



# WebSphere Development Studio Client for iSeries Product Overview

*Version 5.1 for Windows*





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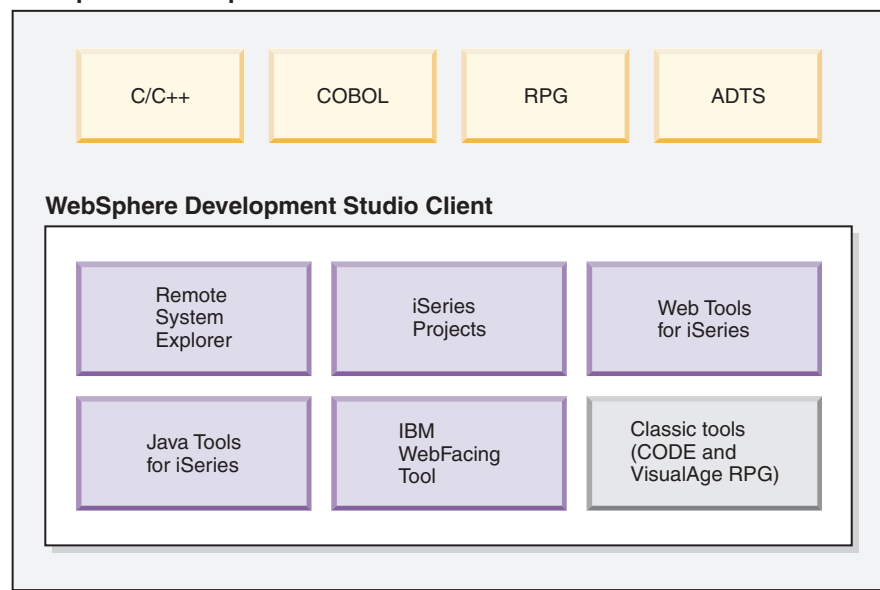
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## Chapter 1. Overview of IBM WebSphere Development Studio Client for iSeries

For a PDF version of this guide, click the following link: [Product overview PDF](#).

With IBM WebSphere® Development Studio Client for iSeries™ you can quickly develop and deploy traditional and e-business applications for your iSeries server. WebSphere Development Studio Client for iSeries is included with the compiler-based host product, WebSphere Development Studio. The following diagram illustrates the interaction between host and client tools:

### WebSphere Development Studio



The client component of the overall package is designed to help you accomplish three primary programming goals:

1. Develop and maintain iSeries applications
2. Create Web front ends to iSeries business logic
3. Create GUI front ends to iSeries business logic

You can use this product to perform all of the following tasks from a Windows® workstation.

#### Goal 1: Develop and maintain iSeries applications

- Connect to remote systems and perform programming tasks
- Edit, compile, run, and debug applications, whether green-screen, Web-based, or combined
- Work on iSeries applications when disconnected from the iSeries server
- Develop iSeries business logic in the Java programming language
- Develop in a team-based environment with version control

#### Goal 2: Create Web-enabled front ends to iSeries business logic

- Generate Web front ends to existing iSeries applications
- Develop Java servlets and Java Server Pages (JSP files) that access iSeries programs and data, whether your core skills are in Java or ILE and Original Program Model (non-ILE) programming
- Customize the appearance of a the static HTML pages and JSP files for a Web site
- Test Web applications on a local test environment
- Quickly add a Web interface to an existing application and deploy to an iSeries application server

**Goal 3: Create GUI front ends to iSeries business logic**

- Develop graphical user interfaces to RPG programs using visual design tools
- Produce Java applets, Java applications, and native Windows applications from the same source

**Additional goals**

- Develop XML resources
- Develop SQL statements
- Create Web services
- Generate Web pages from local and remote relational databases

## Understanding the WebSphere Studio family

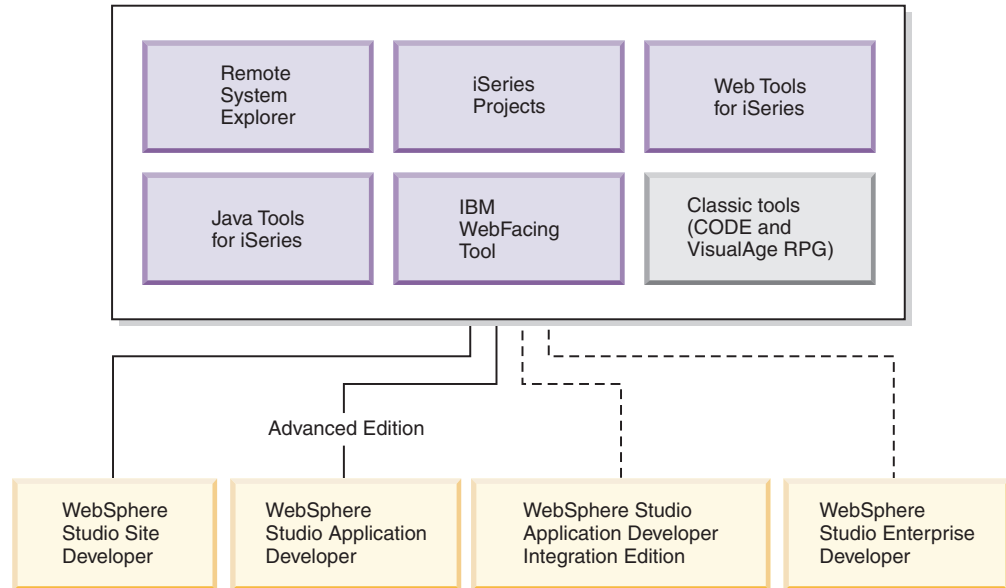
WebSphere Studio is IBM's solution for application and Web development. The product comes in two editions for iSeries programmers. Both editions of the product come with an additional base WebSphere Studio product:

- WebSphere Development Studio Client for iSeries includes WebSphere Studio Site Developer.
- **Advanced** WebSphere Development Studio Client Advanced Edition for iSeries includes WebSphere Studio Application Developer.

You can also install either edition over WebSphere Studio Application Developer – Integration Edition or WebSphere Studio Enterprise Developer (represented by the dotted lines). The following diagram illustrates how our product fits into the WebSphere Studio family of products:



## WebSphere Development Studio Client for iSeries



WebSphere Development Studio Client for iSeries is packaged with WebSphere Studio Site Developer. Site Developer includes support for Web services, XML development tools, and core support for Java and Web development tools.

**Advanced** IBM WebSphere Development Studio Client Advanced Edition for iSeries is packaged with WebSphere Studio Application Developer. This base product provides end-to-end support for the creation and maintenance of J2EE applications and Web services. It also provides extensive support for Enterprise JavaBeans, and for Java messaging services. See *What's new in this release* for a list of product features and extra features you gain with the Advanced Edition of the product.

See also our *Web Resources* for background information on all of the technology used in both versions of Development Studio Client.

The next two sections, *Tasks overview* and *Tools overview*, describe in more detail the main tasks that IBM WebSphere Development Studio Client for iSeries addresses, and the product tools used for these tasks:

- Read the *Tasks overview* if you are new to the product and want to understand how to choose the right tools to do your job.
- Read the *Tools overview* if you have used a previous version of this product, or a similar product and you want to understand what new tasks you can perform with each of the tools.

### Prerequisite information

1. If you have not yet installed the product, see the installation notes on the first product CD or the product DVD under `x:\install\help\helpnls\install.htm`, where *nls* denotes the appropriate language.
2. You can use the integrated server and test environment for the development and testing stages of your product. To deploy and run your e-business applications in a production environment, you need to install and configure IBM WebSphere Application Server for iSeries and an HTTP server such as IBM

HTTP Server for iSeries (powered by Apache) on the hosting iSeries server. Some configuration instructions and links to other sources of documentation are included in this guide.

3. You can also deploy your Web applications to WebSphere Application Server – Express. This is an entry-priced, entry level server in the WebSphere Application Server family, providing support for static content, servlets, and JSP files.
4. If you purchased Development Studio Client as a workstation-only product, you need to ensure that WebSphere Development Studio is installed on any iSeries server where you do the host portion of your development work. WebSphere Development Studio is not required on the iSeries server you use for Web application deployment.

## Scenario information

To help you get started with Development Studio Client, a scenario is included in the product documentation as the iSeries retail store scenario application. The same material also exists on our Web site, updated occasionally between releases. If you choose to work with the version on our Web site, you can download the sample application along with accompanying documentation: iSeries Scenario Application. The scenario applies to both editions of Development Studio Client, Version 5.1.

## What’s new in this release?

Version 5.1 of Development Studio Client and Development Studio Client Advanced Edition include the following new features, sorted by your role and the version of Development Studio Client you purchased. (Please see “Tools overview” on page 11 for descriptions of all components):

| Your role                | New features   |
|--------------------------|--|
| RPG and COBOL programmer | <ul style="list-style-type: none"> <li>• Enhancements to the Remote System Explorer:               <ul style="list-style-type: none"> <li>– Multiple selection when you compile members</li> <li>– Fast open of iSeries members</li> <li>– PDM-style filtering of iSeries objects from your library list</li> <li>– The ability to define new procedures when editing ILE RPG code in the Remote Systems LPEX editor with an RPG Procedure wizard.</li> </ul> </li> <li>• Enhancements to iSeries Projects so that you can generate CL compilation scripts</li> <li>• Enhancements to Content assist (also known as Code assist); you can now, for example, use CTRL+space to invoke a list of code segments for your target column and specification</li> <li>• The ability to define code templates using a Templates preference page and then using Content Assist to insert the code into the Remote Systems LPEX editor.</li> <li>• Enhanced Outline view to show you more of the structure of your RPG or COBOL programs, synchronized with the LPEX editor as you click on the outline structure</li> </ul> |

|  |   |
|--|---|
| Java developer                             | <ul style="list-style-type: none"> <li>• Event support for the Visual Editor</li> </ul> <p><b>Advanced</b> For Advanced Edition users of Development Studio Client, Version 5.1</p> <ul style="list-style-type: none"> <li>• Improved speed and memory performance for Enterprise JavaBean (EJB) deployment</li> <li>• Hot method replace (hot swap) support, so that you do not need to restart the integrated iSeries debugger after you make changes to your Java methods</li> </ul> |
| Web developer                              | <ul style="list-style-type: none"> <li>• The ability to create, import, and manage Web sites with a user-friendly Web site designer</li> <li>• Event support for the Web tools for Page Designer</li> <li>• Struts 1.1 support</li> </ul> <p><b>Advanced</b> For Advanced Edition users of Development Studio Client, Version 5.1</p> <ul style="list-style-type: none"> <li>• The ability to run a Web application in a portal server with a new iFrame portlet and sample</li> </ul>  |
| Web services developer                     | <ul style="list-style-type: none"> <li>• Web services description language editor and Explorer support, including Web services interoperability, a technology to support ready-to-run Web services across platforms, applications, and programming languages</li> </ul>   |
| RPG programmer and IBM WebFacing Tool user | <ul style="list-style-type: none"> <li>• Struts 1.1 support</li> <li>• Performance enhancements to support higher data volumes</li> </ul> <p><b>Advanced</b> For Advanced Edition users of Development Studio Client, Version 5.1</p> <ul style="list-style-type: none"> <li>• The ability to generate open-source Struts infrastructure for your Web interface</li> <li>• The ability to replace the default HTML code by using conversion-time extension points</li> </ul>            |

|                |  |
|----------------|--|
| All developers | <ul style="list-style-type: none"> <li>• Enhanced performance, particularly in the WebSphere test environment and for User Interface development</li> <li>• Migration from Eclipse Version 2.0 to Version 2.1, with improvements to the Java editor, debugger, and refactoring process, as well as improvements to JUnit integration, the plug-in development environment, general editor navigation, and project organization</li> <li>• The ability to publish, test, profile, and debug Java and WebSphere Application Server applications on supported remote servers with the IBM Agent Controller</li> <li>• Structured Query Language for Java (SQLJ) support, including support for the SQLJ Editor, SQLJ Profile, DB2 SQLJ stored procedures, and Debugging capabilities</li> </ul> <p><b>Advanced</b> For Advanced Edition users of Development Studio Client, Version 5.1</p> <ul style="list-style-type: none"> <li>• Improved speed and memory performance for Enterprise JavaBean (EJB) deployment</li> <li>• New version of Rational<sup>(R)</sup> ClearCase<sup>(R)</sup> LT featuring improved integration with Application Developer and improved Unified Change Management (UCM) performance</li> <li>• The ability to detect and diagnose errors in code that contains Active Script (such as client-side JavaScript) or Active Script objects, with the Active Script debugger</li> </ul> |
| New users      | <ul style="list-style-type: none"> <li>• Improved iSeries samples and examples</li> <li>• A preview of iSeries cheat sheets, with a Remote System Explorer cheat sheet provided</li> <li>• A ShowMe tutorial to help you understand how to use the workbench</li> </ul>  |

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## Tasks overview

The section explains how to use the different tools in Development Studio Client to accomplish your major development goals.

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## Goal 1: Develop and maintain applications

Development Studio Client is designed to ease the entire life cycle of developing and maintaining iSeries applications. Whether you work on traditional green-screen applications, or are responsible for making existing iSeries programs accessible as Web applications, your productivity is greatly increased as you work on the following tasks.

### Edit, compile, and debug ILE and non-ILE applications

You can create and manage development projects on your iSeries server from your Windows-based workstation with the Remote System Explorer and iSeries projects. With these tools, you can view iSeries libraries, files, and members. You can also launch the host compilers, the workstation editor, and various debuggers.

Your program editing tasks are simplified with the Remote Systems LPEX editor. The editor can access source files on your workstation or your iSeries server. When a compilation results in errors, you can jump directly from the compiler messages to an editor containing the source. The editor opens with the cursor positioned at the offending source statements so that you can correct them.

With the integrated iSeries debugger you can debug your program running on the iSeries server from a graphical user interface on your workstation. You can also set breakpoints directly in your source before running the debugger. The integrated iSeries debugger client user interface also enables you to control program execution. For example, you can run your program, set line, watch, and service entry point breakpoints, step through program instructions, examine variables, and examine the call stack. You can also debug multiple applications, even if they are written in different languages, from a single debugger window. Each session you debug is listed separately in the Debug view.

## **Develop iSeries business logic in Java**

You can use the Java development tools that are provided with IBM WebSphere Development Studio Client for iSeries, to create Java applications that can access iSeries data. Java development tools are extended to provide iSeries support so that you can call native iSeries applications from your Java code.

## **Create and edit DDS definitions easily**

You can create and update DDS definitions for display files, printer files, and physical files using CODE Designer when you are on or offline. This tool provides a graphical user interface with which you can quickly define your DDS files, and save them locally or upload them directly to your iSeries server. By creating your DDS screens visually you can improve their usability (because more of your time is spent on visual design, and less on getting the syntax right) and your programming productivity.

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## **Goal 2: Create Web front ends**

With Development Studio Client you can make your iSeries applications and data accessible beyond the green-screen interface. You can generate a Web-based user interface for your program's DDS screens, or create a new Web interface that connects directly to your program's input and output parameters. Which path you choose depends on the way your iSeries application is designed, and on trade-offs you need to make between rapid deployment and customized look and feel. With IBM WebSphere Development Studio Client for iSeries you can perform the following Web-enabling tasks for your iSeries applications.

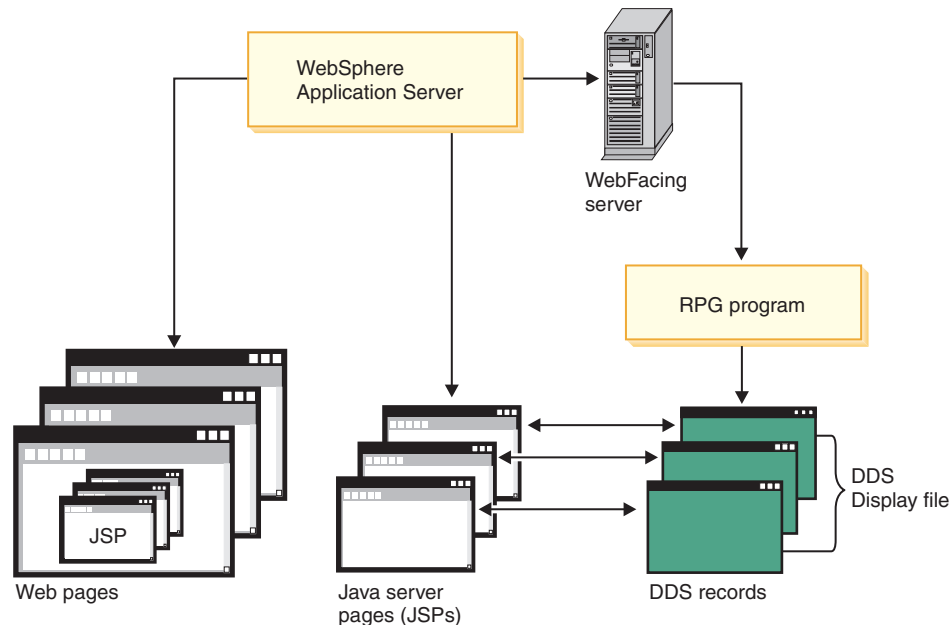
### **Generate Web front ends to existing applications**

You can use the IBM WebFacing Tool to create Web front ends to iSeries applications that use DDS for their green-screen transactions. You choose a Web style for your green-screen application, generate a set of JSP and XML files that interact with the logic of your program, and then easily test your application in the WebSphere test environment of the workbench. When you are ready to deploy your application, you can generate standard J2EE WAR and EAR files that can be installed on a WebSphere Application Server.

The WebFacing Tool is ideal for applications that you want to deploy broadly over a corporate intranet or the Internet, where rapid deployment takes precedence over customizing the look and feel of each page. With the WebFacing Tool you can continue to deliver your application as a 5250 application, and use the same ILE and non-ILE programs to deliver the application through the Web. Note that there are some restrictions, described in the WebFacing documentation, on which DDS keywords can be converted to generate sets of JSP and XML files.

CODE Designer has been enhanced to work with the WebFacing Tool. A new **Web Settings** section helps you specify how your DDS fields will be handled by a browser after they are converted using the WebFacing Tool, without affecting their appearance on the green-screen.

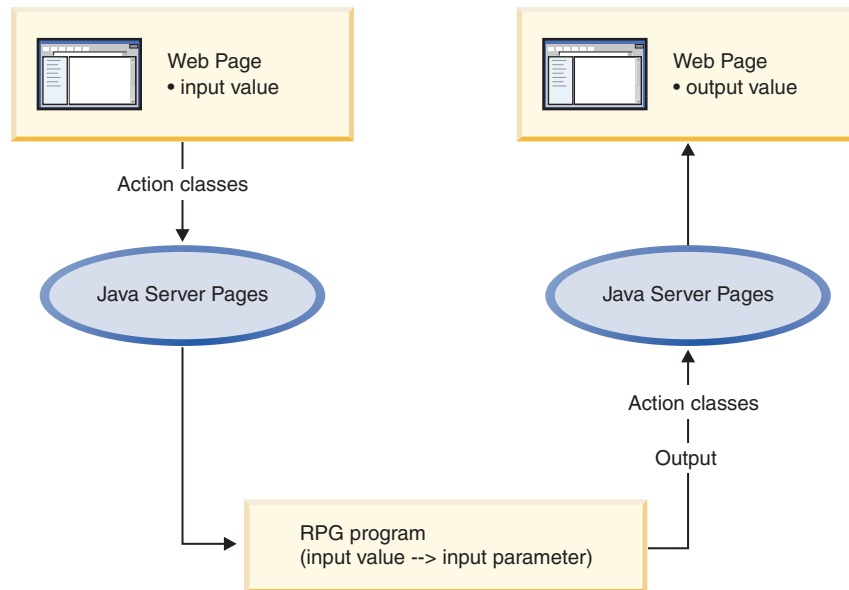
The following diagram illustrates the run-time process for the WebFacing Tool:



Use the WebFacing Tool for programs where the DDS user interface is interwoven with the business logic. If you architect programs with a set of distinct entry points for each element of business logic, and a user-interface component that simply generates appropriate calls to business logic entry points based on user inputs, you should consider using Web development tools to develop your own servlets and JSP files to access your code, as described in the next task.

## Develop Java Action classes and JSP files to access iSeries programs and data

You can create interactive Web pages using Web development tools. Use the Web Interaction wizard to define how your pages interact with one or more ILE or non-ILE applications. This wizard generates Java Action classes and JSP files for use with data from HTML forms. When the end user enters data in a form, the input becomes data to your ILE and non-ILE programs, and the output from the programs is formatted for the Web. Your ILE and non-ILE logic can be separated into different programs for each stage of input and output (known as a Web transaction), or can be a single service program with entry points to handle each Web interaction. The following diagram illustrates the Web development tools process:



You can also use Web development tools to develop customized Java servlets that run on the iSeries server. These servlets make use of iSeries data directly, or can access the data through ILE and non-ILE applications. IBM Toolbox for Java classes included with Java development tools let you access iSeries data files and issue ILE and non-ILE program calls from the Java servlets. You develop the servlets using Web development tools, and use the Record I/O and Program Call classes from the toolbox to retrieve and update iSeries data. You can launch your servlets or customize their output from the JSP files that you create in the Page Designer editor in Web development tools.

## Customize the appearance of your Web site pages

You can easily customize your HTML and JSP files using the editing tools in Web development tools. Use these tools to create and update input forms, change the appearance or placement of blocks of text, and add backgrounds and images to your pages. The iSeries-specific Web components help you create Web versions of your input and output pages with the same kinds of input validation, output formatting, and subfile controls that native DDS screens provide. You do not need a detailed knowledge of HTML or Java to accomplish these tasks.

## Test and deploy your Web-enabled applications

You need an easy test mechanism for your Web-enabled applications. These include applications you have hand-coded on your workstation that use:

- HTML
- JSP files
- Java servlets
- Web front-ends created using one of the code-generating wizards in Web development tools.

You can easily run your program in the WebSphere test environment of the workbench, quickly make changes, and retest, rather than redeploy, your application every time you want to verify functions. When you are finished, you can package and deploy your Web applications as J2EE-based Web archive (WAR) and Enterprise Archive (EAR) files, and then install them in a WebSphere Application Server.

When you deploy your work, Web development tools take care of creating the necessary files and folders on the iSeries server, and also of creating or checking for the WebSphere Application Server services that your application needs. Then you can use the WebSphere Application Server console to stop and start the required services after deployment.

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## **Goal 3: Create GUI front ends**

You do not have to deploy your iSeries applications on the Web in order to give them a more modern look and feel. You can produce graphical user interface (GUI) front ends to your iSeries applications with Java development tools.

### **Develop graphical user interfaces for RPG programs**

If you are already an experienced RPG programmer, you can create graphical user interfaces to RPG programs very quickly with VisualAge RPG, by selecting visual parts from a parts palette and dropping them on a representation of your program's user interface. You can alter the size and text of push buttons and check boxes, and associate user events, such as the pressing of a button, with code you develop. The code can include statements to access iSeries databases on a specific server. The compiled program runs as an executable on a Windows system, or as an applet in a Java Virtual Machine in a Web browser, and accesses remote data on the iSeries server using TCP/IP. The only skills you need to develop these thick-client applications are the RPG skills you already have, and the ability to learn the straightforward user interface of the integrated development environment. The communications code is generated for you in the compiled program.

### **Produce applets and native graphical user interfaces from the same source**

After you create a visual interface and associated logic on your workstation, you can deploy your application as a native Windows application, or as a Java applet that can run in any Web browser with an appropriate Java Virtual Machine (JVM™). This gives you extra flexibility in making your application available to users. If you want to control access tightly, you can deploy the application as a Windows executable. If you want widespread access you can place your applet (and associated files generated by Java development tools) on a Web site, so that users with browser access to the Web site can run the applet in their browser and communicate with data on the iSeries server.

### **Create Java-based graphical user interfaces to ILE and non-ILE applications**

Use your own custom calls to Java GUI classes (such as Swing classes), and the Java visual editor to develop your graphical user interface, and then use classes provided by IBM Toolbox for Java or Java beans provided by Java development tools to access your iSeries server. Although this option gives you great flexibility over your program's look and feel, it requires a bit more work than using Web development tools to develop HTML-based interfaces to iSeries programs.



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## Tools overview

This section describes the main tools of Development Studio Client, and the kinds of tasks you can perform with each tool. The tools are:

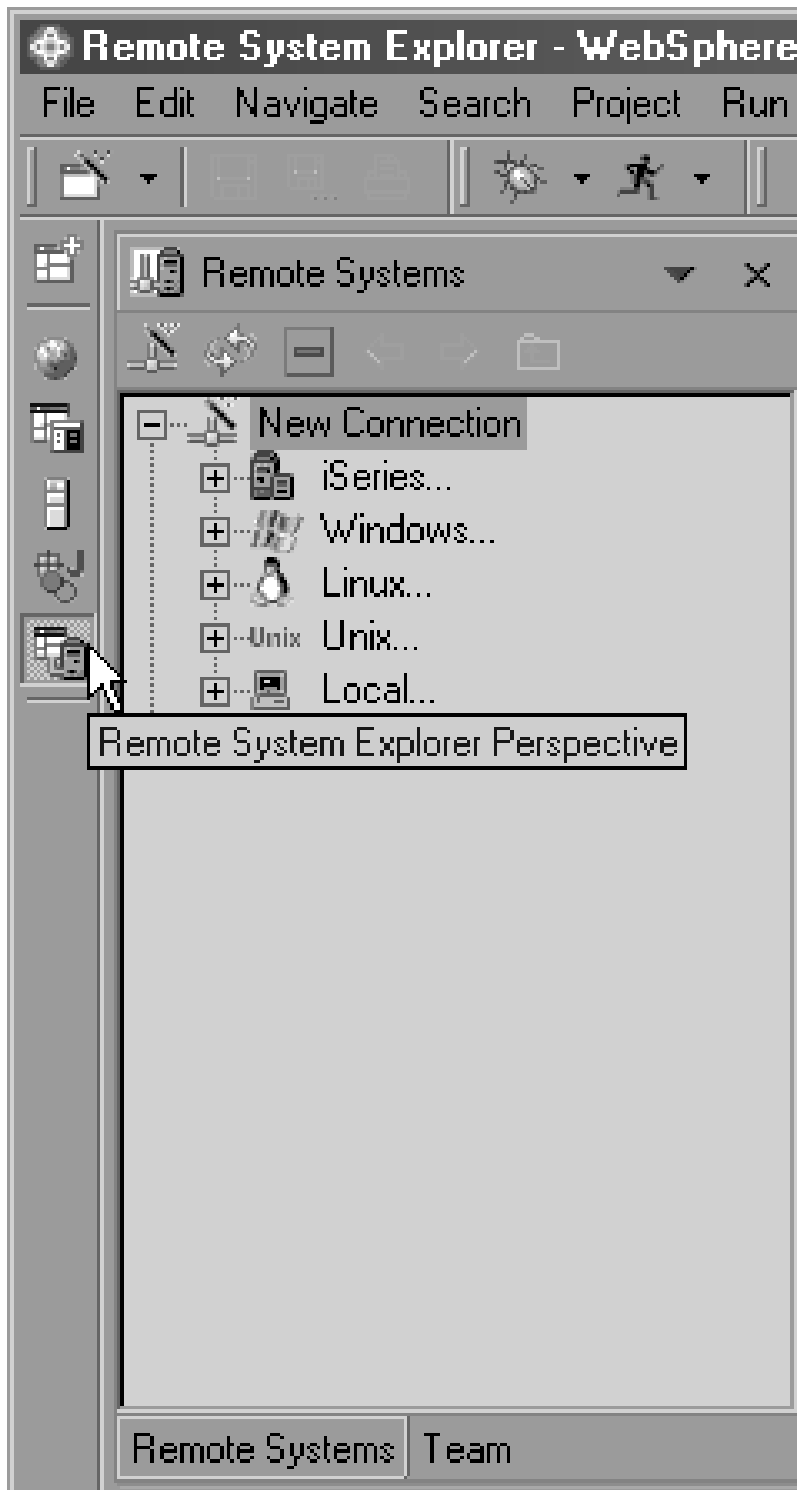
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- “The IBM WebFacing Tool” on page 18
- “VisualAge RPG” on page 19
- “CoOperative Development Environment (CODE)” on page 19
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### The workbench-based integrated development environment

IBM WebSphere Development Studio Client for iSeries uses WebSphere Studio Workbench version 2.1. The workbench offers you e-business tools in a comprehensive development environment that integrates all your tools, teams, assets, and other workbench-based projects seamlessly. The platform provides the core frameworks and services upon which all plug-in extensions are created, the run time in which plug-ins are loaded, integrated, and executed, plus a common user interface model for working with tools. Plug-in tools can be integrated into the workbench portable Application Program Interface, yet run unchanged on any supported operating systems. Thus, the architecture discovers these plug-ins and integrates them all into the new base environment, providing a standard user navigation model for building integrated Web and application development tool projects. Because development resources for a project are stored in a single repository, the workbench is ideal for resource sharing and for providing consistent team support for shared projects.

#### Perspectives

Perspectives define the initial set and layout of views in the Workbench window. They provide a set of capabilities aimed at accomplishing a specific type of task or working with specific types of resources. Open perspectives are represented by icons on the shortcut bar (the toolbar at the top-left of the workbench window). When you have more than one perspective open, you can switch between them by clicking the icons on the shortcut bar.



You can also customize your workbench desktop with the specific views or perspectives (task-oriented combinations of views) you need for everyday work, and still have access to other functions if you need them later.

## iSeries development tools

The two major iSeries development tools, the Remote System Explorer and iSeries projects, provide the framework, user interface, editing capability, and performable actions on iSeries files, commands, and jobs.

A good place to begin in the help contents is: Native iSeries applications: accessing and editing in the Remote System Explorer.

The Remote System Explorer and iSeries projects include the following features:

- Tools to access and edit Native iSeries applications
- Universal file and command subsystems
- iSeries exploration and command execution
- iSeries actions for edit, compile, run, and debug
- iSeries Projects perspective
- Extension of the Remote System Explorer and iSeries Projects for business partners

### **Tools to access and edit Native iSeries applications with the Remote System Explorer and iSeries Projects**

iSeries development tools include two workbench perspectives that support views, editors, tools, and tool extensions, all to help you develop applications while working with remote operating systems. The interface gives you access to files and resources, and the ability to monitor jobs and run commands. The Remote System Explorer and iSeries Projects perspectives are programming environments, providing support similar to CODE Project Organizer, but in the workbench. iSeries development tools also support other system types, such as UNIX<sup>®</sup>, Linux, and Windows. The perspectives guide you through various connections to your remote systems, and it provides support for the sharing of work through a team perspective. Most users can easily do their work using the Remote System Explorer perspective. The iSeries Projects perspective is designed more specifically to support structured programming, offline development, and team collaboration.

The Remote System Explorer and iSeries projects provide additional support for:

- Manipulating library lists
- Using wizards to create data areas, data queues, and message files
- Using copy, paste, and drag-and-drop support, even between host systems
- Defining your own actions to support all PDM substitution variables
- Searching source members for text and hexadecimal strings, with integrated feedback you can click to jump to the appropriate place in the source
- Extending the Remote System Explorer and iSeries projects by plugging in third-party tools

### **Universal file and command subsystems**

You can export and import files, explore remote files, and execute remote commands for servers other than iSeries, such as UNIX, Linux, and Windows servers. Using the Remote System Explorer, you can use the workbench editor of your choice for any remote file on any type of remote server. After running programs on a remote server, you can double-click errors in the Remote System Explorer command console to automatically open the remote source file in question at the position of the error.

## **iSeries exploration and command execution**

Use the Remote System Explorer to list libraries, objects, and source members to your local machine, and organize these elements into filters. You can create and share filters for rapid access to specific artifacts and commands. Filters can also be partitioned into pools to allow for easier organization of filters. To save time, you can also directly open source members directly in the Remote Systems view without having to create a filter. You can work with iSeries native file system (QSYS) files and CL commands, and generic file and command subsystems that involve the Integrated File System files and QSHELL commands. You can also create your own actions and commands, or use the ones supplied by IBM for any remote object.

## **iSeries actions for edit, compile, run, and debug**

The Remote System Explorer contains the Remote Systems LPEX editor, so that you can edit source code directly in the workbench. The interface provides right-click actions so that you can compile and run your programs.

The Remote Systems LPEX editor also supports:

- The Outline view and Content assist for ILE COBOL and ILE RPG source
- The ability to create a new RPG procedure when editing source in the editor
- RPG, COBOL, CL and DDS syntax checking
- RPG, COBOL, and DDS program verification
- Enhanced debugger support for breakpoints in RPG, COBOL, CL, C, and C++ source
- Location bookmarks in source code

## **iSeries Projects perspective**

The iSeries Projects perspective is the ideal tool for team-based RPG, COBOL, and DDS application development. The perspective encourages structured programming and allows for disconnected development. In the perspective, you can also monitor error feedback, and inspect timestamps to resolve conflicts between remote and local files.

## **Extension of the Remote System Explorer and iSeries Projects for business partners**

Using the workbench IDE, you can integrate your tool sets into the Remote System Explorer. Many leading iSeries tool vendors are actively integrating their tools into Development Studio Client. In this release, we provide enhanced functions to make this easier.

## **iSeries Web development tools**

iSeries Web development tools give you the ability to create new e-business applications that use a Web-based front end to communicate with the business logic in an ILE or non-ILE language program residing on an iSeries server. You can create the high-level design of your Web site and apply page templates using Web site designer. Then, you can create the individual pages with Page Designer, or generate input and output JSP files with the Web Interaction wizard. You can also add iSeries Web components to your pages, for example, Web equivalents of iSeries command keys, input fields that accept only particular types of data, or output fields such as subfile names.

The tools also give you open standards, greater flexibility, and the ability to tie in existing applications with Web services wizards to help you write applications that are portable across platforms.

Web development tools include the following features:

- Integrated visual layout tool for JSP/HTML file creation, validation, editing, and debugging
- Compliance with Java 2 Enterprise Edition (J2EE) specifications and hierarchy, giving you access to enterprise systems, thereby helping you create Web projects
- Maximum programming performance, with automatic Web link updates, JavaScript media tools for image editing and animation, built-in Java refactoring tools, XML file creation and editing, transformation of XML using Visual XML, an integrated unit-test environment and a distributed, remote debugger
- Integrated support for the WebSphere Application Server (WAS)
- HTTP/FTP import support, FTP export to a server, and Web Application Archive (WAR) file import and export support
- Link viewing, parsing, and management, so that iSeries Web development tools update links when resources move or are renamed
- A Servlet wizard that can create servlets and related files
- Wizards that generate Web applications from database queries and beans
- Integration in the Web development tools test environment

The specific iSeries extensions of Web development tools include:

- Updates to Page Designer to support Web components and a links builder. Web components replace ActiveX Design time Controls, can be rendered in the HTML Designer, and provide test field, label, drop-down, and push-button controls
- Support for the Struts run-time environment through the Web Interaction wizard
- A Web Site Designer tool that helps you create graphic titles, logos, buttons, and photo frames
- Integration with the Struts Web Diagram editor
- iSeries Web Tools Run-time Configuration wizard that captures server name, user ID, password, and library list information
- A Web Interaction wizard that links the Web components for a Web page to parameters of your Program Call and defines the Program Call parameters without the need to deal directly with JSP files and iSeries classes. The wizard is designed so that you can access iSeries programs from a Java or Web application, or include them as the base for a Web service

## **iSeries Java development tools**

iSeries Java development tools give you the ability to develop Java applications and write, compile, test, debug, and edit programs written in Java. Java development tools include an integrated environment that supports the complete cycle of Java program development. Java development tools are the ideal tools for:

- Developing and compiling business logic in Java that runs on a remote server, such as an iSeries or Linux server
- Creating applications and Java GUIs that access existing server data, business logic, and resources
- Deploying or exporting your Java class or source files to a remote server
- A visual Unified Modeling Language (UML) editor with two-way synchronization between source and GUI
- JavaScript debugger, library, and code assist
- Enterprise JavaBean (EJB) to relational database table (RDB) mapping, with the model, run-time environment, and interface to help you with the mapping

- Support for EJB query language, container managed persistence (CMP) version 2.0, and message-driven Java beans
- The ability to externalize strings for creating multilingual applications

The specific iSeries extensions of Java development tools include:

- Support for PCML 4.0
- The iSeries Java Transform and Run view, for remotely transforming and running Java applications
- iSeries-specific launch configuration support, so that you can remotely execute and debug Java programs on an iSeries server
- Export to and import from the universal file system
- A Program Call wizard that can create Java beans and Program Call Markup Language (PCML) files to call your iSeries programs or service programs. The Java beans can also be used to create Web Services using Web Services development tools.
- The ability to trace and determine performance issues for iSeries Java programs with the Profiling perspective
- The IBM Toolbox for Java
- iSeries-specific Java beans

## Struts environment support

Development Studio Client offers support for Struts and the Web Diagram editor. Struts is a framework for building Web applications based on the Model-View-Controller paradigm, organizing the application into three separate components:

- Model: the application model with corresponding data representation and business logic
- View: data presentation, providing views for user input
- Controller: to dispatch requests and control data flow

The framework provides internal caching and lower run-time memory requirements. The Controller component is built to integrate with other technologies, including the technology behind the iSeries Web development tools and the WebFacing Tool. Support is added for these two tools. The Web Diagram editor is the visual development environment for developing Struts-based applications. You can drag and drop JSP files and action servlets onto a palette, make connections between items on the palette, and then realize those items by double-clicking and editing them through a wizard or source code.

## Web Services development tools

When components in a system are tightly coupled, and based on database records and flat files, they are rigid and sensitive to change. Web Services tackle the problem of inefficient distributed computing, because system components need to be loosely coupled and dynamically bound to provide greater flexibility, scalability, lower overhead costs, and hence, better business growth. Web services are self-contained, modular applications that can be described, published, located, and invoked over the Internet, employing 'just-in-time' integration of services. The architecture involves a relationship between Service providers, brokers, and requesters. More specifically, Service requesters submit a request to a Service broker, which finds the right service from a Service provider. Web Services development tools allow you to develop this service.

The Web Service wizard creates a Web Service, using a JavaBean generated by the iSeries Program Call wizard, to call one or more server programs or service program procedures on the iSeries. More specifically, the Web Service wizard works in the context of a Web Project and allows for creation, deployment, testing, generation of a proxy, and publication to a Universal Description, Discovery, and Integration (UDDI) registry of Web services based on Java beans, input and output URLs, DB2® XML extender calls, DB2 Stored Procedures, and SQL queries.

Web services also includes:

- Support for UDDI V2.0 and discovery through Web Service Inspection Language (WSIL)
- Support for Simple Object Access Protocol (SOAP), a standard for transporting data between business applications
- A Web services client test environment
- Samples enhanced with pop-up actions

## XML development tools

XML development tools is the ideal environment for developing XML-based applications. The environment includes tools for:

- building DTDs, XML Schemas, XML, and XSLT
- mapping between XML and different back-end files such as an SQL query or relational table
- debugging XSL code

Using XML development tools, you can:

- Generate Java beans from XML documents and vice-versa
- Use the Xalan processor to create HTML and XML documents with the XSL Stylesheet
- Create and execute an XPath with the XPath wizard
- Generate documents access definition scripts for use with IBM DB2
- Create XML documents from DB2 data and vice-versa
- Validate your XML code for use with an iSeries server

## Server development tools

Server development tools let you test your applications in locally or remotely installed run-time environments. You do so by creating a server project that represents your environment and can associate your Web projects with a server configuration. This tells your server tools how to configure the instance for that particular Web project.

Server development tools include the following components and features:

- The WebSphere test environment
- A local copy of the WebSphere Application Server run-time environment so that you can test Web and Enterprise Application Archive projects
- A local copy of the TCP/IP Monitoring Server run-time environment, which forwards requests and responses, and monitors test activity
- Support for the local Apache TomCat run-time environment so that you can test Web projects that contain servlets and JSP files

- Support for Remote Agent Controller (installed on your remote machine) if you want to let WAS create a server project instance and configuration for you when you run your Web application (rather than having you create the server project yourself)

**Note:** If you use an external server instance, such as WAS on your Windows machine or remote iSeries server, you need to deploy your project before running. To deploy, you can use Server development tools to create a remote file transfer instance to handle the details of how and where to copy files.

## Database development tools

Database development tools support any local or remote database that has a Java™ Database Connectivity (JDBC) driver. Database development tools contain the following features:

- Relational Schema Center– views to enable database, table, view, index, and key creation
- Online and offline support– metadata generated as XML
- SQL Query Builder– visually constructed SQL statements that perform SQL and XML mapping
- A meta-data model that enables tools needing relational database information to share connections and function independently
- A visual interface for creating databases, tables, and views
- Support for DB2, DB2 for iSeries and for 390, Oracle, Oracle9i, Sybase, MySQL, SQL server, and Cloudspace
- Validation for use with an iSeries server

## The IBM WebFacing Tool

With the IBM WebFacing Tool, you can quickly convert your DDS display file source members so that the user interface of your iSeries programs can run in a browser. When you convert your DDS display files, JSP files and Java beans are generated for you that substitute for the DDS code and make Web access possible.

In the WebFacing Project wizard, you can select one or more DDS source members to convert, and select a Web look and feel from one of several predefined styles, or you can design your own Web style for use with your applications. The tool creates three JSP and XML files for your record formats. The XML files hold the data for the record format, or control its appearance or other characteristics, and the JSP handles displaying the Web version of the screen, prompting for data, and handling input errors. The wizard generates an application home page to launch the Web-enabled version of your program.

When a user invokes a converted application from the browser, the WebFacing server on the iSeries server starts the server program. The server intercepts all calls to READ, WRITE, and EXFMT operations to DSPFs, so that in many cases your program (\*PGM) can run without modifications, and without even detecting that it is being accessed using WebFacing. You might need to make coding changes if your application uses DDS keywords that are not supported by WebFacing, or if you want to modify the DDS screens so that the conversion to Web format produces a more attractive or consistent result.

The WebFacing Tool also contains:

- **Advanced** Support for viewing and printing spooled files



- **Advanced** Struts-compliant code generated by the WebFacing Tool conversion process
- Automatic configuration for UTF-8 support when you deploy to WebSphere Application Server version 5.0
- Support for custom tags and run-time extensions
- Support for function keys within window records

## VisualAge RPG

Using VisualAge RPG you can develop and maintain client/server applications in a visual development environment on the workstation. You leverage your existing RPG skills to create graphical user interface (GUI) applications that you can deploy as native Windows applications, or as Java applets that can run on any Java-capable Web browser. These applications can access iSeries data and other iSeries objects.

With VisualAge RPG you can create, edit, compile, and debug applications on your workstation. You can build an application from the top down. You start by focusing on the look and feel of the interface, and then you tie all the parts together with workstation RPG logic that you write in the VARPG language. You can reuse RPG logic and import display files (DSPF) from an existing application.

You can learn VisualAge RPG quickly thanks to its tightly integrated tools and its visual development environment. For example, you can quickly create text, buttons, and fields in your design window using a point-and-click action.

VisualAge<sup>®</sup> RPG includes the following features and tools:

- The VARPG compiler incorporates the latest changes from the ILE RPG V5R2 compiler.
- You can create interfaces in the GUI Designer by selecting visual parts and dropping them onto your design window, rather than by coding UI capabilities in source code. Select a part such as a push button or an entry field, drag it with the mouse, and drop it on the window you are designing. You can then select an event for the part from the part's popup menu, and use the editor to create the workstation RPG program logic behind the event. From the GUI Designer, you can also launch the editor, the compiler, and the debugger.
- The syntax checker helps you detect syntax errors quickly in your VARPG programs.
- The compiler performs compilations on the workstation, where your applications eventually run.
- The help and message compiler allows you to incorporate online help and messages into your workstation application.
- The editor allows you to add new editor functions or change existing ones. Language-sensitive editing and language-sensitive help are provided with the editor.

## CoOperative Development Environment (CODE)

CODE gives you a suite of utilities for creating source and DDS files, and managing your projects. CODE consists of CODE Designer, CODE Editor, and CODE Program Generator.

## CODE Designer

CODE Designer removes the drudgery from managing your DDS files. Using a customized visual editor, you perform the following DDS editing tasks with CODE Designer:

- Create new DDS screens, printer files, and physical files
- Add text to DDS screens, simply by clicking and typing
- Insert new screen fields for input, output or both, from a popup menu
- Manipulate fields and text using drag-and-drop actions
- Change the attributes and properties of data fields and plain text
- Link DDS fields to iSeries database fields, by connecting to the database and selecting appropriate fields from a pull-down list
- View the hierarchical relationships among files, records, fields, help specifications, keys, and keywords in each selected DDS object
- Organize records into groups for a particular screen, report, or printer file

You can view the DDS source for each element when you add or update it. You can even edit the DDS code that CODE Designer generates for you. CODE Designer also saves you time by flagging errors before the DDS source is compiled on the iSeries server.

## CODE Editor

CODE Editor provides many powerful editing features for file management:

- Seamless access to local and server files
- Member locking of OS/400 members and Application Development Manager parts that is similar to SEU (source entry utility)
- Concurrent multiple edit sessions as well as multiple views of the same document
- Navigation through procedures and subroutines in one or more files
- Multiple file search and a file compare utility.

CODE Editor also includes:

- Language-sensitive editing that offers token highlighting, interactive syntax checking, and online language-sensitive help for C, C++, REXX, CL, Java, RPG, COBOL and DDS, as well as program verifiers for some of these languages
- Capability to view only specific types, such as C specs or lines with a specific string pattern
- Unlimited undo and redo actions
- Local verification and error feedback
- Block move, insert, delete, and case switching actions
- Sequence numbers, which allow the use of SEU-style commands in the prefix (sequence number) area
- Command shell for running local or server commands with logged output

With CODE Editor you can develop not only source code, but custom programs that run in the editor to make you more productive. It provides these programming features:

- Ability to customize and program the editor using REXX or Java. You can also use the set of Java macros or "Lpexlets" that are provided with the product, to help you understand your code. (To use these macros, you must have the Java 2 Software Development Kit [J2SDK] from JavaSoft™ installed on your workstation.)

- Powerful regular expression searching
- Keystroke recording and playback

### **CODE Program Generator**

You can use CODE Program Generator on your workstation to:

- Specify compiler and linker options
- Submit requests to compile, bind, or build objects on the host or local workstation

You can also compile and link your C and C++ programs from a Windows command line:

- The **ixlc** command can compile source files residing on your Windows client, and can be used in conjunction with make files to control the compilation process.
- The **ixlclink** command links modules residing on an iSeries system to create bound programs.

You can also use **ixlc** as a host-based command, using the QSHELL interface from a 5250 emulation window.

## **Integrated iSeries debugger**

The integrated iSeries debugger helps you debug code that is running on the iSeries server or on your Windows system, using a graphical user interface on your workstation. It supports the following tasks:

- Setting breakpoints on a source code line or on a function or procedure, and setting watchpoints to see when a variable or storage location gets changed.
- Two types of stepping operations: step-into and step-over. You can even step between functions or procedures written in different languages.
- Viewing the contents of global or local variables, call stacks, and data storage in specialized panes.
- Quick restart of programs you debug repeatedly: Breakpoints and debugger window layouts for a given program are automatically saved between debugging sessions so that you don't have to set them again the next time.
- Attaching to an already running job or Java Virtual Machine on the iSeries server.

The integrated iSeries debugger supports any program written in the following languages:

- ILE RPG, ILE COBOL, ILE CL, C, C++, as well as Original Program Model (non-ILE) RPG, COBOL, and CL.
- Java, when running the program under Windows, or when running on any iSeries server with OS/400 V4R2, V5R1, or V5R2. You can even debug servlets, JavaServer Pages™, and Enterprise JavaBeans on the iSeries server.

By using Object Level Trace along with the integrated iSeries debugger, you can trace and debug applications running on various operating systems including iSeries servers and Windows servers. Object Level Trace provides a graphical view of the different components of your application, and you can click one or more elements to start debugging that component.



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## Chapter 2. Prerequisites

Before you deploy Web applications using Development Studio Client or Development Studio Client Advanced Edition, and any other relevant tools, you need to ensure that IBM WebSphere Application Server for iSeries and other services are properly configured on your iSeries system. This chapter describes the steps you need to take and provides links to appropriate documentation to prepare your iSeries system for operation. The minimum memory recommendations to run Development Studio Client or Development Studio Client Advanced Edition are 256 MB, 512 MB if you want to use the WebSphere Test Environment. The recommended amount is 768 MB.

If you plan to undertake development work using the Remote System Explorer, Java development tools, or other ILE-focused tools, you need only know how to access your iSeries system to begin development, and you can skip the majority of this chapter.

See information on Start here: Connecting to your iSeries server in the Remote System Explorer.

---

### Working with your HTTP server and WebSphere Application Server

Your Web-enabled iSeries applications use WebSphere Application Server to run the Java servlets and JavaServer Pages™ (JSPs) that allow communication between the Web user's browser and the iSeries programs or data. **Advanced** In the Advanced Edition of Development Studio Client, WebSphere Application Server can also run your Enterprise Java Beans (EJBs) based on J2EE technology.

To serve your HTML pages and JSPs from the same iSeries system, you also need an HTTP server on that host. We recommend that you use the IBM HTTP Server powered by Apache. You can find documentation about how to use this server in the following place: IBM HTTP Server for iSeries Documentation Center.

WebSphere Application Server handles executing the JavaServer Pages, JavaBeans, Java servlets, and EJBs for the Advanced Edition of Development Studio Client, that are generated for various processes. The primary documentation resources for IBM WebSphere Application Server for iSeries are available at the following Web sites:

- WebSphere Application Server 3.5 Standard Edition documentation
- WebSphere Application Server 3.5 Advanced Edition documentation

For 3.5 versions of WAS, as a minimum you need to carry out the steps under the section *Installing WebSphere Application Server*.

Becoming familiar with the IBM WebSphere® Application Server documentation, in particular the sections on *Installing WebSphere Application Server* and *Setting up multiple instances of the WebSphere administrative server*, is highly recommended.

- IBM WebSphere Application Server Version 4.0 Advanced Edition for iSeries at <http://publib.boulder.ibm.com/was400/40/AE/english/docs/>
- IBM WebSphere Application Server Version 4.0 Advanced Single Server Edition for iSeries at <http://publib.boulder.ibm.com/was400/40/AEs/english/docs/>

For 4.0 versions of WAS, minimally you need to carry out the steps under the *Installation* link. Becoming familiar with the IBM WebSphere Application Server documentation, in particular the sections on *Installation* and *Setting up multiple instances of the WebSphere administrative server*, is highly recommended.

For WebSphere Application Server version 5.0 and WebSphere Application Server Express:

- RedBooks page for WebSphere: Search for RedBooks for WebSphere Application Server Version 5.0 and WebSphere Application Server Version 5.0 Express Edition at <http://publib-b.boulder.ibm.com/redbooks.nsf/portals/WebSphere>

In order to prepare your system for Web application development and deployment, you need to complete the following tasks. iSeries-specific information is included below, but follow the links above for information about the IBM HTTP Server and WebSphere Application Server servers.

- Become familiar with server port numbers (information provided below)
- Find the port for your HTTP instance
- Find the port for your WebSphere Application Server instance
- Start the HTTP server job
- Create your HTTP configuration
- Create your HTTP instance (optional; you can use the default instance)
- Start your HTTP instance
- Install the sample libraries (information provided below)
- Configure your WebSphere Application Server
- Start your WebSphere Application Server instance (information provided below)
- Change the HTTP port for your WebSphere Application Server instance
- Map a network drive to the iSeries system (information provided below)
- Start the WebSphere Administrative Console

---

## Server port numbers

If you plan to use the default port numbers for WebSphere Application Server and the HTTP server, typically, these default ports are:

- The HTTP server instance uses port 80.
- The WebSphere Application Server instance uses port 900, but this could vary depending on the version of WebSphere Application Server you are using.

If these are not the correct default port numbers, contact your system administrator to determine what these ports are. You can use these port numbers for your HTTP and WAS instances, or you can create your own. See the appropriate documentation for creating your own instances.

---

## Installing the sample libraries

To work with the samples in this guide, you need to restore the WHOLESale and WDSCLAB libraries on your iSeries system. You should do this even if you have already restored the libraries for a previous release of the product, because their contents are different. The instructions describe how to restore the WHOLESale library. To restore the WDSCLAB library, repeat the instructions exactly except use the word "WDSCLAB" everywhere you see the word "WHOLESale".

**Note:** The save files used to install the sample library are for use with a V5R1 or later iSeries system.

To restore the WHOLESale library:

1. On the iSeries system, create a library to contain the save files. To create a new library in the emulator, use the CRTLIB command and follow the prompts.

2. Create a save file using the CRTSAVF command:

```
CRTSAVF FILE(MYLIB/WHOLESale)
```

where *MYLIB* is the library you created.

3. On your workstation, open a Command Prompt window.
4. Change to the following directory: `cd x:\WDSC\wdscsamp1` where *x:\WDSC\* is the Development Studio Client or Development Studio Client Advanced Edition installation directory.
5. On the command line, enter: `ftp hostname` where *hostname* is the name of your iSeries system.
6. Enter your iSeries user ID and password.
7. On the command line, enter `cd /qsys.lib/MYLIB.lib` where *MYLIB* is the library you created to contain the save files.
8. Enter the following:

```
bin  
put wholesale.sav wholesale  
quit
```

9. Back in the iSeries console, enter RSTLIB and press F4.
10. In the **Saved Library** field, enter WHOLESale and press the tab key.
11. In the **Device** field, enter \*savf and press the tab key.
12. Press enter in the next field to display additional values and tab to the **Save file** field.
13. Enter WHOLESale and press the tab key.
14. In the **Library** field, enter *MYLIB*, where *MYLIB* is the library you created to contain the save files.
15. Press enter to restore the WHOLESale library to your iSeries system.
16. Enter addlible WHOLESale to add the WHOLESale library to the library list.

## Adding the sample library to your initial library list

To make your library addition show up permanently when you expand your library list in the Remote system explorer, you can change your job description (associated with your user profile) to add the library to your initial library list. To add the library:

1. Open a 5250 emulator and sign on to your iSeries host.
2. Enter `dspusrprf <userid>` to display your user profile.
3. Press the page down button to scroll through your profile until you find the lines for Job description and Library. (Library appears right after Job description.)
4. Make sure that the job description is yours or one used by your team. If not, create your own job description and associate it with your user profile. If you need assistance, see your system administrator.
5. Return to the main menu and enter `chgjobd` and then press F4.

6. In the **Job description** field, enter the name and library for your job description. If you do not know the name of your job description, perform a `dspusrprf` to display your user profile. Your job description is on one of the pages of your user profile.
7. Press F10 to access additional parameters.
8. Press the page down button to scroll through your job description until you find the line `Initial library list`.
9. In the field beside the line that says `+ for more values`, type `a +` followed by a space and then press Enter.
10. On the **Specify more values** display, type `WHOLESALE` in the first available field and press Enter to change your job description. Repeat this step for `WDSCLAB`.

---

## Starting your WebSphere Application Server instance

You need to restart your WebSphere Application Server instance each time it is stopped, and each time your iSeries system is restarted. Follow these steps:

1. Log onto the iSeries system and open a QShell prompt by using the `qsh` command.
2. Change to the `bin` directory of the installation directory of WebSphere Application Server using the `cd` command.
3. Enter the following command:

```
strwasinst -instance wasinst -http httpinst
```

where:

*wasinst*

is the name of the WebSphere Application Server instance you are using, and

*httpinst*

is the name of the HTTP instance you are using.

Note that for WebSphere Application Server Express edition you use the `startServer` command instead of `strwasinst`.

4. When the command completes and you see a prompt character (usually a dollar sign), exit QShell by pressing F3.

---

## Mapping a network drive to the iSeries system

Web development tools deploys your HTML, JSP, servlet, and other publishable files (EJBs for the Advanced edition of Development Studio Client) to the iSeries system on a shared network drive. If you can map a network drive to the `/QIBM` directory of your iSeries system using the `NET USE` command or the `Map Network Drive` command, you already have `NET USE` access set up correctly. Follow these steps to set up `NET USE` access to the iSeries system, depending on your operating system.

For Windows® 98 and Windows Me:

1. Ensure that you have logged on to your Windows workstation using an ID that is valid on the iSeries system:
  - a. Click the Start menu icon.
  - b. If you see an entry **Log off** *username* on the Start menu, and *username* matches your iSeries user ID, skip to step 2.
  - c. Click **Log off**.



- d. When prompted to log on to Windows again, enter your iSeries user ID and password.
2. Open a command prompt and type the command NET USE.
3. If you see a drive letter assigned to the /QIBM directory on your iSeries system, you are already set up for NET USE access. Otherwise, enter the following command: NET USE \* \\MYHOST\QIBM \* and enter your iSeries password when prompted.

For Windows 2000 and XP:

1. Open a command prompt and type the command NET USE.
2. If you see a drive letter assigned to the /QIBM directory on your iSeries system, you are already set up for NET USE access.
3. Enter the following command: NET USE \* \\MYHOST\QIBM /USER:USERNAME \* where USERNAME is your iSeries user ID.
4. Enter your iSeries password when prompted.

If you can successfully connect to the network drive, NET USE access is set up properly. If instead an error message is displayed indicating problems connecting to the iSeries system, check with the system administrator that TCP/IP is properly started on the iSeries system. You can start it yourself if you have administrative privileges, by logging onto the iSeries system, typing STRTCPSVR \*NETSVR and answering any prompts as needed. When this command completes, try the steps described above again. If you are unable to map a network drive to your iSeries system, contact the system administrator.



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## **Programming interface information**

Programming interface information is intended to help you create application software using this program.


General-use programming interfaces allow you to write application software that obtain the services of this program's tools.

However, this information may also contain diagnosis, modification, and tuning information. Diagnosis, modification and tuning information is provided to help you debug your application software.

**Warning:** Do not use this diagnosis, modification, and tuning information as a programming interface because it is subject to change.

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- AFP
- AIX
- AIX windows
- APPN
- Application System/400
- AS/400
- AS/400e
- BookManager
- C Set ++
- C/400
- CICS
- CICS/400
- CICS/ESA
- COBOL/2
- COBOL/400
- Common User Access
- CUA
- DB2
- DB2 Extenders
- DB2 Universal Database
-  server
- GDDM
- IBM
- IBMLink
- Integrated Language Environment
- iSeries
- Language Environment
- MQSeries
- Network Station
- Open Class
- Operating System/2
- Operating System/400
- OS/2
- OS/390
- OS/400
- POWER2
- PowerPC
- PROFS
- RPG/400
- RS/6000
- S/390
- SAA
- SQL/400
- System/36
- System/38
- VisualAge
- VTAM
- WebSphere

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