Master Data Management with DB2 for z/OS Hints and Tips to Run an IBM WebSphere Application Successfully

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Agenda

• Overview
• Infrastructure Setup
  • DB2 for z/OS for distributed Java applications
  • WebSphere Application Server
• Application Design Hints and Tips
  • DDL recommendations
  • Java coding best practice
• Application Performance
  • DB2 reports
  • Dynamic statement cache statistics and SQL tuning
  • Locking and concurrency
• Summary
What is InfoSphere Master Data Management (MDM)?

- From a business perspective
  - InfoSphere MDM manages master data for single or multiple domains – customers, citizens, suppliers, locations, products, services offerings, accounts or more

- From a technical perspective
  - It is a product using J2EE technology running in distributed WebSphere environment accessing the database via a JDBC type 4 driver
  - Provides pre-built and extensible data models

- From a DB2 for z/OS perspective
  - Very normalized data model which leads to many SQL per transaction
  - Uses random-random key by default, can be customized
  - Uses triggers to maintain history tables
Business Value of MDM with DB2 for z/OS

- System Z and z/OS is centered around efficient sharing of resources
  - Tight integration between hardware, operating system, and subsystems
  - Proven disaster recovery capabilities
  - Workload Manager (WLM)
  - Mature systems management tools
- zEnterprise provides centrally managed environment for distributed application across X, P, Z
- DB2 for z/OS hosting enterprise databases
  - Unmatched availability
  - Unparalleled security
Database Related Infrastructure Setup

- DB2 – setup for distributed Java applications
  - Group and member DVIPA
    - Provides continues availability for distributed access to DB2 group
  - DB2 location alias for sub grouping
    - Our choice to setup location alias for 2 member subgroup to limit MDM workload execution to 2 members on z196
- DB2 10 High Performance DBAT
- Review relevant zParms
- WLM
- WebSphere Application Server
  - Data source properties for sysplex workload balancing
  - Connection pool properties
Sysplex Distributor and DVIPA

- Group DVIPA provides a virtual TCP/IP address into the data sharing group
- Sysplex distributor routes the connection request to the most available member based on WLM recommendation
- Member DVIPA for transparent restart of DB2 on a different LPAR
Team effort among
- SWG MDM
- SWG DB2 for z/OS
- STG
New –MODIFY DDF command with the ALIAS keyword to configure and manage aliases dynamically without taking a DB2 or DDF outage.
DB2 Location Alias for Subgrouping (2)

- DB2 10 – MODIFY DDF command with the ALIAS keyword to configure and manage aliases dynamically without taking a DB2 or DDF outage
  - Values are stored in the DDF communication record of DB2 BSDS and used during DDF start processing
- Example:
  - MODIFY DDF ALIAS(WQ2G13) ADD
    Alias1 is created and is stopped by default.
  - MODIFY DDF ALIAS(WQ2G13) PORT(50260)
    Alias1 is associated with port 50260.
  - MODIFY DDF ALIAS(WQ2G13) START
    DDF will accept requests for WQ2G13 on port 50260. When a client connects to WQ2G13, member IP address is returned in the server list.
  - MODIFY DDF ALIAS(WQ2G13) STOP
    WQ2G13 is stopped and will not accept new requests. Existing requests will be allowed to complete.
DB2 High Performance DBAT

- High Performance DBATs reduce CPU consumption by
  - Supporting RELEASE(DEALLOCATE) to avoid repeated package allocation/deallocation
  - Avoids processing to go inactive and then back to active
- Enable High Performance DBAT
  - BIND client packages into different collection coll2 with RELEASE(DEALLOCATE)
  - BIND other frequently executed packages with RELEASE(DEALLOCATE)
    - In case of MDM REBIND trigger packages
  - Set -MODIFY DDF PKGREL(BNDOPT) to enable
- In WAS datasource property definition point to new collection
  - E.g. jdbcCollection=coll2
ZPARAM Values for Distributed Access

- **CONDBAT**
  - Includes inactive and active connections, may be large
  - DB2 queues DBAT requests to become active up to CONDBAT

- **MAXDBAT**
  - Incl. V9, max. value could be limited by available storage in DBM1 (check IFCID 225)

- **CMTSTAT INACTIVE**
  - Prerequisite for sysplex workload balancing
  - Inactive connections use little storage in DIST and free up DBM1 resources

- **IDTHTOIN**
  - Inactive connections are not subject to idle thread timeout
  - Strongly recommended to not set to 0 – disable, default works well

<table>
<thead>
<tr>
<th>WAS Connection Pool:</th>
<th>DB2 Connect/JCC:</th>
<th>DB2 zparm:</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>unused timeout</em></td>
<td><em>max Agents/Transports</em></td>
<td><strong>MAXDBAT</strong></td>
</tr>
<tr>
<td><em>max connection</em></td>
<td><em>Connections</em></td>
<td><strong>CONDBAT</strong></td>
</tr>
<tr>
<td></td>
<td><em>DB2_MAX_CLIENT_CONNRETRIES</em></td>
<td><strong>IDTHTOIN</strong></td>
</tr>
</tbody>
</table>
DSNL080I @WQ21 DSNLTDFF DISPLAY DDF REPORT FOLLOWS:
DSNL081I STATUS=STARTD
DSNL082I LOCATION    LUNAME    GENERICLU
DSNL083I USIBMDB2WQ2G USIBMT6.DB2WQ21 -NONE
DSNL084I TCPPORT=50200 SECPOR=0    RESPORT=50201 IPNAME=-NONE
DSNL085I IPADDR=::10.20.10.35
DSNL086I SQL  DOMAIN=wq2g.pokprv.stglabs.ibm.com
DSNL086I RESYNC DOMAIN=wq21.pokprv.stglabs.ibm.com
DSNL087I ALIAS    PORT    SECPOR  STATUS
DSNL088I WQ2G1    50210 0      STARTD
DSNL088I WQ2G12   50240 0      STARTD
DSNL088I WQ2G13   50260 0      STARTD
DSNL089I MEMBER IPADDR=::10.20.10.31
DSNL090I DT=I  CONDBAT=  10000 MDBAT=  200
DSNL092I ADBAT=    1 QUEDBAT=    0 INADBAT=    0 CONQUED=    0
DSNL093I DSCDBAT=    0 INACONN=    3
DSNL100I LOCATION SERVER LIST:
DSNL101I WT IPADDR    IPADDR
DSNL102I 34 ::10.20.10.31
DSNL102I 17 ::10.20.10.32
DSNL102I 11 ::10.20.10.33
DSNL105I CURRENT DDF OPTIONS ARE:
DSNL106I PKGREL = BNDOPT
DSNL099I DSNLTDFF DISPLAY DDF REPORT COMPLETE
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
  - Consider setting min connections to 0 (zero) to free up unused resources in DB2 in a controlled way and to reduce the exposure of long living threads

- **Reap Time**
  - How often cleanup of pool is scheduled in seconds

- **Unused Timeout**
  - How long to let a connection sit in the pool unused
  - Set WAS "connection unused time" to a smaller value than DB2 "idle thread timeout" to avoid stale connection conditions.

- **Aged Timeout**
  - How long to let a connection live before recycling
  - Set to 2 – 5 min if JCC type 2 on z/OS and JCC package bound with RELEASE(DEALLOCATE)

- **Statement Object Cache**
WebSphere Application Server Connection Pooling

Connection pools that can be modified to change the behavior of the J2C connection pool manager. Default values are provided for non-production use. Reviewing and possible modification of these configuration values is recommended.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Scope</td>
<td>cells:carlasr31,network:nodes:carlasr31</td>
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<tr>
<td>Connection Timeout</td>
<td>180 seconds</td>
</tr>
<tr>
<td>Max Connections</td>
<td>10 connections</td>
</tr>
<tr>
<td>Min Connections</td>
<td>1 connections</td>
</tr>
<tr>
<td>Reap Time</td>
<td>180 seconds</td>
</tr>
<tr>
<td>Unused Timeout</td>
<td>1800 seconds</td>
</tr>
<tr>
<td>Aged Timeout</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Purge Policy</td>
<td>EmptyPool</td>
</tr>
</tbody>
</table>

WebSphere Status: Done

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**WAS Data Source Custom Properties**

Use this page to specify custom properties that your enterprise information system (EIS) requires for the resource providers and resource factories that you configure. For example, most database vendors require additional custom properties for data sources that access the database.

<table>
<thead>
<tr>
<th>Select</th>
<th>Name</th>
<th>Value</th>
<th>Description</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>user</td>
<td>tsomd mdb</td>
<td></td>
<td>false</td>
</tr>
<tr>
<td></td>
<td>password</td>
<td>*****</td>
<td>Set isolation level to TRANSACTION_READ COMMITTED</td>
<td>false</td>
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<tr>
<td></td>
<td>webSphereDefaultIsolationLevel</td>
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<td></td>
<td>false</td>
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<tr>
<td></td>
<td>downgradeHoldCursorsUnderXa</td>
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<td>Set for execution of BatchProcessor</td>
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<tr>
<td></td>
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<td>Set for pME</td>
<td>false</td>
</tr>
<tr>
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<tr>
<td></td>
<td>enableSysplexWLP</td>
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<td></td>
<td>false</td>
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Total: 9
### JDBC and DB2 Isolation Level

<table>
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<tr>
<th>Possible values</th>
<th>JDBC Isolation Level</th>
<th>DB2 Isolation Level</th>
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</thead>
<tbody>
<tr>
<td>8</td>
<td>TRANSACTION_SERIALIZABLE</td>
<td>Repeatable Read (RR)</td>
</tr>
<tr>
<td>4 (default)</td>
<td>TRANSACTION_REPEATABLE_READ</td>
<td>Read Stability (RS)</td>
</tr>
<tr>
<td>2</td>
<td>TRANSACTION_READ_COMMITTED</td>
<td>Cursor Stability (CS)</td>
</tr>
<tr>
<td>1</td>
<td>TRANSACTION_READ_UNCOMMITTED</td>
<td>Uncommitted Read (UR)</td>
</tr>
</tbody>
</table>
DDL Recommendation

- DB2 behavior is influenced by DDL definitions, requires no application changes
  - Use COMPRESS YES
  - Strategic table space type is UTS (PBR and PBG) since DB2 10
  - UNICODE
  - CLOSE YES
  - TRACKMOD(NO) if not using incremental image copies
  - Review key generation algorithm, partitioning ranges, clustering
    - Choice of clustering index
Java Performance Problem Areas…

• Java Application
  • autocommit(true) - default
  • Mismatch of Java and DB2 data types
  • Usage of String for numbers
  • Retrieval of unused columns (select * )
  • Transaction isolation

• JDBC
  • JDBC resources not closed (cursor, statements, connections)
  • No usage of Parameter Markers
    • E.g. select c1, c2 FROM t1 WHERE c3=?
  • Cursor declared as WITH HOLD
  • Usage of Statement() instead of preparedStatement() objects
    • No object caching in WAS
Java Performance Problem Areas…

- Environment
  - Old System levels (JDK, JDBC/SQLJ driver)
  - JVM heap too small
  - DB2 Dynamic Statement Cache not active for dynamic SQL
Use ClientInfo fields

• Can be used in WLM, RLF and profile definition and performance monitoring

• WebSphere Application Server Version 6.0 supports explicit and implicit setting of client information
  • Example how to call explicitly
  • …

        WSConnection conn = (WSConnection) ds.getConnection();
        props.setProperty(WSConnection.CLIENT_ID, "user123");
        conn.setClientInformation(props);

• Example how to call implicitly by turning on WebSphere Trace Group

        WAS.clientinfo=all=enabled or
        WAS.clientinfopluslogging=all=enabled
Using DB2 Accounting Reports (1)

- Processing "in DB2" (Class 2) should be the same regardless of connection type

**Time in DB2 is:**

- **Local Access:**
  - CL.2 non-nested ET +
  - CL.1 SP, UDF, trigger ET

- **Distr. Access:**
  - CL.2 non-nested ET +
  - CL.1 SP, UDF, trigger ET +
  - Nonnested (CL.1 CPU - CL.2 CPU)

**Time outside DB2 is**

- **Total CL.1 ET - time in DB2**
  (previous calculation)

- **Total CL.1 ET** also includes idle time when thread is reused

<table>
<thead>
<tr>
<th></th>
<th>AVERAGE</th>
<th>APPL (CL.1)</th>
<th>DB2 (CL.2)</th>
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<td>5.287841</td>
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<tr>
<td><strong>Nonnested</strong></td>
<td>7:20.65807</td>
<td>4.456104</td>
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<tr>
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<td>2.027677</td>
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</tr>
<tr>
<td><strong>UDF</strong></td>
<td>0.000000</td>
<td>0.000000</td>
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</tr>
<tr>
<td><strong>Trigger</strong></td>
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<td>0.010875</td>
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</tr>
<tr>
<td><strong>CPU Time</strong></td>
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<td></td>
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<tr>
<td><strong>Agent</strong></td>
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<td>2.139824</td>
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<tr>
<td><strong>Nonnested</strong></td>
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<tr>
<td><strong>Trigger</strong></td>
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<td></td>
</tr>
<tr>
<td>AVERAGE</td>
<td>APPL (CL.1)</td>
<td>DB2 (CL.2)</td>
<td>IFI (CL.5)</td>
</tr>
<tr>
<td>---------</td>
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<td>ELAPSED TIME</td>
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</tr>
<tr>
<td>UDF</td>
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</tr>
<tr>
<td>TRIGGER</td>
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<tr>
<td>AGENT</td>
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<td>SUSPEND TIME</td>
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<tr>
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<td>STORED PROC</td>
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<tr>
<td>UDF</td>
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<td>0.000000</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- Look also at RMF CPU Activity and Coupling Facility Activity reports
Using DB2 Accounting Report (2)

- JDBC executes dynamic SQL
- Check DB2 dynamic statement cache

--- DISTRIBUTED ACTIVITY ---
REQUESTER : 10.10.10.10
SQL RECEIVED : 2.00
MESSAGES SENT : 4.00
MESSAGES RECEIVED : 4.00
BYTES SENT : 713.93
BYTES RECEIVED : 616.00
MESSAGES IN BUFFER : 28.28
ROWS SENT : 15.14
BLOCKS SENT : 1.62

SQL DML AVERAGE TOTAL
SELECT 0.00 29
INSERT 1.00 0
UPDATE 1.00 0
DELETE 0.00 0
DESCRIBE 0.00 0
DESC.TBL 0.00 0
PREPARE 0.00 0
OPEN 1.00 29
FETCH 15.14 439
CLOSE 0.00 0
DML-ALL 17.14 497

Distributed access
- Check distributed activity

- Distributed access
- Check distributed activity
Dynamic Statement Cache Statistics

- Create DSN_STATEMENT_CACHE_TABLE to hold the statistics
  - Sample job DSNx10.SDSNSAMP(DSNTESC)
  - START TRACE(P) CLASS(30) IFCID(316,317,318)
    - IFCID 316 contains the first 60 bytes of SQL text and execution statistics
    - IFCID 317 captures the full text of the SQL statement
    - IFCID 318 enables collecting the statistics
  - Run the workload
  - Issue statement EXPLAIN STMTCACHE ALL
    - Puts all the statements from the global cache and statistics information into DSN_STATEMENT_CACHE_TABLE
  - Stop the performance trace
  - Evaluate the cached dynamic statements performance by selecting on the inserted rows from the DSN_STATEMENT_CACHE_TABLE table
Dynamic Statement Cache Statistics

<table>
<thead>
<tr>
<th>ID</th>
<th>STAT_EXEC</th>
<th>STAT_GPG</th>
<th>Avg_GPG</th>
<th>STAT_EROW</th>
<th>STAT_PROW</th>
<th>STAT_SORT</th>
<th>STAT_INDEX</th>
<th>STAT_RSCN</th>
<th>STAT_ELAP</th>
<th>STAT_CPU</th>
<th>STMT_TEXT</th>
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<tbody>
<tr>
<td>1</td>
<td>254634</td>
<td>19169138</td>
<td>75.28</td>
<td>254634</td>
<td>254634</td>
<td>0</td>
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<td>8432.114261</td>
<td>722.263</td>
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<td>UPDATE LOCATIONGROUP SET LAST</td>
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<tr>
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<td>UPDATE CONTACTMETHODGROUP</td>
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<tr>
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Complete your sessions evaluation online at SHARE.org/SanFranciscoEval
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
SQL Tuning

- Use dynamic statement cache statistics to identify top-10 frequently executed SQL and top-10 SQL with most CPU consumption
- Consider consolidating repetitive small queries with large queries with JOINs, use DB2 join rather than application join.
- Use inline extension rather than external extension
  - Explosion of SQL
- Use DB2 10 system time instead of triggers to populate history tables
Locking and Concurrency

- If deadlocks and timeouts, turn on DB2 Performance Trace class(6)
  - Use LOCKSIZE ROW selectively for top reported tables
  - Combine with MEMBER CLUSTER if data sharing to reduces page P-lock and page latch contention on data pages
    - Can be defined via deferred ALTER/REORG in DB2 10
- Review indexes
  - Missing index causing table scan and deadlocks
  - Drop unused indexes and RIs
  - Zparm SKIPUNCI – skip uncommitted inserts for ISOLATION(CS|RS)
  - Zparm EVALUNC – evaluated uncommitted data for ISOLATION(CS|RS)
Database and DB2 System Tuning

- Reduce not accounted time in DB2 reporting (CPU dispatching priority)
- Reduce sync I/O suspensions (faster DASD)
- REBIND TRIGGER PACKAGE with RELEASE(DEALLOCATE)
- Bufferpool strategy
  - Large table data, large table index, large LOB table
  - Small data table, small data index, small LOB table
  - History data table, history index, history LOB objects
- Duplex group bufferpool but not lock and SCA structures
- Enable auto alter for all DB2 CF structures
- Use GBPCACHE(.CHANGED) for most GBPs, and CHANGED or SYSTEM for LOB tables
- Use ARM to restart DB2 following a DB2 failure
- GBP size and threshold tuning
Summary

• Business critical distributed WebSphere applications with DB2 for z/OS as enterprise database server have been implemented commonly and successfully for a couple of years now

• Going through installation checklist is highly recommended prior to each implementation to ensure success
  • Communication among WAS Administrator, DB2 System Programmer, and Application Architect

• No shortcuts in respect to setup for availability
  • User sees application availability and not DB2 system availability

• Monitor and react proactively and do not wait until users complain
  • Workload behavior changes over time
References


• SC19-2973-04, DB2 10 for z/OS Data Sharing: Planning and Administration.

• IBM developerWorks DB2 for z/OS with best practices presentations. Please refer to http://www.ibm.com/developerworks/data/bestpractices/db2zos/
Closing Slide - Master Data Management with DB2 for z/OS Hints and Tips to Run an IBM WebSphere Application Successfully

David Zhang
Maryela Weihrauch
IBM Silicon Valley Lab

2/6/2013
Session Number 12797