Batch Modernization:
Batch Improvements in z/OS 1.13

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Agenda

• Why is batch important?
• z/OS batch – part of the OS fabric
• IBM’s Batch Modernization effort
• New features
• Improvements
What is batch computing?

Batch processing is a system for processing data with little or no operator intervention. This allows efficient use of the computer and is well suited to applications of a repetitive nature, such as file format conversion, payroll, or the production of utility bills.

In interactive computing, by contrast, data and instructions are entered while the processing program is running.

<table>
<thead>
<tr>
<th>Batch / Bulk Processing</th>
<th>Interactive Computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface designed for machine</td>
<td>Interface designed for human</td>
</tr>
<tr>
<td>Optimized for machine utilization</td>
<td>Optimized for efficiency of human</td>
</tr>
<tr>
<td>Many items of data processed per human intervention</td>
<td>Single transaction processed per intervention</td>
</tr>
<tr>
<td>Automated</td>
<td>Manual</td>
</tr>
<tr>
<td>Served well by legacy languages &amp; technology – COBOL, JCL, JES</td>
<td>Served well by modern languages &amp; frameworks – Java, WebKit</td>
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<tr>
<td>Ceased to be a significant element of University curricula</td>
<td>Significant part of University curricula</td>
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- By eliminating human reaction time, batch can process in one hour what OLTP would take one month (or require 50,000 people)
- Batch is part of a continuous spectrum of workload
- Enterprise clients run a continual mix of online and batch – response to global, 24 x 7 business
- Business events as a trigger for batch e.g. end-of-day are a hallmark of a critical workload

Interactive Computing

Source: “Consider Scheduling Tools for Batch Application Integration”, Gartner.
Why Batch?

• Economies of Scale
  • Processing all items in a collection
  • Pre-fetch optimizations
• Period based processing
  • End of day, month, year
  • Consistent reporting
  • Integration with others on a consistent basis
z/OS 45 years of Batch – From punch cards to Java Batch

45 years of evolution in Batch processing on the IBM Mainframe have provided the foundation for heavy-duty, reliable and efficient Batch for most large companies in the world:

- WLM, WLM Batch initiators
- Batch & Print Subsystem JES2, JES3, PSF
- Job Control Language (JCL)
- Batch Management Interfaces (for example, SDSF)
- Step and Job dependencies by means of Condition Codes and Job Networks
- Online and Batch in parallel
- Time-driven Job execution
- Job / Step Restart functions, Start, Submit, Remote submit, Syntax Scanner
- Accounting based on Job/USER, Job statistics and RMF reports
- Pre-loaded address spaces (initiators)
- All Mainframe programming languages can be used in Batch
z/OS Batch – Integral part of the OS

- OS based batch submission
  - Always there
  - Scheduled
  - Secure
  - Resource Accounting
- OS based resource management
  - Dataset synchronization via enqueues
  - CPU, memory, I/O access based on WLM policy
- OS based device management
  - Disk, Tapes
IBM Batch Modernization initiative

- Ensure that IT architects and the industry recognize
  - Almost all large scale IT projects include batch
  - The web focus of the last decade has focused on online work, response time, transactions
  - Backend processing is often best implemented as batch
- Provide an IBM Batch solution for any platform – including z/OS
  - WebSphere Compute Grid
    - Both java programming model and execution environment
- CICS Compute Grid on z/OS
- Maintain leadership in z/OS batch
  - Improvements to existing function
  - Integrate and support the Compute grid programming model
WebSphere XD Compute Grid

- Java Batch combined with all functionality provided by the WebSphere JEE Container

- Extension on top of WebSphere Application Server
  - Available as a feature pack on WAS V7 (limited function), or a product, WebSphere XD Compute Grid (full function)

- Java stand-alone functionality plus
  - WAS Container management
    - security, transactions and connection management
  - Checkpointing
  - Persistent JVM
  - QoS, such as high availability

- Reuse of OLTP code in WAS XD Compute Grid Batch Container
Compute Grid Overview diagram

Jobs are written in XJCL, an XML version of a job control language.

Compute grid provides parallel job management.

Batch Container is reusable application code.
WebSphere XD Compute Grid programming environment

As with all WebSphere work, it is run transactionally and uses architected connectors to get to the resources.

Client

WebSphere Application Server for z/OS

- Start Transaction
- Business Logic
- Commit Transaction

- JEE Application
- JDBC
- JCA
- CICS
- etc

External Scheduler

- BATCH
- Web Service
- EJB
- Request (HTTP/IIOP)
- Response (HTTP/IIOP)
Benefits of Java (Batch) on z/OS

- Specific Java Batch APIs for z/OS
  - Dataset and VSAM access
  - Condition Code passing
  - DFSORT support with a Java Class
  - Writing Logstreams
  - Triggering of Jobs from Java
  - RACF APIs
- Local DB2 Database driver for high throughput
- Access to many Java skills
- Effective and efficient development tools available
  - Rational Tools available specific to Batch Container
- Availability of many classes, libraries, frameworks and applications based on open source
- Interoperability with other programming languages on z/OS
z/OS Batch Runtime Environment (New)

- A new option for running batch work in z/OS 1.13
- Provides a managed environment for integration of Java and COBOL
- Consistent with IBM WebSphere based batch
  - A subset of the WebSphere programming model
  - Incorporated in the operating system
- DB2 as a resource manager
Batch Execution Runtime Environment
Java COBOL with DB2 Interoperability

- Ability to extend COBOL/DB2 applications with either COBOL or Java:
  - Requires local attach z/OS DB2 connection sharing for common DB2 access
  - Requires Transactional integrity among the application components

- A generalized solution in a pure batch environment, without requiring a specific run time or middleware. It does not require an application server like CICS or DB2 Stored Procedures.

- Implementation requires little or no changes to existing code!
  - Only requires special callbacks for commit/rollback

- Enables interoperability between COBOL, Java and DB2 in batch
Our z/OS Topology
JES Single Step based

Submit JCL

JES
Initiator

JZOS JVM zOS BC
Transaction Service
Execution Service
z/OS Plugin
z/OS Plugin
Policy/logs
Process Job Step
Commit Rollback

JDBC
JAVA/Cobol App

Local DB2

/STEP EXEC PROC=BCDBATCH
/MAINPROG DD *
PGMNAME
/PARMS DD *
TYPE=JAVA / COBOL
PARM = 'Parm String '
ARG1=
ARG2=

... 

ARGN=
/ *

JCL is familiar to operations
code in the batch container is the same as the code one could write anywhere
JOBS REST API for z/OS – use with z/OS BATCH

- Today’s options:
  - Allocate and open internal reader
  - TSO/ISPF submit,
  - FTP “interface-level2”
  - Java z/OS submit interface

- Complex programming
  - Security protocol limitations

- Improve access to z/OS batch
  - Increase client coverage
  - Add a non-controversial remote interface
  - Align with Web technologies
  - Make z/OS a little more approachable

- New RESTful HTTPs based API
  - Secure
  - Firewall friendly
  - Text like

- Any web-based, Java, PHP, Perl application, etc. supporting HTTP

- Submit JCL, get status, retrieve output files, change jobclass, cancel job, purge job

- z/OSMF R13
- z/OS JES2
- z/OS JES3

- Invoke the power of z/OS batch from virtually any non-z/OS application
JOBS REST Interface (cont)

- Four verbs: Get, Post, Put and Delete

- Example
  - A job named G1JAVA1B with job number JOB00023

GET /zosmf/restjobs/jobs/G1JAVA1B/JOB00023 HTTP/1.1

- Result returned in JSON format

HTTP/1.1 200 OK
Date: Thu, 13 Jan 2011 05:39:28 +0000GMT
Content-Type: application/json
Connection: close

```json
{
  "jobid":"JOB00023","jobname":"G1JAVA1B","subsystem":null,"owner":"G1JAVA1","status":"OUTPUT","type":"JOB","class":"A","retcode":"CC 0000","url":"https://host:port/zosmf/restjobs/jobs/G1JAVA1B/JOB00023","files-url":"https://host:port/zosmf/restjobs/jobs/G1JAVA1B/JOB00023/files"
}
```

Using the files-url you can retrieve the individual datasets. Data can be retrieve in chunks etc.
Instream data in PROCs and INCLUDEs

- Instream data in procs and includes (JES2)

//PROC1 PROC
//ASTEP EXEC PGM=xyz
//DD1 DD *

This is instream data

// PEND

- Prior to this support you could not have instream data in a JCL procedure
- Support also allows instream data in include statements wherever a DD statement is allowed
- Requires both z/OS 1.13 and JES2 1.13 on the converting system and the initiating system
- This is not supported for MSTR subsystems
- This is not supported by JES3
Instream data in PROCs and INCLUDEs

Instream data in PROC example

//HELLO   PROC
//STEP1   EXEC ASMHCLG
//C.SYSIN DD *
TEST CSECT ,
STM 14,12,12(13)
BALR 12,0
USING *,12
ST 13,SAVAREA+4
LA 13,SAVAREA
SPACE 1
WTO 'Hello world!
SPACE 1
L 13,SAVAREA+4
LM 14,12,12(13)
SR 15,15
BR 15
SPACE 1
SAVAREA DC 18F'0'
END
//L.TEST DD DUMMY
//L.SYSXX DD *
// PEND
JOB return code (JES2 only)

- There is no formal definition of the job return code. The defacto standard is JES2 returning the maximum return code of the job.
- New job card keyword to control job return code
  - JOBRC= MAXRC | LASTRC | (STEP, name.name)
    - MAXRC is existing processing (default)
    - LASTRC is return code of last step
    - (STEP, name.name) is return code of identified step
      - If step not executed, defaults to MAXRC
- JOBCLASS JOBRC= MAXRC|LASTRC to affect processing for all jobs in the jobclass
- Affects return code seen in
  - Extended status (e.g. SDSF)
  - ENF 70
  - HASP165 message
  - $DJ,CC= command
Suspend a job at next step (JES2 only)

• If a job is restartable
  • A new operator command is defined to suspend the job at the next step
  • The job is requeued for execution
• Allows a faster and/or less disruptive shutdown
• The job must complete the step it is running.
  • This remains an issue for long running steps
• Can reduce Mean-Time-To-Recovery (MTTR) if the system must be gracefully brought down.
Suspend a job at next step (JES2 only)

- Remove job on step boundary
  - New STEP operand on $EJ command
    - Causes job to exit execution at end of current step
    - Optional HOLD operand makes job held
    - Job is requeued for execution
  - Job must be journaling (JOURNAL=YES on JOBCLASS)
  - Uses existing continue restart function of z/OS
    - Previously used to restart jobs after an IPL
  - Full syntax $EJxxx,STEP [,HOLD]
    - Full cross member support
Spin Any (JES 2 only)

- Ability to specify automatic spin options in JCL
  - Eliminates the requirement to take down a long running process to release spool space
  - Similar to what was done for JESLOG
  - Applies to any data set allocated as SPIN
    - No application code/JCL change needed
  - Provides a time, size, or command based option to spin output

- Update to SPIN= parameter on DD statement
  
  ```plaintext
  SPIN= { NO }  
  { (UNALLOC,'hh:mm') }  Spin at specific time
  { (UNALLOC,+hh:mm') }  Spin every hh:mm interval
  { (UNALLOC,nnn [K|M]) }  Spin every nnn lines
  { (UNALLOC,NOCMND) }  Cannot be spun by command
  { (UNALLOC,CMNDONLY) }  Can be spun via operator command
  ```

- `$TJn,SPIN,DDNAME=name command added`
Freeing Tape Volumes before end of step

- A new FREEVOL=EOV keyword on the JCL DD statement:
  - This is intended to allow overlapped processing for multivolume data sets, which can reduce batch processing elapsed time.
  - Specifies that a tape that is a part of a multivolume data set become available at end-of-volume rather than at step end.
  - Allows other jobs to use the tape immediately.
  - Allows overlapped processing of multivolume tape data sets.
IEBCOPY

- IEBCOPY performance is improved for copying from a partitioned data set (PDS) to another PDS
- IEBCOPY now exploits 31-bit storage for buffers
- The requirement for APF authorization of IEBCOPY is removed
COPYCNT

- New JCL OUTPUT statement keyword
- Synonym for COPIES=
- COPYCNT=x
  - Where x can be 1-4G
  - Usage depends on print driver… if the print driver is COPYCNT aware it will supersede any specification of COPIES=

- z/OS now allows the specification of copies >255
- No support in JES2 or JES3 for detecting or changing the value of COPYCNT
- SDSF can display and change COPYCNT
Options for improved Batch Elapsed time

• Hardware
  • CPU
    • Faster
    • More
  • I/O
    • zHPF
    • SSD drives
  • Memory
    • Large pages, More
• Software
  • Parallel
    • I/O, setup, execution
  • Optimize
    • Use less resource, exploit new algorithms
References

- Redbook – Batch Modernization for z/OS – SG24-7779
- Redpaper – Batch Processing with Websphere Compute Grid: Delivering Business Value to the Enterprise
- Java Batch Programming with XD Compute Grid
Question

• Where would you like to see us focus on batch modernization?

• Please send e-mail to Gary Puchkoff (puchkoff@us.ibm.com)