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

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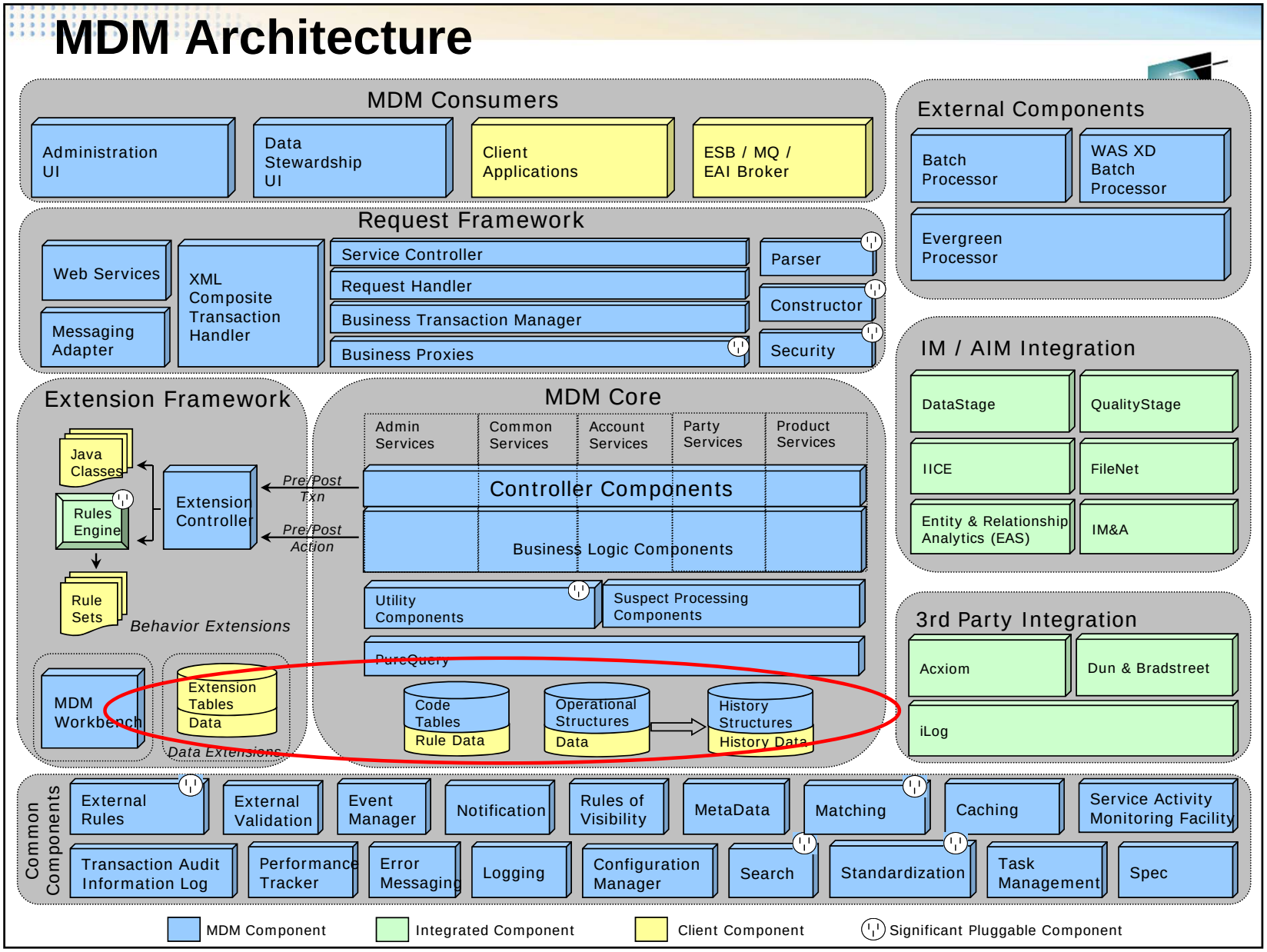
Agenda

- 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

MDM Architecture



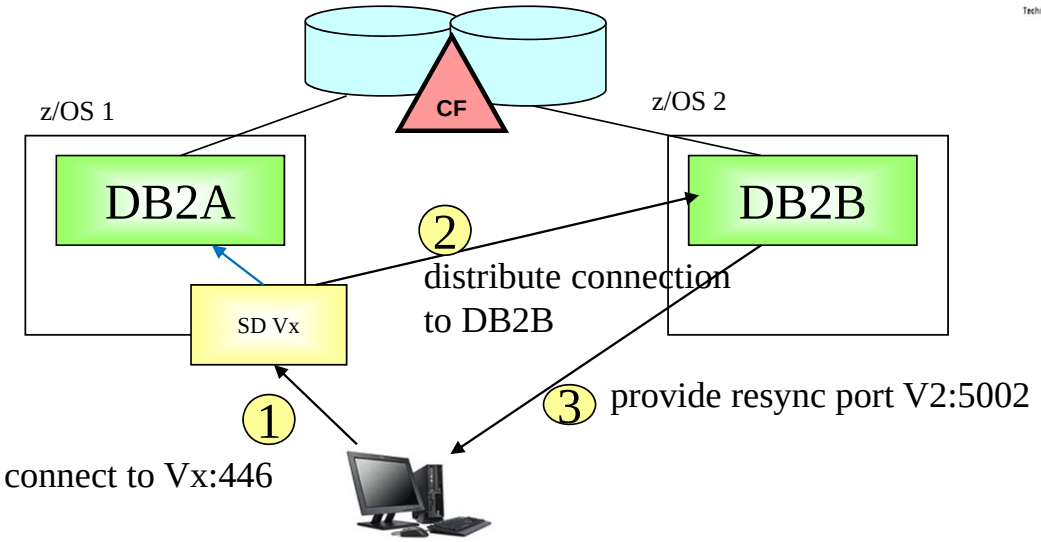
Business Value of MDM with DB2 for z/OS

- 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

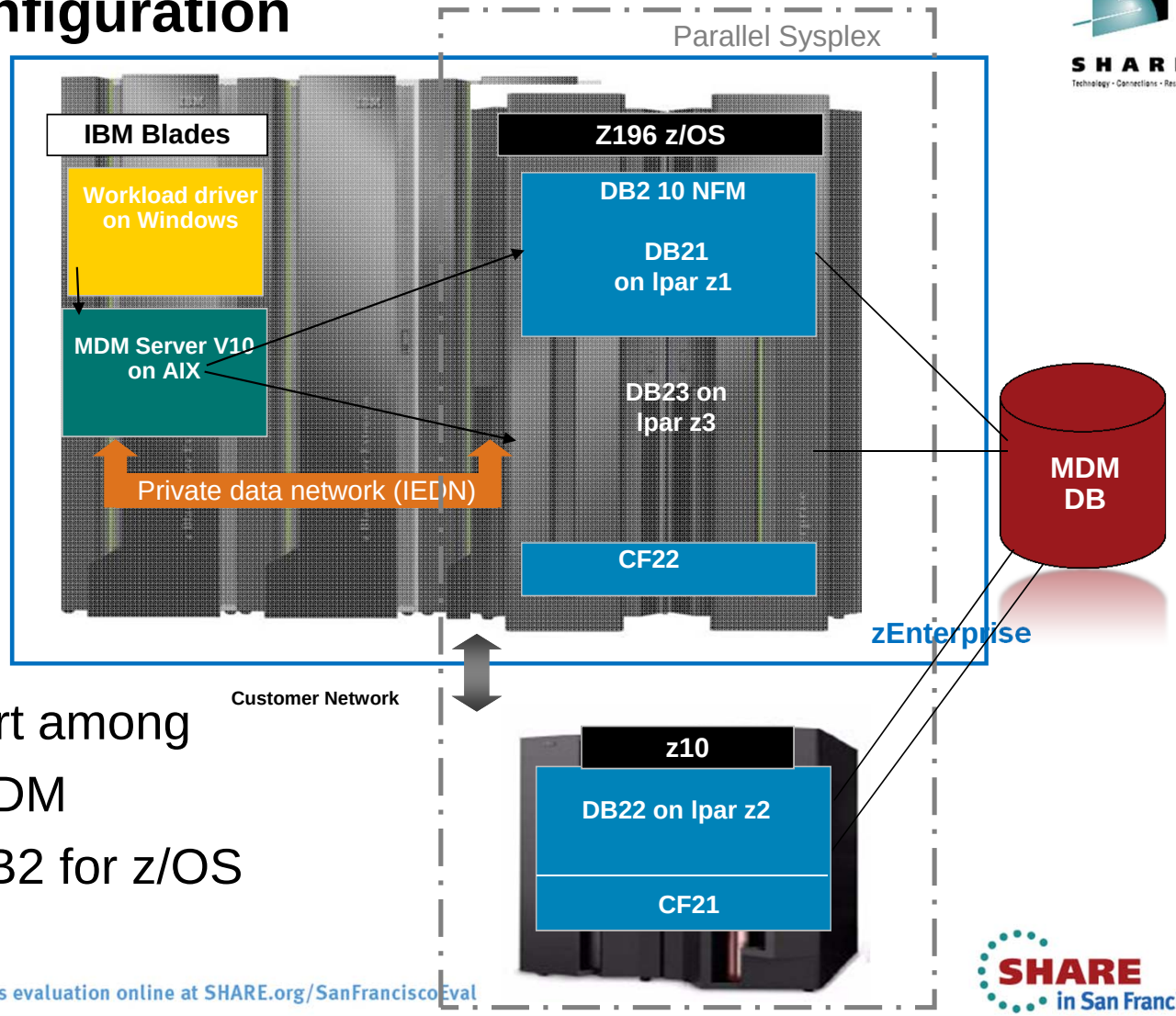
- DB2 – setup for distributed Java applications
  - Group and member DVIPA
    - Provides continues availability for distributed access to DB2 group
  - DB2 location alias for sub grouping
    - Our choice to setup location alias for 2 member subgroup to limit MDM workload execution to 2 members on z196
  - 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

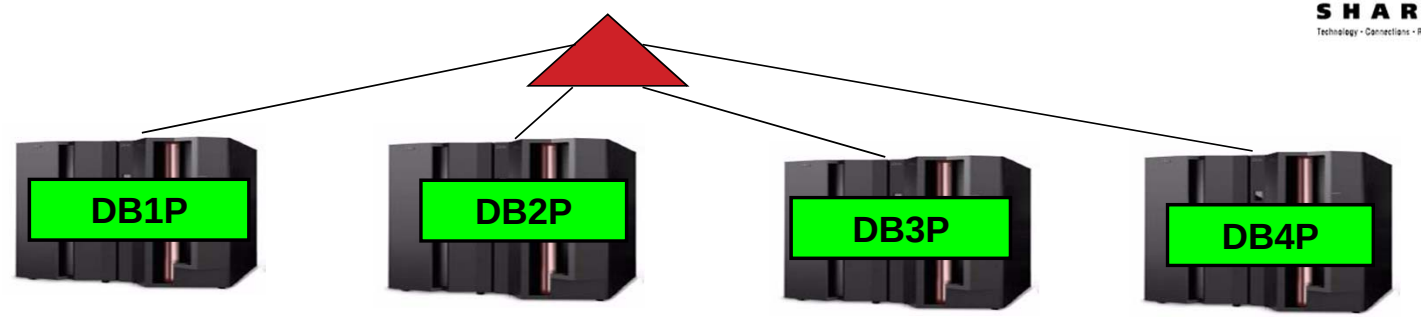
Our Configuration



Team effort among

- SWG MDM
- SWG DB2 for z/OS
- STG

DB2 10 Location Alias for Subgrouping (1)



LocationAlias1
LocationAlias2

LocationAlias1

LocationAlias3

LocationAlias1
LocationAlias2

LocationAlias1

LocationAlias3

Application1	Application2	Application3
LocationAlias1	LocationAlias2	LocationAlias3
To all members	To DB1P, DB3P	To DB2P, DB3P

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

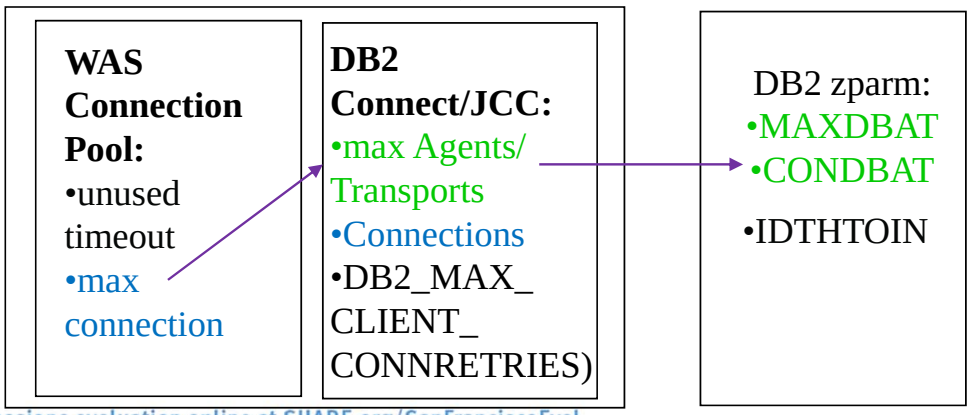
    WQ2G13 is stopped and will not accept new requests. Existing requests will be allowed to complete.

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

ZPARM 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



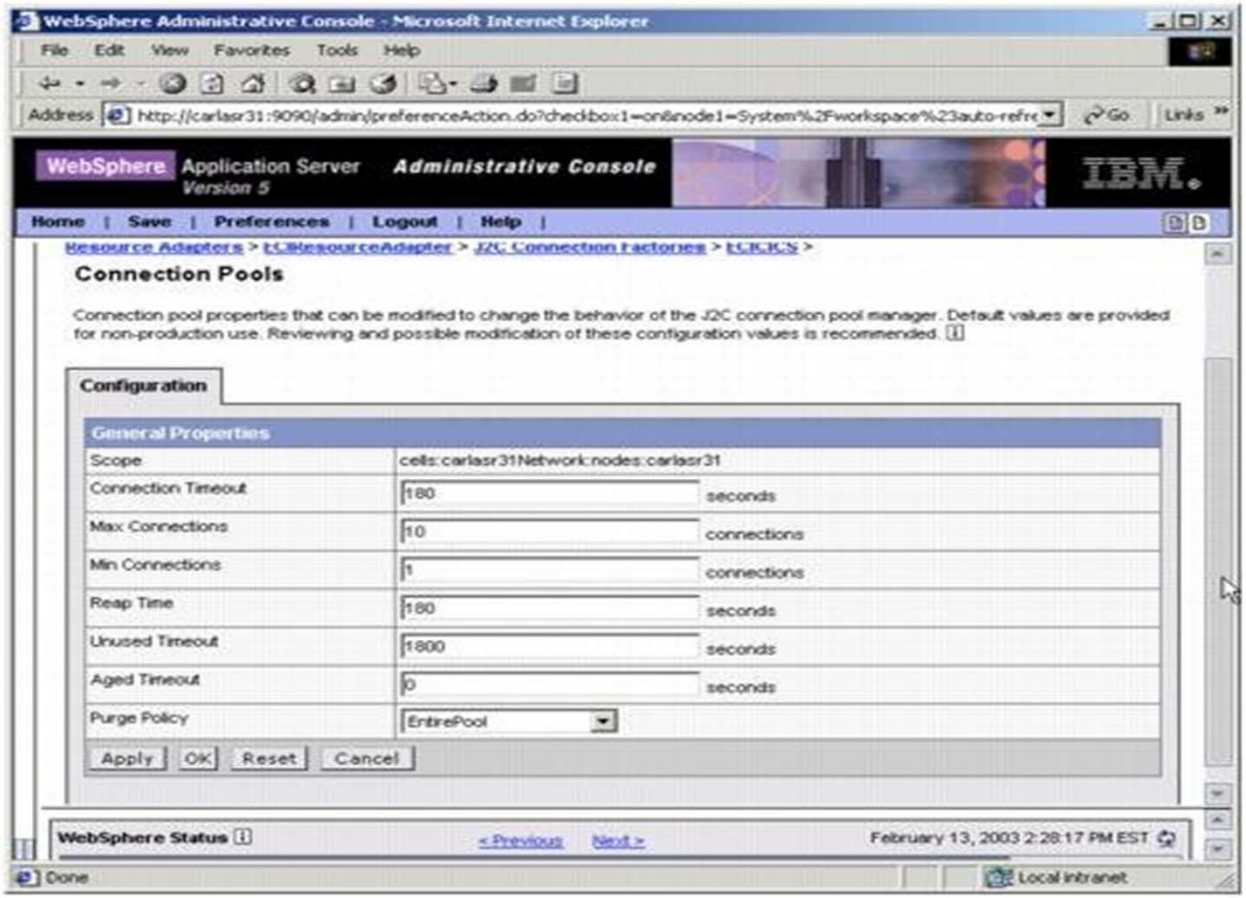
-DISPLAY DDF Sample

```
DSNL080I  @WQ21 DSNLTDDF DISPLAY DDF REPORT FOLLOWS:
DSNL081I STATUS=STARTD
DSNL082I LOCATION          LUNAME          GENERICLU
DSNL083I USIBMDB2WQ2G      USIBMT6.DB2WQ21   -NONE
DSNL084I TCPPORT=50200 SECPORT=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       SECPORT 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 DSNLTDDF 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



WAS Data Source Custom Properties

Data sources > **DWLCustomer** > **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.

⊞ Preferences

New | Delete

Select	Name	Value	Description	Required
You can administer the following resources:				
☐	user	tsomdmdb		false
☐	password	******		false
☐	webSphereDefaultIsolationLevel	2	Set isolation level to TRANSACTION_READ_COMMITTED	false
☐	downgradeHoldCursorsUnderXa	true	Set for execution of BatchProcessor	false
☐	useRRASetEquals	true	Set for pME	false
☐	currentSchema	MDMPRF01		false
☐	keepDynamic	0		false
☐	jdbcCollection	M10RELDA		false
☐	enableSysplexWLB	true		false
Total 9				

JDBC and DB2 Isolation Level

Possible values	JDBC Isolation Level	DB2 Isolation Level
8	TRANSACTION_SERIALIZABLE	Repeatable Read (RR)
4 (default)	TRANSACTION_REPEATABLE_READ	Read Stability (RS)
2	TRANSACTION_READ_COMMITTED	Cursor Stability (CS)
1	TRANSACTION_READ_UNCOMMITTED	Uncommitted Read (UR)

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
  - Local Access: CPU spent in app. Nonnested (CL.1 CPU - CL.2 CPU)

AVERAGE	APPL(CL.1)	DB2 (CL.2)
ELAPSED TIME	7:22.69662	5.287841
NONNESTED	7:20.65807	4.456104
STORED PROC	2.027677	0.820862
UDF	0.000000	0.000000
TRIGGER	0.010875	0.010875
CPU TIME	3.270153	2.139824
AGENT	3.270153	2.139824
NONNESTED	2.434445	1.551221
STORED PRC	0.835235	0.588131
UDF	0.000000	0.000000
TRIGGER	0.000472	0.000472
PAR.TASKS	0.000000	0.000000
SUSPEND TIME	N/A	2.433828
AGENT	N/A	2.433828
PAR.TASKS	N/A	0.000000

Sample Accounting Report

AVERAGE	APPL(CL.1)	DB2 (CL.2)	IFI (CL.5)
ELAPSED TIME	0.373569	0.311756	N/P
NONNESTED	0.322622	0.260809	N/A
STORED PROC	0.000000	0.000000	N/A
UDF	0.000000	0.000000	N/A
TRIGGER	0.050947	0.050947	N/A
CP CPU TIME	0.011996	0.010076	N/P
AGENT	0.011996	0.010076	N/A
NONNESTED	0.010812	0.008892	N/P
STORED PRC	0.000000	0.000000	N/A
UDF	0.000000	0.000000	N/A
TRIGGER	0.001184	0.001184	N/A
PAR.TASKS	0.000000	0.000000	N/A
SECP CPU	0.001209	N/A	N/A
SE CPU TIME	0.012823	0.010668	N/A
NONNESTED	0.011492	0.009338	N/A
STORED PROC	0.000000	0.000000	N/A
UDF	0.000000	0.000000	N/A
TRIGGER	0.001330	0.001330	N/A
PAR.TASKS	0.000000	0.000000	N/A
SUSPEND TIME	0.000000	0.185165	N/A
AGENT	N/A	0.185165	N/A
PAR.TASKS	N/A	0.000000	N/A
STORED PROC	0.000000	N/A	N/A
UDF	0.000000	N/A	N/A
NOT ACCOUNT.	N/A	0.105847	N/A
DB2 ENT/EXIT	N/A	N/P	N/A
EN/EX-STPROC	N/A	0.00	N/A

CLASS 3 SUSPENSIONS	AVERAGE TIME	AV.EVENT
LOCK/LATCH(DB2+IRLM)	0.000975	0.73
IRLM LOCK+LATCH	0.000485	0.07
DB2 LATCH	0.000491	0.65
SYNCHRON. I/O	0.062437	76.58
DATABASE I/O	0.061659	76.05
LOG WRITE I/O	0.000777	0.53
OTHER READ I/O	0.013563	4.96
OTHER WRTE I/O	0.000654	0.53
SER.TASK SWTCH	0.000091	0.01
UPDATE COMMIT	0.000000	0.00
OPEN/CLOSE	0.000030	0.00
SYSLGRNG REC	0.000028	0.01
EXT/DEL/DEF	0.000022	0.00
OTHER SERVICE	0.000011	0.00
ARC.LOG(QUIES)	0.000000	0.00
LOG READ	0.000000	0.00
DRAIN LOCK	0.001883	0.95
CLAIM RELEASE	0.000000	0.00
PAGE LATCH	0.005021	1.93
NOTIFY MSGS	0.000000	0.00
GLOBAL CONTENTION	0.059414	34.84
COMMIT PH1 WRITE I/O	0.000000	0.00
ASYNCH CF REQUESTS	0.041127	34.56
TCP/IP LOB XML	0.000000	0.00
TOTAL CLASS 3	0.185165	155.09

HIGHLIGHTS	
#OCCURRENCES	194840
#ALLIEDS	0
#ALLIEDS DISTRIB:	0
#DBATS	194840
#DBATS DISTRIB.	0
#NO PROGRAM DATA:	N/P
#NORMAL TERMINAT:	0
#DDFRRSAF ROLLUP:	9742
#ABNORMAL TERMIN:	0
#CP/X PARALLEL.	0
#IO PARALLELISM	0
#INCREMENT. BIND:	0
#COMMITS	194934
#ROLLBACKS	12
#SVPT REQUESTS	0
#SVPT RELEASE	0
#SVPT ROLLBACK	0
MAX SQL CASC LVL:	1
UPDATE/COMMIT	6.63
SYNCH I/O AVG.	0.000815

- 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

DYNAMIC SQL STMT	AVERAGE	TOTAL
REOPTIMIZATION	0.00	0
NOT FOUND IN CACHE	0.06	12058
FOUND IN CACHE	0.00	273
IMPLICIT PREPARES	0.00	0
PREPARES AVOIDED	0.00	0
CACHE_LIMIT_EXCEEDED	0.00	0
PREP_STMT_PURGED	0.00	0

DYNAMIC SQL STMT	AVERAGE	TOTAL
REOPTIMIZATION	0.00	0
NOT FOUND IN CACHE	0.00	0
FOUND IN CACHE	11.78	3115688
IMPLICIT PREPARES	0.00	0
PREPARES AVOIDED	0.00	0
CACHE_LIMIT_EXCEEDED	0.00	0
PREP_STMT_PURGED	0.00	0

- Distributed access
  - Check distributed activity

```
--- 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

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

	K	L	M	P	Q	R	S	T	V	W	
1	STAT_EXEC	STAT_GPAG	Avg_GPAG	STAT_EROW	STAT_PROW	STAT_SORT	STAT_INDX	STAT_RSCN	STAT_ELAP	STAT_CPU	STMT_TEXT
2	254634	19169138	75.28	254634	254634	0	254634	0	8432.114261	722.263	UPDATE LOCATIONGROUP SET LAST
3	254634	1580039	6.21	254634	254634	0	254634	0	5823.524417	169.371021	UPDATE CONTACTMETHODGROUP S
4	127451	254961	2.00	0	127451	0	0	0	2010.754211	98.163196	INSERT INTO ADDRESS (LAST_UPDAT
5	254635	2843838	11.17	254639	254635	0	254635	0	3398.618713	217.631793	UPDATE CONTACTMETHOD SET LAS
6	127451	640620	5.03	3	1	0	127453	0	1362.365295	12.359935	SELECT LOCATIONGROUP.CONT_ID
7	127451	1274565	10.00	0	127451	0	0	0	1245.035217	102.210987	INSERT INTO PERSONNAME (LAST_U
8	4468	67014	15.00	13404	13404	0	13404	0	35.590686	1.177051	SELECT CONT_ID FROM CONTACT W
9	381627	6963157	18.25	774078	387036	381627	1542741	0	2925.884826	135.75365	SELECT PERSONNAME.GIVEN_NAME
10	254635	2546354	10.00	509270	254635	0	509270	0	1599.976379	46.772632	SELECT CONTACTMETHODGROUP.LC
11	1881111	58366712	31.03	9405137	1881111	3762221	9405488	13167776	10583.02832	1525.357727	SELECT CONTACT.LAST_VERIFIED_D
12	127451	1274687	10.00	2	127451	0	0	0	677.612121	78.515506	INSERT INTO IDENTIFIER (LAST_UPD
13	387036	5761133	14.89	1160913	386971	0	1548014	0	2012.469787	95.110828	SELECT ADDRESSGROUP.LOCATION_
14	17115	171133	10.00	34230	34230	0	34230	0	86.325321	3.131588	SELECT CONT_ID FROM CONTACT W
15	127451	254936	2.00	0	127451	0	0	0	559.817444	72.64899	INSERT INTO CONTACT (LAST_UPDA
16	127451	1274599	10.00	0	127451	0	0	0	533.54718	67.241306	INSERT INTO PERSON (LAST_UPDATE
17	127451	255140	2.00	8	127451	0	0	0	523.783996	63.988834	INSERT INTO CONTACTMETHOD (LAS
18	127451	2295390	18.01	4	127451	0	0	0	450.547668	63.055606	INSERT INTO CONTACTMETHODGRO
19	1881111	48529656	25.80	7523257	1880813	0	15047103	0	6529.708011	681.098938	SELECT LOCATIONGROUP.LAST_USE
20	97202	1506843	15.50	2	97202	0	0	0	335.98053	50.87688	INSERT INTO SUSPECT (LAST_UPDAT
21	127451	2294744	18.00	0	127451	0	0	0	404.56427	92.168506	INSERT INTO PERSONSEARCH (LAST_
22	1881111	44875757	23.86	7523260	1880815	0	13166296	0	5880.524417	490.387024	SELECT LOCATIONGROUP.CONT_ID

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

- Redbook SG24-7817, System z Parallel Sysplex Best Practices, Part 4 DB2 sysplex best practices in http://www.redbooks.ibm.com/redpieces/abstracts/sg247817.html.
- 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/

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

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