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IBM DB2 for z/OS

Distributed Strategy in the Mobile Age

DB2 11 for z/OS

The Enterprise Data Server for Business
Critical Transactions and Analytics.

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Agenda



- V10/V11
- High Availability
- Properties
- Tuning
 - Timeouts/connections
- WLM
 - Application Identification



Driver properties



- **DB2 10 high performance database access threads**
 - Provides additional CPU benefits in DB2 10 (10-20% CPU) reintroduces RELEASE(DEALLOCATE) to DDF
 - Requires rebinding of DB2 Connect client packages
 - Should use the set **currentPackageSet** in driver for ‘good’ applications to point to another collection ID – not NULLID
 - DB2Binder utility defaults to **releasePackageResourcesAtCommit(false)** for DB2 10 packages (9.7 FP 3a) – so you get DEALLOCATE by default
 - Can be altered on and off with -MODIFY DDF PKGREL command
 - COMMIT / BINDOPT / BNDPOOL
 - POOLINAC will determine how long a high performance DBAT remains idle before being destroyed
 - Threads are recycled after 200 uses, but can be pooled if the application continues to issue connection requests (PI20352)



Remote connection monitoring for High Perf. DBATs



- Starting in DB2 10
 - Stats Class 7 record trace (IFCID 365 Remote Location Statistics)
 - Can be used to track rows, bytes, messages and initiated conversations or logical connections between a requestor and a server (IP address)
- Initiated conversations [from remote site] are logical connections
 - High number of conversations deallocated would indicate a poor candidate for HPD

```
DDF DATA BY LOCATION

LOCATION NAME (SHORT).....: ::FFFF:192.0.1.6
LOCATION NAME (LONG).....: ::FFFF:192.0.1.68

INITIATED CONVERSATIONS.....: 0
INITIATED FROM REMOTE SITE.: 5
MESSAGES SENT TO REMOTE.....: 10815873
SQL STMTS SENT TO REMOTE....: 0
BYTES SENT TO REMOTE.....: 2005208369
ROWS SENT TO REMOTE.....:
BLOCKS TRANSMITTED.....:
```

- In the accounting short report compare #DDFS (occurrences) to CONVI (conversations)
 - If > 200 it is an easy fit
 - PI20352 should eliminate most of the overhead if the ratio is < 200:1
 - Using client acctn info instead of IP address could make this easier

REQUESTER	METH	#DDFS	TRANS	#ROLLBK	#COMMIT	SQLRECV	ROWSENT	CONVI
::FFFF:11.190#04	DRDA	4	N/A	0	6	1.50	88.75	0.25
::FFFF:11.190#05	DRDA	10	N/A	0	12	1.20	36.70	0.10
::FFFF:11.190#07	DRDA	4	N/A	0	6	1.50	27.00	0.25
::FFFF:11.190#08	DRDA	1	N/A	0	1	1.00	1.00	0.00
::FFFF:11.190#09	DRDA	244	N/A	0	246	1.01	3.81	0.00





Cancel thread and Interrupt statement

- Pre DB2 11 DDF CANCEL THREAD may not work in some cases
 - Historically "soft", or reactive in nature
 - Cancel detection point may not be encountered in a timely manner
- DB2 11 New FORCE keyword on CANCEL DDF THREAD command
 - Purges thread of a remote connection in the DB2
 - FORCE option accepted only after CANCEL THREAD issued without the FORCE option
 - Available in CM
- Purge running DDF SRB using new z/OS purge SRB function
 - Requires new z/OS CALLRTM TYPE=SRBTERM service

Syntax

```
>>-CANCEL ---THREAD (token)-----+--+-----+--+-----+--+-----+--+-----+--+-----+--+<br>      +---DDF THREAD(---luwid---)+ +---DUMP+ +---LOCAL+ +---NOBACKOUT+ +---FORCE+<br>      +-token-+
```



High Availability...why not to use the Connect Gateway

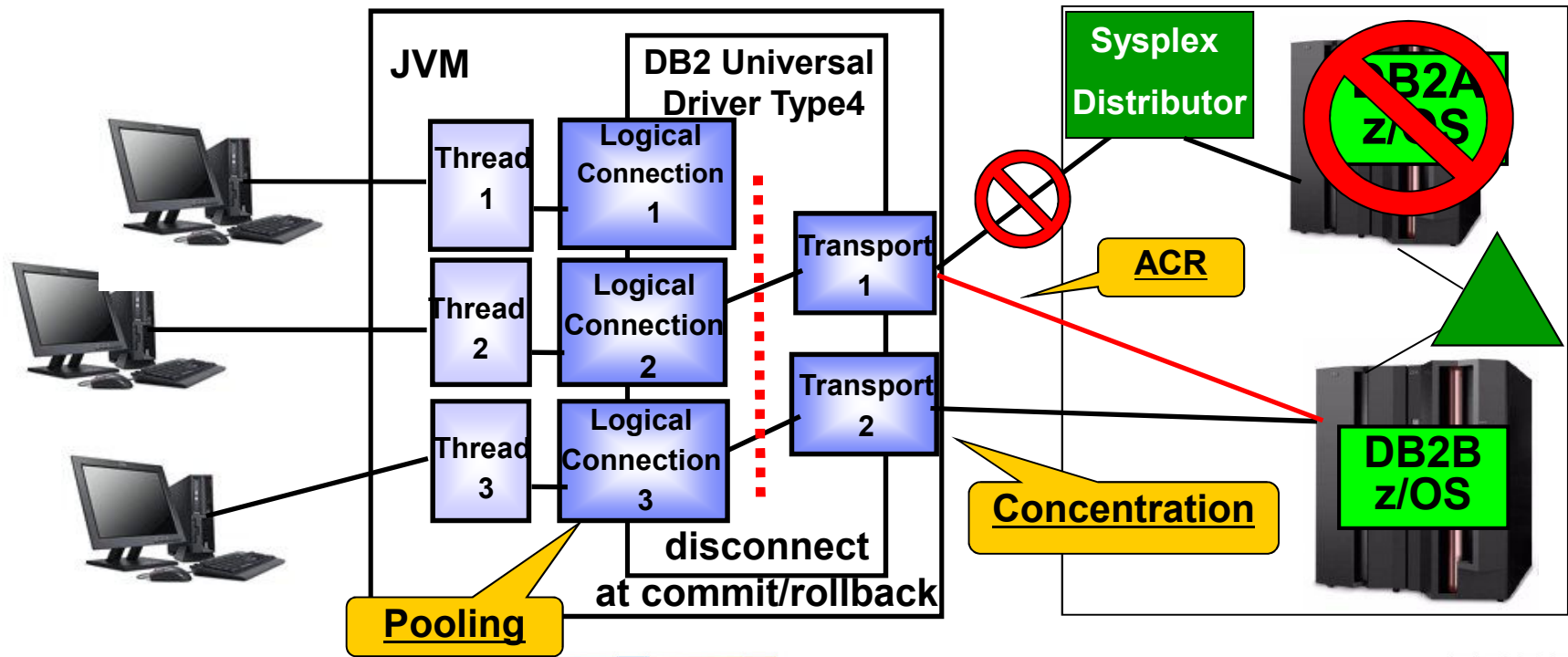


- Availability is the key advantage to the IBM Data Server Driver
 - Automatic client reroute
 - Transaction level Sysplex Workload Balancing
- Automatic Client Reroute (ACR) - only available in driver
 - Connection to DB2 drops, seamless reroute connection at transaction boundary to other DB2 in data sharing group
 - SQL statement re-driven under the covers to another member
 - JAVA applications will not get -30108 during re-connection to another DB2
 - If DB2 crashed then in-flight transaction is rolled back – app needs to re-drive transaction
- Sysplex WLB - transaction level balancing only available in driver
 - Every 10 seconds WLM refreshes list of optional DB2 members with relative weights
 - At transaction boundary next SQL can be routed to another member due to
 - Displaceable CPU on the LPAR
 - DB2 health
 - Enclave WLM Service class goal attainment and queuing
 - RTPIFACTOR in IEAOPT can reduce the impact of PI>1, reduce connection sloshing
 - MAXCONQN / MAXCONQW



Sysplex Workload Balancing...ACR

- Availability aspect is arguably more important because if we loose a DB2 or connection, we can re-drive the SQL request across another existing connection to another member of the group without the application's knowledge – Automatic Client Reroute only exists in driver, not Connect Gateway. Gateway will reroute at Connection level
- Even without failure WLM will feed back results so transactions, not just connections are managed across the sysplex



Sysplex Workload Balancing routing



- Think of it as ‘contingency management’ not balancing **
- Where would the next transaction be assigned when a 2 member group has Member A weight =30 / Member B =10 (3:1 ratio)
 - (Member’s currently active transactions) / (Total active transactions for the group) <= (Member priority) / (Total of all member priorities)
 - Member A has 25 active connections (in a UoW)
 - Member B has 10 active connections (in a UoW)
 - Current ratios -
 - Member A = active connections / total connections = 25 / 35 = 0.71 (which is < 0.75 target ratio)
 - Member B = 10 / 35 = 0.28 (which is > 0.25 target ratio)
 - Next transaction would be assigned to Member A

DSNL102I
displays the
relative weights
of the servers
returned by WLM

```
-DIS DDF DETAIL  
DSNL101I WT IPADDR  
DSNL102I 30 ::10.138.48.221  
DSNL102I 10 ::10.138.48.218
```



Sysplex WLB properties JAVA driver



- **Java datasource properties - V9.7 FP6/ V10.1 FP2/ V10.5 FP4**
 - **EnableSysplexWLB= TRUE** enables sysplex workload balancing
 - **MaxTransportObjects** specifies maximum number of connections managed across the data sharing group. The default is 1,000 (previously unlimited)
 - **maxRefreshInterval** maximum amount of time between refreshes of the client copy of the WLM server list. The default is 10
 - **maxTransportObjectIdleTime** maximum elapsed time before an idle transport is dropped. The default is 10
 - **maxTransportObjectWaitTime** time waiting for a transport to become available. The default is 1 second or -4210 (previously unlimited)
 - **minTransportObjects** the lower limit for the number of transport objects in a global transport object pool. The default is 0





Tuning Data Connections



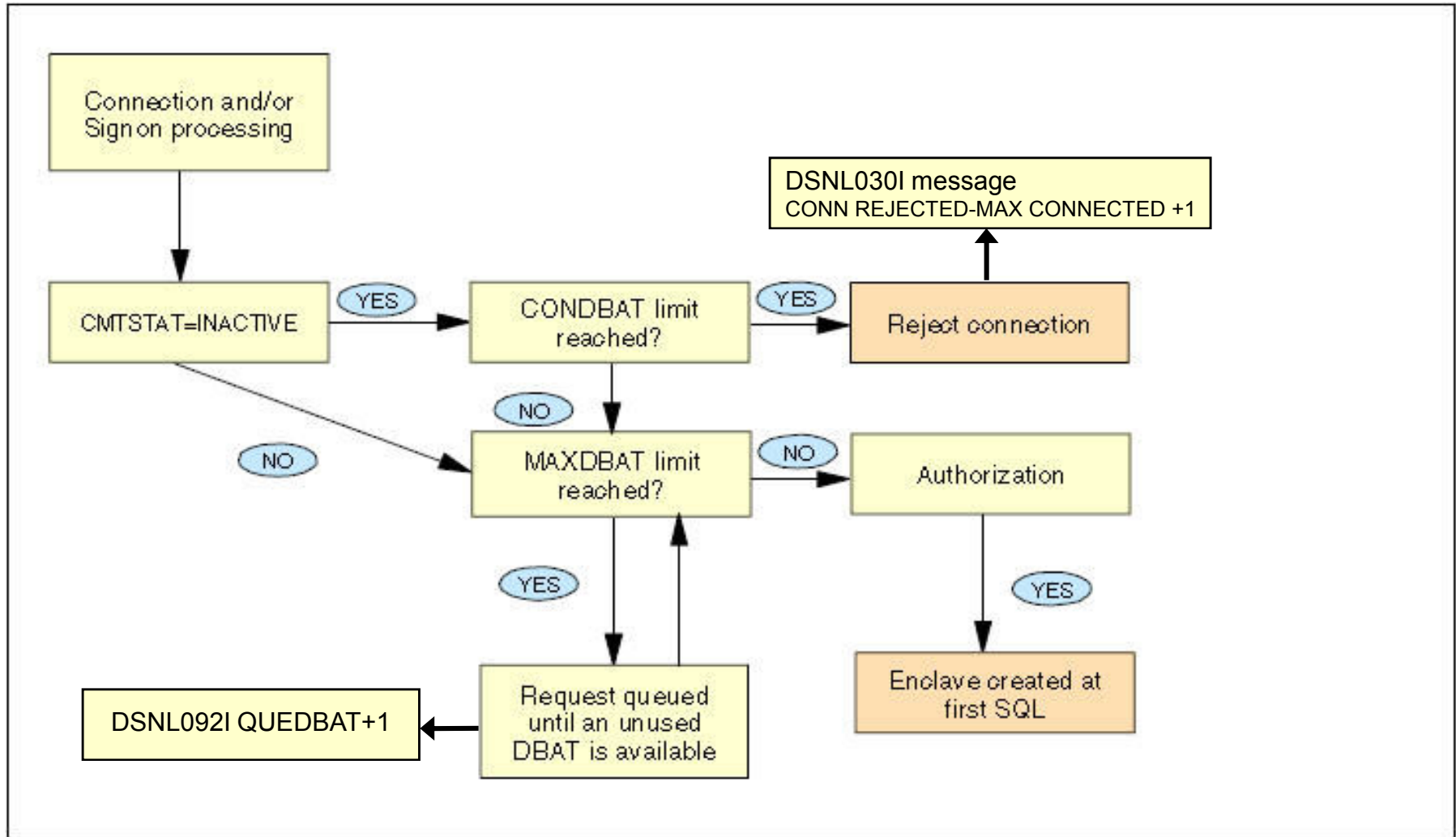
Key DB2 DDF Parameters



Parameter	Possible values	Default - V8*	Description
DDF	NO / AUTO / COMMAND	No	DDF Startup
CMTSTAT	ACTIVE / INACTIVE	INACTIVE*	Thread Pooling - Pool inactive threads
CTHREAD	1-2,000 (V10 – 10,000)	200*	Max users - allied (local) threads RRSAA or CAF (CICS, IMS, TSO, Batch attach, SPUFI, Classic QMF, etc)
MAXDBAT	0-1,999 (V10 – 10,000)	200*	Max remote active DDF Threads - DBM1 Address Space
CONDBAT	0-15,000 (V10 – 150,000)	10,000*	Max remote connections - DDF Address Space
MAXTYPE1	0-CONDBAT	0	Max inactive DBATs, these are used for private protocol. DRDA uses inactive connections.
POOLINAC	0-9,999	120	Approximate time, in seconds that an inactive/unused DBAT can remain idle in the pool before it is terminated. DBAT deleted after being used 200 times also.
IDTHTOIN	0-9,999	120*	The IDLE THREAD TIMEOUT (IDTHTOIN) parameter specifies the time (in seconds) that an active DBAT can remain idle before it is canceled. – Should set a “little” higher than TCPKPALV
TCPKPALV	ENABLE / DISABLE / 1-65534	120*	TCP/IP keep alive (Goes hand-in-hand with IDTHTOIN)
TCPALVER	NO (server), YES, CLIENT, SERVER, SERVER_ENCRYPT	NO	whether DB2 is to accept TCP/IP connection requests that contain only a user ID (no password, RACF PassTicket, or Kerberos ticket).



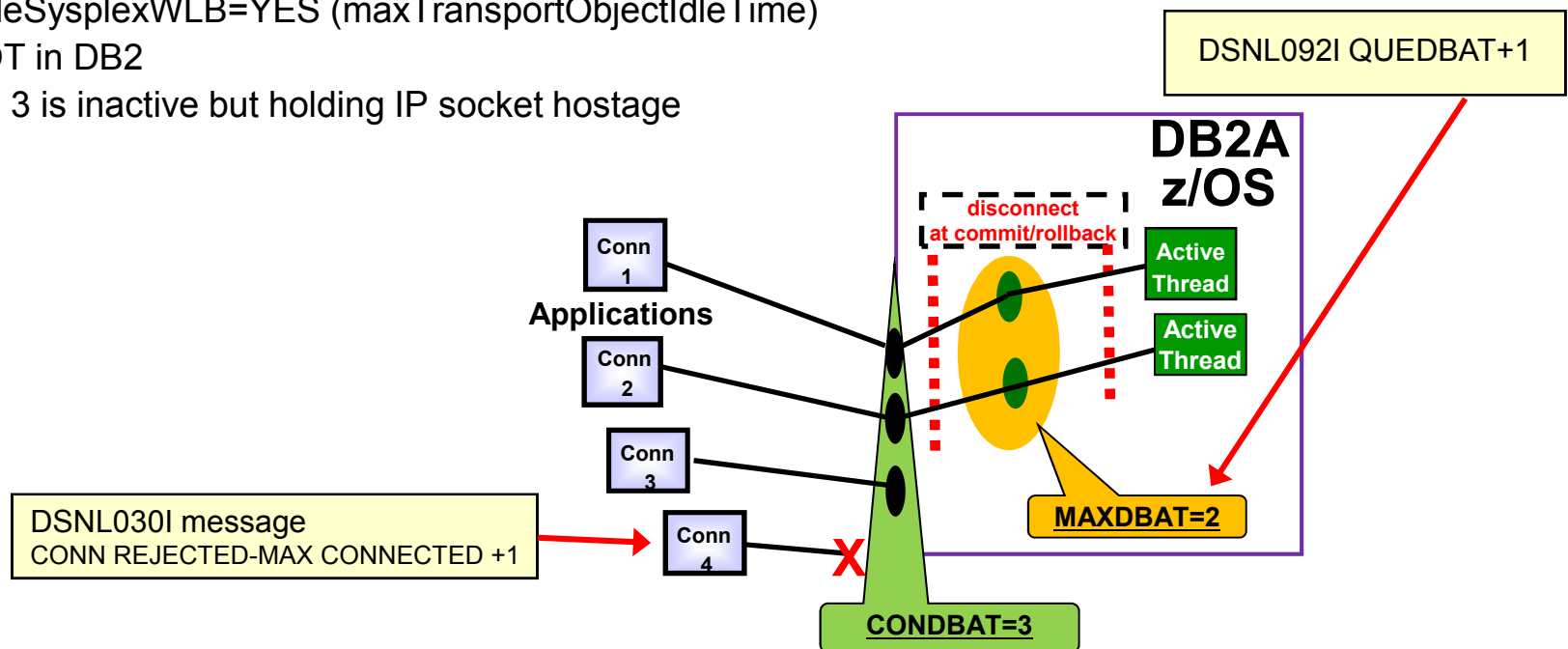
Connection flowchart on DB2 for z/OS





Remote Connections


- With relief of virtual storage constraint MAXDBAT has been raised but many customers ignored the new default of CONDBAT in V8 (10,000)
 - Much better to queue DBAT requests outside DB2 between MAXDBAT and CONDBAT, than to have the connection request be rejected
- With more remote apps/app servers no control over connections without a Gateway
- If inactive connections continue to grow and reach CONDBAT they could cause a service outage to other applications
 - Connection timeouts exist in the application servers (AGED timeout) or Driver with enableSysplexWLB=YES (maxTransportObjectIdleTime) NOT in DB2
 - Conn 3 is inactive but holding IP socket hostage



Connection Pool Properties

PercentUsed	connectionPoolModule.percentUsed	9	The average percent of the pool that is in use	Per connection pool
PercentMaxed	connectionPoolModule.percentMaxed	10	The average percent of the time that all connections are in use	Per connection pool

- Statement Cache Size (Default: 10)
 - Number of statements to keep in prepared Statement Cache
- Connection Timeout (Default: 180)
 - How long to attempt connection creation before timeout
- Max Connections (Default: 10)
 - max connections from JVM instance
- Min Connections (Default: 0)
 - lazy minimum number of connections in pool
- Reap Time (Default: 180)
 - How often cleanup of pool is scheduled in seconds
- Unused Timeout (Default: 1800)
 - How long to let a connection sit in the pool unused
- Aged Timeout (Default: 0)
 - How long to let a connection live before recycling – controls inactive connections seen on host
- Purge Policy (Default: EntirePool)
 - After StaleConnectionException, does the entire pool get purged or only individual connection


Connection Pool statistics in WebSphere should be used to determine the applications need for concurrent connections





Transport Pool Statistics

- For monitoring driver Sysplex behavior (global transport object pool)
- Configuration property settings
 - `db2.jcc.dumpPool=DUMP_SYSPLEX_MSG|DUMP_POOL_ERROR`
 - `db2.jcc.dumpPoolStatisticsOnSchedule=60`
 - `db2.jcc.dumpPoolStatisticsOnScheduleFile=/home/WAS/logs/srv1/poolstats`
- Example fields
 - `npr` - total number of requests made to the pool since the pool was created.
 - `nsr` – number of times pool returned an object (successful requests)
 - `lwroc` – light weight reuse
 - `hwroc` – heavy weight reuse
 - `lbt` – longest time thread waited to get an object
 - `tpo` – transport object count
- Application API also exists to gather transport pool statistics (DB2PoolMonitor class)



Tomcat / WAS/ JCC driver



<u>Tomcat</u>	<u>WebSphere Equivalent</u>	<u>Driver</u>
Remove abandoned Timeout (seconds)	Aged Timeout	maxTransportObjectIdleTime
Remove Abandoned (boolean)	Aged Timeout = non-zero	N/A
Log abandoned	none	N/A
maxActive – Tomcat also has settings for maxIdle connections	maxConnections – WAS does not distinguish between active and idle in number	maxTransports
minIdle / maxIdle – only in Tomcat	N/A	N/A
minEvictableIdleTime	Unused Timeout	N/A
timeBetweenEvictionRuns	REAP time	N/A
initialSize – Tomcat creates all these at start up	Min Connections- WAS will wait until they are needed then keep them around	minTransportObjects
**validationQuery – string for query to submit (leave it out) – pops on query timeout in driver	Connection validation timeout - SQL validation deprecated, use JDBC validation (JDBC 4.0)	Sysplex WLB should take care of this, re-drive failed connections through sysplex distributor, and automatic client reroute
testOnBorrow- check it when connection used from pool testOnReturn –check in going back to pool	Validate new connections Validate existing connections	** <u>Turn Validation off to avoid overhead.</u>
maxWait	Connection timeout	maxTransportObjectWaitTime





.NET / WAS/ JCC driver

<u>.NET provider/ Default</u>	<u>WebSphere Equivalent</u>	<u>Driver</u>
Connection Pooling = true		
**N/A	Aged Timeout	maxTransportObjectIdleTime (10)
Max Pool Size = No Maximum	maxConnections – WAS does not distinguish between active and idle in number	maxTransports (1,000)
Connection Lifetime	Unused Timeout	N/A
N/A	REAP time	N/A
Min Pool Size = 0	Min Connections- WAS will wait until they are needed then keep them around	minTransportObjects
Connection timeout	Connection timeout	maxTransportObjectWaitTime (1 sec)

**** This means there is no way to timeout the connections coming from the driver**

**** Settings from PMR →**

	Default

Max Pool Size	No max
Min Pool Size	0
Connection Lifetime	60





Setting Driver Properties

- **DataSource** is preferred over DriverManager for portability/consistency/admin

- **DriverManager (specified in URL)**

```
Class.forName("com.ibm.db2.jcc.DB2Driver");  
Connection con = DriverManager.getConnection("jdbc:db2://localhost:446/sample[property= value,..]");
```

- **DataSource**

```
Context ctx=new InitialContext();  
DataSource ds=(DataSource)ctx.lookup("jdbc/myDB");  
Connection con=ds.getConnection();
```

- **Central Properties file preferred over the URL method**

- **For the JAVA driver**

- DB2JccConfiguration.properties in CLASSPATH can be used
- db2jcc.override.*property-name* – overrides any setting with same name

- **For non-JAVA driver how do I maintain standards?**

- db2cli.ini (text) and/or db2dsdriver.cfg (XML file) – **preferred**

- **Order of precedence** - [http://www-](http://www-01.ibm.com/support/knowledgecenter/SSEPGG_10.5.0/com.ibm.swg.im.dbclient.config.doc/doc/r0061062.html?cp=SSEPGG_10.5.0%2F2-0-2-5-7-0-4&lang=en)

[01.ibm.com/support/knowledgecenter/SSEPGG_10.5.0/com.ibm.swg.im.dbclient.config.doc/doc/r0061062.html?cp=SSEPGG_10.5.0%2F2-0-2-5-7-0-4&lang=en](http://www-01.ibm.com/support/knowledgecenter/SSEPGG_10.5.0/com.ibm.swg.im.dbclient.config.doc/doc/r0061062.html?cp=SSEPGG_10.5.0%2F2-0-2-5-7-0-4&lang=en)



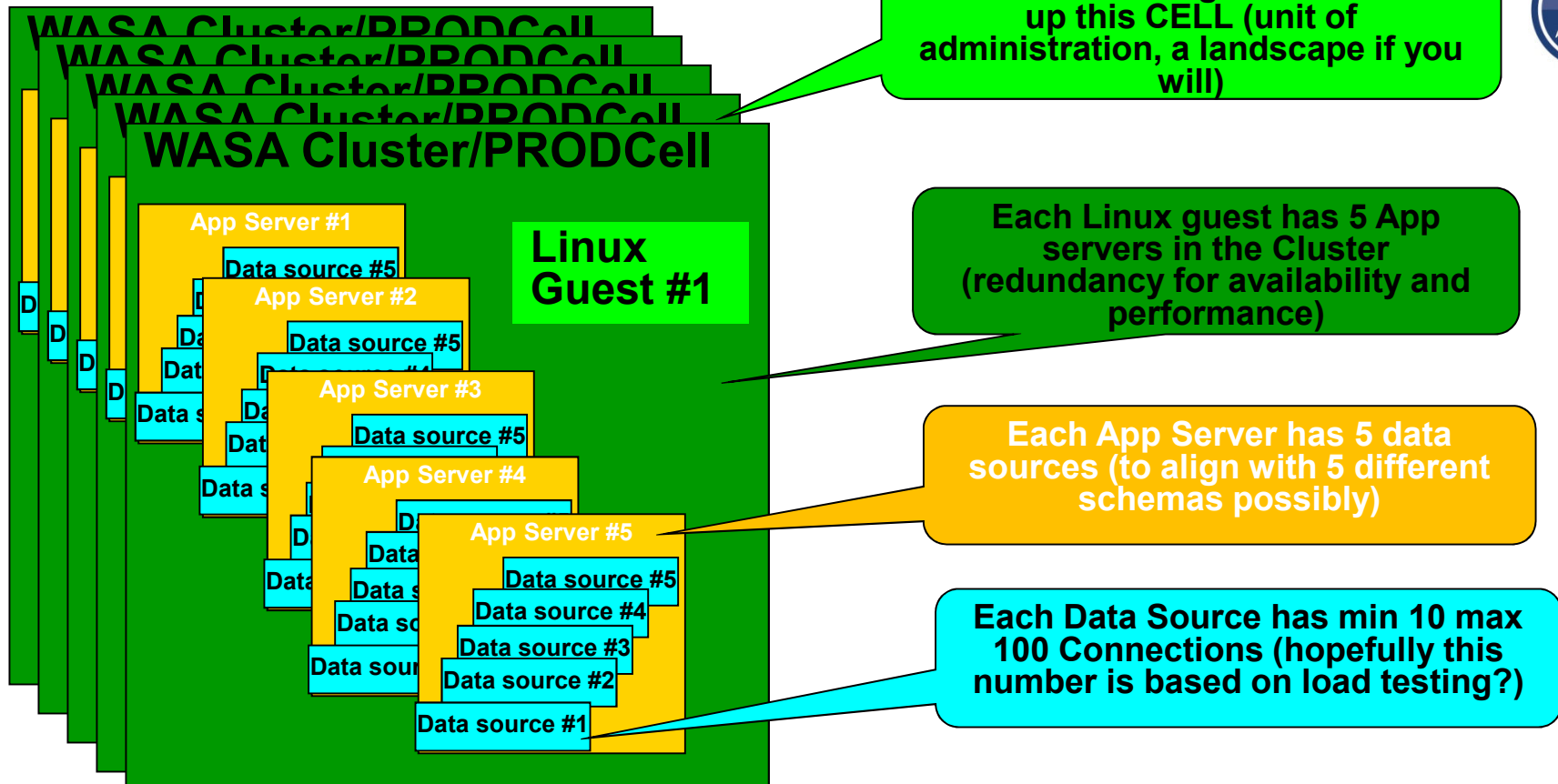
Basic strategy for Connection pools



- Ideally an application would be tested for throughput and an appropriate Max Connections set by monitoring pool stats... but otherwise start by setting the Max Connections value to the sum of all of the max threads possible in the app server thread pools used by the application which might access DB2
- Multiply the Max Connection values by the number data sources and then by the number of application servers going against that particular DB2 member or group. This gives you the real number of total connections that could be made to the database at anytime.
 - This number should relate to maxTransports in the driver if Sysplex WLB enabled, since the transport is the physical connection
- If the total max connections going to the database (DB2 on z/OS) is larger than CONDBAT, then CONDBAT should be reassessed to absorb the overage, and avoid the Connection Timeout popping –
 - Should WAS be allowed to hold all the available connections?
 - CONDBAT +1 means –SQLCODE and DB2 appears unavailable
- What about DB2? – connections are not a big deal, we are concerned with threads
 - MEMU2 or IFCID 225 information to determine max number of threads based on 31-bit virtual constraint
 - Do you have enough REAL storage to back more threads? **



Example WAS Environment



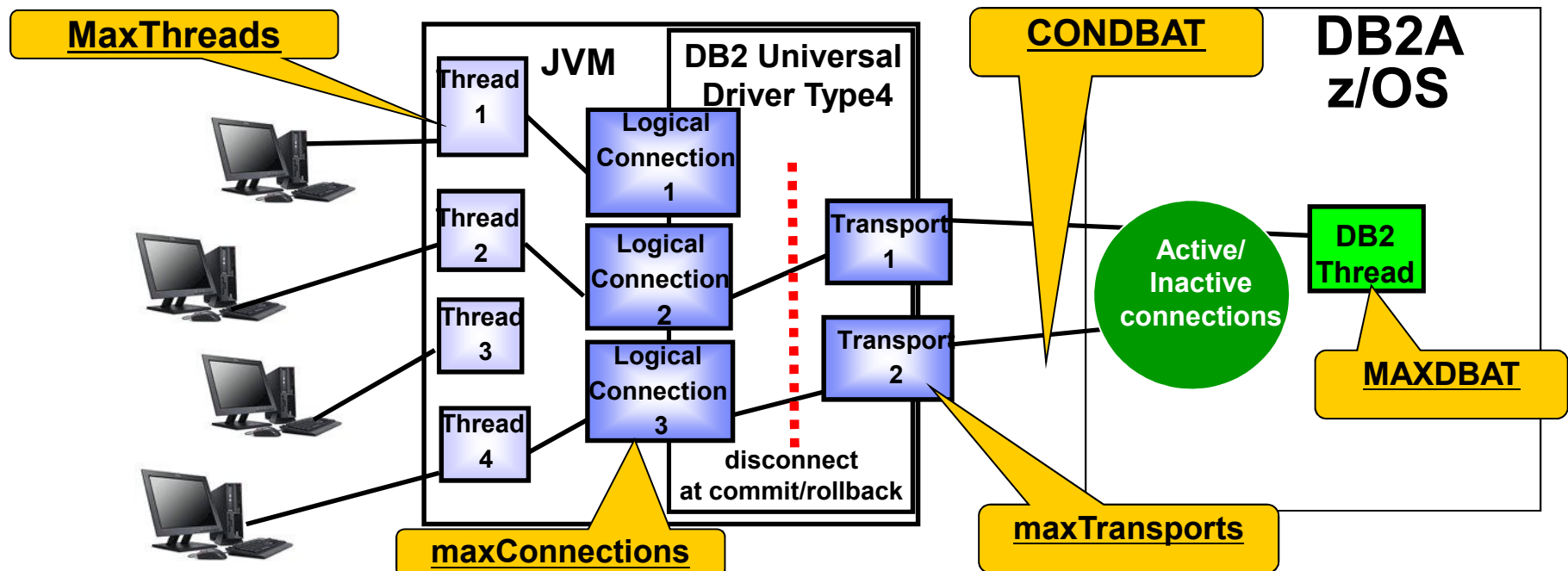
- For this example: Min connections of 10 and Max connections of 100 is defined at the CELL level which is the overarching administrative unit of control, meaning EVERY data source will have that min and max, they are not divvied up amongst all the servers
 - 5 data sources x 10 connections x 5 app servers x 5 clusters = min of 1,250 connections
 - 5 data sources x 100 connections x 5 app servers x 5 clusters = max of 12,500 connections
- This may be just one application landscape consuming 12,500 connections in the data sharing group!!



So when you say connections.....??



- Scope of defined resources = CELL → NODE → CLUSTER → SERVER
 - More granular setting overrides more general one – need to account for resources SERVERs consume
 - So if maxConnections at cell is 50 with 5 servers, then total connections is really 250
- General logic: I have more app server threads than I need connections to DB2
 - I have more app server 'connections' than transports (real connection to DB2)
 - I have more connections to DB2 than active threads in DB2
 - Thus we funnel the most abundant resources down the most finite::
 - How many concurrent threads can I support in DB2??



Recommendations WITHOUT Sysplex WLB



- WAS settings relative to DB2 timeouts, use <, > suggestions to adjust defaults
 - TCPKPALV (Enable=720) < IDTHTOIN (120) - we want to ping the socket prior to having DB2 cancel a thread for being idle incase we have lost the TCP/IP connection
 - IDTHTOIN (120) > Aged Timeout (0) - This may be the most controversial one, having aged timeout lower will recycle the connections after so many seconds (minutes) in order to: 1) reduce the possible number of inactive connections seen in the DB2 member 2) Allow the connection to be re-driven to another member when Sysplex WLB is being used
 - The downside to this would be the small overhead in re-establishing a new connection, and thread reuse when the connection is closed
 - Unused Timeout (1800) > Reap Time (180) - means we kill unused connections at the server to free up unused resources, and that no setting should be less than the Reap time, since it is the daemon that goes out to determine if other timeouts have popped
 - But if you have a minimum connection count then those will not be affected by Unused timeout
 - Connection Timeout (Network Timeout) – how long can the application handle not getting a connection, this should be a very small number of seconds with sysplex distributor connecting to a data sharing group
 - ****IDTHTOIN > TCPKPALV > Aged Timeout > Unused Timeout > Reap > ConnectionTimeout - this the end-to-end picture with all 4 of the major timeout values**

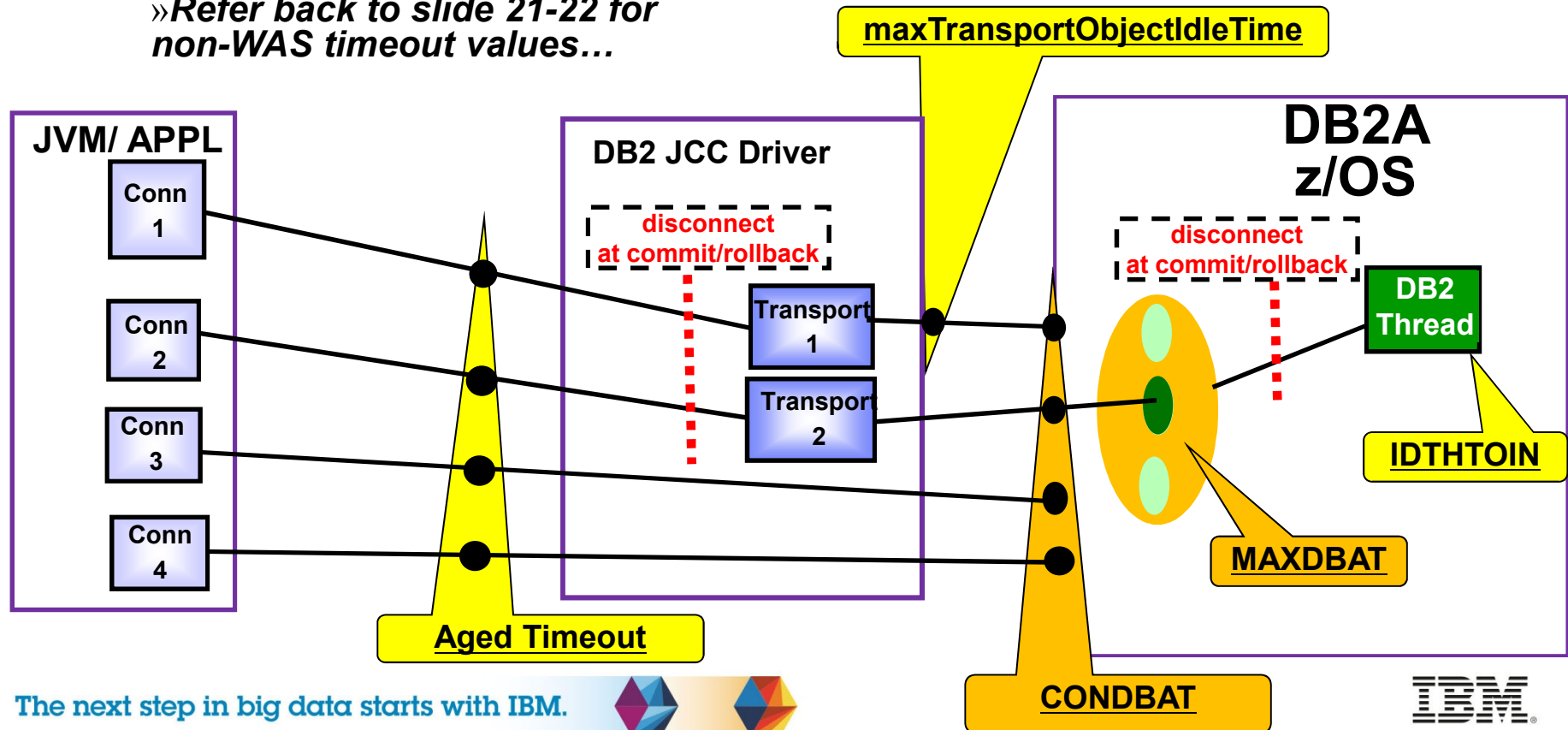
****These settings are to eliminate stale, inactive, and hung connections in DB2**



Timeout Values

- Timeout values should be used to avoid stranded resources
- If inactive connections continue to grow and reach CONDBAT they could cause a service outage to other applications
 - These timeouts can be used to keep inactive connections to a minimum
 - AgedTimeout in the WebSphere data source
 - maxTransportObjectIdleTime in the JDBC properties if enableSysplexWLB=True

»Refer back to slide 21-22 for non-WAS timeout values...



Recommendations WITH Sysplex WLB



- Zero out application server parameters that correspond to Transport object settings
 - Aged timeout = 0 back to default / Unused = 0
 - Reap Time = 0 (also disables aged and unused timeouts)
 - Purge Policy = FailingConnectionOnly
 - Applications should know how to handle stale connection exceptions :
 - <http://www-01.ibm.com/support/docview.wss?rs=180&uid=swg21063645>
- Use the Driver settings to further tune connections/timeouts if there are issues
 - maxTransportObjects (1,000 default)
 - Max number of connections at driver level (not data source level)
 - TOTAL # transports < CONDBAT * DB2 Members of DS Group
 - But MAXDBAT limits concurrency of execution
 - maxTransportObjectIdleTime = 10 seconds (default)
 - This is how you get rid of inactive connections (like Aged timeout in WAS)
 - As long as this is less than IDLTHTOIN then we are okay
 - maxTransportObjectWaitTime, default is 1 second
 - SQLCODE -4210, SQLSTATE 57033 for connection waiting for a transport
 - maxRefreshInterval = 10 seconds (for WLM)



Protecting DB2



- DBAs want to control the connection queue depth and the wait time for a queued connection to get a DBAT, exceeding which the connection should failover to another member, AND have health decrease as connections approach CONDBAT
 - Two new zPARMs: MAXCONQN (depth) and MAXCONQW (wait time) are supported
 - ON means MAXCONQN reacts when queue = MAXDBAT
 - DSNL074I issued first time when > 80% of CONDBAT reached (DB2 health cut to 50%)
 - DSNL075I issued when condition is relieved
 - Otherwise it takes WLM 10 seconds to lower DB2 member health
 - APAR number is PM43293 (V9 & V10).
 - <http://www-01.ibm.com/support/docview.wss?crawler=1&uid=swg1PM43293>
- -DIS DDF DETAIL will show the current configured values and connections closed because limit exceeded. Message DSNL030I also issued with reason code and stats updated

```
DSNL094I WLMHEALTH=100 CLSDCONQN= 0 CLSDCONQW= 0
```

```
CUR QU INACT CONNS (TYPE 2) 0.00
MIN QUEUE TIME 0.000008
MAX QUEUE TIME 0.000384
AVG QUEUE TIME 0.000038
HWM QU INACT CONNS (TYPE 2) 13.00
```



Thread Monitoring:



-DIS DDF DETAIL

How many open sockets (connections) possible

How many threads are currently doing work as well as DSCDBATs

How many threads you think you can handle.

```

DSNL090I DT=I CONDBAT= 1000 MDBAT= 200
DSNL091I MCONQN= 0 MCONQW= 0
DSNL092I ADBAT= 31 QUEDBAT= 0 INADBAT= 0 CONQUED= 0
DSNL093I DSCDBAT= 9 INACONN= 168
DSNL094I WLMHEALTH=100 CLSDCONQN= 0 CLSDCON
DSNL100I PKGREL= COMMIT
    
```

You hit MAXDBAT at some point and requests were queued

How many threads are lounging in the pool

Type 2 inactive thread/ inactive connection

RELEASE(COMMIT)

-DIS THREAD(*) DETAIL → V482-WLM-INFO=DB2DDFHI:1:2:50 (need OA45996 with z/OS 2.1)

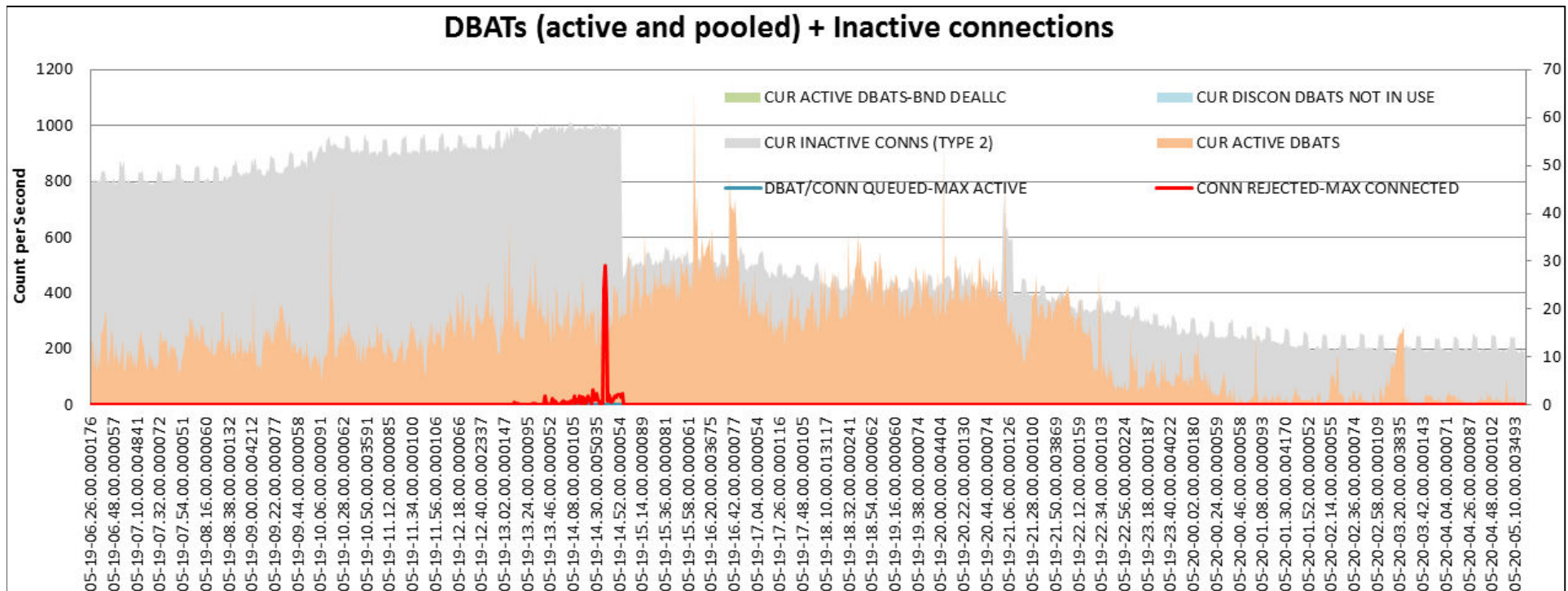
- Shows WLM service class of enclave
- Shows what period it is executing in
- Shows the WLM Importance
- Shows performance index * 100 (50 = P.I. of 0.5) of the service class period



Customer Conns Rejected



- A connection storm or incremental growth can occur when database access threads are not even consumed
- Need to monitor the number of inactive connections and ensure CONDBAT is never encroached upon
 - Sum of inactive connections and active DBATS
- DSNL047I (CONDBAT at 80%) messages generally come too late to react





Who is connection to DB2?

- *-DIS LOCATION DETAIL*

- DSNL200I – JCC' is the driver, SQL' is DB2 Connect Server

- *vv* A 2-digit number that identifies the product version number, such as 09 or 10.
- *rr* A 2-digit number that identifies the product release level, such as 01 or 05.
- *m* A 1-digit number that identifies the product modification level, such as 0 or 1

- In the –DIS you can see the IP address it came from, product ID to let you know what level it is at.

- The ATT column shows if the connection is using Sysplex WLB, XA two phase commit, or encryption (AES/ TLS)

JCC03640	<-- 9.7 FP6
SQL09076	<-- 9.7 FP6
JCC03660	<-- 10.5 GA or FP1
JCC04160	<-- 10.5 GA or FP1

<http://www-01.ibm.com/support/docview.w.wss?uid=swg21363866>

```
Example 2-2 DISPLAY LOCATION report
-----
DSNL200I  -D0Z2 DISPLAY LOCATION REPORT FOLLOWS-
LOCATION                                PRDID   T ATT CONNS
::9.12.4.142                          JCC03640 S      50
                                         WLB    50
                                         XA     50
```





Cancelling Inactive Connections

- If you have 'stale' connections you can get rid of them one-at-a-time
- Display the inactive connections

```
-DISPLAY THREAD(*) TYPE(INACTIVE) DETAIL
```

```
V437-WORKSTATION=9.76.193.254 ← IP address
```

```
V448--( 1) 446:53637 ← local and foreign ports
```

- Find the connection identifier (CONN) associated with the IP addresses for that foreign local port combination:

```
D TCPIP,,NETSTAT,conn,ipaddr=9.76.193.254
```

```
USER ID  CONN  STATE
```

```
DB1SDIST 162724E6 ESTBLSH ← get the CONN identifier
```

- Drop the inactive connection which corresponds to that identifier:

```
V TCPIP,,DROP,CONN=162724E6
```



Monitor profiles to limit threads/connections



- Catalog table holds profiles
- Can limit:
 - Active threads
 - Idle thread timeout
 - Connections
- Limit based on
 - LOCATION only
 - PRDID only
 - AUTHID, ROLE, or both.
 - COLLID, PKGNAME, or both
 - One of CLIENT_APPLNAME, CLIENT_USERID, CLIENT_WORKSTNNAME

PRO-FILEID	KEYWORDS	ATTRIBUTE1	ATTRIBUTE2	ATTRIBUTE3	ATTRIBUTE TIMES TAMP	RE-MARKS
1	MONITOR THREADS	EXCEPTION_D IAG-LEVEL2	10		2008-12-19...	
2	MONITOR CONNECTIONS	WARNING	50		2008-12-17...	
3	MONITOR IDLE THREADS	EXCEPTION_D IAG-LEVEL1	300		2009-01-25...	

- Warning or Exception
 - 1 attribute could be warning (just once or for each threshold), another could be exception where incoming connections are queued or failed
 - DSNT771I reason code 00E3050x





Limiting Total Connections

- Could use Profiles to protect DB2 from connections spawned by application servers in a loop (garbage cleanup), poorly behaving application, or a denial of service attack
 - Profile #1: Wildcard location so any remote IP address or domain using more than 1,000 connections to any member writes a warning to the master log (DSNT772I)
 - Profile #2: That IP address can only use up to 500 connections to a member where the profile is started, and the 501st is rejected

SYSIBM.DSN_PROFILE_TABLE

PROFILEID	LOCATION
1	*
2	9.76.193.254

SYSIBM.DSN_PROFILE_ATTRIBUTES

PROFILEID	KEYWORDS	ATTRIBUTE1	ATTRIBUTE2
1	MONITOR CONNECTIONS	WARNING	1000
2	MONITOR CONNECTIONS	EXCEPTION	500

http://www.ibm.com/support/knowledgecenter/SSEPEK_11.0.0/com.ibm.db2z11.doc.perf/src/tpc/db2z_monitorconnection_profiles.dita?lang=en





WLM





WLM Qualifiers:

Work qualifiers are used to help identify a thread or unit of work

- AI - Accounting Information*
- CAI – Client Accounting Info*#(ACCTNG)
- CUI – Client User ID*#(USERID)
- CWN- Client Workstation Name*#(CLIENT_WRKSTNNAME)
- CTN – Client Transaction Name*
- CI - Correlation Information*
- CN - Collection Name
- CT - Connection Type
- CTG - Connection Type Group
- LU - LU Name
- CIP- Client IP Address*
- LUG - LU Name Group
- NET - Net ID
- NETG - Net ID Group
- PC - Process Name*# (APPLNAME)
- PF - Perform
- PFG - Perform Group
- PK - Package Name
- PKG - Package Name Group
- PN - Plan Name
- PNG - Plan Name Group
- PR - Procedure Name
- PX - Sysplex Name
- SI - Subsystem Instance
- SIG - Subsystem Instance Group
- SSC - Subsystem Collection
- UI - Userid*

- **Remote processes***
- **New in V11**
- **Special register#**

The next step in big data starts with IBM.



Classifying Threads



<u>JAVA</u>	<u>.NET or .cfg keyword</u>	<u>English</u>	<u>WLM Classification</u>	<u>Monitor Profile</u>	<u>Special Register</u>	<u>Size bytes</u>	<u>Macro</u>
		Accounting Information	AI			143	QMDAAINF
ClientAccountingInformation	ClientAccountingString	Client Accounting Information	CAI		CLIENT_ACCTNG	512	QWDASUFX
ClientProgramName		Correlation ID	CI			8	QWHCCV
ClientCorrelationToken		Client CorrelationToken			CLIENT_CORR_TOKEN	255	
		Client IP Address (domain name)	CIP	Y		39	QWHDRQNM
		DB2 Collection (first accessed)	CN			8	
ClientUser	ClientUserID	Client User ID (END_USER)	CUI		CLIENT_USERID	128	QWHCEUID_Var
ClientHostName	ClientWorkStationName	Client Workstation Name	CWN		CLIENT_WRKSTNNAME	255	QWHCEUWN_var
ApplicationName	ClientApplicationName	Client Transaction or application name	CTN	Y	CLIENT_APPLNAME	255	QWHCEUTX_Var
ApplicationName	ClientApplicationName	Process Name (client tran or appl name)	PC	Y	CLIENT_APPLNAME	39	QWHCEUTX
		Stored Procedure Name	PR				
		Subsystem Parameter	SPM				16 bytes client userID, 18 bytes client workstation, 255 221 bytes reserved
		Client IP Address	CIP	Y		39	

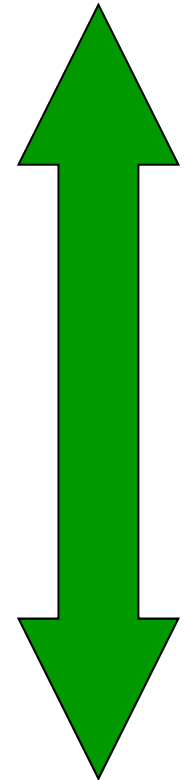


Setting Client info: `clientWorkstation`, `clientAccountingInformation`, `clientUser`, `clientApplicationInformation`, `clientProgramName`



- In data source
 - All applications sharing data source appear the same to DB2
 - Need source per application to change information
- In the Resource Reference (WebSphere Application Server)
 - Specific to the application
 - Create extended data source properties (same keywords)
- Calling stored procedure – `WLM_SET_CLIENT_INFO`
 - Requires application add a call to proc and populate the information
- Having application set it using JAVA APIs
 - `setClientInfo()` method to set correlation and accounting info
- Create a wrapper from incoming `getConnection()` string that dynamically picks up program name and IDs
 - Can use Hibernate or Spring class to populate their intermediary config file
 - Could use a wrapper from Websphere that uses `getConnection()` and `WSSubject` class to pull the information out of the incoming request to populate client info

**Ease of implementing
But static**

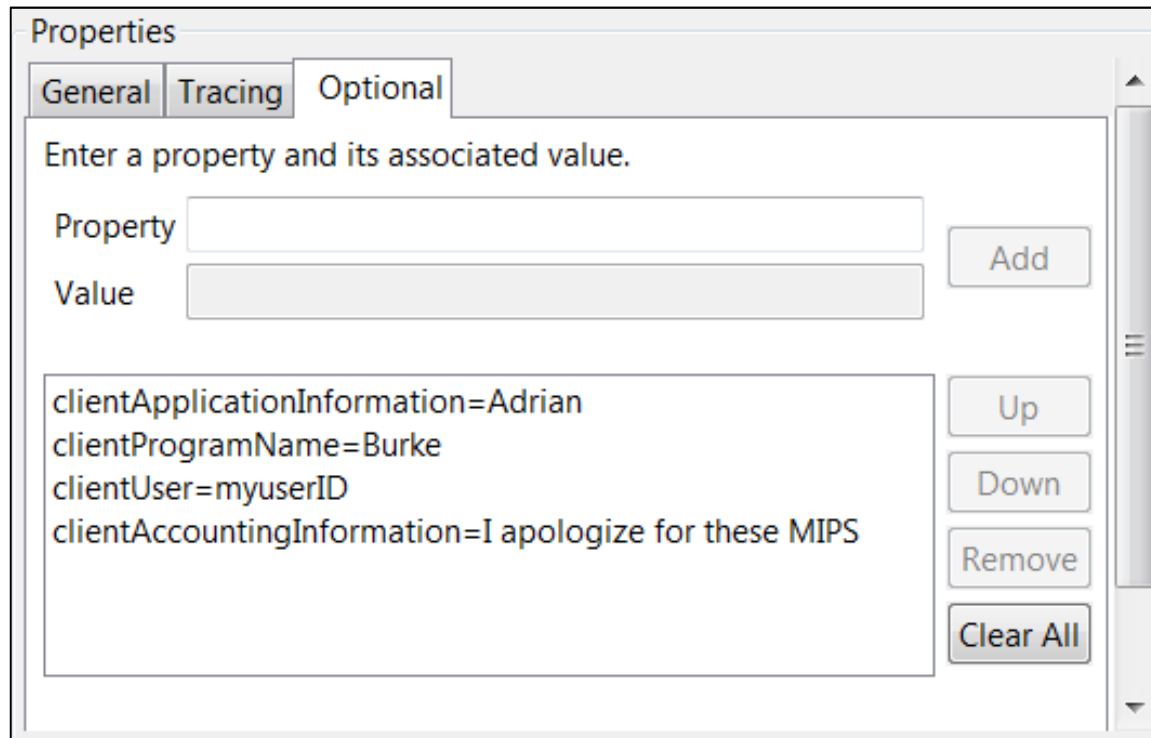


Requires coding, but flexible



Example of Populating Client Accounting Fields

- Data Studio Example
- If a service class of 'PC=Adrian' had been created and the application code contained `connectionProperties.put("clientProgramName", "Burke")`, and `connectionProperties.put("clientApplicationInformation", "Adrian")` and `connectionProperties.put("clientAccountingInformation", "I apologize for these MIPS")` in connection string: then the snapshot of the enclave screen would show the following details:



The screenshot shows a 'Properties' dialog box with three tabs: 'General', 'Tracing', and 'Optional'. The 'Optional' tab is selected. The dialog contains a text area for entering properties and their values, and a list of properties that have been added. The list includes:

- clientApplicationInformation=Adrian
- clientProgramName=Burke
- clientUser=myuserID
- clientAccountingInformation=I apologize for these MIPS

Buttons for 'Add', 'Up', 'Down', 'Remove', and 'Clear All' are visible on the right side of the dialog.





SDSF Enclave Display

- Before:

```
Enclave F000008F16 on System DEMOMVS

Subsystem type      DDF          Plan name          DISTSERV
Subsystem name     DSNB          Package name       SYSLH200
Priority
Userid             DNET305       Connection type    SERVER
Transaction name   Correlation    Collection name    NULLID
Transaction class  Procedure name db2jcc_appli
Netid              Function name   DB2_DRDA
Logical unit name  Performance group
Subsys collection  Scheduling env
Process name       db2jcc_application
Reset              NO
```

- After:

```
Enclave F000008B9C on System DEMOMVS

Subsystem type      DDF          Plan name          DISTSERV
Subsystem name     DSNB          Package name       SYSLH200
Priority
Userid             DNET305       Connection type    SERVER
Transaction name   Correlation    Collection name    NULLID
Transaction class  Procedure name Burke
Netid              Function name   DB2_DRDA
Logical unit name  Performance group
Subsys collection  Scheduling env
Process name       Adrian
Reset              NO
```



Display DDF Detail



- Before:

```
DSNV401I - DISPLAY THREAD REPORT FOLLOWS -
DSNV402I - ACTIVE THREADS -
NAME      ST A   REQ ID          AUTHID   PLAN      ASID  TOKEN
SERVER    RA *   32 db2jcc_appli DNET305  DISTSERV  00AC  57843
V437-WORKSTATION=192.168.1.3
        USERID=dnet305
        APPLICATION NAME=db2jcc_application
V441-ACCOUNTING=JCC03660192.168.1.3
```

- After:

```
DSNV401I - DISPLAY THREAD REPORT FOLLOWS -
DSNV402I - ACTIVE THREADS -
NAME      ST A   REQ ID          AUTHID   PLAN      ASID  TOKEN
SERVER    RA *   32 Burke         DNET305  DISTSERV  00AC  50791
V437-WORKSTATION=192.168.1.3
        USERID=myuserID
        APPLICATION NAME=Adrian
V441-ACCOUNTING=I apologize for these MIPS
```





WLM and MOBILE Apps

- I can define a WLM service classification rule to subset transactions with client accounting information out from those using a specific Authorization ID on the server
 - This IP address would be the same one you would see in the accounting string if you did a –DIS THREAD
- Using a sub-rule for the classification where the accounting string is ‘WASMOB’ I can push it down into a lower service class
- The CPU consumption will then be reported as well

```
Modify Rules for the Subsystem Type Row 1 to 4 of 4
Command ==> _____ Scroll ==> PAGE
Subsystem Type . : DDF Fold qualifier names? Y (Y or N)
Description . . : Distributed DDF work
Action codes: A=After C=Copy M=Move I=Insert rule
               B=Before D=Delete row R=Repeat IS=Insert Sub-rule
               <=== More
Action -----Qualifier----- Storage Reporting Manage Region
Action Type Name Start Critical Attribute Using Goals Of
_____ 1 UI WAS* _____ N/A NONE N/A
_____ 2 CAI WASMOB _____ N/A MOBILE N/A
```

TRANSACTION	APPL%	TOTAL	CP	N/A	AAP/IIP	ON	CP	N/A	AAP/IIP	N/A
		MOBILE	CP	N/A	AAP/IIP	ON	CP	N/A	AAP/IIP	N/A





References

- PI63531 – Improve granularity of monitor profile messages
 - <http://www-01.ibm.com/support/docview.wss?crawler=1&uid=swg1PI63531>
- Techdoc for V10 and V11 MEMU2 with spreadsheet sample
 - <http://www-03.ibm.com/support/techdocs/atmastr.nsf/WebIndex/PRS5279>
- DB2 for z/OS and WebSphere Integration for Enterprise Java Applications
 - <http://www.redbooks.ibm.com/abstracts/sg248074.html?Open>
- Subsystem and Transaction Monitoring and Tuning with DB2 11 for z/OS
 - <http://www.redbooks.ibm.com/redpieces/abstracts/sg248182.html?Open>
- DB2 and WebSphere Synergy Workshop to help manage connections
 - Contact me at agburke@us.ibm.com
- World of DB2
 - <http://www.worldofdb2.com/events/event/listUpcoming>





Thank You
(??'s)

