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**Redbooks**

## Migrating Applications to WebSphere Application Server V5 for z/OS

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## Agenda

- Migration Overview
- Infrastructure Migration
- Application Migration
  - ▶ From WAS V3.5
  - ▶ From WAS V4.01
- ▶ Development environment migration



## Migration overview

- Development environment
- Actual application code
- Application deployment procedures
- Test runtime environment
- Production runtime environment





## Runtime migration

- Monoplex migration
  - No co-existence
  - Co-existence
- Sysplex migration

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## Monoplex with no co-existence

z/Series - S/390

LPAR 1	LPAR 2
z/OS	z/OS
WAS v4.01	WAS v4.01
Production	Test

Current LPAR configuration



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## Monoplex with no co-existence

z/Series - S/390

LPAR 1	LPAR 2	LPAR 3
z/OS	z/OS	z/OS
WAS v4.01	WAS v4.01	WAS v5
Production	Test	Test

Migration configuration



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## Monoplex with no co-existence

z/Series - S/390

LPAR 1	LPAR 2	LPAR 3
z/OS	z/OS	z/OS
WAS v5		WAS v5
Production		Test

Final production configuration



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## Monoplex with co-existence

z/Series - S/390



LPAR 1	LPAR 2
z/OS	z/OS
WAS v4.01	WAS v4.01 Test
Production	<div>WAS v5 Test</div>



Initial migration configuration

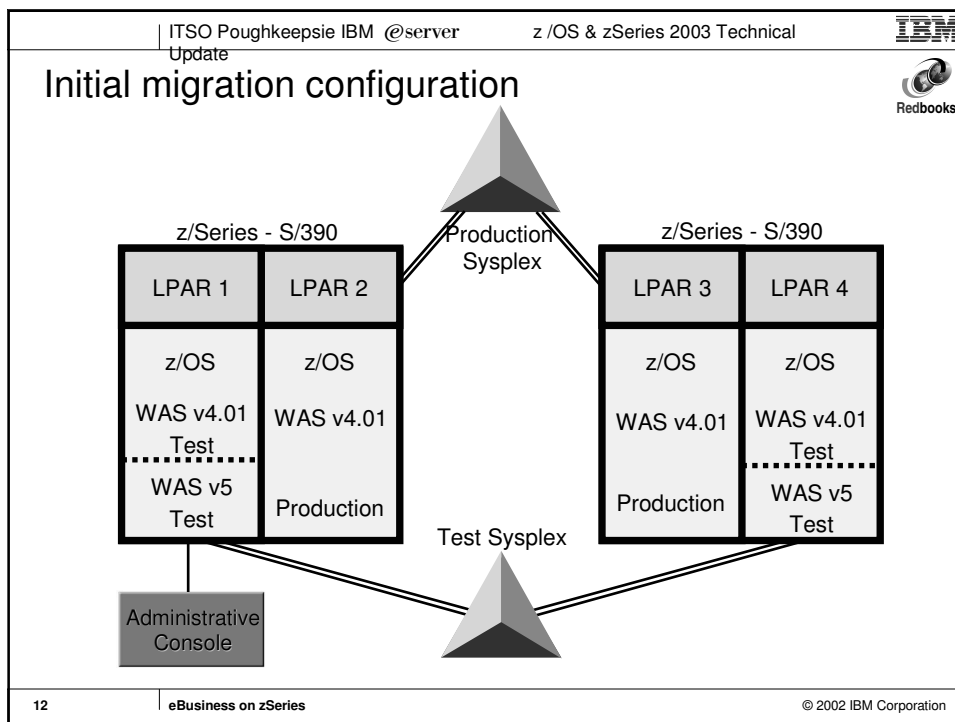
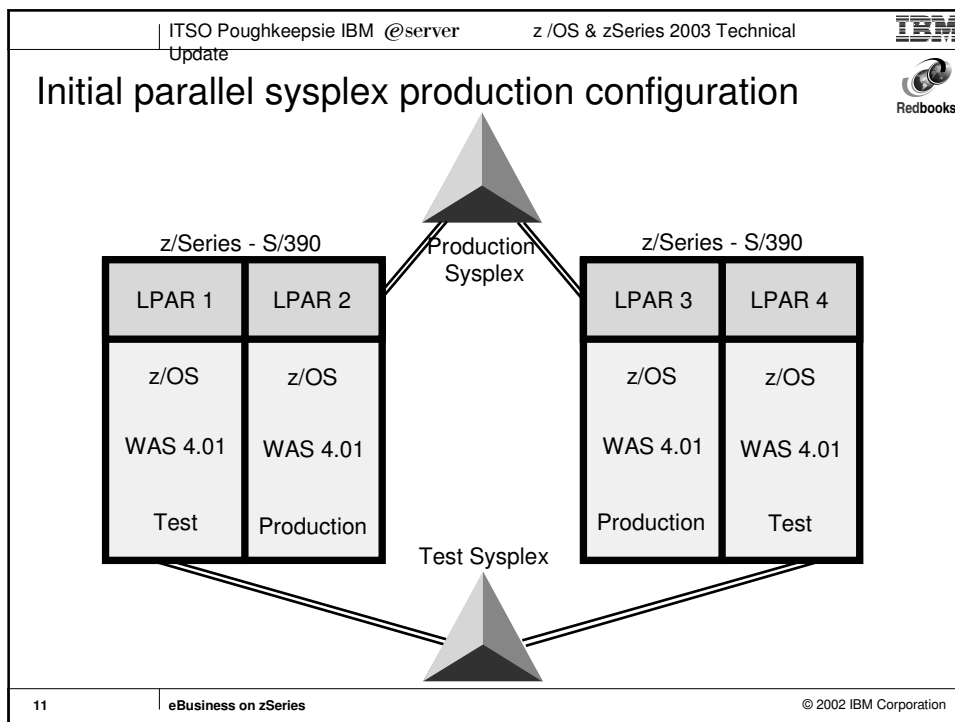
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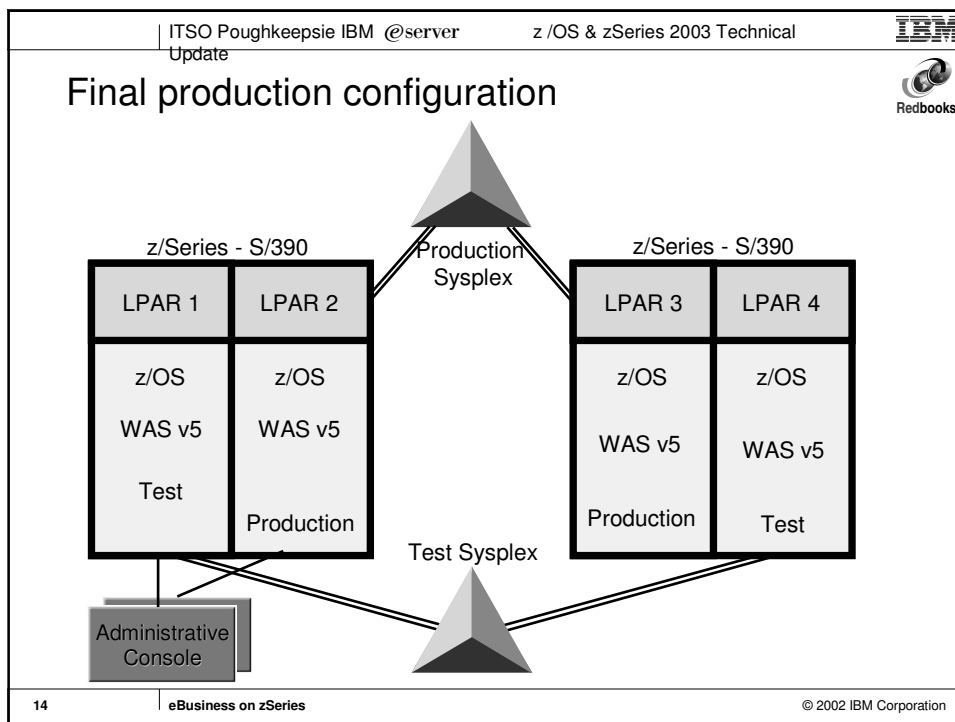
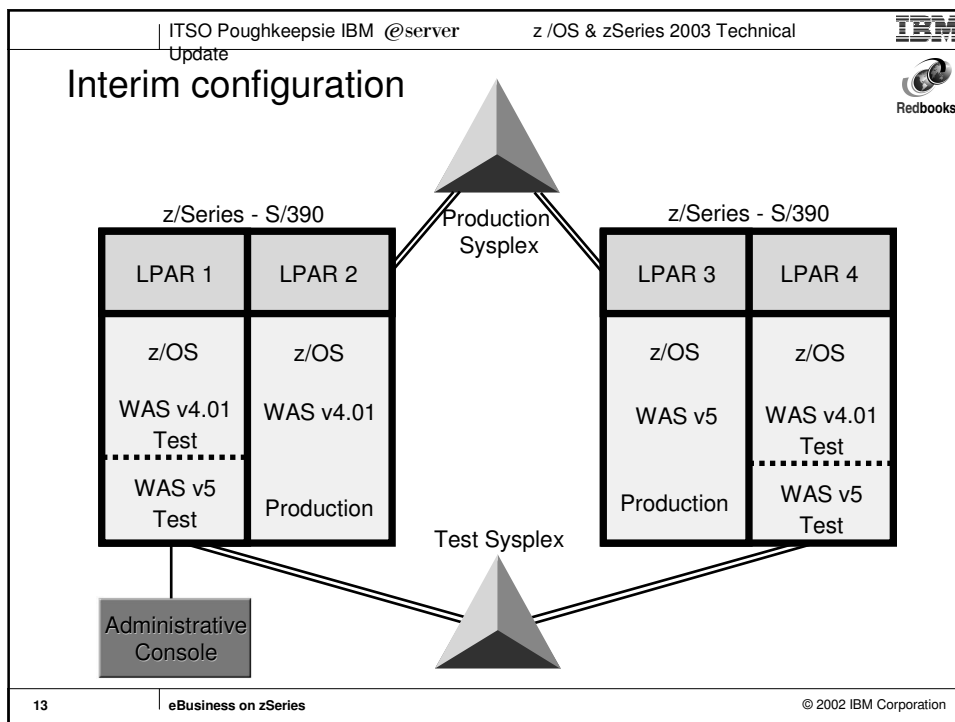
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<h2 style="margin: 0;">Monoplex with co-existence</h2> <p style="margin: 0;">z/Series - S/390</p> <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <tr> <th style="padding: 5px;">LPAR 1</th> <th style="padding: 5px;">LPAR 2</th> </tr> <tr> <td style="padding: 10px; vertical-align: top;"> z/OS   WAS v5   Production </td> <td style="padding: 10px; vertical-align: top;"> z/OS   WAS v5   Test </td> </tr> </table> <p style="margin: 0;">Final production configuration</p>			LPAR 1	LPAR 2	z/OS  WAS v5  Production	z/OS  WAS v5  Test
LPAR 1	LPAR 2					
z/OS  WAS v5  Production	z/OS  WAS v5  Test					
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<h2 style="margin: 0;">Sysplex migration</h2> <h3 style="margin: 0;">Things to consider with WAS V4 and WAS V5 co-existence</h3> <ul style="list-style-type: none"> <li>▪ Use STEPLIBs for WebSphere for z/OS V5</li> <li>▪ Make sure TCP/IP ports used in WebSphere for z/OS V5 are unique and do not conflict with WebSphere for z/OS and OS/390 V4.01.</li> <li>▪ Make sure WLM application environment names are unique</li> <li>▪ Establish unique RACF profiles for each of the WAS environments</li> <li>▪ Plan server names and procedure names for WebSphere for z/OS V5</li> <li>▪ PLAN - PLAN - PLAN is basically the name of the game!</li> </ul>		
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## Application migration from WAS V3.5

Migration Issues
Packaging/Assembling
Web applications
Constructing Enterprise Applications
Deployment procedures
Security
ASCII/EBCDIC
Connectors
JDBC/SQLJ, Datasources
Plug-In
Migration tools

## Web applications (WAR files)

- Visually inspect code
- Import in WSAD V5 and check warnings, error messages and deprecations
- Use CACT tool (Class API Check Tool)  
[http://www7b.software.ibm.com/wsdd/library/techarticles/0208\\_cocasse/0208\\_cocasse.html](http://www7b.software.ibm.com/wsdd/library/techarticles/0208_cocasse/0208_cocasse.html)
- HTTP sessions



## ASCII/EBCDIC considerations

- WAS V5 default JVM encoding of ISO-8850-1 (US ASCII)
- Applications accessing EBCDIC encoded files need to change codepage:

```
private String readHFS(String file) {
    String theString = "file not read properly";
    String fileEncoding = null;
    try {
        // file.encoding is the default code page of the JVM
        fileEncoding = System.getProperty("file.encoding");
        System.out.println("Default file.encoding: " + fileEncoding);
        // input: CP1047 to ASCII
        FileInputStream fis = new FileInputStream(file);
        BufferedReader r =
            new BufferedReader(new InputStreamReader(fis, "CP1047"));
        theString = r.readLine();
        System.out.println("<<< String: " + theString);
    }
    catch (IOException iOex)
    { iOex.printStackTrace(); }
    catch (Exception ex)
    { ex.printStackTrace(); }
    return theString + " - " + "The default encoding for the JVM is: " + fileEncoding;
}

private void writeHFS(String file) {
    try {
        // output: ASCII to CP1047
        FileOutputStream fos = new FileOutputStream(file);
        Writer w = new BufferedWriter(new OutputStreamWriter(fos, "CP1047"));
        w.write(writeData);
        w.flush();
        w.close();
    }
    catch (IOException iOex)
    { iOex.printStackTrace(); }
    catch (Exception ex)
    { ex.printStackTrace(); }
}
```



## Connectors / JDBC / SQLJ



- CCF connectors are no longer supported -> use WSADIE V5 to migrate to J2C
- WAS 3.5 Applications using JDBC 2.0 are still working if coded as following:

```
import java.sql.*;
import javax.naming.*;
InitialContext ctx = new InitialContext();
javax.sql.DataSource ds = (DataSource)ctx.lookup("jdbc/myDS");
java.sql.Connection conn = ds.getConnection();
```

- WAS V3.5 early support of connection manager and pooling is no longer supported – code such as following needs to be changed

```
import javax.naming.*;
import java.util.Hashtable;
import com.ibm.ejs.dbm.jdbcext.*; // Early connection pooling code
Hashtable parms = new Hashtable();
parms.put
( Context.INITIAL_CONTEXT_FACTORY
, "com.ibm.ejs.ns.jndi.CNInitialContextFactory"
);
InitialContext ctx = new InitialContext(parms);
javax.sql.DataSource ds = (DataSource)ctx.lookup("jdbc/myDS");
java.sql.Connection conn = ds.getConnection();
```

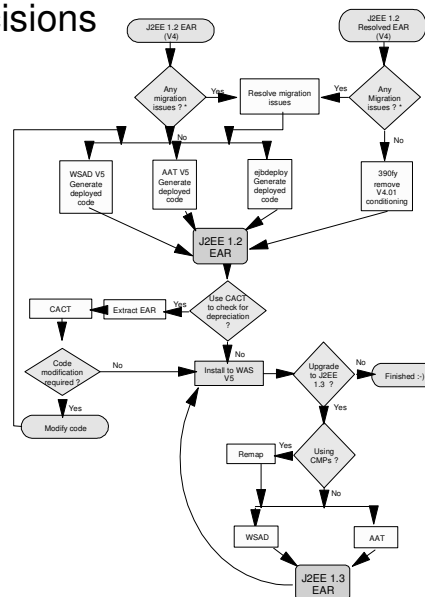
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<h2 style="margin: 0;">Plug-in</h2> <ul style="list-style-type: none"> <li>▪ WAS V5 requires use of HTTP transport handler</li> <li>▪ Plug-Ins available for IBM HTTP Server 5.3 on z/OS and into web servers on distributed platform</li> <li>▪ On z/OS add following directives:             <div style="margin-left: 20px;"> <pre>ServerInit /webserver_install_root/bin/hs390WAS50Plugin_http.so:init_exit fully_qualified_path ServerTerm /webserver_install_root/bin/hs390WAS50Plugin_http.so:term_exit</pre> </div> </li> <li>▪ For each webapp add a services directive:             <div style="margin-left: 20px;"> <pre>Service /webapp_contextroot/* /webserver_install_root/bin/hs390WAS50Plugin_http.so:service_exit</pre> </div> </li> <li>▪ Deploy application into WAS V5</li> <li>▪ Run <b>install_root/AppServer/bin/GenPluginCfg.sh</b> to create plugin-cfg.xml file</li> <li>▪ plugin-cfg.xml is EBCDIC encoded</li> <li>▪ Manually edit plugin-cfg.xml if necessary             <div style="margin-left: 20px;"> <p>Change localhost to with defined hostname</p> <p>Include portnumbers where HTTP server is listening for incoming requests to the VirtualHost in the VirtualHostGroup</p> </div> </li> <li>▪ In case of initialization problems check <b>.../AppServer/logs/native.log.x.y</b> <div style="margin-left: 20px;"> <p>X ...date</p> <p>Y ... Sequence number</p> </div> </li> </ul>		
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<h2 style="margin: 0;">Migration tools</h2> <ul style="list-style-type: none"> <li>▪ AAT             <ul style="list-style-type: none"> <li>▶ Assemble JSP/servlet components developed by third party tools and/or <b>javac</b> to produce EAR files</li> <li>▶ Flexibility in assembling applications from various sources: WAR,RAR,EJB JARs and JARs</li> <li>▶ Available options:                 <ul style="list-style-type: none"> <li>- Import existing module (JAR, RAR or WAR files)</li> <li>- Creating new module while creating new applications</li> <li>- Copying code artifacts, such as servlets, from one module to another</li> </ul> </li> <li>▶ Download AAT from <b>.../AppServer/lib/setup.exe</b></li> </ul> </li> <li>▪ WSAD V5             <div style="margin-left: 20px;"> <p>Includes complete development environment for transition to J2EE 1.3 applications</p> </div> </li> </ul>		
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## Application migration from WAS V4 - Overview

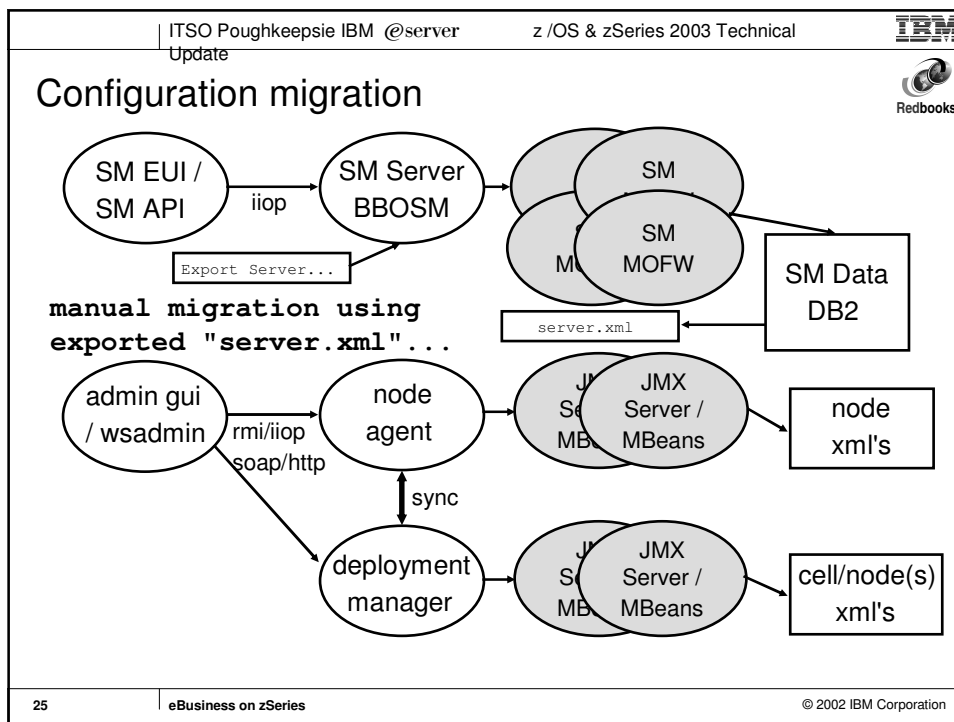
- Finding the existing EAR file
- Resolving any migration issues
- Generating a new (J2EE 1.2) ear
- Installing to WAS V5
- Optionally migrating ear to J2EE 1.3 (recommended)
- Re-install to WAS V5

## Migration decisions

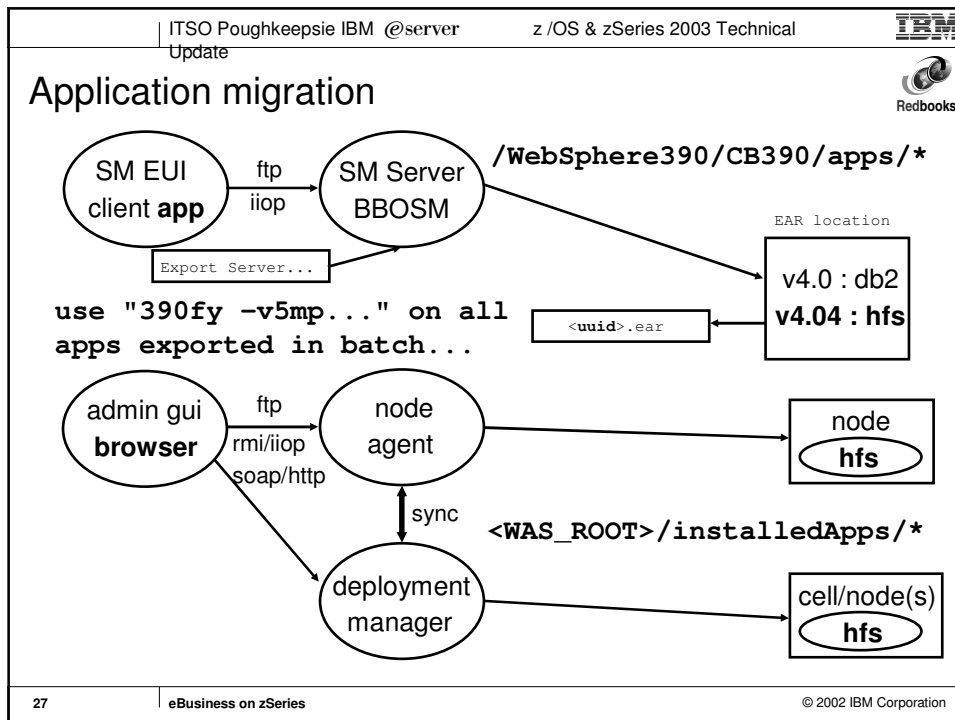


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<h2>Migration Overview</h2> <ul style="list-style-type: none"> <li>▪ Migration tools</li> <li>▪ Configuration migration</li> <li>▪ Application migration</li> <li>▪ Installation script migration</li> </ul>		
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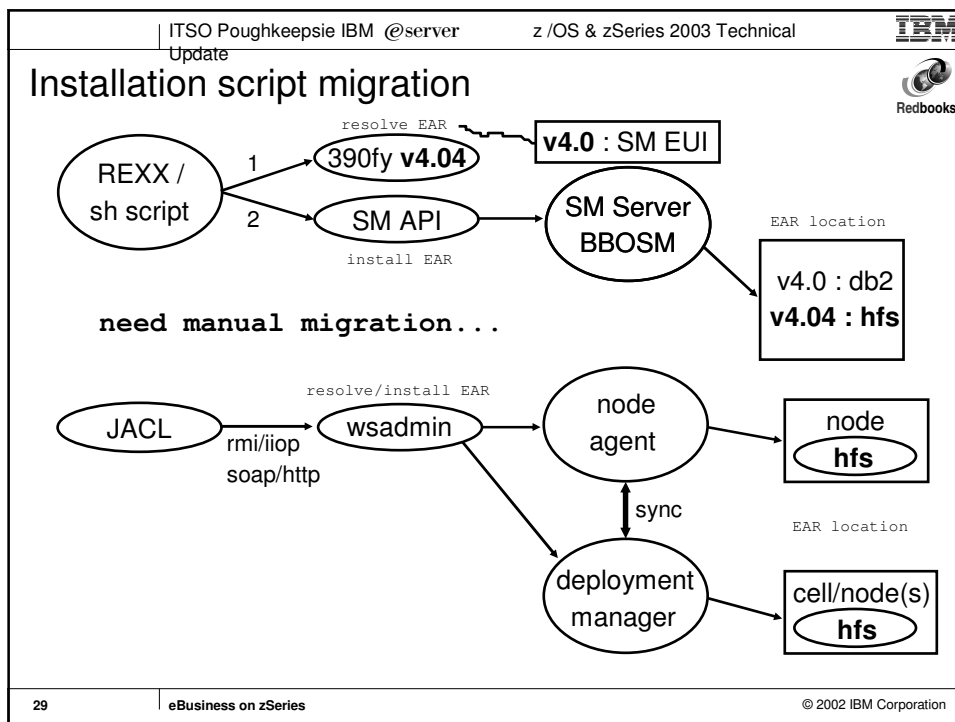
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<h2>Migration Tools</h2>												
<table border="1"> <tr> <td>WSAD</td> <td>Comprehensive development environment</td> </tr> <tr> <td>AAT</td> <td>Create/edit applications modules, verify archive files generate deployment code, alternative to WSAD</td> </tr> <tr> <td>EJBDEPLOY</td> <td>Commandline tool to generate deploy code</td> </tr> <tr> <td>390fy</td> <td>WAS V4 tools, migration option removes V4 conditioning to produce ear file to be deployed in WAS V5</td> </tr> <tr> <td>CACT</td> <td>Class API Checker Tool analyzes compiled JAVA servlets and EJBs and provides information on deprecated code</td> </tr> </table>			WSAD	Comprehensive development environment	AAT	Create/edit applications modules, verify archive files generate deployment code, alternative to WSAD	EJBDEPLOY	Commandline tool to generate deploy code	390fy	WAS V4 tools, migration option removes V4 conditioning to produce ear file to be deployed in WAS V5	CACT	Class API Checker Tool analyzes compiled JAVA servlets and EJBs and provides information on deprecated code
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- ## Configuration migration
- v4.0 configuration setup
    - ▶ SMEUI / SMAPI is used to change the current config settings
    - ▶ SM Server processes the request via MOFW (IBM specific - managed object framework CORBA) objects
    - ▶ SM configuration data is stored in DB2 for all servers in various SM managed DB2 tables
  - v4.0 => v5.0 configuration **migration** [manual]
    - ▶ use "Export server..." task to specify <export\_dir> within HFS
    - ▶ use <export\_dir>/<server\_name>/server.xml & transfer config
  - v5.0 configuration setup
    - ▶ admin gui / wsadmin used to change the current config settings
    - ▶ each server process contains "node agents" (aka MBean agent/server) which processes config change requests
    - ▶ SM configuration data is stored in HFS via various xml files  
/WebSphere/V5R0M0/AppServer/config/cells/SY1/...\*.xml
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- ## Application migration
- v4.0 application installation
    - ▶ SM EUI and/or SM API is used to deploy applications
    - ▶ SM Server processes the **resolved** ear file and installs it into:
      - DB2 for certain application information + **[v4.0]** EAR file as BLOB
      - [v4.04]** HFS as an EAR file **[/WebSphere390/CB390/apps/\*]**
  - v4.0 => v5.0 application **migration**
    - ▶ use "Export server..." task to specify **<export\_dir>** within HFS
    - ▶ [optional] change the **<UUID>.ear** name format to regular name
    - ▶ run **"390fy -v5mp <export\_dir>/<server\_name>"** to migrate all
  - v5.0 application installation
    - ▶ admin gui / wsadmin can be used to deploy each migrated ear [will need to provide server specific info during install for v5.0]
    - ▶ appropriate deployment process ("node agent" and/or "dmgr") will take the migrated **(resolved)** ear file and install it into:
      - HFS as a directory that matches the EAR file name (ear unpacked)
      - .../AppServer/config/cells/SY1/applications/\*.ear**
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## Installation script migration

- v4.0 application installation
  - ▶ REXX exec written to expose SM API commands to deploy application and/or change system configurations
  - ▶ REXX exec can both resolve + install your applications all in one:
    - [v4.0 : NO] EAR must first be resolved using SMEUI
    - [v4.04 : YES] EAR can be applied **390fy** for resolve & installed via SMAPI
- v4.0 => v5.0 application **migration** [manual]
  - ▶ No way to migrate scripts
    - [Note: even on WAS Distributed - need to throw away wscp scripts]
  - ▶ Learn how to write JACL script and use wsadmin commands
- v5.0 application installation
  - ▶ JACL script along with wsadmin can be used to deploy each migrated ear file
  - ▶ JACL script written for WAS Distributed (even wsadmin with different host/port on Windows can be used) can be used on zOS

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## Migrating a J2EE 1.2 ear file to 1.3 using WSAD

- May save time that would otherwise be spent reworking CMPs
- Migration procedure
  - Import the 1.2 ear file into WSAD
  - On Enterprise application perspective select Migrate -> J2EE migration wizard
  - Explicitly request that CMPs are migrated and local client views are generated
  - Once migration wizard has completed check and correct compiler errors
  - EJB QL statements in the ejb.xml may have to be rewritten due to the EJB 2.0 specs
  - Fig. 7-12
- Check section Chapter 8. Migrating from EJB 1.0 to EJB1.1or toEJB2.0 of the migrate.pdf in the WSAD filesystem readme folder

## JDBC/SQLJ

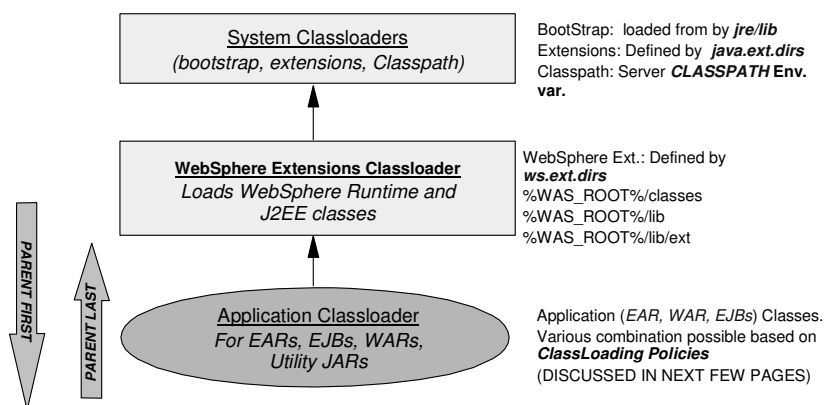
- db2sqljdbc.properties
  - Required by JDBC driver
  - Location defined in DB2SQLJPROPERTIES
  - Set at node level – related to specific DB2 subsystem !
- Loading external modules
  - WAS V4: specify location of DB2 DLLs in LIBPATH of server region
  - WAS V5: loading of external modules done by runtime classloader defined in Native Library Path during definition of resource
- Accessing DB2 Version 6 data
  - WAS V5 supports connection to DB2 V7
  - Use DDF (distributed data facility) of DB2 to access DB2 V6 data
  - See IBM Techdoc WP100217: WAS/390 V4 DB2 V7 Conundrum



## Classloader

- Classloaders hierarchy in WebSphere v5
- Application classloader policy
- WAR classloader policy
- Classloader Mode
- Application Classloader Policy – SINGLE
- Application Classloader Policy – MULTIPLE
- v4 vs. v5 Classloading Policies – Comparison
- Reloading Classes in Version 5
- Application Specific Libraries

## Classloaders Hierarchy in WebSphere v5



**Note:** WAS 5.0 default of **PARENT\_FIRST** is the opposite of most WAS v4.0x behavior, except for v4.0x J2EE Application Mode which did default to **PARENT\_FIRST**

## Application Classloader policy

- Determines how the applications share classloader
- At the Application Server level - choose SINGLE or MULTIPLE
  - SINGLE means the EJB, RAR modules and dependent JARs for all the EARs are loaded by one classloader called the Application classloader
  - MULTIPLE means the EJB, RAR modules and dependent JARs for each EAR are loaded by its own classloader
  - Whether the WAR is loaded by this Application classloader is dictated by the WAR classloader policy

## WAR Classloader policy

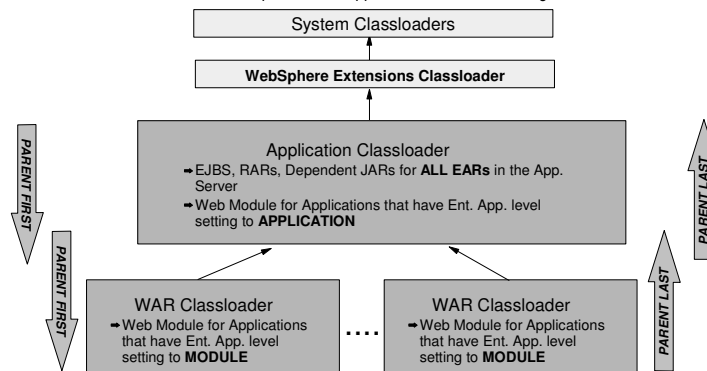
- Determines how the WAR modules are loaded per Application
- At the Enterprise Application level, choose APPLICATION or MODULE
  - APPLICATION: all the Web modules in the application EAR use the Application classloader (dictated by the Application Classloader Policy)
  - MODULE: every WAR uses its own classloader, different than the Application Classloader
  - Selection can be made at application install time

## Classloader Mode

- Set for Application Classloader policy and WAR Classloader policy
- PARENT\_FIRST - default
  - Search the immediate parent first and then its policy would determine if that got search first or its parent
- PARENT\_LAST
  - Tries to find and load the class from its own classloader and if the class was not found, it delegates to its immediate parent classloader and then the immediate parent's classloader policy would take control

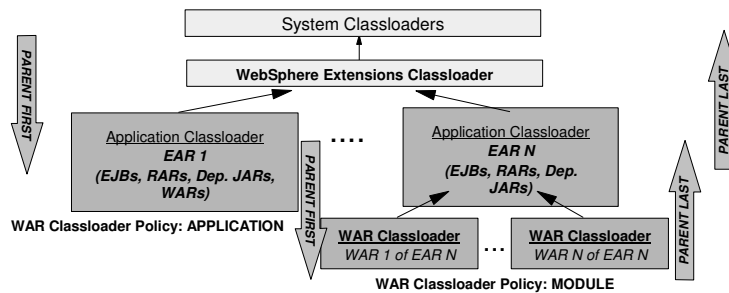
## Application Classloader Policy - SINGLE

- Application Classloader policy of **SINGLE** and WAR classloader policy of **APPLICATION** or **MODULE**
  - Pros: Each Application EJBs, RARs, Dep. JARs can reference other classes in other Applications
  - Cons: Cannot start and stop individual Applications without affecting others



## Application Classloader Policy - MULTIPLE

- Application Classloader policy of **MULTIPLE**
- WAR classloader policy of **APPLICATION** or **MODULE**
- Pros:
  - Can restart each application without affecting others
  - Classes within each EAR can reference all the classes with the same EAR even if in different modules of the EAR (classes in WAR may or maynot be referenced, depending on Ent. Application level policy)
- Cons: Classes within one EAR cannot reference classes in another EAR



## v4 vs. v5 Classloading Policies - Comparison



v4		v5	
4.0 Classloader Policy		v5 Application Classloader Policy	v5 WAR Classloader Policy
SERVER		SINGLE	APPLICATION
COMPATIBILITY		SINGLE	MODULE
APPLICATION		MULTIPLE	APPLICATION
MODULE		N/A	N/A
J2EE Application Mode		MULTIPLE	MODULE



## Reloading Classes in Version 5

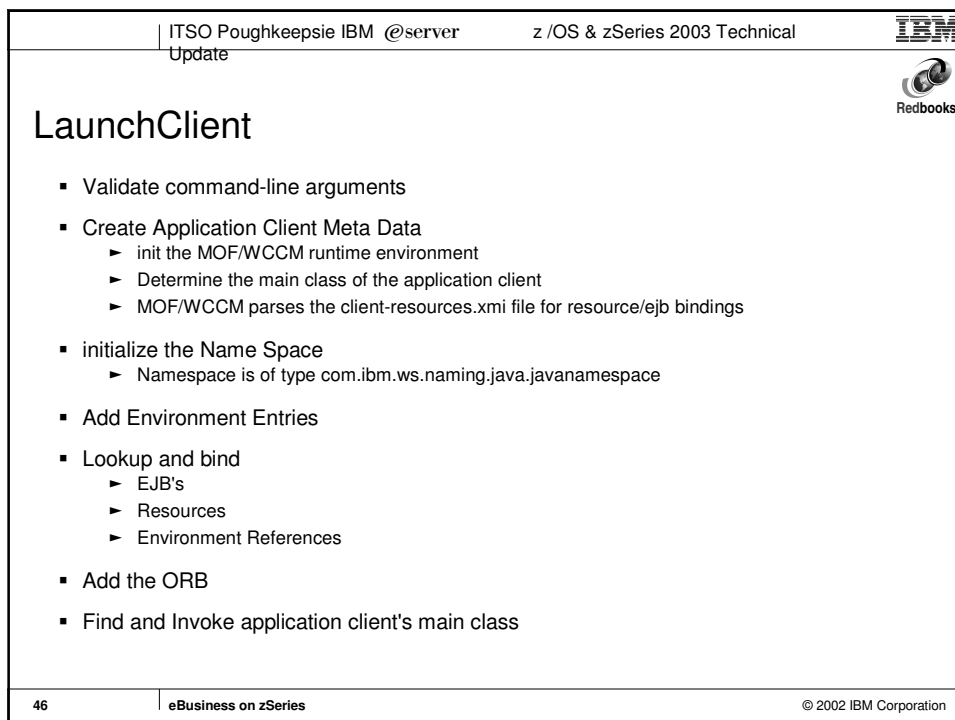
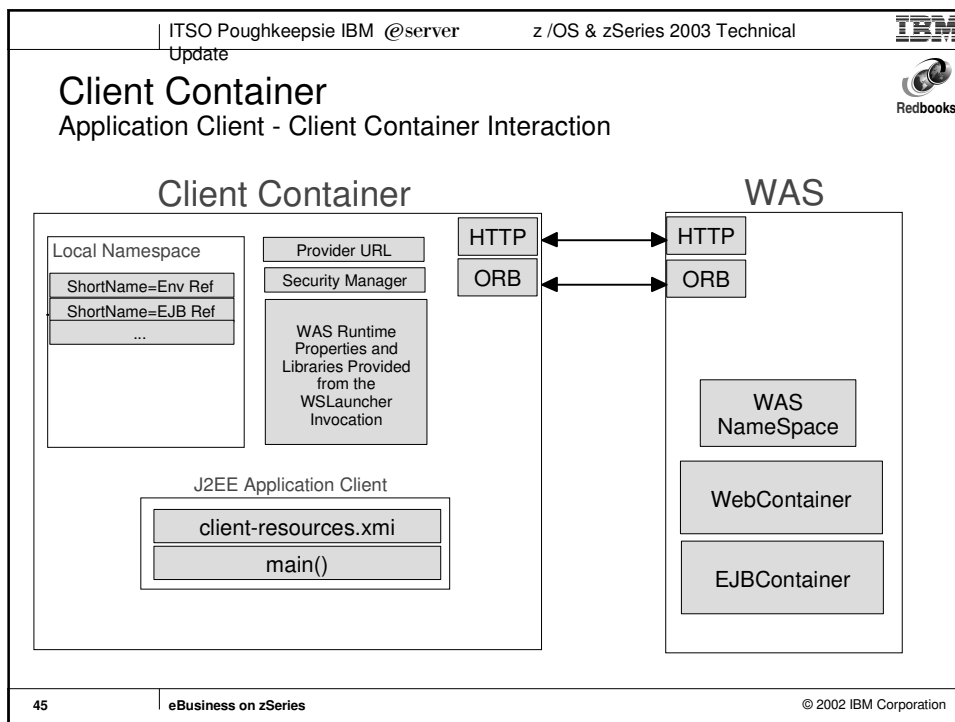
- Web Modules can be reloaded independently
  - Stop/Restart the Web Module
  - Also, can configure Web Modules to restart automatically if contents changes
- EJB Modules
  - Cannot be stopped/restarted independently in Version 5
  - The entire application has to be restarted
- Best practice: stop/restart the Enterprise App
  - This will ensure that all the dependencies are also reloaded



## Application Specific Libraries



- Application Specific Libraries can be defined
  - For libraries of code that needs to be shared across multiple applications within a server
  - Support for java and native libraries.
  - Environment -> Shared Libraries -> New
- On the Enterprise Application
  - Specify the shared libraries to be used
  - Enterprise Applications -> Application -> Libraries -> Add (add one of the defined Shared Libraries)

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<h2>Client Container</h2> <ul style="list-style-type: none"> <li>▪ Overview</li> <li>▪ Application Client - Client Container Interaction</li> <li>▪ LaunchClient</li> </ul>			
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<h2>Client Container - Overview</h2> <ul style="list-style-type: none"> <li>▪ The Client Container is a runtime environment that provides a specific set of services and resources to J2EE Application Clients.</li> <li>▪ J2EE application client can be built with WSAD</li> <li>▪ Resources include: <ul style="list-style-type: none"> <li>▶ JDBC Databases</li> <li>▶ URL's</li> <li>▶ JMS Message Queues</li> <li>▶ Java Mail</li> <li>▶ Environment Entries (Native Types)</li> <li>▶ EJB's</li> </ul> </li> <li>▪ Services include: <ul style="list-style-type: none"> <li>▶ Security</li> <li>▶ Naming</li> <li>▶ Communications Protocols (RMI/IIOP, HTTP, etc.)</li> </ul> </li> </ul> <p>Note: J2EE Specification allows for the option of Application Clients to directly participate in Global Transactions. For WebSphere, Application Clients cannot directly participate in RRS Transactions</p>			
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<h2>Development environment migration</h2> <ul style="list-style-type: none"> <li>▪ IBM VisualAge for Java Enterprise Edition <ul style="list-style-type: none"> <li>Common Connector Framework (CCF)</li> <li>Enterprise Access Builder (CCF)</li> </ul> </li> <li>➔ J2C standards evolved <ul style="list-style-type: none"> <li>First shipped as beta with VA Java and WSADIE V4</li> </ul> </li> <li>▪ WebSphere Studio Integration Edition V5 <ul style="list-style-type: none"> <li>Fully supports J2C</li> </ul> </li> </ul>		
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<table border="1"> <tr> <td><b>Summary: Migration Issue</b></td> </tr> <tr><td>Servlet/JSPs</td></tr> <tr><td>EJBs</td></tr> <tr><td>CMPs</td></tr> <tr><td>Resources, DB2, JMS, IMS and CICS</td></tr> <tr><td>Connectors</td></tr> <tr><td>ASCII/EBCDIC</td></tr> <tr><td>JDBC/SQLJ</td></tr> <tr><td>Transactions</td></tr> <tr><td>Deployment Descriptors</td></tr> <tr><td>Plugin</td></tr> <tr><td>Packaging/Assembling</td></tr> <tr><td>Security</td></tr> <tr><td>Constructing Enterprise Applications</td></tr> <tr><td>Migration Tools</td></tr> <tr><td>JMS/WMQ</td></tr> </table>			<b>Summary: Migration Issue</b>	Servlet/JSPs	EJBs	CMPs	Resources, DB2, JMS, IMS and CICS	Connectors	ASCII/EBCDIC	JDBC/SQLJ	Transactions	Deployment Descriptors	Plugin	Packaging/Assembling	Security	Constructing Enterprise Applications	Migration Tools	JMS/WMQ
<b>Summary: Migration Issue</b>																		
Servlet/JSPs																		
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CMPs																		
Resources, DB2, JMS, IMS and CICS																		
Connectors																		
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