. Refer to the document *install_root*\web\docs\jsse\readme.jsse.ibm.html for further information.

Opening a cryptographic token using the key management utility (iKeyman)

Verify that your cryptographic token device is installed and functions properly. Create a cryptographic token, following the instructions provided by the manual of the cryptographic device.

From your cryptographic token device documentation, identify the token library. For example, the IBM 4758 PCI Cryptographic Card uses CRYPTOKI.DLL as the PKCS#11-type token library (see http://www.ibm.com/security/cryptocards/html/library.shtml for details).

Read the documentation located in the http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for further information about using the key management utility (iKeyman).

You can use the key management utility to open a cryptographic token. Once opened, you can manage your keys and certificates just like you do with keystore and truststore files:
- Create a self-signed digital certificate
- Add certificate authority (CA) roots as a signer certificate
- Request and receive a digital certificate from a CA

1. Start the key management utility, if it is not already running.
2. Click **Key DataBase File > Open**.
3. Click **Cryptographic Token** from the list of key database types.
4. Fill in the information for **File Name** and **Location**, or browse for the cryptographic device library.
5. Click **OK** to open the library.
6. Type in the slot number in the next panel. This is the number of the slot in which you previously created the cryptographic token.
7. Enter the password. This is the password configured for the cryptographic token that you created.

All of the personal and signer certificates are stored on the cryptographic token card. With the token open, you can create or request digital certificates and receive CA-signed certificates.

Using a cryptographic token device as a key database to manage keys and certificates for an SSL connection.

Once the cryptographic token is open, you can add or delete keys and certificates. Configure the cryptographic token settings in WebSphere Application Server.

Configuring to use cryptographic tokens

You can configure cryptographic token support in both client and server configuration. To configure a Java client application, use the `sas.client.props` configuration file. By default, the `sas.client.props` is located in the `properties` directory under the *<install_root>* of your WebSphere Application Server installation. To configure a WebSphere Application Server, use the administrative console. To start the administrative console, specify URL: `http://<server_hostname>:9090/admin`.

To understand how to make WebSphere Application Server (both the run time and the key management utility) work correctly with any cryptographic token device, become familiar with the Java Secure Socket Extension (JSSE) documentation available from the application server product installation `http://www.ibm.com/developerworks/java/jdk/security/jsseDocs.zip` and `http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip`.

Unzip the *install_root*`/web/docs/jsse/native-support.zip` file and copy the correct libraries, with respect to target operating system, to the appropriate location. Otherwise, link errors might occur at run time, or the key management tool might not work properly with the cryptographic device library.

Follow the documentation that accompanies your device to install your cryptographic device. Installation instructions for IBM cryptographic hardware devices can be found in the Administration section of Resources for learning.

Important: To use cryptographic token devices in the Solaris Operating Environment, you must edit the `${WAS_INSTALL_ROOT}/java/jre/lib/security/java.security` file. Uncomment the line containing `com.ibm.crypto.pkcs11.provider.IBMPKCS11`. By default, the line is commented out because the algorithm MD4 is not present in the IBMPKCS11 provider.

1. To configure a client to use a cryptographic token, edit the `sas.client.props` file and set the following properties. Leave the **KeyStore File Name**, **KeyStore File Password**, **TrustStore File Name**, **TrustStore File Password** fields in a Secure Sockets Layer (SSL) configuration blank, if you want to use only cryptographic tokens as your keystore.

   com.ibm.ssl.tokenType
   Specifies the type of built-in keystore file that is implemented in the cryptographic token. (For example, `com.ibm.ssl.tokenType=PKCS\#11`). The valid values are: **PKCS\#7**, **PKCS\#11**, **PKCS\#12**, and **MSCAPI**.

   com.ibm.ssl.tokenLibraryFile
   Specifies the token file name for **PKCS#7** tokens, **PKCS#12** tokens, and the library name for **PKCS#11**, MSCAPI tokens. Make sure the cryptographic token device is installed and functions properly with a cryptographic token created. Unzip the `native-support.zip` file from *install_root*`/web/docs/jsse` directory to copy the required libraries with respect to the target operating system.

   com.ibm.ssl.tokenPassword
   Specifies the password to unlock the cryptographic token.

2. Configure your server to use the cryptographic device. Leave the **KeyStore File Name**, **KeyStore File Password**, **TrustStore File Name**, **TrustStore File Password** fields in an SSL configuration blank, if you want to use only cryptographic tokens as your keystore. You can modify an existing configuration if you click **Security > SSL >** *alias*. You must specify an alias and

select the **Cryptographic token** option. If you are using the default cryptographic device, unzip the `native-support.zip` file from *`install_root`*`/web/docs/jsse` directory to copy the required libraries with respect to the target operating system. The following directions explain how to configure WebSphere Application Server for a new cryptographic device.

a. Specify `http://`*`server_hostname`*`:9090/admin` to start the administrative console.
b. Click **Security > SSL** to open the SSL Configuration Repertoires panel.
c. Click **New** to create a new SSL setting alias if you do not want to use the default.
d. Specify an alias name in the **alias** field for the new cryptographic device After you configure the cryptographic device, this alias appears on the **Security > SSL** panel and in the **Authentication protocol > SAS outbound transport** list.
e. Select **Cryptographic token** and click **OK**. The **SAS outbound transport** panel opens.
f. Complete the information for **Token Type** to specify the type of built-in keystore file that is implemented in the cryptographic token. The valid values are: **PKCS#7**, **PKCS#11**, **PKCS#12**,or **MSCAPI**.
g. Complete the information for **Library File** to specify the path to the cryptographic device driver. Make sure the cryptographic token device is installed and functions properly with a new cryptographic token.
h. Complete the information for **Password** to specify the password for unlocking the cryptographic device.
i. Click **Apply** and **OK**. WebSphere Application Server displays the **Authentication protocol > SAS outbound transport** list.
j. Select the appropriate cryptographic device from the SSLSettings menu.

The configuration is enabled to support the specified cryptographic token for and SSL connection.

WebSphere Application Server uses the cryptographic token as a keystore file for and SSL connection.

If the server configuration has changed, restart the configured server.

To use cryptographic token devices in the Solaris Operating Environment, you must edit the `${WAS_INSTALL_ROOT}/java/jre/lib/security/java.security` file. Uncomment the line containing `com.ibm.crypto.pkcs11.provider.IBMPKCS11`. By default, the line is commented out because the algorithm MD4 is not present in the IBMPKCS11 provider.

Cryptographic token settings

Use this page to configure cryptographic token settings.

To view this administrative console page, click **Security > SSL >** *alias_name* **> Cryptographic Token**.

Token Type:

Specifies the type of built-in keystore file that is implemented in the cryptographic token, such as PKCS#11.

The WebSphere Application Server uses an implementation of Java Secure Socket Extension (JSSE) to support cryptographic token with Secure Sockets Layer (SSL). Different cryptographic devices are supported. For an SSL server, the following devices are supported:
- IBM 4758-23
- nCipher nForce
- Rainbow Cryptoswift
- Eracom CSA8000

For an SSL client, the following devices are supported:
- IBM 4758-23
- nCipher nForce
- Rainbow Cryptoswift
- IBM Security Kit Smartcard
- GemPlus Smartcards
- Rainbow iKey 1000/2000 (USB ″Smartcard″ device)
- Eracom CSA8000

Follow the documentation that accompanies your device to install your cryptographic token.

Data type: String

Library File:

Specifies the dynamic link library (DLL) or shared object that implements the interface to the cryptographic token device.

Data type: String

Password:

Specifies the password for the cryptographic token device.

Data type: String

Using Java Secure Socket Extension and Java Cryptography Extension with Servlets and enterprise bean files

Java Secure Socket Extension

Java Secure Socket Extension (JSSE) provides the transport security for WebSphere Application Server. It provides application programming interface (API) framework and the implementation of the APIs, for Secure Sockets Layer (SSL) and Transport Layer Security (TLS) protocols, including functionality for data encryption, message integrity and authentication. With the JSSE APIs, other SSL or TLS protocols, and Public Key Infrastructure (PKI), implementations can plug in.

IBM Java Secure Socket Extension

The WebSphere Application Server uses the IBMJSSE provider, which is pre-installed and pre-registered with the Java Cryptography Architecture (JCA) of the Java 2 platform. IBMJSSE supports the following cryptographic services:
- Rivest Shamir Adleman (RSA) public key cryptography support
- SSL and TLS security protocols and common cipher suites

- X.509-based key and trust managers
- PKCS12 as JCA keystore type

The IBMJSSE provider is pre-registered in the `java.security` properties file located at *install_root*`/java/jre/lib/security` directory. It also supports cryptographic token types PKCS#7, PKCS#11, PKCS#12 and MSCAPI (only on Windows platforms) for cryptographic token support.

Note: The IBM Java Secure Socket Extension (JSSE) is currently not supported within applets.

Customizing Java Secure Socket Extension

Note: Make sure you understand the implication to your application before you begin customizing.

You can customize a number of aspects of JSSE by plugging in different implementations of Cryptography Package Provider, X509Certificate and HTTPS protocols, or specifying different default keystore files, key manager factories and trust manager factories. A provided table summarizes which aspects can be customized, what the defaults are, and which mechanisms are used to provide customization. Some of the key customizable aspects follow:

Customizable item	Default	How to customize
X509Certificate	X509Certificate implementation from IBM	cert.provider.x509v1 security property
HTTPS protocol	Implementation from IBM	java.protocol.handler.pkgs system property
Cryptography Package Provider	IBMJSSE	A security.provider.n= line in security properties file. See description.
Default keystore	None	* javax.net.ssl.keyStore system property
Default truststore	jssecacerts, if it exists. Otherwise, cacerts	* javax.net.ssl.trustStore system property
Default key manager factory	`IbmX509`	ssl.KeyManagerFactory.algorithm security property
Default trust manager factory	`IbmX509`	ssl.TrustManagerFactory.algorithm security property

For aspects that you can customize by setting a system property, statically set the system property by using the `-D` option of the Java command (you can set the system property using the administrative console), or set the system property dynamically by calling the `java.lang.System.setProperty` method in your code: `System.setProperty(propertyName,"propertyValue")`.

For aspects that you can customize by setting a Java security property, statically specify a security property value in the `java.security` properties file located in the *install_root*`/java/jre/lib/security` directory. The security property is `propertyName=propertyValue`. Dynamically set the Java security property by calling the `java.security.Security.setProperty` method in your code.

Application Programming Interface

The JSSE provides a standard application programming interface (API) available in packages of the `javax.net` file, `javax.net.ssl` file, and the `javax.security.cert` file. The APIs cover:

- Sockets and SSL sockets
- Factories to create the sockets and SSL sockets
- Secure socket context that acts as a factory for secure socket factories
- Key and trust manager interfaces
- Secure HTTP UTL connection classes
- Public key certificate API

5.1.1 There is more information documented for the JSSE APIs in the `http://www.ibm.com/developerworks/java/jdk/security/jsseDocs.zip` file.

Samples using Java Secure Socket Extension

5.1.1 The Java Secure Socket Extension (JSSE) also provides samples to demonstrate its functionality. Download and unzip the samples included in the `http://www.ibm.com/developerworks/java/jdk/security/jsseDocs.zip` file. Look in `jsseDocs/samples/` directory for the following files:

Files	Description
`ClientJsse.java`	Demonstrates a simple client and server interaction using JSSE. All enabled cipher suites are used.
`ClientJsseProvider.java`	Demonstrates a simple client and server interaction using JSSE. All enabled cipher suites are used.

`ServerJsse.java`
`ServerJsseProvider.java`
`OldClientJsse.java`
	Demonstrates a simple client and server interaction using JSSE. All enabled cipher suites are used.

`OldServerJsse.java`	Back-level samples
`ServerPKCS12Jsse.java`	Demonstrates a simple client and server interaction using JSSE with the PKCS12 keystore file. All enabled cipher suites are used.
`ClientPKCS12Jsse.java`	Demonstrates a simple client and server interaction using JSSE with the PKCS12 keystore file. All enabled cipher suites are used.
`OldClientPKCS12Jsse.java`	Back-level samples
`OldServerPKCS12Jsse.java`	Back-level samples
`UseHttps.java`	Demonstrates accessing an SSL or non-SSL Web server using the Java protocol handler of the`com.ibm.net.ssl.www.protocol` class. The URL is specified with the `http` or `https` prefix. The HTML returned from this site displays.

Files	Description
`HTTPTest.java`	Demonstrates accessing an SSL or non-SSL Web server using the Java protocol handler of the `com.ibm.net.ssl.www.protocol` class. The URL is specified with the `http` or `https` prefix. The HTML returned from this site is displayed.
`HTTPSPanel.java` `OldHTTPTest.java`	Back-level sample

See more instructions in the source code. Follow these instructions before you run the samples.

Permissions for Java 2 security

You might need the following permissions to run an application with JSSE: (This is a reference list only.)
- java.util.PropertyPermission ″java.protocol.handler.pkgs″, ″write″
- java.lang.RuntimePermission ″writeFileDescriptor″
- java.lang.RuntimePermission ″readFileDescriptor″
- java.lang.RuntimePermission ″accessClassInPackage.sun.security.x509″
- java.io.FilePermission ″${user.install.root}${/}etc${/}.keystore″, ″read″
- java.io.FilePermission ″${user.install.root}${/}etc${/}.truststore″, ″read″

For the IBMJSSE provider:
- java.security.SecurityPermission ″putProviderProperty.IBMJSSE″
- java.security.SecurityPermission ″insertProvider.IBMJSSE″

For the SUNJSSE provider:
- java.security.SecurityPermission ″putProviderProperty.SunJSSE″
- java.security.SecurityPermission ″insertProvider.SunJSSE″

Debugging

By configuring through the `javax.net.debug` system property, JSSE provides the following dynamic debug tracing: `-Djavax.net.debug=true`.

A value of **true** turns on the trace facility, provided that the debug version of JSSE is installed. Use the administrative console to set the system property for debugging the application server.

Documentation

See the “Security: Resources for learning” on page 495 article for documentation references to JSSE.

JCE

Java Cryptography Extension (JCE) provides cryptographic, key and hash algorithms for WebSphere Application Server. It provides a framework and implementations for encryption, key generation, key agreement, and Message Authentication Code (MAC) algorithms. Support for encryption includes symmetric, asymmetric, block and stream ciphers.

IBMJCE

The IBM Java Cryptography Extension (IBMJCE) is an implementation of the JCE cryptographic service provider used in WebSphere Application Server. The IBMJCE is similar to SunJCE, except that the IBMJCE offers more algorithms:
- Cipher algorithm (AES, DES, TripleDES, PBEs, Blowfish, and so on)
- Signature algorithm (SHA1withRSA, MD5withRSA, SHA1withDSA)
- Message digest algorithm (MD5, MD2, SHA1, SHA-256, SHA-384, SHA-512)
- Message authentication code (HmacSHA1, HmacMD5)
- Key agreement algorithm (DiffieHellman)
- Random number generation algorithm (IBMSecureRandom, SHA1PRNG)
- Key store (JKS, JCEKS, PKCS12)

The IBMJCE belongs to the com.ibm.crypto.provider.* packages.

5.1.1 For further information, see the `http://www-106.ibm.com/developerworks/java/jdk/security/jceDocs.zip` file.

Application Programming Interface

Java Cryptography Extension (JCE) has a provider-based architecture. Providers can be plugged into the JCE framework by implementing the APIs defined by the JCE. The JCE APIs covers:
- Symmetric bulk encryption, such as DES, RC2, and IDEA
- Symmetric stream encryption, such as RC4
- Asymmetric encryption, such as RSA
- Password-based encryption (PBE)
- Key Agreement
- Message Authentication Codes

5.1.1 For more information about Java Cryptography Extension technology including the JavaDoc for JCE APIs, see the `http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip` file.

Samples using Java Cryptography Extension

5.1.1 There are samples located in `http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip` file. Unzip the file and locate the following samples in the`jceDocs/samples` directory:

File	Description
`SampleDSASignature.java`	Demonstrates how to generate a pair of DSA keys (a public key and a private key) and use the key to digitally sign a message using the SHA1with DSA algorithm
`SampleMarsCrypto.java`	Demonstrates how to generate a Mars secret key, and how to do Mars encryption and decryption
`SampleMessageDigests.java`	Demonstrates how to use the message digest for MD2 and MD5 algorithms
`SampleRSACrypto.java`	Demonstrates how to generate an RSA key pair, and how to do RSA encryption and decryption

File	Description
SampleRSASignatures.java	Demonstrates how to generate a pair of RSA keys (a public key and a private key) and use the key to digitally sign a message using the SHA1withRSA algorithm
SampleX509Verification.java	Demonstrates how to verify X509 Certificates

Documentation

Refer to the "Security: Resources for learning" on page 495 for documentation on JCE.

Java 2 security

Java 2 security provides a policy-based, fine-grain access control mechanism that increases overall system integrity by checking for permissions before allowing access to certain protected system resources. Java 2 security guards access to system resources such as file I/O, sockets, and properties. J2EE security guards access to Web resources such as servlets, JavaServer pages (JSPs) and EJB methods. WebSphere global security includes J2EE role-based authorization, the Common Secure Interoperability Version 2 (CSIv2) authentication protocol, and Secure Sockets Layer (SSL) configuration. Java 2 security is enabled by default. When the security manager detects unauthorized attempts to access system resources, `java.security.AccessControlException` Java 2 security exceptions are thrown and logged in the `SystemOut.log` file.

Since Java 2 security is relatively new, many existing or even new applications might not be prepared for the very fine-grain access control programming model that Java 2 security is capable of enforcing. Administrators should understand the possible consequences of enabling Java 2 security if applications are not prepared for Java 2 security. Java 2 security places some new requirements on application developers and administrators.

Java 2 security for deployers and administrators

Although Java 2 security is supported in WebSphere Application Server Version 5, it is disabled by default. However, it is enabled automatically if you also enable global security when configuring security. Although it becomes enabled automatically when you enable WebSphere global security, you can choose to disable it. You can configure Java 2 security and global security independently of one another. Disabling global security does not disable Java 2 security automatically. You need to explicitly disable it.

If your applications, or third-party libraries are not ready, having Java 2 security enabled causes problems. You can identify these problems as Java 2 security AccessControlExceptions in the `SystemOut.log` file, `SystemError.log` file, or the trace log files. If you are unsure about the Java 2 security readiness of your applications, disable Java 2 security initially to get your application installed and verify that it is working properly.

There are implications if Java 2 Security is enabled; deployers or administrators are required to make sure that all the applications are granted the required permissions, otherwise, applications might fail to run. By default, applications are

granted the permissions recommended in the J2EE 1.3 Specification. For details of default permissions granted to applications in the product, refer to the following policy files:

- *install_root*/java/jre/lib/security/java.policy
- *install_root*/properties/server.policy
- *install_root*/config/cells/<*cell name*>/nodes/<*node_name*>/app.policy

Note: This policy embodied by these policy files cannot be made more restrictive because the product might not have the necessary Java 2 security doPrivileged APIs in place. The restrictive policy is the default policy. You can grant additional permissions, but you cannot make the default more restrictive because AccessControlExceptions is generated from within WebSphere Application Server. The product does not support a more restrictive policy than the default defined in the policy files previously mentioned.

There are several policy files used to define the security policy for the Java process. These policy files are static (code base is defined in the policy file) and they are in the default policy format provided by the IBM Developer Kit, Java Technology Edition. For enterprise application resources and utility libraries, WebSphere Application Server provides dynamic policy support. The code base is dynamically calculated based on deployment information and permissions are granted based on template policy files during run time. Refer to the section of Java 2 security policy management.

Note: Syntax errors in the policy files cause the application server process to fail. Edit these policy files carefully using the Policy Tool provided by the IBM Developer Kit, Java Technology Edition for editing the policy files (*install_root*/java/jre/bin/policytool).

If an application is not prepared for Java 2 security, if the application provider does not provide a was.policy file as part of the application, or if the application provider does not communicate the expected permissions the application is likely to cause Java 2 security access control exceptions at run time. It might not be obvious that an application is not prepared for Java 2 security. Several run-time debugging aids help troubleshoot applications that might have access control exceptions. See the Java 2 security debugging aids for more details. See Handling applications that are not Java 2 security ready for information and strategies for dealing with such applications.

It is important to note that when Java 2 Security is enabled in the Global Security settings, the installed SecurityManager does not currently check modifyThread and modifyThreadGroup permissions for non-system threads.Allowing Web and EJB application code to create or modify a thread can have a negative impact on other components of the container and can affect the capability of the container to manage enterprise bean life cycles and transactions.

Java 2 security for application developers

Application developers must understand the permissions granted in the default WebSphere policy and the permission requirements of the SDK APIs that their application calls to know whether additional permissions are required. The "Permissions in the Java 2 SDK" reference in the resources section describes which APIs require which permission.

Application providers can assume that applications have the permissions granted in the default policy previously mentioned. Applications that access resources not covered by the default WebSphere policy are required to grant the additional Java 2 security permissions to the application.

While it is possible to grant the application additional permissions in one of the other dynamic WebSphere policy files or in one of the more traditional static policy files, such as `java.policy`, the `was.policy` (which is embedded in the EAR file) ensures the additional permissions are scoped to the exact application that requires them. Scoping the permission beyond the application code that requires it can permit code that normally does not have permission to access particular resources.

If an application component is being developed, like a library that might actually be included in more than one `.ear` file, then the library developer should document the required Java 2 permissions needed by the application assembler. There is no `was.policy` file for library type components. The developer must communicate the required permissions through Javadoc or some other external documentation.

If the component library is shared by multiple enterprise applications, the permissions can be granted to all enterprise applications on the node in the `app.policy` file.

If the permission is only used internally by the component library and the application should never be granted access to resources protected by the permission, then it might be necessary to mark the code as **privileged** (inserting doPrivileged). Refer to the article, AccessControlException, for more details. However, improperly inserting a doPrivileged might open up security holes. Understand the implication of doPrivileged to make a correct judgement whether a doPrivileged should be inserted or not.

The section on Dynamic Policy describes how the permissions in the `was.policy` files are granted at run time.

Developing an application with Java 2 security in mind might be a new skill and impose a security awareness not previously required of application developers. Describing the Java 2 security model and the implications on application development is beyond the scope of this section. The following URL can help you get started: `http://java.sun.com/j2se/1.3/docs/guide/security/index.html`.

Debugging Aids

There are two primary aids, the WebSphere `SystemOut.log` file and the com.ibm.websphere.java2secman.norethrow property.

The WebSphere SystemOut.log File

The AccessControl exception logged in the `SystemOut.log` file contains the permission violation that causes the exception, the exception call stack, and the permissions granted to each stack frame. This information is usually enough to determine the missing permission and the code requiring the permission.

The com.ibm.websphere.java2secman.norethrow Property

When Java 2 security is enabled in WebSphere Application Server, the security manager component throws a java.security.AccessControl exception when a

permission violation occurs. This exception, if not handled, often causes a run-time failure. This exception is also logged in the `SystemOut.log` file.

However, when the JVM com.ibm.websphere.java2secman.norethrow property is set and has a value of **true**, the security manager does not throw the AccessControl exception. This information is logged.

To set the `com.ibm.websphere.java2secman.norethrow` property for the server, go to the WebSphere Application Server administrative console and click **Servers > Application Servers**. Under Additional Properties, click **Process Definition > Java Virtual Machine > Custom Properties > New**. In the Name field, type **com.ibm.websphere.java2secman.norethrow**. In the Value field, type **true**.

To set the `com.ibm.websphere.java2secman.norethrow` property for the node agent, go to the WebSphere Application Server administrative console and click **System Administration > Node Agents**. Under Additional Properties, click **Process Definition > Java Virtual Machine > Custom Properties > New**. In the Name field, type **com.ibm.websphere.java2secman.norethrow**. In the Value field, type **true**.

Note: This property is intended for a sandbox or debug environment because it instructs the security manager not to throw the AccessControl exception. Java 2 security is not enforced. This property should not be used in a production environment where a relaxed Java 2 security environment weakens the integrity that Java 2 security is intended to produce.

This property is valuable in a sandbox or test environment where the application can be thoroughly tested and the where the `SystemOut.log` file can be inspected for AccessControl exceptions. Since this property does not throw the AccessControl exception , it does not propagate the call stack and does not cause a failure. Without this property, you have to find and fix AccessControl exceptions one at a time.

Handling applications that are not Java 2 security ready

If the increased system integrity that Java 2 security provides is important, then contact the application provider to have the application support Java 2 security or at least communicate the required additional permissions beyond the default WebSphere policy that must be granted.

The easiest way to deal with such applications is to disable Java 2 security in WebSphere Application Server. The downside is that this solution applies to the entire system and the integrity of the system is not as strong as it might be. Disabling Java 2 security might not be acceptable depending on the organization security policies or risk tolerances.

Another approach is to leave Java 2 security enabled, but to grant either just enough additional permissions or grant all permissions to just the problematic application. Granting permissions however, might not be a trivial thing to do. If the application provider has not communicated the required permissions in some way, there is no easy way to determine what the required permissions are and granting all permissions might be the only choice. You minimize this risk by locating this application on a different node, which might help isolate it from certain resources. Grant the java.security.AllPermission permission in the `was.policy` file embedded in the application's .ear file, for example:

```
grant codeBase "file:${application}" {
            permission java.security.AllPermission;
        };
```

install_root/**properties/server.policy**

This policy defines the policy for the WebSphere classes. At present, all the server processes on the same installation share the same `server.policy` file. However, you can configure this file so that each server process can have a separate `server.policy` file. Define the desired policy file as the value of the Java system properties `java.security.policy`. For details of how to define Java system properties, Refer to the Process definition section of the Manage application servers file.

The `server.policy` file is not a configuration file managed by the repository and the file replication service. Changes to this file are local and do not get replicated to other machines. Use the `server.policy` file to define Java 2 security policy for server resources. Use the `app.policy` file (per node) or `was.policy` file (per enterprise application) to define Java 2 security policy for enterprise application resources.

WAS_HOME/**java/jre/lib/security/java.policy**

The file represents the default permissions granted to all classes. The policy of this file applies to all the processes launched by the WebSphere Application Server JVM.

Troubleshooting

Symptom:

`Error message SECJ0314E`: Current Java 2 security policy reported a potential violation of Java 2 security permission. Refer to Problem Determination Guide for further information.{0}Permission\:{1}Code\:{2}{3}Stack Trace\:{4}Code Base Location\:{5} Current Java 2 security policy reported a potential violation of Java 2 Security Permission. Refer to Problem Determination Guide for further information.{0}Permission\:{1}Code\:{2}{3}Stack Trace\:{4}Code Base Location\:{5}

Problem:

The Java security manager checkPermission() reported a SecurityException on the subject permission with debugging information. The reported information can be different with respect to the system configuration. This report is enabled by either configuring RAS trace into debug mode or specifying a Java property. See Enabling trace for information on how to configure RAS trace in debug mode. Specify the following property in the JVM Settings panel from the administrative console: **java.security.debug**. Valid values include:

access Print all debug information including: required permission, code, stack, and code base location.

stack Print debug information including: required permission, code, and stack.

failure
Print debug information including: required permission and code.

Recommended response:

The reported exception might be critical to the secure system. Turn on security trace to determine the potential code that might have violated the security policy. Once the violating code is determined, verify if the attempted operation is permitted with respect to Java 2 security, by examining all applicable Java 2 security policy files and the application code.

Note: If the application is running with Java Mail, this message might be benign. User can update the `was.policy` file to grant the following permissions to the application.

```
permission java.io.FilePermission "${user.home}${/}.mailcap", "read";
permission java.io.FilePermission "${user.home}${/}.mime.types", "read";
permission java.io.FilePermission "${java.home}${/}lib${/}mailcap", "read";
permission java.io.FilePermission "${java.home}${/}lib${/}mime.types", "read";
```

Messages

Message:	`SECJ0313E`: Java 2 security manager debug message flags are initialized\: TrDebug: {0}, Access: {1}, Stack: {2}, Failure: {3}
Problem:	Configured values of the valid debug message flags for security manager.
Recommended response:	None.

Message:	`SECJ0307E`: Unexpected exception is caught when trying to determine the code base location. Exception: {0}
Problem:	An unexpected exception is caught when the code base location is determined.
Recommended response:	Contact an IBM representative.

AccessControlException

The Java 2 security behavior is specified by its *security policy*. The security policy is an access-control matrix that specifies which system resources certain code bases can access and who must sign them. The Java 2 Security policy is declarative and it is enforced by the java.security.AccessController.checkPermission() method.

The following example depicts the algorithm for the *java.security.AccessController.checkPermission()* method. For the complete algorithm, refer to the Java 2 security check permission algorithm in Resources for learning.

```
i = m;
while (i > 0) {
 if (caller i's domain does not have the permission)
  throw AccessControlException;
 else if (caller i is marked as privileged)
  return;
 i = i - 1;
};
```

The algorithm requires that all the classes or callers on the call stack have the permissions when a java.security.AccessController.checkPermission() is performed or the request is denied (a java.security.AccessControlException is thrown). However, if the caller is marked as *privileged* and the class (caller) is granted the

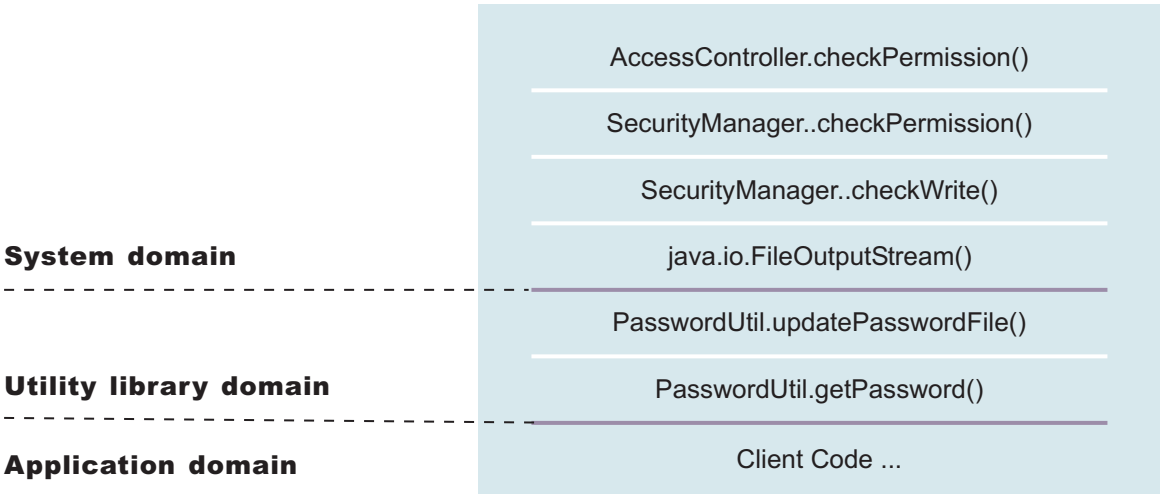
said permissions, the algorithm returns and does not walk the entire call stack. Subsequent classes (callers) do not need the required permission granted.

A java.security.AccessControlException exception is thrown as a result of certain classes on the call stack missing the required permissions during a java.security.AccessController.checkPermission() method. Two possible resolutions to the java.security.AccessControlException exception:

- If the application is calling a Java 2 security-protected API, then grant the required permission to the application Java 2 Security policy. If the application is not calling a Java 2 security-protected API directly and the required permission is because of the side-effect of the third-party APIs accessing Java 2 security-protected resources.
- If the application is granted the required permission, it gains more access than it should. In this case, it is likely that the third party code that accesses the Java 2 Security protected resource is not properly mark as *privileged*.

Example call stack

This example of a call stack indicates where application code is using a third-party API utility library to update the password. The following is only an example to illustrate the point. The decision as to where to mark the code as *privileged* is application-specific and is unique in every situation. This decision requires great depth of domain knowledge and security expertise to make the correct judgement. There are a number of well written publications and books on this topic. Referencing these materials for more detailed information is recommended.



You can use the `PasswordUtil` utility to change the password of a user. The types in the old password and the new password twice to ensure that the correct password is entered. If the old password matches the one stored in the password file, the new password is stored and the password file updates. Assume that none of the stack frame is marked as *privileged*. According to the `java.security.AccessController.checkPermission()` algorithm, the application fails unless all the classes on the call stack are granted *write* permission to the password file. The client application should not have permission to write to the password file directly and update the password file at will.

However, if the `PasswordUtil.updatePasswordFile()` method marks the code that accesses the password file as *privileged*, then the check permission algorithm does not check for the required permission from classes that call the

PasswordUtil.updatePasswordFile() method for the required permission as long as the PasswordUtil class is granted the permission. Then the client application can successfully update a password without granting the permission to write to the password file.

The ability to mark code *privileged* is very flexible and powerful. If this ability is used incorrectly, the overall security of the system can be compromised and security holes can be exposed. Use the ability to mark code privileged carefully.

Resolution to java.security.AccessControlException

As described previously, there are two possibilities to resolve a java.security.AccessControlException exception. Judge these exceptions individually to decide which of the following resolutions is best:
1. Grant the missing permission to the application.
2. Mark some code as *privileged* (considering the concerns and risks).

Configuring Java 2 security

Java 2 security is a new feature in WebSphere Application Server Version 5. It is a new programming model that is very pervasive and has a huge impact on application development. It is disabled by default, but is enabled automatically when global security is enabled. However, Java 2 security is orthogonal to J2EE role-based security; you can disable or enable it independently of Global Security.

However, it does provide an extra level of access control protection on top of the J2EE role-based authorization. It particularly addresses the protection of system resources and APIs. Administrators should need to consider the benefits against the risks of disabling Java 2 Security.

The following recommendations are provided to help enable Java 2 security in a test or production environment:
1. Make sure the application is developed with the Java 2 security programming model in mind. Developers have to know whether or not the APIs used in the applications are protected by Java 2 security. It is very important that the required permissions for the APIs used are declared in the policy file (*was.policy*), or the application fails to run when Java 2 security is enabled. Developers can reference the Web site for Development Kit APIs that are protected by Java 2 security. See the Programming model and decisions section of the "Security: Resources for learning" on page 495 article to visit this Web site.
2. Make sure that migrated applications from previous releases are given the required permissions. Since Java 2 security is not supported or partially supported in previous WebSphere Application Server releases, applications developed prior to Version 5 most likely are not using the Java 2 security programming model. There is no easy way to find out all the required permissions for the application. Following are activities you can perform to determine the extra permissions required by an application:
   - Code review and code inspection
   - Application documentation review
   - Sandbox testing of migrated enterprise applications with Java 2 security enabled in a pre-production environment. Enable tracing in WebSphere Java 2 security manager to help determine the missing permissions in the application policy file. The trace specification is com.ibm.ws.security.core.SecurityManager=all=enabled.

- Use the com.ibm.websphere.java2secman.norethrow system property to aid debuggging. This property should not be used in a production environment. Refer to "Java 2 security" on page 441.

Note: The default permission set for applications is the recommended permission set defined in the J2EE 1.3 Specification. The default is declared in the config/cells/<*cell_name*>/nodes/<*node_name*>/app.policy policy file with permissions defined in the Development Kit (${JAVA_HOME}/lib/security/java.policy) policy file that grant permissions to everyone. However, applications are denied permissions declared in the config/cells/*cell_name*/filter.policy filter policy file. Permissions declared in the *filter.policy* file are filtered for applications during the permission check.

Note: Define the required permissions for an application in a was.policy file and embed the was.policy file in the application enterprise archive (EAR) file as *YOURAPP.ear/META-INF/was.policy* (see "Configuring Java 2 security policy files" on page 457 for details).

1. Click **Security** in the navigation tree, then click **Global Security**. The **Global Security** page appears.
2. Enable Java 2 security by selecting the check box labeled **Enforce Java 2 Security** (clear the check box for disabling Java 2 Security).
3. Click **OK** or **Apply** on the **Global Security** page.
4. Click **Save** to save the changes.
5. Restart the server for the changes to take effect.

Java 2 security is enabled and enforced for the servers. Java 2 security permission is selected when a Java 2 security protected API is called.

When to use Java 2 security.

1. To enable protection on system resources. For example, when opening or listening to a socket connection, reading or writing to operating system file systems, reading or writing Java Virtual Machine system properties, and so on.
2. To prevent application code calling destructive APIs. For example, calling the *System.exit()* method brings down the application server.
3. To prevent application code from obtaining privileged information (passwords) or gaining extra privileges (obtaining server credentials).

The WebSphere Java 2 security manager is enhanced to dump the Java 2 security permissions granted to all classes on the call stack when an application is denied access to a resource (the java.security.AccessControlException exception is thrown). However, this tracing capability is disabled by default. You can enable it by specifying the server trace service with the com.ibm.ws.security.core.SecurityManager=all=enabled trace specification. When the exception is thrown, the trace dump provides hints to determine whether the application is missing permissions or the product run time code or third party libraries used are not properly marked as *privileged* when accessing Java 2 protected resources. See the Security Problem Determination Guide for details.

Enable or disable Java 2 Security for the cell

1. Click **Security > Global Security** in the navigation tree. The Global Security page appears.

2. Enable Java 2 Security by selecting the check box labeled **Enforce Java 2 Security** (clear the check box to disable Java 2 Security). This enables Java 2 Security for the cell.
3. Click **OK** or **Apply** on the Global Security page.
4. Save the changes and make sure a file sync is performed before restarting the servers.
5. For the changes to take effect, restart all the servers, which include the Network Deployment Manager, all Node Agents, and all application servers.

Enable or disable Java 2 Security for an application server

1. Click **Server > Application Servers** in the navigation tree. The Application Servers page appears.
2. Click the **application server name** in the **Name** column of the Application Server collection table. The configuration panel of the application server selected appears.
3. Click **Server Security** in the Additional Properties section. The Server Security panel of the application server appears.
4. Click **Server Level Security** in the Additional Properties section. The Server Level Security panel of the application server appears.
5. Enable Java 2 Security by selecting the option labeled **Enforce Java 2 Security** (clear the check box to disable Java 2 Security). This enables Java 2 Security for the selected application server.
6. Click **OK** or **Apply** on the Server Level Security page.
7. Save the changes and make sure a file sync is performed before restarting the application server.
8. Restart the application server for the changes to take effect.

Java 2 Security is enabled and enforced for the servers. Java 2 Security permission is checked when a Java 2 Security protected API is called.

When to use Java 2 Security

1. To enable protection on system resources. For example, when opening or listening to a socket connection, reading or writing to operating system file systems, reading or writing Java Virtual Machine system properties, and so on.
2. To prevent application code calling destructive APIs. For example, calling *System.exit()* brings down the application server.
3. To prevent application code obtaining privileged information (passwords) or gaining extra privileges (obtaining Server Credentials).

The WebSphere Java 2 Security Manager is enhanced to dump the Java 2 Security permissions granted to all classes on the call stack when an application is denied access to a resource (the `java.security.AccessControlException` exception is thrown). The trace information is dumped to the configured server log files. Check the server log files to access debugging information when an AccessControlException is thrown. In addition, the product Java 2 Security Manager trace can be enabled with the trace string, `com.ibm.ws.security.core.SecurityManager=all=enabled`. When the exception is thrown, the trace dump provides hints to determine whether the application is missing permissions or the product run time code or third party libraries used are not properly marked as *privileged* when accessing Java 2 protected resources. See the Security Problem Determination Guide for details.

Using PolicyTool to edit policy files

Java 2 security uses several policy files to determine the granted permission for each Java program. See Dynamic policy for the list of available policy files. The Java Development Kit provides *policytool* to edit these policy files. This tool is recommended for editing any policy file to verify the syntax of its contents. Syntax errors in the policy file cause an *AccessControlException* during application execution, including the server start. Identifying the cause of this exception is not easy because the user might not be familiar with the resource that has an access violation. Be careful when you edit these policy files.

1. Start policytool. Enter `%{was.install.root}/java/jre/bin/policytool` from a command prompt.

   The policytool window opens. The policytool looks for the `.java.policy` file in your home directory. If it does not exist, an Error message displays. Click **OK**.
2. Click **File** > **Open**.
3. Navigate the directory tree in the **Open** window to pick up the policy file that you need to update. After selecting the policy file, click **Open**. The code base entries are listed in the window.
4. Create or modify the code base entry.
   a. Modify the existing code base entry by double-clicking the code base, or click the code base and click **Edit Policy Entry**. The Policy Entry window opens with the permission list defined for the selected code base.
   b. Create a new code base entry by clicking **Add Policy Entry**. The Policy Entry window opens. At the code base column, enter the code base information as a URL format, for example, `/WebSphere/AppServer/InstalledApps/testcase.ear`.
5. Modify or add the permission specification
   a. Modify the permission specification by double-clicking the entry you want to modify, or by selecting the permission and clicking **Edit Permission**. The Permissions window opens with the selected permission information.
   b. Add a new permission by clicking **Add Permission**. The Permissions window opens. In the Permissions, window there are four rows for **Permission**, **Target Name**, **Actions**, and **Signed By**.
6. Select the permission from the Permission list. The selected permission displays. After a permission is selected, the **Target Name**, **Actions**, and **Signed By** fields automatically show the valid choices or they enable text input in the right text input area.
   a. Select **Target Name** from the list, or enter the target name in the right text input area.
   b. Select **Actions** from the list.
   c. Input **Signed By** if it is needed.

      Important: The Signed By keyword is not supported in the following policy files: `app.policy`, `spi.policy`, `library.policy`, `was.policy`, and `filter.policy` files. However, the Signed By keyword is supported in the following policy files:`java.policy`, `server.policy`, and `client.policy` files. The Java Authentication and Authorization Service (JAAS) is not supported in the `app.policy`, `spi.policy`, `library.policy`, `was.policy`, and `filter.policy` files. However, the JAAS principal keyword is

supported in a JAAS policy file when it is specified by the Java Virtual Machine (JVM) system property, `java.security.auth.policy`.

7. Click **OK** to close the Permissions window. Modified permission entries of the specified code base display.
8. Click **Done** to close the window. Modified code base entries are listed. Repeat steps 4 through 8 until you complete editing.
9. Click **File** > **Save** after you finish editing the file.

A policy file is updated. If any policy files need editing, use the policytool. Do not edit the policy file manually. Syntax errors in the policy files can potentially cause application servers or enterprise applications to not start or function incorrectly. For the changes in the updated policy file to take effect, restart the Java processes.

Java 2 security policy files:

The J2EE 1.3 specification has a well-defined programming model of responsibilities between the container providers and the application code. Using Java 2 security manager to help enforce this programming model is recommended. There are certain operations that are not allowed in the application code because such operations interfere with the behavior and operation of the containers. The Java 2 security manager is used in the product to enforce responsibilities of the container and the application code.

This product provides support for policy file management. There are a number of policy files in the product, which are either static or dynamic. *Dynamic policy* is a template of permissions for a particular type of resource. There is no relative codebase defined in the dynamic policy template. The codebase is dynamically calculated from the deployment and run-time data.

Static policy files

Policy file	Location
java.policy	*install_root*`/java/jre/lib/security/java.policy`. Default permissions granted to all classes. The policy of this file applies to all the processes launched by the WebSphere Application Server.
server.policy	*install_root*`/properties/server.policy`. Default permissions granted to all the product servers.
client.policy	*install_root*`/properties/client.policy`. Default permissions for all of the product client containers and applets on a node.

The static policy files are not managed by configuration and file replication services. Changes made in these files are local and are not replicated to other nodes in the Network Deployment cell.

Dynamic policy files

Policy file	Location
spi.policy	*install_root*/config/cells/*cell_name*/nodes/*node_name*/spi.policy This template is for the Service Provider Interface (SPI) or third-party resources embedded in the product. Examples of SPI are Java Messaging Service (JMS) (MQSeries) and JDBC drivers. The codebase for the embedded resources are dynamically worked out from the configuration (resources.xml file) and run-time data, and permissions defined in the spi.policy files are automatically applied to these resources. The default permission of spi.policy file is java.security.AllPermissions.
library.policy	*install_root*/config/cells/*cell_name*/nodes/*node_name*/library.policy This template is for the library (Java library classes). You can define a shared library to use in multiple product applications. The default permission of the library.policy is empty.
app.policy	*install_root*/config/cells/*cell_name*/nodes/*node_name*/app.policy The app.policy file defines the default permissions granted to all enterprise applications running on *node_name* in *cell_name*.
was.policy	*install_root*/config/cells/*cell_name*/applications/*ear_file_name*/deployments/ *application_name*/META-INF/was.policy Type the previous location on one continuous line. This template is for application-specific permissions. The was.policy is embedded in the Enterprise Archive (EAR) file.
ra.xml	*rar_file_name*/META-INF/was.policy.RAR. This file can have a permission specification defined in the ra.xml file. The ra.xml file is embedded in the RAR file.

Note: Grant entry specified in the app.policy and was.policy files must have a code base defined. If there are grant entries specified without a code base, the policy files are not loaded properly and the application can fail. If the intent is to grant the permissions to all applications, then use *file:${application}* as a code base in the grant entry.

Syntax of the policy file

A policy file contains several policy entries. The following example depicts each policy entry format:

```
grant [codebase <Codebase>] {
permission <Permission>;
 permission <Permission>;
permission <Permission>;
};

<CodeBase>:  A URL.
   For example,  "file:${java.home}/lib/tools.jar"
      When [codebase <Codebase>] is not specified, listed
```

```
                permissions are applied to everything.
      If URL ends with a JAR file name,  only the classes in the
                JAR file belong to the codebase.
                If URL ends with "/", only the class files in the specified
                directory belong to the codebase.
                If URL ends with "*", all JAR and class files in the specified
                directory belong to the codebase.
                If URL ends with "-", all JAR and class files in the specified
                directory and its subdirectories belong to the codebase.
<Permissions>: Consists from
       Permission Type   : class name of the permission
          Target Name       : name specifying the target
          Actions           : actions allowed on target
   For example,
         java.io.FilePermission "/tmp/xxx", "read,write"
```

Please refer to developer kit specifications for the details of each permission.

Syntax of dynamic policy

You can define permissions for specific types of resources in dynamic policy files for an enterprise application. This action is achieved by using *product-reserved symbols*. The reserved symbol scope depends on where it is defined. If you define the permissions in the `app.policy` file, the symbol applies to all the resources on all of the enterprise applications running on *node_name*. If you define the permissions in the `META-INF/was.policy` file, it only applies to the specific enterprise application. Valid symbols for codebase are listed in the following table:

Symbol	Meaning
file:${application}	Permissions apply to all resources within the application
file:${jars}	Permissions apply to all utility Java archive (JAR) files within the application
file:${ejbComponent}	Permissions apply to EJB resources within the application
file:${webComponent}	Permissions apply to Web resources within the application
file:${connectorComponent}	Permissions apply to connector resources within the application

Other than these entries specified by the codebase symbols, you can specify the module name for a granular setting. For example:

```
grant codeBase "file:DefaultWebApplication.war" {
   permission java.security.SecurityPermission "printIdentity";
 };

grant codeBase "file:IncCMP11.jar" {
permission java.io.FilePermission
"${user.install.root}${/}bin${/}DefaultDB${/}-",
"read,write,delete";
};
```

The 6th and 7th lines in the previous code sample are one continuous line.

You can use a relative codebase only in the `META-INF/was.policy` file.

Several product-reserved symbols are defined to associate the permission lists to a specific type of resources.

Symbol	Meaning
file:${application}	Permissions apply to all resources within the application
file:${jars}	Permissions apply to all utility JAR files within the application
file:${ejbComponent}	Permissions apply to enterprise beans resources within the application
file:${webComponent}	Permissions apply to Web resources within the application
file:${connectorComponent}	Permissions apply to connector resources both within the application and stand-alone connector resources.

There are five embedded symbols provided to specify the path and name for java.io.FilePermission. These symbols enable flexible permission specification. The absolute file path is fixed after the installation of the application.

Symbol	Meaning
${app.installed.path}	Path where the application is installed
${was.module.path}	Path where the module is installed
${current.cell.name}	Current cell name
${current.node.name}	Current node name
${current.server.name}	Current server name

Note: You must not use the `${was.module.path}` in the `${application}` entry.

Carefully determine where to add a new permission. An incorrectly specified permission causes an AccessControlException exception. Since dynamic policy resolves the codebase at run time, determining which policy file has a problem is difficult. Add a permission only to the necessary resources. For example, `use ${ejbcomponent}`, and `etc` instead of `${application}`, and update the `was.policy` file instead of the `app.policy` file, if possible.

Static policy filtering

Limited static policy filtering support exists. If the `app.policy` file and the `was.policy` file have permissions defined in the `filter.policy` file with the keyword, `filterMask`, the run time removes the permissions from the applications and an audit message is logged. However, if the permissions defined in the `app.policy` and `was.policy` are compound permissions, for example, `java.security.AllPermission`, the permission is not removed, rather an warning message is written to the log file. The policy filtering only supports Developer Kit permissions, (the permissions package name begins with `java` or `javax`).

Run time policy filtering support is provided to force stricter filtering. If the app.policy file and was.policy file have permissions defined in the filter.policy file with the keyword, runtimeFilterMask, the run time removes the permissions from the applications no matter what permissions are granted to the application. For example, even if a was.policy file has java.security.AllPermission granted to on of its modules, specified permissions such as runtimeFilterMask are removed from the granted permission during run time.

If the **Issue Permission Warning** flag in the Global Security panel is enabled and if the app.policy file and the was.policy file contain custom permissions (non-Developer Kit permissions, where the permissions package name begins with java or javax), a warning message logs. The permission is not removed. If the permission, AllPermission, is listed in the app.policy file and the was.policy file, a warning message logs.

Policy file editing

Using the policy tool provided by the Developer Kit (*install_root*/java/jre/bin/policytool), to edit the previous policy files is recommended. For Network Deployment, extract the policy files from the repository before editing. After the policy file is extracted, use the policy tool to edit the file. Check the modified policy files into the repository and synchronized them with other nodes.

If there are syntax errors in the policy files, the enterprise application or server process might fail to start. Be cautious when editing these policy files. For example, if a policy has a trailing space in the policy permission target name, the policy fails to parse the permission properly in WebSphere Application Server, Version 5.1 IBM Developer Kit, Java Technology Edition Version 1.4.x. In the following example, note the space before the last quote: * \"*\" "

```
grant {
    permission javax.security.auth.PrivateCredentialPermission
         "javax.resource.spi.security.PasswordCredential * \"*\" ","read";
};
```

If the permission is in a policy file loaded by the IBM Developer Kit, Java Technology Edition Version 1.4.x policy tool, the following message might display:

```
Errors have occurred while opening the policy configuration.
View the warning log for more information.
```

or the following message might display in warning log:

```
Warning: Invalid argument(s) for constructor:
javax.security.auth.PrivateCredentialPermission.
```

To fix this problem, edit the permission and remove the trailing space. When the trailing space is removed, the permission loads properly. The following code sample shows the corrected permission:

```
grant {
    permission javax.security.auth.PrivateCredentialPermission
          "javax.resource.spi.security.PasswordCredential * \"*\"","read";
}
```

Troubleshooting

To debug the dynamic policy, there are three ways to generate the detail report of the exception, AccessControlException.

- **Trace** (Configured by RAS trace). Enables traces with the trace specification:

  Attention: The following command is one continuous line

  ```
  com.ibm.ws.security.policy.*=all=enabled:
  com.ibm.ws.security.core.SecurityManager=all=enabled
  ```
- **Trace** (Configured by property). Specifies a `java` property `java.security.debug`. Valid values for the `java.security.debug` property are:
  - Access. Print all debug information including, required permission, code, stack and code base location.
  - Stack. Print debug information including, required permission, code, and stack.
  - Failure. Print debug information including, required permission and code.
- **ffdc**. Enable `ffdc`, modify the `ffdcRun.properties` file by changing Level=4 and LAE=true. Look for a keyword `Access Violation` in the log file.

Configuring Java 2 security policy files:

Java 2 security uses several policy files to determine the granted permissions for each Java programs. See the Dynamic policy article for the list of available policy files supported by WebSphere Application Server Version.

There are two types of policy files supported by WebSphere Application Server: dynamic policy files and static policy files. Static policy files provide the default permissions. Dynamic policy files provide application permissions. There are six dynamic policy files:

Policy file name	Description
`app.policy`	Contains default permissions for all of the enterprise applications in the cell.
`was.policy`	Contains application-specific permissions for an WebSphere Application Server enterprise application. This file is packaged in an enterprise archive (EAR) file.
`ra.xml`	Contains connector application specific permissions for a WebSphere Application Server enterprise application. This file is packaged in a resource adapter archive (RAR) file.
`spi.policy`	Contains permissions for Service Provider Interface (SPI) or third-party resources embedded in WebSphere Application Server. The default contents grant everything. Update this file carefully when the cell requires more protection against SPI in the cell. This file is applied to all of the SPIs defined in the `resources.xml` file.
`library.policy`	Contains permissions for the shared library of enterprise applications.
`filter.policy`	Contains the list of permissions that require filtering from the `was.policy` file and the `app.policy` file in the cell. This filtering mechanism only applies to the `was.policy` and `app.policy` files.

Important: The Signed By keyword is not supported in the following policy files: `app.policy`, `spi.policy`, `library.policy`, `was.policy`, and `filter.policy` files. However, the Signed By keyword is supported in the following policy files:`java.policy`, `server.policy`, and `client.policy` files. The Java Authentication and Authorization Service (JAAS) is not supported in the `app.policy`, `spi.policy`, `library.policy`, `was.policy`, and `filter.policy` files. However, the JAAS principal keyword is supported in a JAAS policy file when it is specified by the Java Virtual Machine (JVM) system property, `java.security.auth.policy`. You can statically set the authorization policy files in `java.security.auth.policy` with `auth.policy.url.n=`*`URL`* where *`URL`* is the location of the authorization policy.

1. Identify the policy file to update.

   If the permission is required by an application, update the static policy file. Refer to Configuring static policy files.

   If the permission is required by all of the WebSphere Application Server enterprise applications in the node, refer to Configuring spi.policy files.

   If the permission is required only by specific WebSphere Application Server enterprise applications and the permission is required only by a connector, update the `ra.xml` file. Refer to Assembling resource adapter (connector) modules. Otherwise, update the `was.policy` file. Refer to Configuring was.policy files and Adding the was.policy file to applications.

   If the permission is required by shared libraries, refer to Configuring library.policy files.

   If the permission is required by SPI libraries, refer to Configuring spi.policy files.

   Note: It is recommended to pick up the policy file with the smallest scope. You can avoid giving an extra permission to the Java programs and protect the resources. You can update the `ra.xml` file or the `was.policy` file rather than the `app.policy` file. Use specific component symbols ($(ejbcomponent), ${webComponent},${connectorComponent} and ${jars}) than ${application} symbols. Update dynamic policy files than static policy files.

   Add any permission that should never be granted to the WebSphere Application Server enterprise application in the cell to the `filter.policy` file. Refer to Configuring filter.policy files.
2. Restart the WebSphere Application Server enterprise application.

The required permission is granted for the specified WebSphere Application Server enterprise application.

If an WebSphere Application Server enterprise application in a cell requires permissions, some of the dynamic policy files need updating. The symptom of the missing permission is the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example,

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous two lines were split onto two lines because of the width of the page. However, the permission should be on one line.

When a Java program receives this exception and adding this permission is justified, add a permission to an adequate dynamic policy file, for example,

```
grant codeBase "file:<user client installed location>" {
permission java.io.FilePermission
"C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read";
};
```

The previous two lines were split onto two lines because of the width of the page. However, the permission should be on one line.

To decide whether to add a permission, refer to the article AccessControlException.

Configuring app.policy files:

Java 2 security uses several policy files to determine the granted permissions for each Java program. See the Dynamic policy article for the list of available policy files supported by WebSphere Application Server. The `app.policy` file is a default policy file shared by all of the WebSphere Application Server enterprise applications. The union of the permissions contained in the `app.policy` file, the `server.policy` file, the `app.policy` file, the application `was.policy` file and the permission specification of the `ra.xml` file are applied to the WebSphere Application Server enterprise application. The `app.policy` files are managed by configuration and file replication services.

Important: The Signed By and the Java Authentication and Authorization Service (JAAS) principal keywords are not supported in the `app.policy` file. However, the Signed By keyword is supported in the following files: `java.policy`, `server.policy`, and the `client.policy` files. The JAAS principal keyword is supported in a JAAS policy file when it is specified by the Java Virtual Machine (JVM) system property, `java.security.auth.policy`. You can statically set the authorization policy files in `java.security.auth.policy` with `auth.policy.url.n=`*URL* where *URL* is the location of the authorization policy.

If the default permissions for enterprise applications (the union of the permissions defined in the `app.policy` file, the `server.policy` file and the `app.policy` file) are enough, no action is required. The default `app.policy` file is used automatically. If a specific change is required to all of the enterprise applications in the cell, update the `app.policy` file. Syntax errors in the policy files cause start failures in the application servers. Edit these policy files carefully.
Modify the `app.policy` file with the Policy Tool. Changes to the `app.policy` file are local for the node.

The default Java 2 security policies have been changed for the enterprise application.

Several product-reserved symbols are defined to associate the permission lists to a specific type of resource.

Symbol	Meaning
file:${application}	Permissions apply to all resources within the application
file:${jars}	Permissions apply to all utility Java archive (JAR) files within the application

Symbol	Meaning
file:${ejbComponent}	Permissions apply to enterprise bean resources within the application
file:${webComponent}	Permissions apply to Web resources within the application
file:${connectorComponent}	Permissions apply to connector resources both within the application and within stand-alone connector resources.

There are five embedded symbols provided to specify the path and name for java.io.FilePermission. These symbols enable flexible permission specifications. The absolute file path is fixed after the installation of the application.

Symbol	Meaning
${app.installed.path}	Path where the application is installed
${was.module.path}	Path where the module is installed
${current.cell.name}	Current cell name
${current.node.name}	Current node name
${current.server.name}	Current server name

Note: You cannot use the `${was.module.path}` in the `${application}` entry.

The `app.policy` file supplied by WebSphere Application Server resides at *`install_root`*`/config/cells/`*`cell_name`*`/nodes/`*`node_name`*`/app.policy`, which contains the following default permissions:

Attention: In the following code sample, the first two lines related to `permission java.io.FilePermission` were split into two lines each due to the width of the printed page.

```
grant codeBase "file:${application}" {
  // The following are required by Java mail
  permission java.io.FilePermission "${was.install.root}${/}java${/}
  jre${/}lib${/}ext${/}mail.jar", "read";
  permission java.io.FilePermission "${was.install.root}${/}java${/}
  jre${/}lib${/}ext${/}activation.jar", "read";
};

grant codeBase "file:${jars}" {
  permission java.net.SocketPermission "*", "connect";
  permission java.util.PropertyPermission "*", "read";
};

grant codeBase "file:${connectorComponent}" {
  permission java.net.SocketPermission "*", "connect";
  permission java.util.PropertyPermission "*", "read";
};
grant codeBase "file:${webComponent}" {
  permission java.io.FilePermission "${was.module.path}${/}-", "read, write";
  permission java.lang.RuntimePermission "loadLibrary.*";
  permission java.lang.RuntimePermission "queuePrintJob";
  permission java.net.SocketPermission "*", "connect";
```

```
  permission java.util.PropertyPermission "*", "read";
};

grant codeBase "file:${ejbComponent}" {
 permission java.lang.RuntimePermission "queuePrintJob";
 permission java.net.SocketPermission "*", "connect";
 permission java.util.PropertyPermission "*", "read";
};
```

If all of the WebSphere Application Server enterprise applications in a cell require permissions that are not defined as defaults in the `app.policy` file, the `server.policy` file and the `app.policy`file, then update the `app.policy` file. The symptom of a missing permission is the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example, `java.security.AccessControlException: access denied (java.io.FilePermission C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)`.

When a Java program receives this exception and adding this permission is justified, add a permission to the `server.policy` file, for example:

```
grant codeBase "file:<user client installed location>" {
permission java.io.FilePermission
"C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };
```

To decide whether to add a permission, refer to the article AccessControlException.

Restart all WebSphere Application Server enterprise applications to ensure that the updated `app.policy` file takes effect.

Configuring filter.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. Java 2 security policy filtering is only in effect when Java 2 security is enabled. Refer to Configuring Java 2 security. The filtering policy defined in the `filter.policy` file is cell wide. Refer to the article, Dynamic policy, for the list of available policy files supported by WebSphere Application Server. The `filter.policy` file is the only policy file used when restricting the permission instead of granting permission. The permissions listed in the filter policy file are filtered out from the `app.policy` file and the `was.policy` file. Permissions defined in the other policy files are not affected by the `filter.policy` file.

When a permission is filtered out, an audit message is logged. However, if the permissions defined in the `app.policy` file and the `was.policy` file are compound permissions like java.security.AllPermission, for example, the permission is not removed. A warning message is logged. If the Issue Permission Warning flag is enabled (default) and if the `app.policy` file and the `was.policy` file contain custom permissions (non-Java API permission, the permission package name begins with characters other than `java` or `javax`), then a warning message is logged and the permission is not removed. You can change the value of the Issue Permission Warning flag from the administrative console in the Global Security panel. It is not recommended that you use `AllPermission` for the enterprise application.

There are some default permissions defined in the `filter.policy` file. These permissions are the minimal ones recommended by the product. If more

permissions are added to the filter.policy file, certain operations can fail for enterprise applications. Add permissions to the filter.policy file carefully.

Note:
You cannot use the Policy Tool to edit the filter.policy file. Editing must be completed in a text editor. Be careful and verify that there are no syntax errors in the filter.policy file. If there are any syntax errors in filter.policy file, it will not be loaded by the product security run time, which implies that filtering is disabled.

An updated filter.policy file is applied to all of the WebSphere Application Server enterprise application after the servers are restarted.

The filter.policy file is managed by configuration and file replication services. Changes made in the file are replicated to other nodes in the Network Deployment cell.

The filter.policy file supplied by WebSphere Application Server resides at: *install_root*/config/cells/*cell_name*/filter.policy.

It contains these permissions as defaults:

```
filterMask {
permission java.lang.RuntimePermission "exitVM";
permission java.lang.RuntimePermission "setSecurityManager";
permission java.security.SecurityPermission "setPolicy";
permission javax.security.auth.AuthPermission "setLoginConfiguration"; };
runtimeFilterMask {
permission java.lang.RuntimePermission "exitVM";
permission java.lang.RuntimePermission "setSecurityManager";
permission java.security.SecurityPermission "setPolicy";
permission javax.security.auth.AuthPermission "setLoginConfiguration"; };
```

The permissions defined in filterMask are for static policy filtering. The security run time tries to remove the permissions from applications during application startup. Compound permissions are not removed but are issued with a warning, and application deployment is stopped if applications contain permissions defined in filterMask, and if scripting was used (wsadmin tool). The runtimeFilterMask defines permissions used by the security run time to deny access to those permissions to application thread. Do not add more permissions to the runtimeFilterMask. Application start failure or incorrect functioning might result. Be careful when adding more permissions to the runtimeFilterMask. Usually, you only need to add permissions to the filterMask stanza.

WebSphere Application Server relies on the filter policy file to restrict or disallow certain permissions that could compromise the integrity of the system. For instance, WebSphere Application Server considers the exitVM and setSecurityManager permissions as those permissions that most applications should never have. If these permissions are granted, then the following scenarios are possible:

- **exitVM** -- A servlet, JSP file, enterprise bean, or other library used by the aforementioned could call the System.exit() API and cause the entire WebSphere Application Server process to terminate.
- **setSecurityManager** -- An application could install its own SecurityManager that could either grant more permissions or bypass the default policy the WebSphere Application Server SecurityManager enforces.

For the updated filter.policy file to take effect, restart related Java processes.

Configuring the was.policy file:

Java 2 security uses several policy files to determine the granted permission for each Java program. See "Java 2 security policy files" on page 452 for the list of available policy files supported by WebSphere Application Server Version 5. The was.policy file is an application-specific policy file for WebSphere Application Server enterprise applications. It is embedded in the enterprise archive (EAR) file (META-INF/was.policy). The was.policy file is located in:

install_root/config/cells/*cell_name*/applications/
ear_file_name/deployments/*application_name*/META-INF/was.policy

The union of the permission contained in the java.policy file, the server.policy file, the app.policy file, application was.policy file and the permission specification of the ra.xml file are applied to the WebSphere Application Server enterprise application. Configuration and file replication services manage was.policy files. Changes made in these files are replicated to other nodes in the Network Deployment cell.

Several product-reserved symbols are defined to associate the permission lists to a specific type of resources.

Symbol	Definition
file:${application}	file:${application}
file:${jars}	Permissions apply to all utility Java archive (JAR) files within the application
file:${ejbComponent}	Permissions apply to enterprise bean resources within the application
file:${webComponent}	Permissions apply to Web resources within the application
file:${connectorComponent}	Permissions apply to connector resources within the application

Important: The Signed By and the Java Authentication and Authorization Service (JAAS) principal keywords are not supported in the was.policy file. The **Signed By** keyword is supported in the following policy files: java.policy, server.policy, and client.policy. The JAAS principal keyword is supported in a JAAS policy file when it is specified by the Java Virtual Machine (JVM) system property, java.security.auth.policy. You can statically set the authorization policy files in java.security.auth.policy with auth.policy.url.n=*URL* where *URL* is the location of the authorization policy.

Other than these blocks, you can specify the module name for granular settings. For example,

```
"file:DefaultWebApplication.war" {
      permission java.security.SecurityPermission "printIdentity";
 };

grant codeBase "file:IncCMP11.jar" {
      permission java.io.FilePermission
```

```
      "${user.install.root}${/}bin${/}DefaultDB${/}-",
      "read,write,delete";
};
```

There are five embedded symbols provided to specify the path and name for the `java.io.FilePermission`. These symbols enable flexible permission specification. The absolute file path is fixed after the application is installed.

Symbol	Definition
${app.installed.path}	Path where the application is installed
${was.module.path}	Path where the module is installed
${current.cell.name}	Current cell name
${current.node.name}	Current node name
${current.server.name}	Current server name

If the default permissions for the enterprise application (union of the permissions defined in the `java.policy` file, the `server.policy` file and the `app.policy` file) are enough, no action is required. If an application has specific resources to access, update the `was.policy` file. The first two steps assume that you are creating a new policy file.

Note: Syntax errors in the policy files cause the application server to fail. Use care when editing these policy files.

1. Create or edit a new `was.policy` file using the Policy Tool. For more information, see "Using PolicyTool to edit policy files" on page 451
2. Package the `was.policy` file into the enterprise archive (EAR) file.

   For more information, see "Adding the was.policy file to applications" on page 467.The following instructions describe how to import a `was.policy` file. However, you also can use the Assembly Toolkit to create a new file by clicking **File > New > File**.

   a. Start the Assembly Toolkit and open the J2EE Perspective by selecting **Window > Open Perspective > J2EE**.
   b. Import the client EAR file by selecting **File > Import > EAR file**.
   c. Click **Next**.
   d. Enter the path name to the EAR file in the **EAR File** field or click **Browse** to locate the file.
   e. Enter the project name in the **Project name** field.
   f. Click **Finish**.
   g. Open the Project Navigator view.
   h. Expand the EAR file and click **META-INF**. You might find a `was.policy` file in the META-INF directory. If you want to delete the file, right-click the file name and select **Delete**.
   i. At the bottom of the Project Navigator view, click **J2EE Hierarchy**.
   j. Import the `was.policy` file by right-clicking the **Modules** directory and clicking **Import > File system**.
   k. Click **Next**.
   l. Enter the path name to the `was.policy` file in the **From directory** field or click **Browse** to locate the file.
   m. Verify that the path directory listed in the **Into directory** field lists the correct `META-INF` directory.

n. Click **Finish**.
o. To validate the EAR file, right-click the EAR file, which contains the Modules directory, and click **Run Validation**.
p. To save the new EAR file, right-click the EAR file, and click **Export > Export EAR file**. If you do not save the revised EAR file, the EAR file will contain the new `was.policy` file. However, if the workspace becomes corrupted, you might lose the revised EAR file.
q. To generate deployment code, right-click the EAR file and click **Generate Deployment Code**.

3. Update an existing installed application, if one already exists.
   a. Modify the installed `was.policy` file with Policy Tool. For more information, see "Using PolicyTool to edit policy files" on page 451.

The updated `was.policy` file is applied to the application after the application restarts.

If an application must access a specific resource that is not defined as a default in the `java.policy` file, the `server.policy` file and the `app.policy`, then delete the `was.policy` file for that application. The symptom of the missing permission is that the exception, `java.security.AccessControlException`. The missing permission is listed in the exception data, `java.security.AccessControlException: access denied (java.io.FilePermission C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)`.

When a Java program receives this exception and adding this permission is justified, add a permission to the `was.policy` file: `grant codeBase "file:<user client installed location>" { permission java.io.FilePermission "C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };`.

To determine whether to add a permission, refer to the article, "AccessControlException" on page 446.

Restart all applications for the updated `app.policy` file to take effect.

Configuring spi.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. See Dynamic policy for the list of available policy files supported by WebSphere Application Server Version 5.

Since the default permissions for Service Provider Interface (SPI) is AllPermission, the only reason to update the `spi.policy` file is a restricted SPI permission. When a change in the `spi.policy` is required, complete the following steps.

Syntax errors in the policy files cause the application server to fail. Edit these policy files carefully.

Important: Do not place the codebase keyword or any other keyword after the `filterMask` and `runtimeFilterMask` keywords. The Signed By and the Java Authentication and Authorization Service (JAAS) Principal keywords are not supported in the `spi.policy` file. The Signed By keyword is supported in the following policy files: `java.policy`, `server.policy`, and `client.policy`. The JAAS Principal keyword is supported in a JAAS policy file that is specified by the Java Virtual Machine (JVM) system property, `java.security.auth.policy`. You can

statically set the authorization policy files in java.security.auth.policy with auth.policy.url.n=*URL* where *URL* is the location of the authorization policy.

Modify the spi.policy file with the Policy Tool.

The updated spi.policy is applied to the SPI libraries after the Java process is restarted.

The spi.policy file is the template for SPIs (Service Provider Interface) or third-party resources embedded in the product. Example of SPIs are Java Message Services (JMS) (MQSeries) and Java database connectivity (JDBC) drivers. They are specified in the resources.xml file. The dynamic policy grants the permissions defined in the spi.policy file to the class paths defined in the resources.xml file. The union of the permission contained in the java.policy file and the spi.policy file are applied to the SPI libraries. The spi.policy files are managed by configuration and file replication services. Changes made in these files are replicated to other nodes in the Network Deployment cell.

The spi.policy file supplied by WebSphere Application Server resides at *install_root*/config/cells/*cell_name*/nodes/*node_name*/spi.policy. It contains the following default permission:

```
grant {
  permission java.security.AllPermission;
};
```

Restart the related Java processes for the changes in the spi.policy file to become effective.

Configuring library.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java programs. See "Java 2 security policy files" on page 452 for the list of available policy files supported by WebSphere Application Server Version 5. The library.policy file is the template for shared libraries (Java library classes). Multiple enterprise applications can define and use shared libraries. Refer to Managing shared libraries for information on how to define and manage the shared libraries.

If the default permissions for a shared library (union of the permissions defined in the java.policy file, the app.policy file and the library.policy file) are enough, no action is required. The default library policy is picked up automatically. If a specific change is required to share a library in the cell, update the library.policy file.

Syntax errors in the policy files cause the application server to fail. Edit these policy files carefully.

Important: Do not place the codebase keyword or any other keyword after the grant keyword. The Signed By keyword and the Java Authentication and Authorization Service (JAAS) Principal keyword are not supported in the library.policy file. The Signed By keyword is supported in the following policy files: java.policy, server.policy, and client.policy. The JAAS Principal keyword is supported in a JAAS policy file when it is specified by the Java Virtual Machine (JVM) system property, java.security.auth.policy. You can statically set the authorization

policy files in java.security.auth.policy with auth.policy.url.n=*URL* where *URL* is the location of the authorization policy.

Modify the library.policy file with the Policy Tool. For more information, see "Using PolicyTool to edit policy files" on page 451.

An updated library.policy is applied to shared libraries after the servers restart.

The union of the permission contained in the java.policy file, the app.policy file, and the library.policy file are applied to the shared libraries. The library.policy file is managed by configuration and file replication services. Changes made in the file are replicated to other nodes in the Network Deployment cell.

The library.policy file supplied by WebSphere Application Server resides at: *install_root*/config/cells/*cell_name*/nodes/*node_name*/library.policy, contains an empty permission entry as a default. For example,

```
grant {
 };
```

If the shared library in a cell requires permissions that are not defined as defaults in the java.policy file, app.policy file and the library.policy file, update the library.policy file. The missing permission causes the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example:

```
 java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous lines are one continuous line.

When a Java program receives this exception and adding this permission is justified, add a permission to the library.policy file, for example: `grant codeBase "file:<user client installed location>" { permission java.io.FilePermission "C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };`

to decide whether to add a permission, refer to "AccessControlException" on page 446.

Restart the related Java processes for the changes in the library.policy file to become effective.

Adding the was.policy file to applications:

When Java 2 security is enabled for a WebSphere Application Server, all the applications that run on that WebSphere Application Server undergo a security check before accessing system resources. An application might need a was.policy file if it accesses resources that require more permissions than those granted in the default app.policy file. By default, the product security reads an app.policy file that is located in each node and grants the permissions in the app.policy file to all the applications. Include any additional required permissions in the was.policy file. The was.policy file is only required if an application requires additional permissions.

The default policy file for all applications is specified in the app.policy file. This file is provided by the product security, is common to all applications, and should not be changed. Add any new permissions required for an application in the was.policy file.

The app.policy file is located in the *install_root*/config/cells/*cell_name*/nodes/*node_name* directory. The contents of the app.policy file follow:

Attention: In the following code sample, the two permissions that are required by JavaMail were split into two lines each due to the width of the printed page.

```
// The following permissions apply to all the components under the application.
grant codeBase "file:${application}" {
  // The following are required by JavaMail
  permission java.io.FilePermission "
        ${was.install.root}${/}java${/}jre${/}lib${/}ext${/}mail.jar", "read";
  permission java.io.FilePermission "
        ${was.install.root}${/}java${/}jre${/}lib${/}ext${/}activation.jar", "read";
};

  // The following permissions apply to all utility .jar files  (other
  //  than enterprise beans JAR files) in the application.
grant codeBase "file:${jars}" {
  permission java.net.SocketPermission "*", "connect";
  permission java.util.PropertyPermission "*", "read";
};

// The following permissions apply to connector resources within the application
grant codeBase "file:${connectorComponent}" {
  permission java.net.SocketPermission "*", "connect";
  permission java.util.PropertyPermission "*", "read";
};

// The following permissions apply to all the Web modules (.war files)
// within the application.
grant codeBase "file:${webComponent}" {
  permission java.io.FilePermission "${was.module.path}${/}-", "read, write";
        //  where "was.module.path" is the path where the Web module is
        //  installed. Refer to Dynamic policy concepts for other symbols.
  permission java.lang.RuntimePermission "loadLibrary.*";
  permission java.lang.RuntimePermission "queuePrintJob";
  permission java.net.SocketPermission "*", "connect";
  permission java.util.PropertyPermission "*", "read";
};


// The following permissions apply to all the EJB modules within the application.
grant codeBase "file:${ejbComponent}" {
 permission java.lang.RuntimePermission "queuePrintJob";
 permission java.net.SocketPermission "*", "connect";
 permission java.util.PropertyPermission "*", "read";
};
```

If additional permissions are required for an application or for one or more modules of an application, use the `was.policy` file for that application. For example, use codeBase of ${application} and add required permissions to grant additional permissions to the entire application. Similarly, use codeBase of ${webComponent} and ${ejbComponent} to grant additional permissions to all the Web modules and all the enterprise bean (EJB) modules in the application. You can assign additional permissions to each module (`.war` file or `.jar` file) as shown in the following example.

An example of adding extra permissions for an application in the `was.policy` file:

Attention: In the following code sample, the permission for the EJB module was split into two lines due to the width of the printed page.

```
// grant additional permissions to a Web module
grant codeBase " file:aWebModule.war" {
 permission java.security.SecurityPermission "printIdentity";
};

// grant additional permission to an EJB module
grant codeBase "file:aEJBModule.jar"  {
     permission java.io.FilePermission "
         ${user.install.root}${/}bin${/}DefaultDB${/}-" ."read.write,delete";
     // where, ${user.install.root} is the system property whose value is
     // located in the <install_root> directory.
 };
```

1. Create a `was.policy` file using the policy tool. For more information on using the policy tool, see Using PolicyTool to edit policy files
2. Add the required permissions in the `was.policy` file using the policy tool.
3. Place the `was.policy` file in the application enterprise archive (EAR) file under the `META-INF` directory. Update the application EAR file with the newly created `was.policy` file by using the **jar** command.
4. Verify that the `was.policy` file is inserted, and start the Assembly Toolkit .
5. Verify that the `was.policy` file in the application is syntactically correct. In the Assembly Toolkit, right-click the enterprise application module and click **Run Validation**.

An application EAR file is now ready to run when Java 2 security is enabled.

This step is required for applications to run properly when Java 2 security is enabled. If the `was.policy` file is not created and it does not contain required permissions, the application might not access system resources.

The symptom of the missing permissions is the exception, `java.security.AccessControlException`. The missing permission is listed in the exception data, for example:

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous two lines are one continuous line.

When an application program receives this exception and adding this permission is justified, include the permission in the `was.policy` file, for example,

```
grant codeBase "file:${application}" { permission java.io.FilePermission
"C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };
```

The previous two lines are one continuous line.

Install the application.

Configuring static policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. See the "Java 2 security policy files" on page 452 article for the list of available policy files supported by WebSphere Application Server Version 5.

There are two types of policy files supported by WebSphere Application Server Version 5, dynamic policy files and static policy files. Static policy files provide the default permissions. Dynamic policy files provide application's permissions.

Policy file name	Description
`java.policy`	Contains default permissions for all of the Java programs on the node. This file seldom changes.
`server.policy`	Contains default permissions for all of the WebSphere Application Server programs on the node. This files is rarely updated.
`client.policy`	Contains default permissions for all of the applets and client containers on the node.

The static policy file is not a configuration file managed by the repository and the file replication service. Changes to this file are local and do not get replicated to the other machine.

1. Identify the policy file to update.
   - If the permission is required only by an application, update the dynamic policy file. Refer to "Configuring Java 2 security policy files" on page 457.
   - If the permission is required only by applets and client containers, update the `client.policy` file. Refer to "Configuring client.policy files" on page 474.
   - If the permission is required only by WebSphere Application Server (servers, agents, managers and application servers), update the `server.policy` file. Refer to "Configuring server.policy files" on page 472.
   - If the permission is required by all of the Java programs running on the Java virtual machine (JVM), update the `java.policy` file. Refer to "Configuring java.policy files" on page 471.
2. Stop and restart the WebSphere Application Server.

The required permission is granted for all of the Java programs running with the restarted JVM.

If Java programs on a node require permissions, the policy file needs updating. If the Java program that required the permission is not part of an enterprise application, update the static policy file. The missing permission causes the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example:

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

When a Java program receives this exception and adding this permission is justified, add a permission to an adequate policy file, for example:

```
grant codeBase "file:<user client installed location>" {
  permission java.io.FilePermission
  "C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar",
  "read";
};
```

To decide whether to add a permission, refer to "AccessControlException" on page 446.

Configuring java.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. See "Java 2 security policy files" on page 452 for the list of available policy files supported by WebSphere Application Server Version 5. The `java.policy` file is a global default policy file shared by all of the Java programs running in the Java Virtual Machine (JVM) on the node. Modifying this file is not recommended.
If a specific change is required to some of the Java programs on a node and the `java.policy` file requires updating, modify the java.policy file with policy tool. For more information, see "Using PolicyTool to edit policy files" on page 451. A change to the `java.policy` file is local for the node. The default Java policy is picked up automatically. Syntax errors in the policy files cause the application server to fail. Edit these policy files carefully.

An updated `java.policy` file is applied to all the Java programs running in all the JVMs on the local node. Restart the programs for the updates to take effect

The `java.policy` file is not a configuration file managed by the repository and the file replication service. Changes to this file are local and do not get replicated to the other machine. The `java.policy` file supplied by WebSphere Application Server is located at *install_root*`/java/jre/lib/security/java.policy`. It contains these default permissions.

```
// Standard extensions get all permissions by default
grant codeBase "file:${java.home}/lib/ext/*" {
        permission java.security.AllPermission;
};
// default permissions granted to all domains
grant {
        // Allows any thread to stop itself using the java.lang.Thread.stop()
        // method that takes no argument.
        // Note that this permission is granted by default only to remain
        // backwards compatible.
        // It is strongly recommended that you either remove this permission
        // from this policy file or further restrict it to code sources
        // that you specify, because Thread.stop() is potentially unsafe.
        // See "http://java.sun.com/notes" for more information.
        // permission java.lang.RuntimePermission "stopThread";

        // allows anyone to listen on un-privileged ports
```

```
permission java.net.SocketPermission "localhost:1024-", "listen";

// "standard" properties that can be read by anyone

permission java.util.PropertyPermission "java.version", "read";
permission java.util.PropertyPermission "java.vendor", "read";
permission java.util.PropertyPermission "java.vendor.url", "read";
permission java.util.PropertyPermission "java.class.version", "read";
permission java.util.PropertyPermission "os.name", "read";
permission java.util.PropertyPermission "os.version", "read";
permission java.util.PropertyPermission "os.arch", "read";
permission java.util.PropertyPermission "file.separator", "read";
permission java.util.PropertyPermission "path.separator", "read";
permission java.util.PropertyPermission "line.separator", "read";

permission java.util.PropertyPermission "java.specification.version", "read";
permission java.util.PropertyPermission "java.specification.vendor", "read";
permission java.util.PropertyPermission "java.specification.name", "read";

permission java.util.PropertyPermission "java.vm.specification.version","read";
permission java.util.PropertyPermission "java.vm.specification.vendor","read";
permission java.util.PropertyPermission "java.vm.specification.name", "read";
permission java.util.PropertyPermission "java.vm.version", "read";
permission java.util.PropertyPermission "java.vm.vendor", "read";
permission java.util.PropertyPermission "java.vm.name", "read";
};
```

If some Java programs on a node require permissions that are not defined as defaults in the `java.policy` file, then consider updating the `java.policy` file. Most of the time, other policy files are updated instead of the `java.policy` file. The missing permission causes the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example:

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous two lines are one continuous line.

When a Java program receives this exception and adding this permission is justified, add a permission to the `java.policyfile`, for example:

```
grant codeBase "file:<user client installed location>" {
permission java.io.FilePermission
"C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };
```

To decide whether to add a permission, refer to "AccessControlException" on page 446.

Restart all of the Java processes for the updated `java.policy` file to take effect.

Configuring server.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. See "Java 2 security policy files" on page 452 for the list of available policy files supported by WebSphere Application Server Version 5. The `server.policy` file is a default policy file shared by all of the WebSphere servers on

a node. The server.policy file is not a configuration file managed by the repository and the file replication service. Changes to this file are local and do not replicate to the other machine.
If the default permissions for a server (the union of the permissions defined in the server.policy file and the server.policy file) are enough, no action is required. The default server policy is picked up automatically. If a specific change is required to some of the server programs on a node, update the server.policy file with the Policy Tool. Refer to the "Using PolicyTool to edit policy files" on page 451 article to edit policy files. Changes to the server.policy file are local for the node. Syntax errors in the policy files cause the application server to fail. Edit these policy files carefully.

An updated server.policy file is applied to all the server programs on the local node. Restart the servers for the updates to take effect.

If you want to add permissions to an application, use the app.policy file and the was.policy file.

When you do need to modify the server.policy file, locate this file at: *install_root*/properties/server.policy. This file contains these default permissions:

```
// Allow to use sun tools
grant codeBase "file:${java.home}/../lib/tools.jar" {
  permission java.security.AllPermission;
};

// WebSphere system classes
grant codeBase "file:${was.install.root}/lib/-" {
  permission java.security.AllPermission;
};
grant codeBase "file:${was.install.root}/classes/-" {
  permission java.security.AllPermission;
};

// Allow the WebSphere deploy tool all permissions
grant codeBase "file:${was.install.root}/deploytool/-" {
  permission java.security.AllPermission;
};
```

If some server programs on a node require permissions that are not defined as defaults in the server.policy file and the server.policy file, update the server.policy file. The missing permission causes the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example:

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous two lines are one continuous line.

When a Java program receives this exception and adding this permission is justified, add a permission to the server.policy file, for example:

```
grant codeBase "file:<user client installed location>" {
permission java.io.FilePermission
"C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar", "read"; };
```

To decide whether to add a permission, refer to "AccessControlException" on page 446.

Restart all of the Java processes for the updated `server.policy` file to take effect.

Configuring client.policy files:

Java 2 security uses several policy files to determine the granted permission for each Java program. See "Java 2 security policy files" on page 452 for the list of available policy files supported by WebSphere Application Server Version 5. The `client.policy` file is a default policy file shared by all of the WebSphere Application Server client containers and applets on a node. The union of the permissions contained in the `client.policy` file and the `client.policy` file are given to all of the WebSphere client containers and applets running on the node. The `client.policy` file is not a configuration file managed by the repository and the file replication service. Changes to this file are local and do not replicate to the other machine. The `client.policy` file supplied by WebSphere Application Server is located at *install_root*`/properties/client.policy`. It contains these default permissions:

```
grant codeBase "file:${java.home}/lib/ext/*" {
  permission java.security.AllPermission;
};
// IBM Developer Kit, Java Technology Edition classes
grant codeBase "file:${java.home}/lib/ext/-" {
  permission java.security.AllPermission;
};
grant codeBase "file:${java.home}/../lib/tools.jar" {
  permission java.security.AllPermission;
};
// WebSphere system classes
grant codeBase "file:${was.install.root}/lib/-" {
  permission java.security.AllPermission;
};
grant codeBase "file:${was.install.root}/classes/-" {
  permission java.security.AllPermission;
};
grant codeBase "file:${was.install.root}/installedConnectors/-" {
  permission java.security.AllPermission;
};
// J2EE 1.3 permissions for client container WAS applications
// in $WAS_HOME/installedApps
grant codeBase "file:${was.install.root}/installedApps/-" {
  //Application client permissions
  permission java.awt.AWTPermission "accessClipboard";
  permission java.awt.AWTPermission "accessEventQueue";
  permission java.awt.AWTPermission "showWindowWithoutWarningBanner";
  permission java.lang.RuntimePermission "exitVM";
  permission java.lang.RuntimePermission "loadLibrary";
  permission java.lang.RuntimePermission "queuePrintJob";
  permission java.net.SocketPermission "*", "connect";
  permission java.net.SocketPermission "localhost:1024-", "accept,listen";
```

```
  permission java.io.FilePermission "*", "read,write";
  permission java.util.PropertyPermission "*", "read";
};
// J2EE 1.3 permissions for client container - expanded ear file code base
grant codeBase "file:${com.ibm.websphere.client.applicationclient.archivedir}/-"
 {
  permission java.awt.AWTPermission "accessClipboard";
  permission java.awt.AWTPermission "accessEventQueue";
  permission java.awt.AWTPermission "showWindowWithoutWarningBanner";
  permission java.lang.RuntimePermission "exitVM";
  permission java.lang.RuntimePermission "loadLibrary";
  permission java.lang.RuntimePermission "queuePrintJob";
  permission java.net.SocketPermission "*", "connect";
  permission java.net.SocketPermission "localhost:1024-", "accept,listen";
  permission java.io.FilePermission "*", "read,write";
  permission java.util.PropertyPermission "*", "read";
};
// For MQ Series
grant codeBase "file:${mq.install.root}/java/*" {
  permission java.security.AllPermission;
};
```

1. If the default permissions for a client (union of the permissions defined in the `client.policy` file and the `client.policy` file) are enough, no action is required. The default client policy is picked up automatically.
2. If a specific change is required to some of the client containers and applets on a node, modify the `client.policy` file with the policy tool. Refer to "Using PolicyTool to edit policy files" on page 451, to edit policy files. Changes to the `client.policy` file are local for the node.

All of the client containers and applets on the local node are granted the updated permissions at the time of execution.

If some client containers or applets on a node require permissions that are not defined as defaults in the `client.policy` file and the default `client.policy` file, update the `client.policy` file. The missing permission causes the exception, java.security.AccessControlException. The missing permission is listed in the exception data, for example,

```
java.security.AccessControlException: access denied (java.io.FilePermission
C:\WebSphere\AppServer\java\jre\lib\ext\mail.jar read)
```

The previous two lines of sample code are one continuous line, but extended beyond the width of the page.

When a client program receives this exception and adding this permission is justified, add a permission to the `client.policy` file, for example, grant codebase "file:*user_client_installed_location*" { permission java.io.FilePermission "C:\WebSphere\AppServer\java\jre\lib\ext\mail.ja", "read"; };.

To decide whether to add a permission, refer to "AccessControlException" on page 446.

Close and restart the browser. You also must restart the client application if you have one.

Migrating Java 2 security policy

Previous WebSphere Application Server releases

Starting from Version 3.x, WebSphere Application Server installed a Java 2 security manager in the server run time to prevent enterprise applications from calling the `System.exit()` and the `System.setSecurityManager()` methods. These two Java APIs have undesirable consequences if called by enterprise applications. The `System.exit()` API, for example, causes the Java virtual machine (application server process) to exit prematurely, which is an undesirable operation for an application server.

However, Java 2 security was not a fully supported feature prior to Version 5. To support Java 2 security properly, all the server run time must be marked as `privileged` (with `doPrivileged()` API calls inserted in the correct places), and identify the default permission sets or policy. Application code is not privileged and subject to the permissions defined in the policy files. The `doPrivileged` instrumentation is important and necessary to support Java 2 security. Without it, the application code must be granted the permissions required by the server run time. This is due to the design and algorithm used by Java 2 security to enforce permission checks. Please refer to the Java 2 security check permission algorithm.

The following two permissions are enforced by the WebSphere Java 2 security manager (hard coded):
- `java.lang.RuntimePermission(exitVM)`
- `java.lang.RuntimePermission(setSecurityManager)`

Application code is denied access to these permissions regardless of what is in the Java 2 security policy. However, the server run time is granted these permissions. All the other permission checks are not enforced.

Partial support was introduced since the version 4.02 product release. Prior to version 4.0.2, Java 2 security was not supported. From version 4.02 and later, only two permissions are supported:
- `java.net.SocketPermission`
- `java.net.NetPermission`

However, not all the product server run time is properly marked as `privileged`. You must grant the application code all the other permissions besides the two listed previously or the enterprise application can potentially fail to run. This Java 2 security policy for enterprise applications is liberal.

What changed

Java 2 Security is fully supported in version 5, which means all permissions are enforced. The default Java 2 security policy for enterprise application is the recommended permission set defined by the J2EE 1.3 specification. Refer to the `${`*`install_root`*`}/config/cells/`*`cell_name`*`/nodes/`*`node_name`*`/app.policy` file for the default Java 2 security policy granted to enterprise applications. This is a much more stringent policy compared to previous releases.

All policy is declarative. The product security manager honors all policy declared in the policy files. There is an exception to this rule: enterprise applications are denied access to permissions declared in the `${`*`install_root`*`}/config/cells/`*`cell_name`*`/filter.policy` file.

Note: Enterprise applications that run on Version 4.0.x with Java 2 security enabled are not guaranteed to run successfully when migrating to Version 5 (when Java 2 security is enabled), even if the Java 2 security policy is migrated properly. The default Java 2 security policy for enterprise applications is much more stringent and all permissions are enforced in Version 5. It might fail because the application code does not have the necessary permissions granted where system resources (such as file I/O for example) can be programmatically accessed and are now subject to the permission checking.

Migrating system properties

The following system properties are used in previous releases in relation to Java 2 security:

- **java.security.policy**. The absolute path of the policy file (action required). It contains both system permissions (permissions granted to the Java Virtual Machine (JVM) and the product server run time) and enterprise application permissions. Migrate the Java 2 security policy of the enterprise application to Version 5. For Java 2 security policy migration, see the steps for migrating Java 2 security policy.
- **enableJava2Security**. Used to enable Java 2 security enforcement (no action required). This is deprecated; a flag in the WebSphere configuration application programming interface (API) is used to control whether to enabled Java 2 security. Enable this option through the administrative console.
- **was.home**. Expanded to the installation directory of the WebSphere Application Server (action might be required). This is deprecated; superseded by `${user.install.root}` and `${was.install.root}` properties. If the directory contains instance specific data then `${user.install.root}` is used; otherwise `${was.install.root}` is used. Use these properties interchangeably for the WebSphere Application Server or the Network Deployment environments. See the steps for migrating Java 2 security policy.

Migrating the Java 2 Security Policy

There is no easy way of migrating the Java policy file from Version 4.0.x automatically because there is a mixture of system permissions and application permissions in the same policy file. Manually copy the Java 2 security policy for enterprise applications to a `was.policy` or `app.policy` file. However, migrating the Java 2 security policy to a `was.policy` file is preferable because symbols or relative codebase is used instead of absolute codebase. There are many advantages to this process. The permissions defined in the `was.policy` file should only be granted to the specific enterprise application, while permissions in the `app.policy` file apply to all the enterprise applications running on the node where the `app.policy` file belongs. Refer to the "Java 2 security policy files" on page 452 article for more details on policy management.

The following example illustrates the migration of a Java 2 security policy from a previous release. The contents include the Java 2 security policy file (the default is *install_root*`/properties/java.policy`) for the `app1.ear` enterprise application and the system permissions (permissions granted to the JVM and product server run time). Default permissions are omitted for clarity:

```
// For product Samples
   grant codeBase "file:${install_root}/installedApps/app1.ear/-" {
     permission java.security.SecurityPermission "printIdentity";
```

```
  permission java.io.FilePermission "${install_root}${/}temp${/}somefile.txt",
    "read";
};
```

For clarity of illustration, all the permissions are migrated as the application level permissions in this example. However, you can grant permissions at a more granular level at the component level (Web, enterprise beans, connector or utility Java archive (JAR) component level) or you can grant permissions to a particular component.

1. Ensure that Java 2 security is disabled on the application server.
2. Create a new `was.policy` file (if one is not present) or update the `was.policy` for migrated applications in the configuration repository in (`config/cells/<cell_name>/applications/app.ear/deployments/app/META-INF/was.policy`) with the following contents:

   ```
   grant codeBase "file:${application}" {
        permission java.security.SecurityPermission "printIdentity";
        permission java.io.FilePermission "
                ${user.install.root}${/}temp${/}somefile.txt", "read";
      };
   ```

   The third and fourth lines in the previous code sample are one continuous line, but extended beyond the width of the page.
3. Use the Assembly Toolkit to attach the `was.policy` file to the enterprise archive (EAR) file. You also can use the Assembly Toolkit to validate the contents of the `was.policy` file. For more information, see "Configuring the was.policy file" on page 463.
4. Validate that the enterprise application does not require additional permissions to the migrated Java 2 Security permissions and the default permissions set declared in the `${was.install.root}/config/cells/cell_name/nodes/node_name/app.policy` file. This requires code review, code inspection, application documentation review, and sandbox testing of migrated enterprise applications with Java 2 security enabled in a pre-production environment. Refer to developer kit APIs protected by Java 2 security for information about which APIs are protected by Java 2 security. If you use third party libraries, consult the vendor documentation for APIs that are protected by Java 2 security. Verify that the application is granted all the required permissions, or it might fail to run when Java 2 security is enabled.
5. Perform pre-production testing of the migrated enterprise application with Java 2 security enabled. **Hint**: Enable trace for the WebSphere Application Server Java 2 security manager in the pre-production testing environment (with trace string: `com.ibm.ws.security.core.SecurityManager=all=enabled`). This can be helpful in debugging the *AccessControlException* exception thrown when an application is not granted the required permission or some system code is not properly marked as *privileged*. The trace dumps the stack trace and permissions granted to the classes on the call stack when the exception is thrown. For more information, see "AccessControlException" on page 446.

   Note: Because the Java 2 security policy is much more stringent compared with previous releases, it is strongly advised that the administrator or deployer review their enterprise applications to see if extra permissions are required before enabling Java 2 security. If the enterprise applications are not granted the required permissions, they fail to run.

Troubleshooting security configurations

Refer to Security components troubleshooting tips for instructions on how to troubleshoot errors related to security.

The following topics explain how to troubleshoot specific problems related to configuring and enabling security configurations:
- Errors when configuring or enabling security
- Errors or access problems after enabling security
- Errors after enabling Secure Sockets Layer (SSL) or SSL-related error messages

For more information on these topics, see the InfoCenter.

Tuning security configurations

Performance issues typically involve trade-offs between function and speed. Usually, the more function and the more processing involved, the slower the performance. Consider what type of security is necessary and what you can disable in your environment. For example, if your application servers are running in a Virtual Private Network (VPN), consider whether you must disable Single Sockets Layer (SSL). If you have a lot of users, can they be mapped to groups and then associated to your J2EE roles? These questions are things to consider when designing your security infrastructure.

Complete the following steps for general security tuning:

1. Consider disabling Java 2 Security Manager if you know exactly what code is put onto your server and you do not need to protect process resources. Remember that in doing so, you put your local resources at some risk.
2. Disable security for the specific application server that does not require resource protection because some application servers do not have protected resources. If the application server needs to go downstream with credentials, however, this action might not be feasible.
3. Consider propagating new security settings to all nodes before restarting the deployment manager and node agents to change the new security policy. If your security configurations are not consistent across all servers, you get access denied errors. Therefore, you must propagate new security settings when enabling or disabling global security in a Network Deployment environment.

   Configuration changes are generally propagated using configuration synchronization. If auto-synchronization is enabled, you can wait for the automatic synchronization interval to pass, or you can force synchronization before the synchronization interval expires. If you are using manual synchronization, you must synchronize all nodes.

   If the cell is in a configuration state (the security policy is mixed with nodes that have security enabled and disabled) you can use the syncNode utility to synchronize the nodes where the new settings are not propagated.

   Refer to the article, Enabling and disabling global security in the WebSphere Application Server Network Deployment package for more detailed information about enabling security in a distributed environment.
4. Consider increasing the cache and token time-out if you feel your environment is secure enough. By doing so, you have to re-authenticate less often. This action supports subsequent requests to reuse the credentials that already are created. The downside of increasing the token time-out is the exposure of having a token hacked and providing the hacker more time to hack into the

system before the token expires. You can use security cache properties to determine the initial size of the primary and secondary hashtable caches, which affect the frequency of rehashing and the distribution of the hash algorithms. See the article Security cache types and sizes for a list of these properties.

5. Consider changing your administrative connector from Simple Object Access Protocol (SOAP) to Remote Method Invocation (RMI) because RMI uses stateful connections while SOAP is completely stateless. Run a benchmark to determine if the performance is improved in your environment.
6. Use the `wsadmin` script to complete the access IDs for all the users and or groups to speed up the application startup. Complete this action if applications contain many users, or groups, or if applications are stopped and started frequently.
7. Consider tuning the Object Request Broker (ORB) because it is a factor in enterprise bean performance with or without security enabled. Refer to the article, ORB tuning guidelines.

Tuning CSIv2

1. Consider using SSL client certificates instead of a user ID and password to authenticate Java clients. Since you are already making the SSL connection, using mutual authentication adds little overhead while removing the service context containing the user ID and password completely.
2. If you send a large amount of data that is not very security sensitive, reduce the strength of your ciphers. The more data you have to bulk encrypt and the stronger the cipher, the longer this action takes. If the data is not sensitive, do not waste your processing with 128-bit ciphers.
3. Consider putting just an asterisk (*) in the trusted server ID list (meaning trust all servers) when you use Identity Assertion for downstream delegation. Use SSL mutual authentication between servers to provide this trust. Adding this extra step in the SSL handshake performs better than having to fully authenticate the upstream server and check the trusted list. When an asterisk is used, we simply trust the identity token. The SSL connection trusts the server by way of client certificate authentication.
4. Ensure that stateful sessions are enabled for Common Secure Interoperability Version 2 (CSIv2). This is the default, but only requires authentication on the first request and any subsequent token expirations.
5. If you are only communicating with WebSphere Application Server Version 5 servers, make the Active Authentication Protocol CSI, instead of CSI and z/SAS or CSI and SAS. This action removes an interceptor invocation for every request on both the client and server sides.
6. For a pure Java client, you can disable the creation of server sockets used for Object Request Broker (ORB) callbacks. Do this only if you are communicating with servers running WebSphere Application Server, Version 5 or later.
   a. In the `sas.client.props` file, add `com.ibm.CSI.claimTransportAssocSSLTLSRequired=false` and `com.ibm.CSI.claimTransportAssocSSLTLSSupported=false`.
   b. Set the active protocol to `csiv2` instead of `both` in the `sas.client.props` file. The protocol property changes to `com.ibm.CSI.protocol=csiv2`.

Tuning LDAP authentication

1. Select the **Ignore Case** check box in the WebSphere Application Server LDAP User Registry configuration, when case-sensitivity is not important.

2. Select **Reuse Connections** in the WebSphere Application Server LDAP User Registry configuration.
3. Check to see which caches your LDAP server has and take advantage of them. This action is best with LDAP servers that do not change frequently.
4. Choose the directory type of either IBM_Directory_Server or SecureWay, if you are using an IBM Directory Server. The IBM Directory Server yields improved performance because it is programmed to use the new group membership attributes to improve group membership searches. However, it is required that authorization is case insensitive to use IBM Directory Server.
5. Choose either iPlanet Directory Server (also known as Sun ONE) or Netscape as the directory if you are an iPlanet Directory user. Using the iPlanet Directory Server directory increases performance in group membership lookup. However, only use **Role** for group mechanisms.

Tuning Web authentication

1. Consider increasing the cache and token time-out if you feel your environment is secure enough. The Web authentication information is stored in these caches and as long as the authentication information is in the cache, the login module is not invoked to authenticate the user. This supports subsequent requests to reuse the credentials already created. The downside of increasing the token time-out is the exposure of having a token stolen and providing the thief more time to hack into the system before the token expires. See the article Security cache types and sizes for a list of these properties.
2. Consider enabling single singon (SSO). SSO is only available when you select **LTPA** as the authentication mechanism in the **Global Security** panel. When you select SSO, a single authentication to one application server is enough to make requests to multiple application servers in the same SSO domain. There are some situations where SSO is not desirable and should not be used in those situations.
3. 5.1.1 Consider disabling or enabling the **Web Inbound Security Attribute Propagation** option on the SSO panel if the function is not required. In some cases, having the function enabled improves performance. This improvement is most likely for higher volume cases where a considerable number of user registry calls reduces performance. In other cases, having the feature disabled improves performance. This improvement is most likely when the user registry calls do not take considerable resources.

Tuning authorization

1. Consider mapping your users to groups in the user registry. Then associate the groups with your J2EE roles. This association greatly improves performance as the number of users increases.
2. Judiciously assign method-permissions for enterprise beans. For example, you can use an asterisk (*) to indicate all methods in the method-name element. When all the methods in enterprise beans require the same permission, use an asterisk (*) for the method-name to indicate all methods. This indication reduces the size of deployment descriptors and reduces the memory required to load the deployment descriptor. It also reduces the search time during method-permission match for the enterprise beans method.
3. Judiciously assign security-constraints for servlets. For example, you can use the URL pattern `*.jsp` to apply the same authentication data constraints to indicate all JSP files. For a given URL, the exact match in the deployment descriptor takes precedence over the longest path match. Use the extension

match (*.jsp, *.do, *.html) if there is no exact match and longest path match for a given URL in the security constraints.

There is always a trade off between performance, feature and security. Security typically adds more processing time to your requests, but for a good reason. Not all security features are required in your environment. When you decide to tune security, you should create a benchmark before making any change to ensure the change is improving performance.

In a large scale deployment, performance is very important. Running benchmark measurements with different combinations of features can help you to determine the best performance versus the benefit configuration for your environment.

Continue to run benchmarks if anything changes in your environment, to help determine the impact of these changes.

Security cache properties

The following system properties determine the initial size of the primary and secondary hash table caches, which affect the frequency of rehashing and the distribution of the hash algorithms. The larger the number of available hash values, the less likely a hash collision occurs, retrieval time might be slower. If several entries compose a hash table cache, creating the table in a larger capacity supports more efficient hash entries than letting automatic rehashing determine the growth of the table. Rehashing causes every entry to move each time.

com.ibm.websphere.security.util.authCacheEnabled
: This property determines whether the Subject cache is enabled for the process. When the Subject cache is disabled, a new Java Authentication and Authorization Service (JAAS) login occurs for every request, which results in a performance degradation. Disable the Subject cache with caution.

com.ibm.websphere.security.util.tokenCacheSize
: This cache stores LTPA credentials in the cache using the LTPA token as a lookup value. When using an LTPA token to log in, the LTPA credential is created at the security server for the first time. This cache prevents the need to go to the security server on subsequent logins using an LTPA token.

com.ibm.websphere.security.util.LTPAValidationCacheSize
: Given the credential token for login, this cache returns the concrete LTPA credential object, without the need to revalidate at the security server. If the token has expired, revalidation is required.

Secure Sockets Layer performance tips

The following are two types of Secure Sockets Layer (SSL) performance:

- Handshake
- Bulk encryption and decryption

When an SSL connection is established, an SSL handshake occurs. After a connection is made, SSL performs bulk encryption and decryption for each read-write. The performance cost of an SSL handshake is much larger than that of bulk encryption and decryption.

To enhance SSL performance, decrease the number of individual SSL connections and handshakes.

Decreasing the number of connections increases performance for secure communication through SSL connections, as well as non-secure communication

through simple TCP/IP connections. One way to decrease individual SSL connections is to use a browser that supports HTTP 1.1. Decreasing individual SSL connections can be impossible if you cannot upgrade to HTTP 1.1.

Another common approach is to decrease the number of connections (both TCP/IP and SSL) between two WebSphere Application Server components. The following guidelines help to verify the HTTP transport of the application server is configured so that the Web server plug-in does not repeatedly reopen new connections to the application server:

- Verify that the maximum number of keep alives are, at minimum, as large as the maximum number of requests per thread of the Web server (or maximum number of processes for IBM HTTP Server on UNIX). Make sure that the Web server plug-in is capable of obtaining a keep alive connection for every possible concurrent connection to the application server. Otherwise, the application server closes the connection after a single request is processed. Also, the maximum number of threads in the Web container thread pool should be larger than the maximum number of keep alives, to prevent the keep alive connections from consuming the Web container threads.
- Increase the maximum number of requests per keep alive connection. The default value is 100, which means the application server closes the connection from the plug-in after 100 requests. The plug-in then has to open a new connection. The purpose of this parameter is to prevent denial of service attacks when connecting to the application server and preventing continuous send requests to tie up threads in the application server.
- Use a hardware accelerator if the system performs several SSL handshakes.

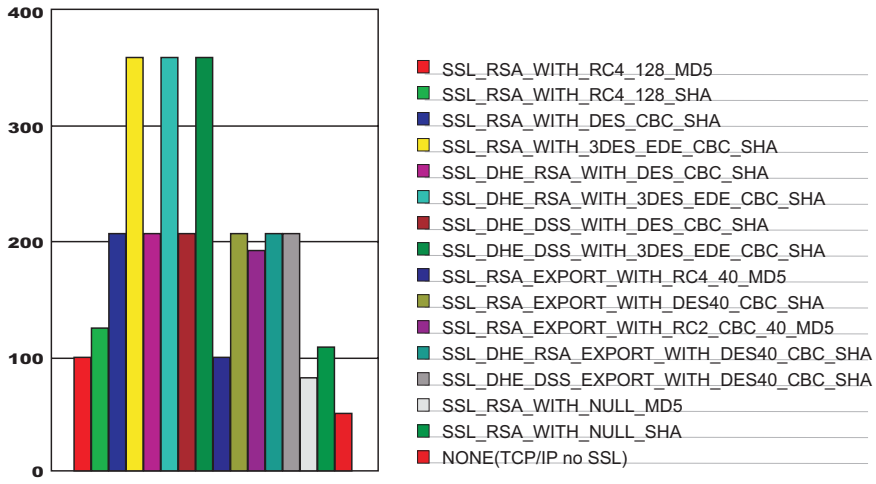
  Hardware accelerators currently supported by WebSphere Application Server only increase the SSL handshake performance, not the bulk encryption and decryption. An accelerator typically only benefits the Web server because Web server connections are short-lived. All other SSL connections in WebSphere Application Server are long-lived.
- Use an alternative cipher suite with better performance.

  The performance of a cipher suite is different with software and hardware. Just because a cipher suite performs better in software does not mean a cipher suite will perform better with hardware. Some algorithms are typically inefficient in hardware (for example, DES and 3DES), however, specialized hardware can provide efficient implementations of these same algorithms.

  The performance of bulk encryption and decryption is affected by the cipher suite used for an individual SSL connection. The following chart displays the performance of each cipher suite. The test software calculating the data was Java Secure Socket Extension (JSSE) for both the client and server software, which used no crypto hardware support. The test did not include the time to establish a connection, but only the time to transmit data through an established connection. Therefore, the data reveals the relative SSL performance of various cipher suites for long running connections.

  Before establishing a connection, the client enables a single cipher suite for each test case. After the connection is established, the client times how long it takes to write an integer to the server and for the server to write the specified number of bytes back to the client. Varying the amount of data had negligible effects on the

relative performance of the cipher suites.



An analysis of the above data reveals the following:

- Bulk encryption performance is only affected by what follows the WITH in the cipher suite name. This is expected since the portion before the WITH identifies the algorithm used only during the SSL handshake.
- MD5 and SHA are the two hash algorithms used to provide data integrity. MD5 is 25% faster than SHA, however, SHA is more secure than MD5.
- DES and RC2 are slower than RC4.Triple DES is the most secure, but the performance cost is high when using only software.
- The cipher suite providing the best performance while still providing privacy is SSL_RSA_WITH_RC4_128_MD5. Even though SSL_RSA_EXPORT_WITH_RC4_40_MD5 is cryptographically weaker than RSA_WITH_RC4_128_MD5, the performance for bulk encryption is the same. Therefore, as long as the SSL connection is a long-running connection, the difference in the performance of high and medium security levels is negligible. It is recommended that a security level of high be used, instead of medium, for all components participating in communication only among WebSphere Application Server products. Make sure that the connections are long running connections.

Tuning security

Enabling security decreases performance. The following tuning parameters give you considerations for increasing performance.

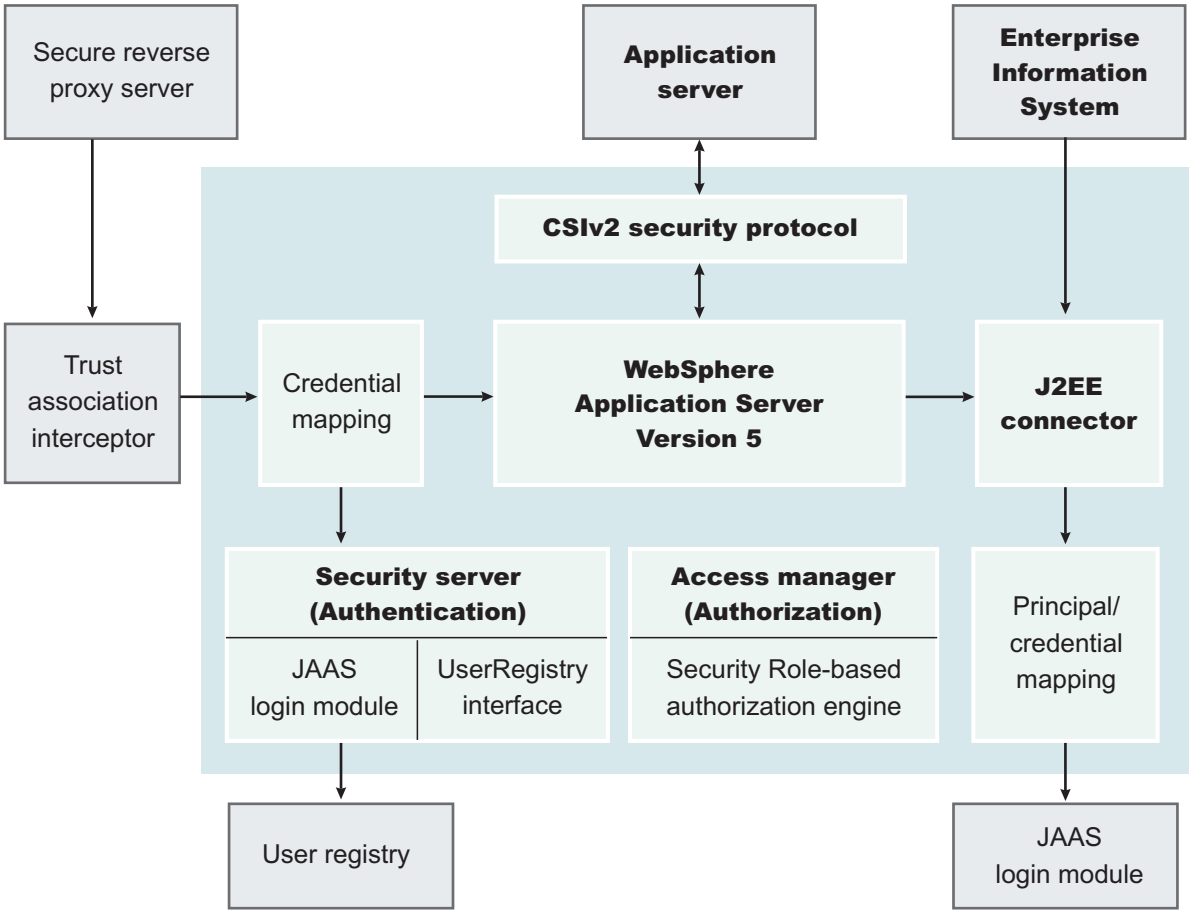
- Disable security on any application servers that does not need security. You can disable security by clicking **Servers > Application servers >** *server_name*. Under Additional properties, click **Server Security > Server level security**. Disable the **Enabled** option.
- Fine tune **Cache time-out** in "Global security settings" on page 140.
- Configure "Security cache properties" on page 482.
- Enable **SSL session tracking mechanism** as described in Session Management settings.
- Improve the performance of Web services security by **downloading a Java Cryptography Extension (JCE) jurisdiction policy file** that does not have restrictions on cryptography strength from Tuning Web services security.

- You can also read about “Secure Sockets Layer performance tips” on page 482 and “Tuning security configurations” on page 479.

Chapter 3. Integrating IBM WebSphere Application Server security with existing security systems

WebSphere Application Server plays an integral part of the multiple-tier enterprise computing framework. WebSphere Application Server adopts the open architecture paradigm and provides many plug-in points to integrate with enterprise software components to provide end-to-end security. WebSphere Application Server plug-in points are based on standard J2EE specifications wherever applicable. WebSphere Application Server is actively involved in various standard bodies to externalize and to standardize plug-in interfaces.

In the following example, several typical multiple-tier enterprise network configurations are discussed. In each case, various WebSphere Application Server plug-in points are used to integrate with other business components. The discussion starts with a basic multiple-tier enterprise network configuration:



A list of terms used in this discussion follows:

Protocol firewall
Prevents unauthorized access from the Internet to the demilitarized zone. The role of this node is to provide the Internet traffic access only on certain ports and to block other IP ports.

WebSphere Application Server plug-in
Redirects all the requests for servlets and JSP pages. Also referred to in

WebSphere Application Server literature as *Web server redirector* was introduced to separate Web server from application server. The advantage of using Web server redirector is that you can move an application server and all the application business logic behind the domain firewall.

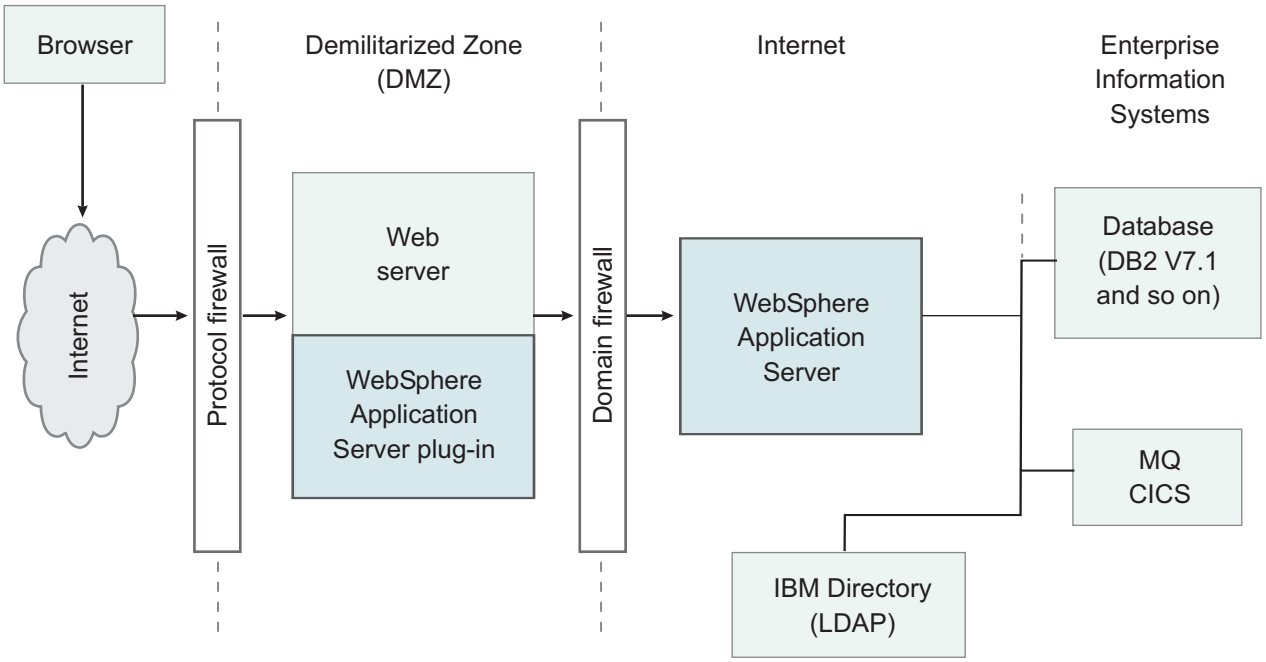
Domain firewall
Prevents unauthorized access from the demilitarized zone to an internal network. The role of this firewall is to allow the network traffic originating from the demilitarized zone and note from the Internet.

Directory
Provides information about the users and their rights in the Web application. The information can contain user IDs, passwords, certificates, access groups, and so forth. This node supplies the information to the security services like authentication and authorization service.

Enterprise information system
Represents existing enterprise applications and business data in back-end databases.

WebSphere Application Server provides the infrastructure to run application business logic and communicate with internal back-end systems and databases Web applications and enterprise beans can access. WebSphere Application Server has a built in HTTPS server that can accept client requests. A typical configuration, however, places WebSphere Application Server behind the domain firewall for better protection. A WebSphere Application Server plug-in to Web server configuration can redirect Web requests to WebSphere Application Server. WebSphere Application Server provides plug-ins for many popular Web servers.

You can configure WebSphere Application Server and the Web server plug-in to communicate through secure SSL channels. You can configure a WebSphere Application Server HTTP server to open communication channels only with a restricted set of Web server plug-ins. You can configure the HTTP server to require client certificate authentication with self-signed certificates and to trust only the signer certificate. For instructions on how to generate self-signed certificates and how to set up secure communications channels between an HTTP server and the WebSphere Application Server plug-in, refer to Configuring IHS plug-in and the Internal Web Server for SSL and Configuring IHS for SSL Mutual Authentication.



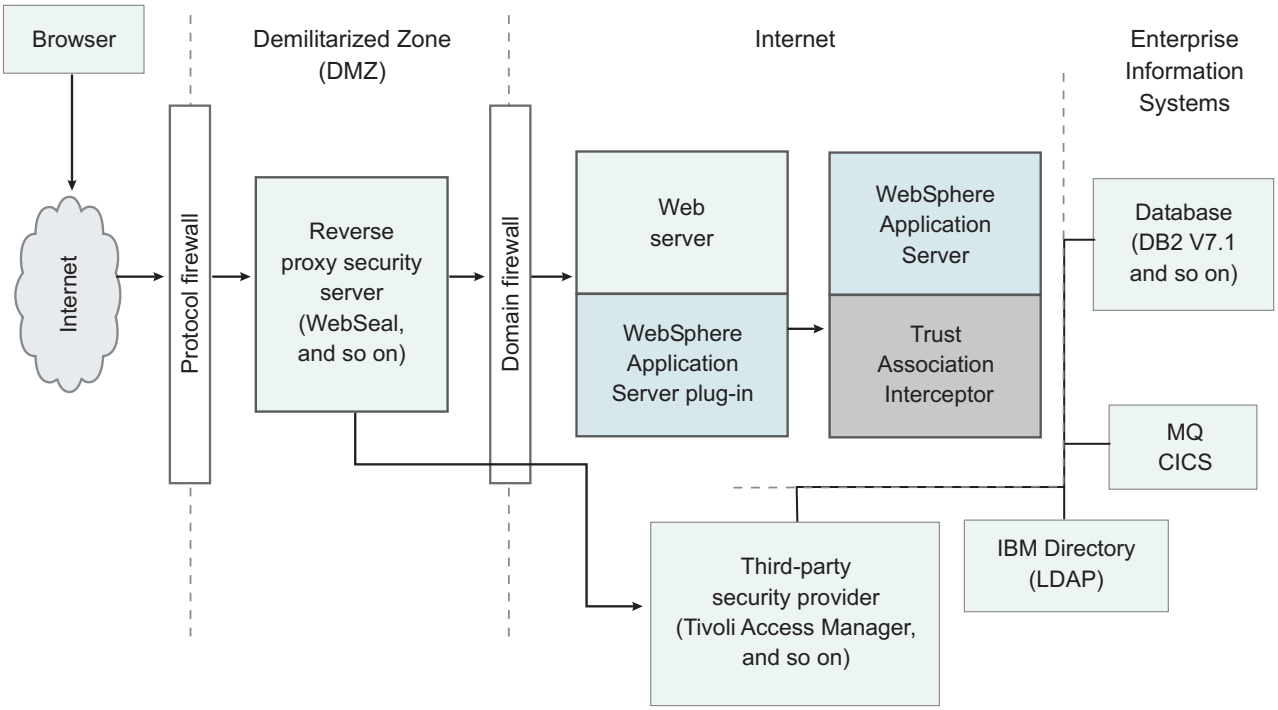
The WebSphere Application Server plug-in routes HTTP requests according to the virtual host and port configuration and the URL pattern matching. Client authentication and finer grained access control are handled by WebSphere Application Server behind the firewall.

In cases where the Web server can contain sensitive data and direct access is not desirable, the following configuration uses Tivoli WebSEAL to shield a Web server from unauthorized requests. WebSEAL is a Reverse Proxy Security Server (RPSS) that uses Tivoli Access Manager to perform coarse-grained access control to filter out unauthorized requests before they reach the domain firewall. WebSEAL uses Tivoli Access Manager to perform access control as illustrated in the picture. WebSphere Application Server supports various user registry implementations through the pluggable user registry interface. WebSphere Application Server ships a Local OS user registry implementation for Windows, AIX, AS/400, and Lightweight Directory Access Protocol (LDAP).

WebSphere Application Server also supports users in developing their own custom registry and plug-in through the pluggable user registry interface. When integrated with a third party security provider, WebSphere Application Server can share the user registry with the third-party security provider. In the particular example of integrating with WebSEAL, you can configure WebSphere Application Server to use the LDAP user registry, which can be shared with WebSEAL and Tivoli Access Manager. Moreover, you can configure WebSphere Application Server to use the Light Weight Third Party (LTPA) authentication mechanism, which supports the Trust Association Interceptor plug-in point.

Basically, the RPSS performs authentication and adds proper authentication data into the request header and then redirects the request to Web server. A trust relationship is formed between an RPSS and WebSphere Application Server, and the RPSS can assert client identity to WebSphere Application Server to achieve single signon between RPSS and WebSphere Application Server. When the request is forward to WebSphere Application Server, WebSphere Application Server uses the TAI plug-in for the particular RPSS server to evaluate the trust relationship and to extract the authenticated client identity. WebSphere Application Server then

maps the client identity to a WebSphere Application Server security credential. For instructions on setting up a trust association interceptor, refer to Trust associations, Configuring trust association interceptors.



When configured to use the LDAP user registry, WebSphere Application Server uses LDAP to perform authentication. The client ID and password are passed from WebSphere Application Server to the LDAP server. You can configure WebSphere Application Server to set up an SSL connection to LDAP so that passwords are not passed in plain text. To set up an SSL connection from WebSphere Application Server to the LDAP server, refer to Configuring SSL for the LDAP client. WebSphere Application Server Version 5 supports the J2EE Connector Architecture (JCA). The connector architecture defines a standard interface for WebSphere Application Server to connect to heterogeneous enterprise information systems (EIS). Examples of EIS includes database systems, transaction processing such as CICS, and messaging such as Message Queue (MQ). The EIS implementation can perform authentication and access control to protect business data and resources. Resource Adapters authenticate EIS. The authentication data can be provided either by application code or by WebSphere Application Server. WebSphere Application Server provides a principal mapping plug-in point. A principal mapping module plug-in maps the authenticated client principal to a password credential, (that is, user ID and password, for the EIS security domain). WebSphere Application Server ships a default principal mapping module, which maps any authenticated client principal to a configured pair of user IDs and passwords.

Each connector can be configured to use a different set of IDs and passwords. For a description on how to configure JCA principal mapping user IDs and passwords, refer to Managing J2C Authentication Data Entries. A principal mapping module is a special purpose Java Authentication and Authorization Service (JAAS) login module. You can develop your own principal mapping module to fit your particular business application environment. For detailed steps on developing and configuring a custom principal mapping module, refer to the articles, Developing

your own Java 2 security mapping module underneath JAAS Programmatic Login and Managing Java Authentication and Authorization Service (JAAS) Login Configuration.

Security and WebSphere MQseries

It is important to note that security logging information on UNIX systems is not protected because of the world-writeable files in the /var file system of MQseries. MQseries ships the following files with its product:
- -rw-rw-rw- /var/mqm/errors/AMQERR01.LOG
- -rw-rw-rw- /var/mqm/errors/AMQERR02.LOG
- -rw-rw-rw- /var/mqm/errors/AMQERR03.LOG

The previously mentioned files are world-writeable and enable any users on the system to fill up the /var file system where all the security logging information is stored. This leaves the security information unprotected because anyone can access the logging information without being tracked.

To work around this problem, create a file system for the embedded messaging component working data on UNIX. Before you install the embedded messaging component of WebSphere Application Server on UNIX platforms, consider creating and mounting a journalized file system called /var/mqm. Use a partition strategy with a separate volume for the WebSphere MQ data. This means that other system activity is not affected if a large amount of WebSphere MQ work builds up.

To determine the size of the /var/mqm file system for a server installation, consider the following:
- Maximum number of messages in the system at one time
- Contingency for message buildups, if there is a system problem
- Average size of the message data, plus 500 bytes for the message header
- Number of queues
- Size of log files and error messages

Allow 50MB as a minimum for a WebSphere MQ server. You need less space in the /var/mqm file system for a WebSphere MQ client (typically 15MB).

Interoperability issues for security

To have interoperability of Security Authentication Service (SAS) between C++ and WebSphere Application Server, use the Common Secure Interoperability Version 2 (CSIv2) authentication protocol over Remote Method Invocation over the Internet Inter-ORB Protocol (RMI-IIOP). To have interoperability of SAS between WebSphere Application Server and WebSphere Application Server for z/OS use the zSAS authentication protocol over RMI-IIOP.

Interoperability with C++ common object request broker architecture client support and limitations

In addition to the WebSphere base installation, you can choose from two types of C++ common object request broker architecture (CORBA) client support, IBM WebSphere Application Server Enterprise, Version 5 or WebSphere Application Server Client Version 5. If you plan to develop or rebuild your own C++ client applications, then the Enterprise version is required. It installs tools, libraries, and include files for the build environment in selecting C++ CORBA client software development kit (SDK). Otherwise, a client installation suffices to run your C++

client applications with security. In Version 5, WebSphere Application Server supports the C++ CORBA client on the Windows 2000, Windows NT, Linux, and AIX operating systems and the Solaris operating environment.

Secure Sockets Layer Version 2 (SSLV2) cipher suites are not supported. In Version 5, only the most commonly used ciphers among Java Secure Socket Extension (JSSE) and Global Security Kit (GSkit) are supported.

Since the WebSphere Enterprise CORBA C++ Client has only implemented security on the transport layer, other authentication mechanisms such as user ID and password (Basic Authentication) are not supported.

Interoperating with a C++ common object request broker architecture client

You can achieve interoperability of Security Authentication Service between the C++ Common Object Request Broker Architecture (CORBA) client and WebSphere Application Server using Common Secure Interoperability Version 2 (CSIv2) authentication protocol over Remote Method Invocation over the Internet Inter-ORB Protocol (RMI-IIOP). The CSIv2 security service protocol has authentication, attribute and transport layers. Among the three layers, transport authentication is conceptually simple, however, cryptographically based transport authentication is the strongest. WebSphere Application Server Enterprise has implemented the transport authentication layer, so that C++ secure CORBA clients can use it effectively in making CORBA clients and protected enterprise bean resources work together.

Security authentication from non-Java based C++ client to enterprise beans. WebSphere Application Server supports security in the CORBA C++ client to access protected enterprise beans. If configured, C++ CORBA clients can access protected enterprise bean methods using client certificate to achieve mutual authentication on WebSphere Application Server Enterprise applications.

To support the C++ CORBA client in accessing protected enterprise beans:

- Create an environment file for the client, such as current.env. Set the variables listed below (security_sslKeyring, client_protocol_user, client_protocol_password) in the file.
- Point to the environment file using the fully qualified pathname through the environment variable WAS_CONFIG_FILE. For example, in the test shell script test.sh, export WAS_CONFIG_FILE=/WebSphere/V5R0M0/AppServer/bin/current.env.

C++ security setting	Description
client_protocol_password	Specifies the password for the user ID.
client_protocol_user	Specifies the user ID to be authenticated at the target server.
security_sslKeyring	Specifies the name of the RACF keyring the client will use. The keyring must be defined under the user ID that is issuing the command to run the client.

To support the C++ CORBA client in accessing protected enterprise beans:

1. Obtain a valid certificate to represent the client and export its public key to the target enterprise bean server.

   A valid certificate is needed to represent the C++ client. Request a certificate from the certificate authority (CA) or create a self-signed certificate for testing purposes.

   Use the Key Management Utility from the Global Security Kit (GSKit) to extract the public key from the personal certificate and save it in the `.arm` format. For details, see the related information about how to extract the personal certificate of the public key.

2. Prepare a truststore file for WebSphere Application Server.

   Add the extracted client public key in the `.arm` file from the client to the server key truststore file. The server can now authenticate the client.

   Note: This is done by invoking the Key Management Utility through ikeyman.bat or ikeyman.sh from WebSphere Application Server installation.

   For details, see the article on Adding truststore files.

3. Configure WebSphere Application Server to support SSL as the authentication mechanism.

   a. Start the administrative console.

   b. Locate the application server that has the target enterprise bean deployed and configure it to use SSL client certificate authentication.

      If it is a base installation, go to **Security > Authentication Protocol > CSIv2 Inbound Authentication** then select **Supported** for Basic Authentication and Client Certificate Authentication and leave the rest as defaults. Go to the CSIv2 Inbound Transport and make sure **SSL-Supported** is selected.

      If it is a Network Deployment setting, go to **Server > Application Server >** *server_name_where_EJB_resides* **> Server Security > CSI Authentication Inbound**. Then select **Supported** for Basic Authentication and Client Certificate Authentication. Leave the rest as defaults. Go to **CSI Transport > Inbound** to make sure **SSL-Supported** is selected.

      For details, see the security articles Configuring CSIv2 inbound authentication and Configuring CSIv2 inbound transport.

   c. Restart the application server.

      The WebSphere Application Server is ready to take a C++ CORBA security client and a mutually authenticated server and client by using SSL in the transport layer.

4. Configure the C++ CORBA client to use a certificate in performing the mutual authentication.

   Client users are accustomed to using property files in their applications because they are helpful in specifying configuration settings. The following list presents important C++ security settings:

C++ security setting	Description
com.ibm.CORBA.bootstrapHostName=ricebella.austin.ibm.com	Specifies the target host name.
com.ibm.CORBA.securityEnabled=yes	Enables security.
com.ibm.CSI.performTLClientAuthenticationSupported=yes	Ensures client is supporting mutual authentication by certificate
com.ibm.CSI.performTransportAssocSSLTLSSupported=yes	Ensures SSL is used, not TCP/IP
com.ibm.ssl.keyFile=C:/ricebella/etc/DummyKeyRingFile.KDB	Specifies which key database file to use.

com.ibm.ssl.keyPassword=WebAS	Specifies the password for opening the key database file. WebSphere Application Server supports a utility called `PasswordEncode4cpp` to encode the plain password.
com.ibm.CORBA.translationEnabled=1	Enables the valueType conversion.

To use the property files in running a C++ client, an environment variable WASPROPS, is used to indicate where a property file or a list of property files exist.

For the complete set of C++ client properties, see the sample property file `scclient.props`, which is shipped with the product located in the `$install_root\etc` directory.

Interoperating with previous product versions

IBM WebSphere Application Server, Version 5 interoperates with the previous product versions (such as Version 4 and Version 3.5). Interoperability is achieved only when the Lightweight Third Party Authentication (LTPA) authentication mechanism and Lightweight Directory Access Protocol (LDAP) user registry are used. Credentials derived from Simple WebSphere Authentication Mechanisms (SWAM) are not forwardable.

1. Enable security with the LTPA authentication mechanism and the LDAP user registry. Make sure that the same LDAP user registry is shared by all the product versions.
2. Extract and add Version 5 server certificates into the server key ring file of the previous version.
   a. Open the Version 5 server key ring file using the key management utility (iKeyman) and extract the server certificate to a file.
   b. Open the server key ring of the previous product version, using the key management utility and add the certificate extracted from product Version 5.
3. Extract and add Version 5 trust certificates into the trust key ring file of the previous product version.
   a. Open the Version 5 trust key ring file using the key management utility and extract the trust certificate to a file.
   b. Open the trust key ring file of the previous product version using the key management utility and add the certificate extracted from Version 5.
4. If single signon (SSO) is enabled, export keys from the Version 5 product and import them into the previous product version. The Version 4 product requires the fix, PQ61779, and the Version 3.5 product requires the fix, PQ59667, for SSO to function.
5. Verify that the application uses the correct JNDI name. In Version 5, the enterprise beans are registered with long JNDI names like, `(top)/nodes/`*`node_name`*`/servers/`*`server_name`*`/HelloHome`. Whereas in previous releases, enterprise beans are registered under a root like, `(top)/HelloHome`. Therefore, EJB applications from previous versions perform a lookup on the Version 5 enterprise beans.

   You can also create EJB name bindings in Version 5 that are compatible with the previous version. To create an EJB name binding at the root Version 5, start the administrative console and click **Environment** > **Naming** > **Naming Space**

Bindings > **New** > **EJB** > **Next**. Complete all the fields and enter a short name (for example, `-HelloHome`) as the JNDI Name. Click **Next** and **Finish**.

6. Stop and restart all the servers.
7. Make sure that the correct naming bootstrap port is used to perform naming lookup. In previous product versions, the naming bootstrap port is **900**. In Version 5, the bootstrap port is **2809**.

Security: Resources for learning

Use the following links to find relevant supplemental information about Securing applications and their environment. The information resides on IBM and non-IBM Internet sites, whose sponsors control the technical accuracy of the information.

These links are provided for convenience. Often, the information is not specific to the IBM WebSphere Application Server product, but is useful all or in part for understanding the product. When possible, links are provided to technical papers and Redbooks that supplement the broad coverage of the release documentation with in-depth examinations of particular product areas.

View links to additional information about:
- Planning, business scenarios and IT architecture.
- Programming model and decisions
- Programming specifications
- Administration

Planning, business scenarios and IT architecture
- WebSphere Application Server Library
- WebSphere Application Server Support
- WebSphere Application Server Version 5 Security Redbook

Programming model and decisions
- JSSE Documentation

  Refer to the http://www.ibm.com/developerworks/java/jdk/security/jsseDocs.zip file for the Javadoc of the application programming interfaces (APIs), JSSE Reference Guide, and JSSE samples.

  –
- iKeyman Documentation

  Look in the http://www.ibm.com/developerworks/java/jdk/security/iKeymanDocs.zip file for the Secure Sockets Layer (SSL) Introduction and iKeyman documentation.
- JCE Documentation
  - For the JCA spec and JCE API usage refer to the http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip file.
  - For JCE sample applications refer to the http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip file.
  - For Java Cryptography Architecture Reference refer to the http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip file.
  - For how to implement a JCE provider refer to the http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip file.
  - For the Javadoc of JCE APIs refer to the http://www.ibm.com/developerworks/java/jdk/security/jceDocs.zip file.
- IBM SDK for z/OS, Java 2 Technology Edition, Version 1.4
  - Refer to Java 2 Security check permission algorithm.

Programming specifications

- J2EE Specifications
- EJB Specifications
- Servlet Specifications
- Common Secure Interoperability Version 2 (CSIv2) Specification
- JAAS Specification.

  For programming and usage in JAAS, refer to the documentation located at http://www.ibm.com/developerworks/java/jdk/security/ and scroll down to find the JAAS documentation for your platform. This document contains the following when unpacked:
  - login.html - LoginModule Developer's Guide
  - api.html - Developer's Guide (JAAS JavaDoc)
  - HelloWorld.tar - Sample JAAS Application
- Java 2 Platform, Standard Edition, v 1.4.2 API Specification

Administration

- WebSphere Application Server Version 4.0 Security Redbook: WebSphere Security Model.
- IBM HTTP Server Support and Documentation
- IBM Directory Server Support and Documentation
- IBM Application Developer Kit Readme
  - For IBM Application Developer Kit refer to `{was_install_root}/java/docs/readme.devkit.ibm.html`
  - For IBM Application Developer Kit Installation and Configuration Readme refer to `{was_install_root}/java/docs/readme.install.ibm.html`
- IBM cryptographic hardware devices
- Supported hardware, software and APIs prerequisite Web site
- WebSphere education on demand: Enabling security best practice tutorials

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