DB2 for z/OS Java Update

Session Number IDZ-1706B

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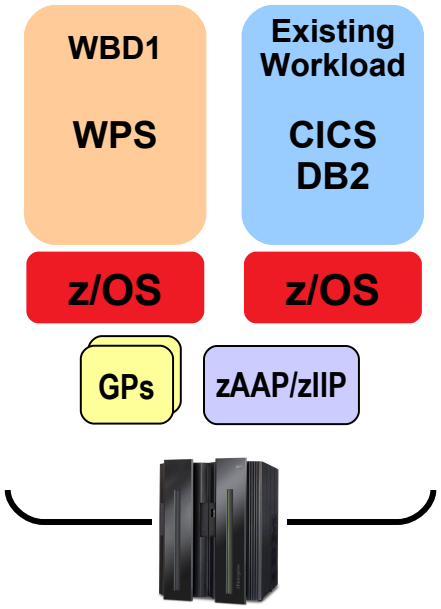
IBM Software
Information On Demand 2011

Agenda

- WebSphere Process Server & DB2 for z/OS Update
- Java and DB2 10 Update
- Java Stored Procedures

Example of DB2 10 Performance for Java App WebSphere Process Server PUC V3

Separate LPAR (Type-4)

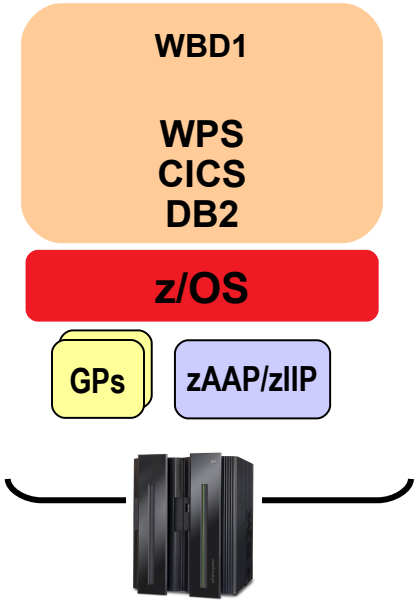


WPS runs in a new LPAR. CICS and DB2 run in a separate LPAR.

Web services are used to access CICS transactions.

JDBC Type 4 driver for DB2 access.

Same LPAR (Type-2)



WPS runs collocated with CICS and DB2.

Web services are used to access CICS transactions.

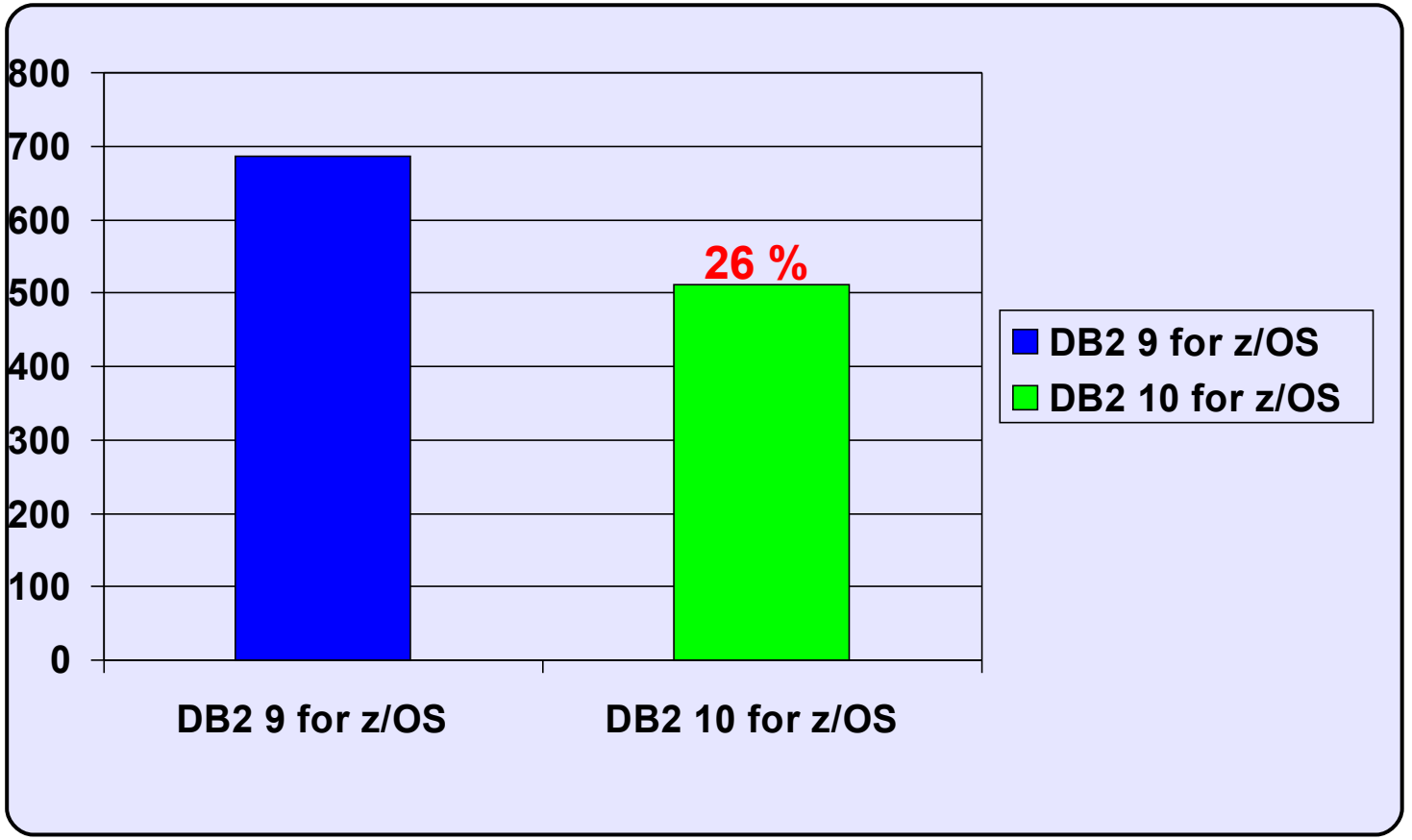
JDBC Local Type 2 adapter is used for DB2 access.

PUC # 3 - 300 WPS User's - Steady State

- Data was gathered for the PUC #3 study on z196 WPS for z/OS v7.0.0.2, DB2 10 for z/OS and CICS backend data targets
- Migration from DB2 9 for z/OS to DB2 10 for z/OS for the study was seamless.
- PUC #3 DB2 10 for z/OS findings were "out of the box" no DB2 10 feature exploitation as yet

WPS Using JCC Type 2 – DB2 9 vs. DB2 10

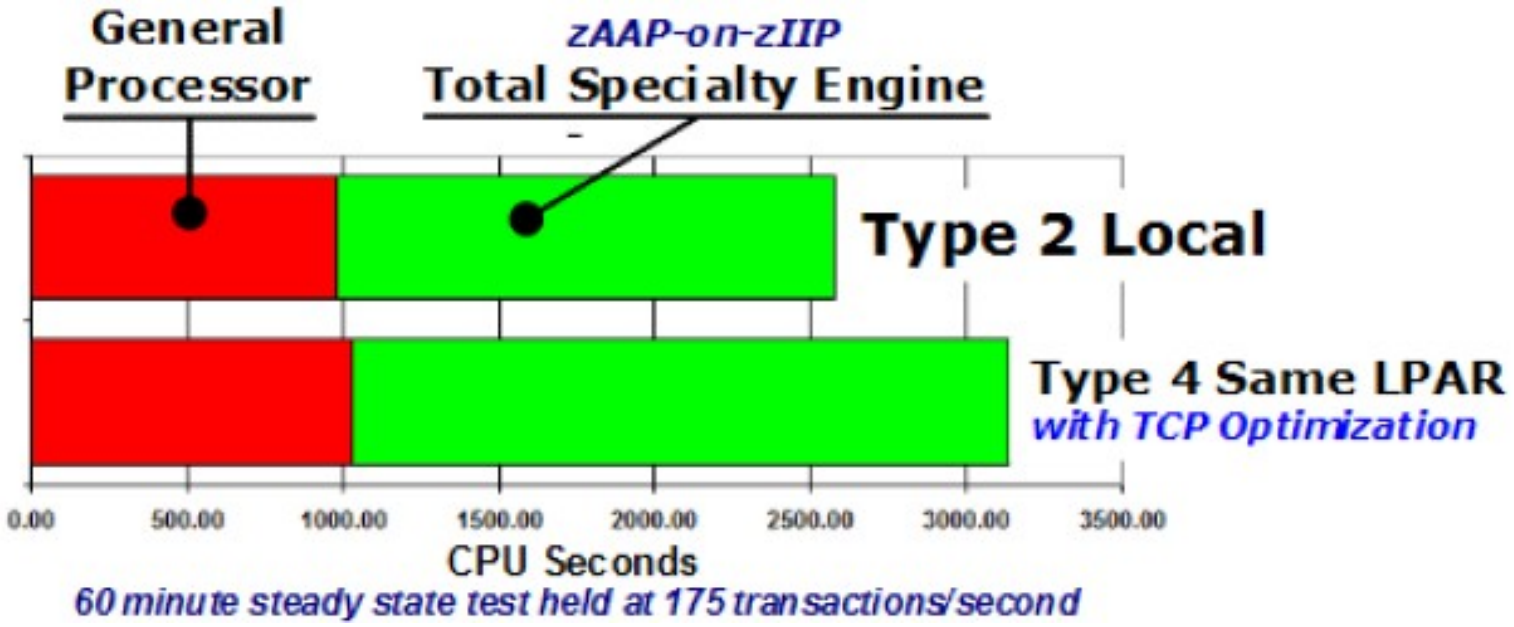
PUC # 3 - 300 WPS User's - steady state



DB2 10 for z/OS consumes 26% less CPU seconds than DB2 9 for z/OS with Type 2 connector

WPS and DB2 10
JCC Type2 vs. JCC “local” Type4

gCP and SE consumption is lower using JCC Type2 compared to JCC Type4 incl. optimized local TCPIP



Total CPU consumed for test run duration

- JCC driver level is 3.62.57 / DB2 10 for z/OS PUT1012
- WP101476-2_The Value of Co-Location

DB2 10 for z/OS and JDBC/SQLJ Update

Java Data Access – Many Forms

POJO with inline SQL
JDBC, SQLJ

Spectrum of choices

POJO iBatis Hibernate EJB 3
pureQuery

EJB application

EJB query lang

OR mapping layer

Persistence Layer

config file for named queries

Pro's:
- Simplicity
- Easy to control SQL
- Good performance
- Good monitoring (SQLJ)

Con's:
- Not tied to object model
- More work for app programmer

DB2

Pro's:
- Less work for app programmer
- Access via OO business objects

Con's:
- Complexity
- Less control over SQL issued
- Performance can suffer
- Very difficult to monitor or diagnose problems

EJB Persistence

- EJB 2.0 Container Managed Persistence (CMP)
- EJB 3.0 Java Persistence Architecture (JPA)
  - only requires a J2SE environment
  - uses Java 1.5 annotation or XML for O-R mapping
  - generates SQL for database access, also joins
  - EJBQL is more flexible and native SQL can be included via named queries
  - easier to use, more flexible and simpler runtime environment
  - JPA 2.0 feature pack
- pureQuery
  - Focus on simplifying the tasks of developing and managing applications that access data.
    - Single API to query databases and in-memory Java objects
  - Embraces SQL as the common query language
  - Tools, APIs, and runtime environment
  - High-performance Java data access technology
    - Heterogeneous Batch Update with Parameter Markers
    - Template support to customize generated code
- WAS 7.0 JPA integration with pureQuery
- WAS 7.0 installation support of SQLJ applications from WAS admin console (manages SQLJ artifacts)

WebSphere Connection Pool Properties

- Connection Timeout
  - How long to attempt connection creation before timeout
- Max Connections
  - max connections from JVM instance
- Min Connections
  - lazy minimum number of connections in pool
- Reap Time
  - How often cleanup of pool is scheduled in seconds
- Unused Timeout
  - How long to let a connection sit in the pool unused
- Aged Timeout
  - How long to let a connection live before recycling
- Purge Policy
  - After StaleConnection, does the entire pool get purged or only individual connection
- Statement Cache Size (different window)
  - Number of statements to keep in prepared Statement Cache (default 10)

WAS/DB2 Active Thread Tuning Considerations

- WAS connections in connection pool that keep an active thread in DB2 are target of the "idle thread timeout“
  - Type 2 on z/OS (RRSAF)
  - Type 4 connection that holds on to resources, e.g. WITH HOLD cursor, KEEPDYNAMIC YES.
- Set WAS "connection unused time" to a smaller value than DB2 "idle thread timeout" to avoid stale connection conditions.
- Consider setting min connections to 0 (zero) and connection unused time to not higher than 10 - 15 min to free up unused resources in DB2 in a controlled way and to reduce the exposure of long living threads
- **In DB2 10 - CPU reduction with client package bind option RELEASE(DEALLOCATE)**
  - Consider setting WAS “aged timeout” to less than 5 min, recommended 120 sec to reduce exposure of long living threads
- Type 4 tuning recommendation covered in presentation
  IDZ 1702: How to Setup Application Server to Access IBM DB2 z/OS with High Availability

WAS V7 Heterogenous Connection Pool

- Heterogeneous pooling is the ability to share one connection pool among multiple *similar* WebSphere data sources
  - Core properties will have to be identical
    - username,
    - host, port …
  - Defer to each application definition of application specific non-core data source properties
    - currentSchema
    - currentFunctionPath …
- Addresses common reason for many data source definitions going to the same DB2 for z/OS system

WAS V7 Heterogenous Connection Pool…

- Benefits
  - More efficient connection usage
    - Reduction in memory consumption in WebSphere. Creating one data source vs. multiple data sources.
    - Reduction in memory consumption in DB2 (threads, connection)
  - Improved performance.
    - Allow for sharing of connections in the same tran if get→use→close pattern is used even if connection requests don't match
    - Reduce number of Global Transaction branches or even eliminate them in some cases.

DB2 Profile Table Facility

- **DB2 9 for z/OS introduced profiles to identify a query or set of queries (job DSNTIJOS)**
  - Profile tables contain information about how DB2 executes a group of statements.
  - Profiles specified in SYSIBM.DSN_PROFILE_TABLE
- **SQL statements identified by a profile are executed based on keywords and attributes in SYSIBM.DSN_PROFILE_ATTRIBUTES**
  - System parameters NPGTHRSH, STARJOIN and SJTABLES can be specified as keywords, providing greater granularity than DSNZPARM
- **DB2 10 for z/OS adds support for filtering and threshold monitoring of system related activities**
  - Number of threads
  - Number of connections
  - Idle thread timeout
  - New scope filters (SYSIBM.DSN_PROFILE_TABLE)
    - ROLE - available through Trusted Context support)
    - PRDID - Product-specific identifier

DB2 10 JCC Type2 Performance Enhancement

- **Local Java and ODBC applications did not always perform faster compared to the same application called remotely**
  - Over last DB2 versions, DDF optimized processing with DBM1 that was not available to local JDBC application.
  - zIIP offload significantly reduced chargeable CP consumption
- Open support of DDF optimization in DBM1 to local JCC type 2 driver
  - Limited block fetch
  - LOB progressive streaming
  - Implicit CLOSE
- Expect significant performance improvement for applications with
  - Queries that return more than 1 row
  - Queries that return LOBs

DB2 z/OS Global Dynamic Statement Cache

- Allows applications to reuse and share prepared SQL statements in DB2
- Conditions for reuse of SQL statement from dynamic statement cache
  - SQL is dynamically prepared SELECT, UPDATE, DELETE or INSERT
  - The statement text is identical - character for character (literals problematic)
  - The authorization ID is the same
- Good programming practice to use parameter marker (?) for best reuse
- ZPARM value CACHEDYN = YES turns on global cache
  - Statement text and executable of the prepared statements are kept in the EDM pool for reuse across all threads
- REOPT(ALWAYS) disables use of cache for that plan/packages
- SQL statement statistics can be collected via IFCID 316,317,318
  - EXPLAIN STMTCACHE ALL writes sql statistics into DSN_STATEMENT_CACHE_TABLE table
    - Select top-10 most frequently executed SQL and most expensive individual SQL to look for SQL tuning opportunities

DB2 10 Literal Replacement for Global Dynamic Statement Cache

- Dynamic SQL with literals can now be re-used in the cache
  - Literals replaced with &
    (similar to parameter markers but not the same)
- To enable set the keyword enableLiteralReplacement='YES' in the JCC Driver
- Lookup Sequence
  - Original SQL with literals is looked up in the cache
  - If not found, literals are replaced and new SQL is looked up in the cache
    - Additional match on literal usability
    - Can only match with SQL stored with same attribute, not parameter marker
  - If not found, new SQL is prepared and stored in the cache

DB2 10 Literal Replacement for Global Dynamic Statement Cache …

- Example:

  SELECT BALANCE FROM ACCOUNT WHERE ACCOUNT_NUMBER = 123456

  - This would be replaced by

  SELECT BALANCE FROM ACCOUNT WHERE ACCOUNT_NUMBER = &

- Performance Expectation
  - Using parameter marker provides still best performance
  - Biggest performance gain for small SQL with literals that have a cache hit now, but did not before
  - Determined access path is not optimized to provided literals,
    - Need to use REOPT for that purpose

DB2 10 – Simplified Performance Analysis of Dynamic SQL

- Static SQL packages can be bound with explain to review access path
- EXPLAIN of dynamic SQL without changing existing source code via DB2 special register
  - **NO** – default
  - **YES** – PLAN tables are populated and statements are executed
  - **EXPLAIN** – PLAN tables are populated, SQL is not executed Intended for tooling without execute authority
- In JCC via connection property **currentExplainMode**
  - JCC flows CURRENT EXPLAIN MODE special register setting from the connection property on behalf of application
  - PLAN tables are populated as statements execute
  - STMTCACHE table is populated if IFCID 316,317,318 started

WebSphere PreparedStatement Cache

- WebSphere manages a cache of previously created preparedStatement objects on a connection
- When a new prepared statement is requested on a connection, the cached preparedStatement object is returned if available on that connection
- Creating a new preparedStatement object is costly in Java besides the cost to prepare the SQL to DB2
- High PreparedStatement object cache hit ratio is needed to benefit from DB2 keepDynamic option

✓ **Both, DB2 Global Dynamic Statement cache and WebSphere preparedStatement object cache should be used for best performance**

DB2 10 Timestamp Enhancements

- **Greater Timestamp precision**
  - Number of fractional digits in a timestamp extended
  - Range supported in DB2 10 – 0 to 12 digits
    - The V9 default of 6 digits remains
    - TIMESTAMP(12) is the maximum
  - TIMESTAMP is the same as TIMESTAMP(6)
  - Other capabilities like timestamp duration and CURRENT TIMESTAMP extended to support new precision capability
  - **In JCC p**roperty timestampFormat
    - Specifies the format in which the result of the ResultSet.getString or CallableStatement.getString method against a TIMESTAMP column is returned
  - java.sql.Timestamp maps to SQL data type TIMESTAMP(*n*)
    - If the timestamp precision of the target is less than the timestamp precision of the assigned value, the excess fractional seconds are truncated.

DB2 10 Timestamp Enhancements …

- **Timestamp with Timezone**
  - A time zone is the time difference in hours and minutes between the local time and UTC (Coordinated Universal Time – formally referred to as Greenwich Mean Time (GMT)).
  - 2007-11-05-08.00.00-08:00 (+|- hours:minutes)
- **java.util.Calendar estcal = java.util.Calendar.getInstance(esttz);**
  // Construct a Calendar object with the GMT-05:00 (Eastern Standard Time) time zone.
  ts=rs.getTimestamp(1,estcal);
  // Retrieve the TIMESTAMP column value into a Timestamp object.
  // Specify a calendar parameter that says that the time zone is GMT-05:00.

DB2 10 Extended Indicator Variables

Simplifies application programming for subset of input data (screen)

Choices before

1) Build a dynamic INSERT/UPDATE statement containing only the columns where the end user provided values. (Not good for the dynamic statement cache, especially if built with constants.)
2) Code static SQL for every combination of inserted columns; possible, but very tedious. Similar scenarios exist for UPDATE, and MERGE.

- DB2 10 EXTENDED INDICATOR VARIABLES (associated with Host Variables)
  - Enabled by PREPARE (dynamic SQL) or as a bind option (static SQL)
    - -5 For INSERT/MERGE INSERT: Insert the default value into the table, For UPDATE/MERGE UPDATE: Update the column value to the default value
    - -7 For INSERT/MERGE INSERT: Insert the default value into the table, For UPDATE/MERGE UPDATE: As if a no-op

- One SQL statement can be used to cater for ALL variations of UPDATE or INSERT

DB2 10 Extended Indicator Variables – SQLJ Sample


```
String dept = null;
String dName = "RECEIVING";
String rptDept = null;
String mgr, locn = null;
short deptInd, dNameInd, mgrInd, rptDeptInd, locnInd;
dNameInd = ExecutionContext.DBNonNull;
mgrInd = ExecutionContext.DBDefault;
deptInd = rptDeptInd = locnInd =
ExecutionContext.DBUnassigned;
#sql [ctxt]
  {UPDATE DEPARTMENT
    SET DEPTNO = :dept :deptInd,
        DEPTNAME = :dName :dNameInd,
        MGRNO = :mgr :mgrInd,
        ADMRDEPT = :rptDept :rptDeptInd,
        LOCATION = :locn :locnInd
    WHERE DEPTNO = "F01"
  };
```

Configurable Query Block Size with JCC 9.7 FP3 and DB2 10

- The query block size determines how many qualifying rows can be returned in a single query block (that maps to a network trip in most cases)
- This property is critical if large resultsets are returned to client to reduce needed network trips
- Existing JCC property, queryDataSize, has a default of 32K and is configurable in range 4k - 256k
- setFetchSize() is also honored for forward-only cursors to configure the number rows to fetch from server on each trip for forward-only cursors

Java Stored Procedure Env.

- Java Stored Procedures widely used
  - Code reuse
  - JVM provided functionality
- Java Stored Procedure Environment
  - Run in WLM-SPAS for Java SPs
  - One JVM started for each service task
  - One Java SP thread per JVM
- Scalability and performance opportunity
  - Overhead to start JVM, less service tasks per wlm-spas
  - Only a few (<4) concurrent executions of Java SP per wlm-spas
  - Not possible for object caching across JVMs

Java SP Change Management with IBM Rational Build Forge

- IBM Rational Build Forge is software delivery automation framework for executing, scheduling and reporting on a various automation activities
  - Builds, deployments, testing, Implementation and audits.
- Build Forge automates, orchestrates, manages, and tracks entire software assembly process.
- Joinedly created sample flow to implement Java SP (SQLJ) change management

Building Blocks of Build Forge

Steps

1a. cp /root/DB2InstallJar.class DB2InstallJar.class
1b. java sqlj.tools.Sqlj ProgrameName.sqlj
1c. jar -cvf TEST_SQLJ_1.jar

2. java com.ibm.db2.jcc.sqlj.Customizer –url jdbc:db2://HostName:Port/DBName –user ${User} -password -bindoptions ${BindOption} ${ProgramName}_SJProfile0.ser

3. java DB2InstallJar DBServer ProgName.jar MYSCHEMA.MY${B}JAR

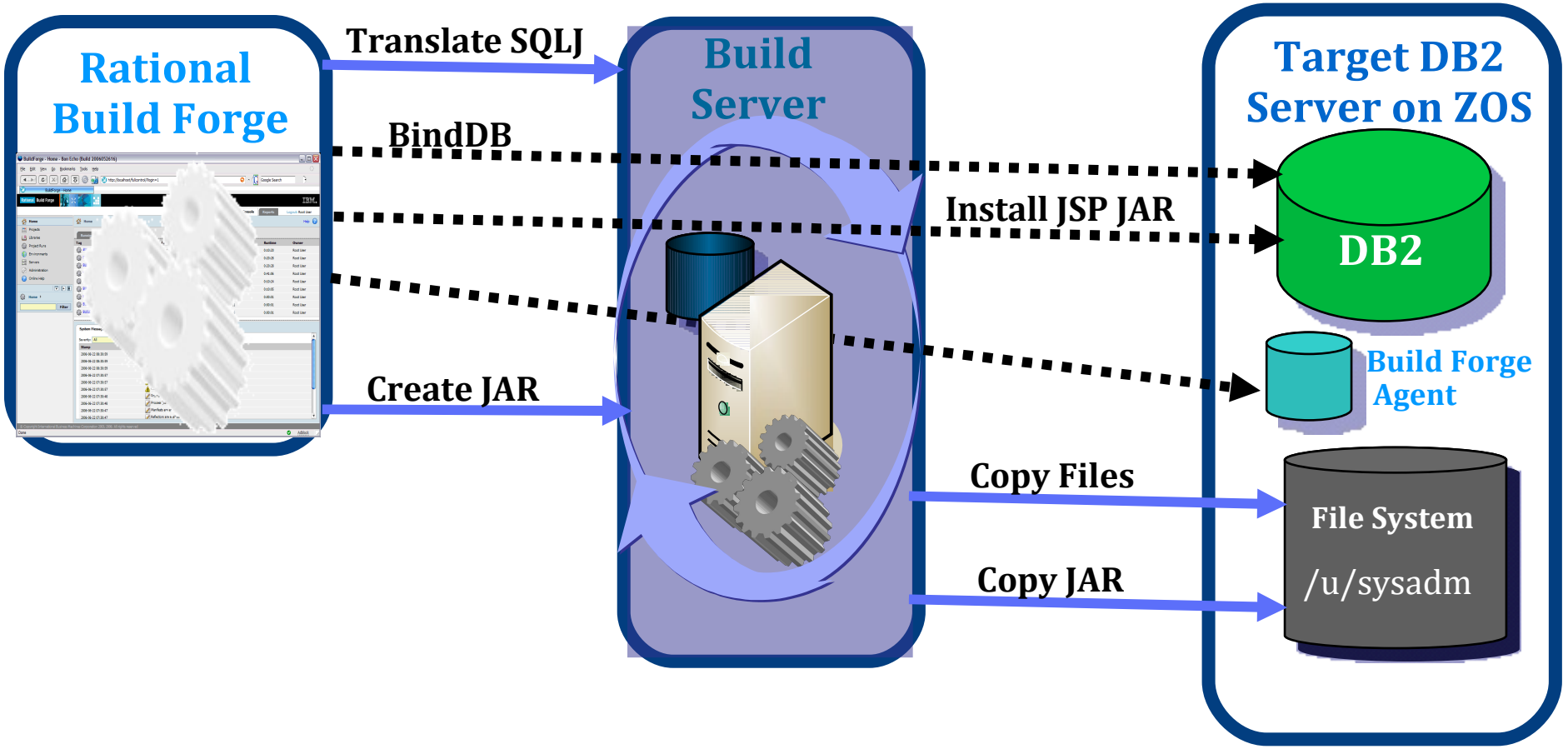
Project

Source | Translate | Bind DB | Create JAR | DB2 Install JAR | …

Environment

1. RELEASE=JavaStoredProcedure_1.0.3
2. JAVA_HOME=/opt/IBM/java/jdk1.5.0_06
3. PATH=/root/JSPSource/:
4. CLASSPATH=/root/lib/sqlj.zip:/root/lib/db2jcc.jar:..~

Process Flow –
Stored Procedure Runtime using Build Forge



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  - Find the community that interests you…
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    - **Information Management ibm.com**/software/data/community
    - **Business Analytics ibm.com**/software/analytics/community
    - **International DB2 User Group** www.idug.org

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Useful DB2 for z/OS URLs

- **DB2 10 Launch Website** → http://bit.ly/DB210Launch
- **DB2 for z/OS Website** → http://www-01.ibm.com/software/data/db2/zos/
- **DB2 Product Library** → http://www.ibm.com/software/data/db2/zos/library.html
- **DB2 Newsletter** → http://www.ibm.com/vrm/newsletter/11065

- **Latest Whitepapers**
  - Business Value of DB2 10 – Julian Stuhler
  - A Matter of Time: Temporal Data Management
  - Why DB2 for z/OS is BETTER than Oracle RAC ?
- **DB2 for z/OS e-Kit** → http://bit.ly/DB210e-Kit
- **Upcoming Conferences/Events**
  - **IDUG DB2 Tech Conference EMEA Prague - 13th -18th Nov 2011**
  - **DB2 10 Migration Planning Workshop Prague - 13th November 2011**
  - **IDUG DB2 Tech Conference AG Denver - 14th -16th May 2012**
  - **IDUG 10 Migration Planning Workshop Denver - 13th May 2012**

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- World of DB2 for z/OS - 1700+ members → http://db2forzos.ning.com/
- DB2 10 LinkedIn - 1000+ members → http://linkd.in/IBMDB210
- DB2 for z/OS What's On LinkedIn – 2000+ members → http://linkd.in/kd05LH
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