

z/OS Java Batch Applications and JZOS Update

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Agenda

- Using the *IBM JZOS Batch Toolkit for z/OS SDKs* to run Java in batch jobs or started tasks
- Review new JZOS functionality available on IBM alphaWorks
- Integrate Java applications with MVS datasets and services
- Use Eclipse effectively to develop, test, and 'one-click' deploy your application
- Reuse Java applications and skills in traditional z/OS workloads
- Exploit open source Java tools and libraries on z/OS, such as Apache Tomcat and Apache Commons
- JZOS Cookbook Preview

Agenda - continued

- Plugs
 - S8369 - z/OS Java Batch Applications - Hands-on Lab
 - S8370 - JZOS, Java, and Batch, They are ready for prime time
 - S8355 - Advanced Eclipse Hands-on-Lab: Remote z/OS Debugging
 - S8356 - z/OS Java Free-for-all
 - S8365 - IBM JVM, SDK V6 Technology Introduction and System z Update
 - S8366 - Introduction to IBM Specialty Engine zAAP

Java™ on z/OS®

- The IBM Java Developer Kits provide a Java VM and runtime environment for all z/OS Java-enabled subsystems, including WebSphere Application Server, CICS, DB2, and IMS.
- Currently six versions supported z/OS:
 - IBM SDK for z/OS, Java 2 Technology Edition, Version 1.4
 - IBM 64-Bit SDK for z/OS, Java 2 Technology Edition, Version 1.4
 - IBM SDK 5.0 for z/OS, 31-bit and 64-bit versions
 - IBM SDK 6.0 for z/OS, 31-bit and 64-bit versions
- The IBM JDKs also provide the standard *java* command line launcher for Unix System Services.
- The BPXBATCH utility can be used to run the *java* command line in a batch job (**Not recommended**)
- zAAP can significantly reduce the cost of running z/OS Java workloads

IBM JZOS Press Release

ARMONK, N.Y. –February 14, 2006 – IBM announced today its purchase of the JZOS batch technology developed by Dovetailed Technologies, LLC. The JZOS toolkit, which provides a simple, easy-to-use facility for running Java batch applications on the IBM mainframe flagship operating system, z/OS ...

JZOS is now available on the following z/OS Java SDKs:

- 1.4.2 SDK (31-Bit) Service Refresh 6 (SR6) and later
- 5.0 SDK (31 and 64-Bit) Service Refresh 3 (SR3) and later
- 6.0 SDK (31 and 64-Bit)
- More information: <http://www.ibm.com/servers/eserver/zseries/software/java/jzos/overview.html>

IBM JZOS Batch Toolkit for z/OS SDKs

- A Java VM **Launcher** that runs as a traditional MVS program (jobstep or started task)
 - Java System.in, System.out, and System.err routed to DDs that support MVS datasets or JES spool files.
 - Controls output encoding separate from default JVM encoding (..more later)
 - Launches the Java VM in the original batch address space
 - Simplifies job accounting and WLM profiles
 - Can use job step DD names
 - Pass condition code from Java `System.exit(--code--)`
 - Flexible/scriptable configuration of environment variables and settings

IBM JZOS Batch Toolkit for z/OS SDKs

- A Java Native Interface (JNI) library **Toolkit**
 - Native "Wrappers" for "C" Library IO routines
 - Text/Binary/Record mode access to MVS datasets
 - FileFactory class for portable use of text files/datasets
 - Wrappers for other system services
 - Access jobname, userid, environment variables, ...
 - Text-command based dynamic allocation via BPXWDYN
 - Communicate with MVS console (WTO, START, STOP, MODIFY)
 - More to come...

You say codepage, I say charset

- Internally, Java VM Strings and chars are (always) Unicode
- The **file.encoding** system property:
 - Specifies the platform's file system character set encoding
 - Determines the *default* charset set when converting unicode characters to/from bytes
- It's common for Java code to (incorrectly) assume that file.encoding is ASCII
 - It's probably best when this happens just to run the JVM with `file.encoding="ISO-8859-1"`

(ASCII/Latin)

- But we (usually) don't want ASCII output!... JZOS Launcher manages separate encoding.
- www.unicode.org/reports/tr17/ - "A character map may also be known as a charset, a character set, a code page"

IBM JZOS Batch Launcher Example

```
//JZOSBAT JOB (999,XXX), 'JAVA JZOS', CLASS=A, MSGLEVEL=(1,1)
//  MSGCLASS=X, REGION=0M, NOTIFY=&SYSUID
//JAVAJVM EXEC PGM=JVMLDM14,
//  PARM='com.foo.MyClass arg1 arg2'
//STEPLIB DD DSN=JZOS.LIBRARY, DISP=SHR
//SYSPRINT DD SYSOUT=*           < System stdout
//SYSOUT DD SYSOUT=*            < System stderr
//STDOUT DD SYSOUT=*            < Java System.out
//STDERR DD SYSOUT=*            < Java System.err
//STDENV DD *
. /etc/profile
. ~/.profile
export CLASSPATH=~/.myapp
for i in ~/myapp/lib/*.jar; do
    export CLASSPATH=$i:$CLASSPATH
done
//
```

File I/O

- Standard java.io package can only access zFs/HFS (Unix) files
- IBM Record IO (JRIO) classes are higher-level abstractions; no transparent access to z/OS library routines.
- JZOS "ZFile" class provides thin JNI wrapper for "C" library I/O routines, which are well tested and documented. Java Exceptions are provided to access to z/OS diagnostic codes.

```
ZFile zFile = new ZFile("//DD:INPUT", "rb,type=record,noseek");
try {
    byte[] recBuf = new byte[zFile.getLrecl()];
    int nRead;
    while((nRead = zFile.read(recBuf)) > 0) {
        String line = new String(recBuf, 0, nRead,
                                ZUtil.getDefaultPlatformEncoding());
        System.out.println(line);
    };
} finally {
    zFile.close();
}
```

Portable File I/O

"C" I/O routines allow MVS datasets to be processed in "text stream" mode
 Portable code to process either PC/Unix files or datasets (on z/OS)

```
import com.ibm.jzos.FileFactory;
...
BufferedReader brdr = FileFactory.newBufferedReader(inFileName);
BufferedWriter bwtr = FileFactory.newBufferedWriter(outFileName);
try {
    String line;
    while ((line = brdr.readLine()) != null) {
        bwtr.write(line);
        bwtr.newLine();
    }
} finally {
    brdr.close();
    bwtr.close();
}
```

File names, at runtime could be: "c:\mypath.txt", "//MVS.DATASET.NAME", or "//DD:DDNAME".
 The FileFactory will select either a ZFile or a java.io.File as appropriate

MVS Console interface

- WTO

```
MvsConsole.wto("FOO1233E processing terminated",
              0x0020, // routecde
              0x4000); // descriptor code
```

- Operator commands
 - START - Java started task can access options
 - STOP(P) - Causes the JZOS batch launcher to issue a Java System.exit()
 - MODIFY(F) - Can send commands into your Java apps via a callback interface

New JZOS Functionality on alphaWorks

JZOS "2.1.0 alphaWorks" version additions:

- Directly launch jar files
- APIs and samples for invoking DFSORT
- Write SMF records via smf_record() api
- Write to z/OS Logstream (IXGxxx macros)
- Job management samples:
 - Submit z/OS job, returning jobname/jobid
 - Get status for a job (TSO STATUS)

- Get job output via REXX SDSF API (z/OS 1.9 only)
- These examples demonstrate REXX child processes

New JZOS Functionality on alphaWorks

JZOS "2.1.1 alphaWorks" version additions:

- MVS Catalog services APIs and samples:
 - Catalog Search (IGGCSI00)
 - LOCATE and OBTAIN (get volumes and DSCB for DSN)
- Complete set of field converter classes for Cobol and Assembler data types
 - use with ZFile to read and write record formatted datasets
- Automatic generation of Java record classes from Assembler DSECTs

New JZOS Functionality on alphaWorks

JZOS "2.1.2 alphaWorks" version additions:

- Automatic generation of Java record classes from COBOL copy books

Note: The alphaWorks version of JZOS is not supported by the IBM support center.

Deploying z/OS Java Batch Apps

Runtime components of a batch Java application

- zFS/HFS files
 - (Binary) ".class" files
 - (ASCII) ".properties", configuration XML, and other "classpath resource" files
 - JAR files (ZIP archives of class and resource files)
- MVS PDS members
 - JCL
 - "control cards", "parms", etc

Where to write and compile your code

- on z/OS ?
 - ISPF ?
 - vi ?
 - ...
- Or...on your workstation

- Your favorite editor + ANT scripts to build and deploy
- an IDE
 - Syntax/code assisted typing
 - Code hyper-navigation
 - Integrated (remote) debuggers
 - Ant integration, wizards, tools

Eclipse

- A *great* open-source Java IDE.
www.eclipse.org
- The basis for other commercial IDEs
- Code, compile, and test on workstation...
 - Code-assist editors
 - Models code structure; hyper-navigation
- ...one-click deploy your application to z/OS using Ant

For a full featured, complete lifecycle development platform based on Eclipse, consider IBM's Rational Developer for System z:

- <http://www.ibm.com/software/awdtools/rdz>

Eclipse setup and usage

- Download, install, and configure Eclipse (see how-to at dovetail.com)
- Download the `BatchSample` Eclipse project from dovetail.com
- Customize `zos.properties` and move to the workspace directory
- Edit and compile (and unit-test) your code
- Run Ant script to deploy Java application Jars, JCL, etc. to z/OS
- Submit JCL

JZOS Cookbook

(Available soon on alphaWorks)

Sample code and guide, covering:

- Setting up an Eclipse development environment
- Easy deployment to z/OS using Ant
- DB2 and Derby SQL database access
- XML processing
- Mapping COBOL records into Java
- Sequential Dataset processing
- VSAM Processing
- Using popular open source tools: Spring, Derby, Apache Commons, JUnit, Ant

SDK 5.0 / 6.0 Class Data Sharing

- Facility with allows multiple JVMs (jobs) to share Java classes
- Cached in named shared memory, and dynamically updated
- Can reduce overall memory footprint
- Can reduce JVM startup time
- Caches can be private or shared across groups of users/jobs
- 6.0 - Caches ahead-of-time (AOT) compiled code

For example, when using shared classes, Tomcat 5.5 can be started in *half* the time.

Common z/OS Java Stand-Alone Recipes

- XML processing with Java jobsteps interleaved into traditional batch schedules
- Java jobsteps as web-services client
- Apache Tomcat as a JSP/Servlet container
 - Web-based UI for z/OS apps and tools
 - Soap web services server
 - ...
- DB2 batch processing
- Long-running Java started tasks
- ...

Recipe: XML Processing with Java Jobs

No time to prepare a complicated application?...

Quickly whip up a Java program to convert field-structured datasets to and from XML.

Ingredients:

- IBM JZOS Batch Launcher
- Java XML parser (built-in SDK 1.4+)
- Open source XML parsing helpers, like Apache Commons "Digester"
- Stir in a tiny bit of your own code...
- Serve in a batch job, exchanging datasets and XML with other batch jobsteps
- Map Cobol/Assembler records with com.ibm.jzos.fields package (alphaWorks)

Recipe: XML Processing Example

The Apache Commons XML Digester makes XML parsing easy:

```
InputStream inputStream = FileFactory.newInputStream(inputFilename);
Digester digester = new Digester();
digester.push(this);
digester.addCallMethod("congress/member", "handleCongressMember", 7);
```

```

digester.addCallParam("congress/member/district", 0);
digester.addCallParam("congress/member/name", 1);
digester.addCallParam("congress/member/party", 2);
digester.addCallParam("congress/member/contact/address", 3);
digester.addCallParam("congress/member/contact/phone", 4);
digester.addCallParam("congress/member/contact/district-phone", 5);
digester.addCallParam("congress/member/contact/url", 6);
digester.parse(inputStream);

```

The Apache Digester uses SAX event parsing, so it's efficient even for very large XML documents.

Recipe: XML Processing Example

```

//JOBNAME JOB (), 'ME', MSGCLASS=H, NOTIFY=&SYSUID
//PROCLIB JCLLIB ORDER=
//*
//PARSEXML EXEC PROC=EXJZOSVM,
// JAVACLS='com.dovetail.jzos.sample.ParseXmlToFile',
// ARGS='//DD:XMLIN //DD:OUTFILE'
//XMLIN DD DSN=MY.XML.DATA, DISP=SHR
//OUTFILE DD DSN=MY.RECORDS, DISP=(NEW,CATLG),
// DCB=(RECFM=VB, LRECL=200, BLKSIZE=0),
// SPACE=(CYL,(1,1), RLSE)
//STDENV DD *
...

```

Recipe: Java job as web service client

Need to order some take-out for your hungry batch users?

Quickly write a Java batch program that calls a SOAP Web service.

- Get the "WSDL" (XML interface description) of your favorite tasty web service.
- With the free Apache Axis Web services toolkit, use "WSDL2Java" to generate the client Java "stub" code to call the web service.
- Write a tiny Java program to run under the JZOS batch launcher...
 - Call the web service using the generated stub proxy...(the SOAP HTTP protocol and XML envelope parsing is done for you!)
 - Write the results to a dataset, DB2 database, etc...
- Try this yourself! - S8369 z/OS Batch Java Applications

Recipe: z/OS JSP/Servlet Container

Tired of EJB dog food? Try Apache Tomcat!

- A ubiquitous open source, pure-Java Servlet / JSP container
- Can be bundled/embedded in a turnkey Java web application
- Can be configured for DB2 JDBC connectivity and SAF authentication and authorization
- Not a full J2EE container -- no EJBs :-)

- No Sysplex clustering, etc
- Nicely supports modern web applications using JSP, STRUTS, Spring/Hibernate, etc
- Can act as a SOAP Web Services container using Apache Axis.
- An "on-ramp" to WebSphere, since....

Mainframe Tomcat in an hour or less!

1. Download and install [Tomcat](#)
2. Tailor and submit the JZOS Tomcat JCL (just as easily a started task)
3. Open for business!
4. Graceful shutdown via MVS STOP command (SDSF "Y")

- Step-by-step instructions at www.dovetail.com/docs/jzos

Recipe: Java DB2 Batch Processing

Recipe, or Ingredient?

- IBM has over the years made significant improvements in the DB2 JDBC drivers
 - The new "Universal Driver" performs well on z/OS, in either "Type-2" or "Type-4" mode.
- Stable high-quality open-source JDBC frameworks can *significantly* benefit database applications
 - [Apache iBatis](#) - lightweight "Data Mapper" framework tames SQL by separating from Java code.
 - [Hibernate](#) - Full featured Object/Relational mapping framework
 - ...many others

Recipe: Long-running Java Jobs/STCs

- Tomcat is only one example, others seen in the wild include...
- Messaging / file transfer server for proprietary TCP/IP Socket protocol
 - Socket programming in Java is a sweet and reliable addition to many entrees.
 - JZOS toolkit interface to BPXWDYN facilitates dynamic dataset allocation.
 - DB2 tables for tracking status, queueing requests
- Long running task that polls DB2 table for new "work" in the form of datasets to process (transform to XML, etc)
- "MQ" message server
 - Queued/Asynchronous DB2 database updates initiated on other platforms
 - Reuse Java "JMS" api programming skills on z/OS

In Summary

- z/OS Java has escaped Websphere; it's running loose in JCL!
- Open source Java software can do amazing things on z/OS
- Free development tools, like Eclipse, are fantastic for z/OS Java development
- **Reuse is King** - code, skills, investments...

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