Understanding Distributed Processing Inside DB2 for z/OS
AGENDA

- Terminology – clearing up the confusion
- Distributed threads – What can I see?
- DDF and DB2 system considerations
- Impact on critical resources
Basic Concepts – Intro
What is “Distributed”

- If not further qualified:
  - Could mean a distributed platform or database
    - UNIX, AIX, Windows
    - Oracle, DB2 LUW, and others
  - Could mean distributed applications
    - Portions of data for a single application implemented across multiple DB2s, possibly geographically dispersed
    - Data distributed vertically or horizontally
  - DB2 on z/OS as a backend database server
    - Application UI and business logic implemented on other platform
    - Requesters coming from multiple front-ends using different technologies
Distributed Processing
Basic Concepts – Units of Work

Remote Request
• One SQL Statement
• Single DB2 instance

Remote Unit of Work
• Multiple statements
• Multiple tables
• Single DB2 instance

Distributed Unit of Work
• Multiple statements
• Multiple tables
• Multiple DB2s
• Single DB2 per statement

Distributed Request
• Multiple statements
• Multiple tables
• Multiple DB2s
• Multiple DB2s/statement

AUSTIN
DB2 PRD1

S1

SAN JOSE
DB2 PRD5

DALLAS
DB2 PRD4

HOUSTON
DB2 PRD3

ATLANTA
DB2 PRD3

PHOENIX
DB2 PRD2

SAN JOSE
DB2 PRD5
Distributed Fundamentals
SQL Access

- **System Directed Access**
  - Three Part Names
  - Alias

- **Application Directed Access**
  - Explicit CONNECT by application
  - Remote BIND required

- **Remote Stored Procedure Call**
  - Explicit CONNECT by application
Distributed Fundamentals
Connectivity Options

Data Server Drivers include:
• IBM Data Server Client
• IBM Data Server Runtime Client
• IBM Data Server Driver for JDBC and SQLJ
• IBM Data Server Driver for ODBC and CLI

**** Other vendors provide distributed
data access drivers
Basic Terminology Definitions

Location (DB2 for z/OS term)
- Or: RDB-Name, VTAM nodes, TCP/IP partners

Connection – between a requester and a server
- TCP/IP ports, or VTAM LUNAMEs

Network protocol – TCP/IP or SNA (VTAM)

Conversation – handle traffic on a connection
- Also referred to as a session
  - DRDA – one per requester to handle SQL & open cursors
Distributed Fundamentals
DB2 on z/OS Distributed Implementation

- In the beginning - 3 DB2 operational address spaces
  - Plus all the allied agent address spaces
  - CICS, IMS, TSO Attach
  - TSO Batch, Call Attach Facility

- Distributed Data Facility (DDF) in DB2 V2R2
  - Access using 3 part names or aliases
  - DIST address space introduced

- DRDA (Distributed Relational Database Architecture) first implemented in DB2 V2R3

- Major enhancements delivered in DB2 V4
  - DRDA support of stored procedures
  - DBAT user priority

- More in DB2 V5
  - TCP/IP, ODBC, CLI, JDBC
  - Much more . . .

- Web-based access comes of age
  - Java, JDBC Universal Driver, Websphere.
A Word About Threads

Database Access Threads (DBATs)
- Service distributed workloads
- Implemented as an MVS WLM enclave running in preemptive SRBs originating in the DIST address space

DBAT Types
- DBAT (Server)
- DBAT (Dist)

Allied Threads
- Service local attachment facilities
- Run at the dispatching priority of the requesting application
- Can become distributed requesters

Allied Agent Types
- Allied
- Allied Dist (requester)
DDF Setup Considerations
Related ZPARM Review

- CMTSTAT – DDF Threads
- IDTHTOIN – Idle Thread Timeout
- TCPKPALV – TCP/IP Keepalive
- POOLINAC – Pool Thread Timeout
- ACCUMACC and ACCUMUID
- KEEPDYNAMIC(YES) / MAXKEEPD
- EXTRAREQ / SRV – Extra Blocks REQ / SRV
- And of course:
  - MAXDBAT – Max Remote Active
  - CONDBAT – Max Remote Connected
<table>
<thead>
<tr>
<th><strong>DDF - Dist Data Facility Definitions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Location</strong></td>
</tr>
<tr>
<td><strong>DDF Startup Facility Name</strong></td>
</tr>
<tr>
<td><strong>DDF Start Option</strong></td>
</tr>
<tr>
<td><strong>DDF Compatibility</strong></td>
</tr>
<tr>
<td><strong>DDF Max Number of Facility Entries</strong></td>
</tr>
<tr>
<td><strong>DBAT Status after Commit</strong></td>
</tr>
<tr>
<td><strong>Idle Thread Timeout (Seconds)</strong></td>
</tr>
<tr>
<td><strong>Minutes between Resync Periods</strong></td>
</tr>
<tr>
<td><strong>TCP/IP KEEPALIVE</strong></td>
</tr>
<tr>
<td><strong>DDF Interval Cycle Frequency</strong></td>
</tr>
<tr>
<td><strong>DDF Queued Conversation Time</strong></td>
</tr>
<tr>
<td><strong>DDF Receive Buffer Size</strong></td>
</tr>
<tr>
<td><strong>Max Extra DRDA Query Blocks for DB2 Req</strong></td>
</tr>
<tr>
<td><strong>Max Extra DRDA Query Blocks for DB2 Svr</strong></td>
</tr>
<tr>
<td><strong>Accounting for DDF and RRSAF threads</strong></td>
</tr>
<tr>
<td><strong>Aggregate field used for DDF/RRSAF thread</strong></td>
</tr>
<tr>
<td><strong>Private Protocol Auth</strong></td>
</tr>
<tr>
<td><strong>Private Protocol processing</strong></td>
</tr>
<tr>
<td><strong>Resolve Alias references in SQL</strong></td>
</tr>
<tr>
<td><strong>DBAT Thread Controls</strong></td>
</tr>
<tr>
<td><strong>Max Concurrent Database Access Threads</strong></td>
</tr>
<tr>
<td><strong>Maximum Remote Database Access Threads</strong></td>
</tr>
<tr>
<td><strong>Maximum Type 1 Inactive Threads</strong></td>
</tr>
<tr>
<td><strong>DDF Pool Thread Timeout Value</strong></td>
</tr>
<tr>
<td><strong>Max depth of connection request queue</strong></td>
</tr>
<tr>
<td><strong>Max time for a conn to wait for a DBAT</strong></td>
</tr>
<tr>
<td><strong>DDF-Related Authorization</strong></td>
</tr>
<tr>
<td><strong>Extended Security</strong></td>
</tr>
<tr>
<td><strong>ID Sent to Second Server</strong></td>
</tr>
<tr>
<td><strong>Accept Already Verified TCP/IP Connects</strong></td>
</tr>
<tr>
<td><strong>DDF RLF Access Error Parameter</strong></td>
</tr>
<tr>
<td><strong>DDF RLF Service Unit Limit</strong></td>
</tr>
</tbody>
</table>
DBAT Processing Modes

- Mode is defined with the ZPARM CMTSTAT
  - Very critical option for DDF that defines the flow of DBAT processing
  - “DDF Threads” on panel DSNTIPR

- Two choices:
  - INACTIVE – highly recommended
    - Provides DBAT pooling for DRDA access
    - More effective WLM classification per UOW
    - Reduced Resource usage
  - ACTIVE
    - DBAT created for each new client application
    - DBAT held through commits
    - Use this only if the applications require it

- ZPARM Considerations
  - CMTSTAT INACTIVE / ACTIVE
  - POOLINAC Used / not applicable
  - IDTHTOIN Used / not recommended
  - CONDBAT:MAXDBAT > / =
DB2 Thread Pooling

- Driven by CMTSTAT INACTIVE in DSNZPARM
  As active DBATs are freed they remain in the pool and can be immediately reused

- Often called Type 2 Inactive Thread support
  - Use the Thread Pooling terminology as it’s more accurate

- DB2 Connect ESE and JDBC Type 4 Driver also provide thread pooling functions that can (and often) should be used with DDF Thread Pooling

Benefits
- Reduces CPU required to create and destroy DBATs
- Reduced number of DBATs decreases real and virtual storage requirements
- Better scalability for distributed connections
Manage Distributed Thresholds in DB2

- Two DSNZPARM keywords MAXDBAT and CONDBAT

- **MAXDBAT**
  - maximum number of concurrent remote DDF threads (DBATs) in DB2’s DBM1
  - Default = 200
  - Sum of MAXDBAT and CTHREAD (max users) ≤ 20,000
  - Restrict distributed transactions to a particular data sharing member
    - MAXDBAT=0

- **CONDBAT**
  - maximum number of remote connections that DDF will allow
  - Default = 10,000
  - MAXDBAT = 0 → CONDBAT = 0
  - set to a value so connection requests aren’t rejected
  
- In INACTIVE mode CONDBAT can be much higher than MAXDBAT

- In ACTIVE mode they should generally be equal
Distributed Access requires DDF connection and DB2 DBAT
  - DBAT occupies 200Kb in DBM1 AS
  - DDF connection 7.5Kb in DDF AS

CMTSTAT=INACTIVE, MAXDBAT > 0 and CONDBAT > MAXDBAT
  - Many connections to share few DBATs

CMTSTAT=ACTIVE
  - CONDBAT is ignored

Cursors defined with WITH HOLD and packages bound with KEEPDYNAMIC (YES) will NOT create an inactive connection or inactive DBAT.

MAXDBAT and CONDBAT can be changed online (-SET SYSPARM)

CMTSTAT requires DB2 subsystem recycle
CHARACTERISTICS

- No end user “think time” included
- Enclave is created when the first SQL is received
- Enclave is deleted at commit/rollback (thread complete)
- New enclave for each UOW, reclassified by WLM
- Use multi-period response time or velocity goals
Processing Diagram
CMTSTAT ACTIVE

CHARACTERISTICS
• End User “think time” is included
• Enclave is created when DBAT is created
• Enclave is deleted at thread termination
• Only one enclave, no reclassification
• Can only use a single-period velocity goal

New Connection

MAXDBAT Reached?
Yes
No
Queue
Create DBAT
Reply “ready” to client

Process SQL

Commit / Rollback?
Yes
No
Term / Thread?
Yes
End enclave / Write Acctg
No
Term. DBAT & Connection

Enclave / Class 1
the IDLE THREAD TIMEOUT

- **IDTHTOIN**
  - Time for idle active thread before it is canceled
  - Never cancel an inactive thread.

- **KEEPDYNAMIC (YES)**
  - Forces a thread to remain active
  - Depending on IDTHTOIN thread may be canceled

- Default = 120 seconds
  - Also lowest recommended value

- **IDTHTOIN = 0 →** Never cancel a thread

- can also be changed online using the –SET SYSPARM
Connection Management

- DSNZPARM keywords MAXCONQN and MAXCONQW.

- MAXCONQN
  - controls the number of connections that can be waiting on a DBAT to come available

- MAXCONQW
  - specifies the amount of time a connection can wait for a DBAT.

- won’t work for a DB2 subsystem using CMTSTAT = ACTIVE.

- DSNL030I – rc 00D31053 MAXCONQN has been exceeded
- DSNL030I – rc 00D31054 MAXCONQW has been exceeded
View the connection management keywords in DISPLAY DDF

DSNL080I ) DSNLTDDF DISPLAY DDF REPORT FOLLOWS: 211
DSNL081I STATUS=STARTD
DSNL082I LOCATION   LUNAME      GENERICLU
DSNL083I STLEC1     USIBMSY.SYEC1DB2-NONE
DSNL084I TCPPORT=446   SECPORT=447   RESPORT=5001  IPNAME=XYZ_A
DSNL085I IPADDR=::9.30.178.50
DSNL085I IPADDR=ABCD::91E:B232
DSNL086I SQL    DOMAIN=xyz_ahost.ibm.com
DSNL089I DT=I
DSNL090I CONDBAT=400 MDBAT=100
DSNL091I MCONQN=-1 MCONQW=0
DSNL092I ADBAT=0 QUEDBAT=0 INADBAT=0 CONQUED=0
DSNL091I MCONQN=-1 MCONQW=0
DSNL092I ADBAT=0 QUEDBAT=0 INADBAT=0 CONQUED=0
DSNL093I DSCDBAT=0 INACONN=0
DSNL094I WLMHEALTH=100 CLSDCONQN=0 CLSDCONQWW=1
DSNL105I DSNLTDDF CURRENT DDF OPTIONS ARE:
DSNL106I PKGREL = COMMIT
DSNL099I DSNLTDDF DISPLAY DDF REPORT COMPLETE
View the connection management keywords in DISPLAY DDF

DSNL080I ) DSNLTDDF DISPLAY DDF REPORT FOLLOWS: 211
DSNL081I STATUS=STARTD
DSNL082I LOCATION LUNAME GENERICLU
DSNL083I STLEC1 USIBMSY.SYEC1DB2 -NONE
DSNL084I TCPPORT=446 SECPORT=447 RESPORT=5001 IPNAME=XYZ_A
DSNL085I IPADDR=:9.30.178.50
DSNL085I IPADDR=ABCD::91E:B232
DSNL086I SQL DOMAIN=xyz_ahost.ibm.com
DSNL090I DT=I CONDBAT= 400 MDBAT= 100
DSNL091I MCONQN= -1 MCONQW= 0
DSNL093I DSCDBAT= 0 INACONN= 0
DSNL094I DSCDBAT= 0 INACONN= 0
DSNL094I DSCDBAT= 0 INACONN= 0
DSNL095I DSCDBAT= 0 INACONN= 0
DSNL094I WLMHEALTH=100 CLSDCONQN= 0 CLSDCONQQW= 1
DSNL105I PKGREL = COMMIT
DSNL099I DSNLTDDF DISPLAY DDF REPORT COMPLETE
**KEEPDYNAMIC DBAT Refresh**

- **KEEPDYNAMIC(YES)**
  - keep prepared statements active across commits
  - eliminating the need to go through the prepare process
  - → a thread’s storage footprint continually increases
  - → fragmentation of DBM1 AS

- **IF KEEP DYNAMIC(YES) is the only reason for DBAT to be active**

- **DDF can terminate a DBAT**
  - A Connection/thread has been used for more than one hour.
  - A Connection/thread has been idle for more than 20 minutes.

- **Requires**
  - CMTSTAT = INACTIVE
  - Sysplex workload balancing
## Comparison of the Keywords

<table>
<thead>
<tr>
<th>Subsystem Parameter</th>
<th>Description</th>
<th>V9</th>
<th>V10</th>
<th>V11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Default</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>CMTSTAT</td>
<td>Active/inactive thread switch</td>
<td>INACTIVE</td>
<td>INACTIVE</td>
<td>INACTIVE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDBAT</td>
<td>Max allowed concurrent inbound DDF connections</td>
<td>10000</td>
<td>150000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10000</td>
<td>150000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10000</td>
<td>150000</td>
<td>0</td>
</tr>
<tr>
<td>MAXDBAT</td>
<td>Max number of concurrently active DBATs allowed</td>
<td>200</td>
<td>19999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td>19999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td>19999</td>
<td>0</td>
</tr>
<tr>
<td>MAXCONQN</td>
<td>Max queued waiting for DBAT</td>
<td>Not</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Available</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF</td>
<td>19999</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF</td>
<td>19999</td>
<td>1</td>
</tr>
<tr>
<td>MAXCONOW</td>
<td>Max wait time for DBAT</td>
<td>Not</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Available</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF</td>
<td>3600</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF</td>
<td>3600</td>
<td>5</td>
</tr>
<tr>
<td>IDTHTOIN</td>
<td>Time an active thread can remain idle</td>
<td>120</td>
<td>9999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120</td>
<td>9999</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120</td>
<td>9999</td>
<td>0</td>
</tr>
<tr>
<td>CTHREAD</td>
<td>Max number of concurrently allocated allied threads</td>
<td>200</td>
<td>20000</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td>20000</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
<td>20000</td>
<td>1</td>
</tr>
</tbody>
</table>
DBATs and Accounting

- **ACTIVE mode**
  - Only cut at thread termination, not at commit

- **INACTIVE mode**
  - at “clean” COMMIT or ROLLBACK
    - “Type 2 inactive”
  - with KEEP_DYNAMIC(YES)
    - At “clean” commit (DB2 V8 and above)

- Active thread is idle too long and is canceled
  - At “Idle Thread Timeout” (IDTHTOIN), if allowed
    - Checked every 2 minutes
Accounting and DDF Rollup

- **Option to reduce accounting volume (as of DB2 V8)**
  - Turned on if ZPARM ACCUMACC > 1
  - the ACCUMACC parm defaults to 10 which means it’s on
    - You could see a big drop in SMF 101 records

- **Data accumulated for specified # of threads**
  - For matching IDs, based on ACCUMUID

- **Accounting written when**
  - “Too old” (staleness threshold)
  - “Too much” (internal storage threshold reached)
  - “Just enough” (limit threshold reached)

- **One accounting record reflects one or more threads**
  - Currently no DDF statistics (QLAC) or QMDA accounting
  - Only one “ROLLUP” package

- **Active thread data only shows the current thread counts**
Alternative for Accounting Rollup: SMF Compression

- DSNZPARM keyword SMFCOMP (as of DB2 v10)
  - OFF (default): SMF trace records are not compressed
  - ON: Trace records written to SMF are compressed

- The z/OS compression service CSRCESRV compresses everything after the SMF header

- Data Sharing environment: SMFCOMP has member scope

- Performance measurements
  - Minimal overhead; ~ 1% with accounting class 1, 2, 3, 7, 8, 10
  - Compression rate of 60% to 80%

- APAR PM27872
  - Decompression routine DSNTSMFD
  - Sample JCL DSNTEJDS
DBAT Thread Status

- **Assigned to a remote client (RA or RX)**
  - Actively processing SQL or waiting for more
  - Waiting for more work after “clean” commit
  - INACTIVE mode – only:
    - KEEPDYNAMIC(YES) – all resources & DBAT kept
    - ACTIVE mode – even after commit
      - All resources & DBAT kept until thread termination

- **Pooled (DA)**
  - DRDA clients only, with INACTIVE mode
    - Freed or newly created DBATs are pooled (also called ‘DBAT slots’)
  - Available for reuse by any new / resumed request
  - Still uses resources (esp. DBM1 storage)
  - Still shown and counted as “active threads”
    - But connection name is “DISCONN”
    - Can be terminated if not used (POOLINAC)
### DISPLAY THREAD Command Output

<table>
<thead>
<tr>
<th>NAME</th>
<th>ST</th>
<th>A</th>
<th>REQ ID</th>
<th>AUTHID</th>
<th>PLAN</th>
<th>ASID</th>
<th>TOKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVER</td>
<td>RX</td>
<td>*</td>
<td>3</td>
<td>xidappl</td>
<td>AdMF001</td>
<td>DISTSERV</td>
<td>0036</td>
</tr>
<tr>
<td>V440</td>
<td>XID=53514C20</td>
<td>00000017</td>
<td>00000000</td>
<td>544D4442</td>
<td>00000000</td>
<td>002F93DD</td>
<td>A92F8C4F</td>
</tr>
<tr>
<td>V445</td>
<td>G91E1F24.BAC1.01E098172410=50 ACCESSING DATA FOR</td>
<td>( 1)::FFFF:9.30.31.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V447</td>
<td>--INDEX SESSID</td>
<td>A</td>
<td>ST</td>
<td>TIME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V448</td>
<td>( 1)</td>
<td>447:47809</td>
<td>W</td>
<td>R2</td>
<td>0522010250267</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISPLAY ACTIVE REPORT COMPLETE**

<table>
<thead>
<tr>
<th>POOLED THREADS</th>
</tr>
</thead>
</table>

| 13.23.46 STC00067 DSNV401I = DISPLAY THREAD REPORT FOLLOWS - |
| 13.23.46 STC00067 DSNV402I = ACTIVE THREADS - |
| NAME | ST | A | REQ ID | AUTHID | PLAN | ASID | TOKEN |
| DISCONN | DA | * | 8 | NONE | NONE | DISTSERV | 003B | 11 |
| V471 | US1BMSY.SYEC1DB2.C1C38BDE809D=11 |

**DISPLAY ACTIVE REPORT COMPLETE**

**EXECUTING THREADS**
Inactive Connections

- Inactive connections (R2)
  - Associated with a remote requester
  - Waiting for more work
  - Speeds up response to additional SQL

- Previously called Inactive Type 2 DBATs
  - Not DBATs at all

```
13.27.47 =dis thread(*) type(inactive)
13.27.47 STC00067 DSNV401I = DISPLAY THREAD REPORT FOLLOWS -
13.27.47 STC00067 DSNV424I = INACTIVE THREADS -
NAME ST A REQ ID AUTHID PLAN ASID TOKEN
SERVER R2 0 javaw.exe ADMF001 DISTSERV 003B 12
  V437-WORKSTATION=KFUKUSH, USERID=admf001,
  APPLICATION NAME=javaw.exe
  V445-G91E1686.EF04.080107212323=12 ACCESSING DATA FOR ::FFFF:9.30.22.134
SERVER R2 0 db2bp.exe ADMF001 DISTSERV 003B 14
  V437-WORKSTATION=KFUKUSH, USERID=admf001,
  APPLICATION NAME=db2bp.exe
  V445-G91E1686.F104.080107212343=14 ACCESSING DATA FOR ::FFFF:9.30.22.134
DISPLAY INACTIVE REPORT COMPLETE
13.27.47 STC00067 DSNVDT !-DIS THREAD! NORMAL COMPLETION
```
Analyzing DDF Thread Data

- The accounting data is the first source
- Still analyze other application considerations
  - Elapsed and CPU times, I/O, SQL counts . ..
- But in addition:
  - Elapsed time inside / outside the DB2 server
  - Number of messages and blocks sent / received
- Batch reports summarized by
  - The important DDF identifiers for your workloads
Thread Accounting – DBAT Specifics
Summary Information

DBAT Accounting Metrics
- “Application” processing is occurring in the workstation client
  - Class 2 – Class 1 CPU measures time not processing SQL in DB2
    - Includes parts of thread creation and termination and moving data from and to communication buffers

zIIP Metrics
- Actual CPU time on the zIIP
  - Not included in “standard” class 1 & 2 CPU times
- CPU eligible for the zIIP
### Thread Accounting – DBAT Specifics

#### DDF Summary

<table>
<thead>
<tr>
<th>Current Location: Dia (DBAT Server)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation User ID: AFDQA User</td>
</tr>
<tr>
<td>Workstation Name: AFDQA Workstation</td>
</tr>
<tr>
<td>Workstation Transaction ID: AFDQA TEST appdemo</td>
</tr>
<tr>
<td>MVS WLM Service Class Name: DDF</td>
</tr>
<tr>
<td>Client = DB2 Universal JDBC Driver. / Vers. Mod. 0</td>
</tr>
<tr>
<td>Client Platform = AFDQA Workstation</td>
</tr>
<tr>
<td>Job accounting data = AFDQA CLIENT ACCOUNTING01234567891011121314151617181920212223242526272829303132333435363738394041424344454647484950515253545</td>
</tr>
</tbody>
</table>

#### Remote

<table>
<thead>
<tr>
<th>Location: 192.168.7.5</th>
<th>SQL Statements</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait on MAX DBAT 0 us</td>
<td>8</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

#### DBAT Details
- Wait on MAX DBATs
- PROD-ID = IBM Universal Driver for JDBC and SQLJ
- Traffic Information

#### WLM Service Class

- Client Identifiers
Tracing Distributed Workloads

- Additional focus on one workload
  - Summary exception trace (accounting)
  - Detail trace with important event IFCIDs

- All the usual qualifiers are available

- For DDF, important to reduce the data:
  - Filter by requesting location
  - Filter by Workstation ID(s)

- Exception Filters can be used to keep only threads that may need analysis (high In-DB2 elapsed, etc.)
Detail Traces

- Detail traces can include selected event groups
  - Basic thread flow and SQL
  - Also can choose to add scans, I/O, locks
- Another group to include specific DDF events
  - The volume can be high
  - Use it only when needed
  - To understand the conversation flow
- Each event has a pop-up view with the IFCID details
DDF Statistics

- The next place to look are the statistics
- Global statistics
  - Critical DB2 subsystem tuning information
- Location statistics
  - Application impact on DB2 and network
    - DRDA_Remote_Locs
- DDF Address Space CPU usage
  - TCB and SRB
### Global DDF Statistics

#### Status - Current and High Water Mark

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>HWM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total DBATs - Active &amp; Pooled</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DBATs Pooled for Reuse (Type 2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inactive DBATs (Type 1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Active DBATs Bound with RELEASE(DEALLOCATE)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total Remote Connections | 0       |
| Type 2 Inactive Connections | 0       |
| Type 2 Connections Queued for DBAT | 0       |

#### Maximums Reached

<table>
<thead>
<tr>
<th></th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queued for DBAT (MAXDBAT Reached)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Connections Deallocated (CONDBAT Reached)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Type 1 Connections Terminated (MAXTYPE1 Reached)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Queued Client Connections Closed (MAXDBAT Reached)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### DBAT Usage Statistics

<table>
<thead>
<tr>
<th></th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>New DBATs Created</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pooled DBATs Reused</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New/Resumed (Type 2) Requests</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Two-Phase Commit Activity

<table>
<thead>
<tr>
<th></th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Start Connections</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Warm Start Connections</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Resync Attempts</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Resync Succeeds</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Exception Monitoring

- Review your current exceptions
  - Are DDF conditions being monitored?

- Statistics
  - DBAT high water mark
  - Queuing for a DBAT?
  - DDF still active?
  - DBM1 storage usage
  - DDF conversations queued
  - DDF Excessive Getpages

- Accounting
  - Focus on DDF service levels
    - Filter for DBATs / most important work
    - Elapsed time / CPU usage
Dynamic SQL Cache Details

<table>
<thead>
<tr>
<th>SQL Cache in Statement Pool</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Pages</td>
<td></td>
<td>25599</td>
</tr>
<tr>
<td>Pages Used</td>
<td>99.98</td>
<td>25595</td>
</tr>
<tr>
<td>Free Pages</td>
<td>0.02</td>
<td>4</td>
</tr>
<tr>
<td># of Statements in Pool</td>
<td></td>
<td>8530</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Global Cache Usage</th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests</td>
<td>359</td>
<td>69577</td>
</tr>
<tr>
<td>Inserts</td>
<td>359</td>
<td>69458</td>
</tr>
<tr>
<td>Found in Cache (Short Prepare)</td>
<td>0</td>
<td>68.0</td>
</tr>
<tr>
<td>Not Found in Cache (Long Prepare)</td>
<td>359</td>
<td>69512</td>
</tr>
<tr>
<td>Global Cache Hit Ratio</td>
<td>0.0</td>
<td>66.7</td>
</tr>
<tr>
<td>Failures - Statement Pool Full</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local Cache Effectiveness</th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided PREPARE (Match)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Implicit PREPARE (No Match)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Local Cache Hit Ratio</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Statement Discarded (&gt;MAXKEEPD)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Statement Purged (Drop/Alter/Revoke)</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Extended Reporting

- Distributed workloads are often volatile
  - Less insight and control

- Can be useful to track activity over time
  - Store and query summary data in DB2 tables

- When needed, distributed traces and monitoring

- z/OS reporting on WLM can be helpful
  - Enclaves – SMF 30
  - Workloads by service class – SMF 72
References

- DB2 11 for z/OS Information Center
- DB2 11 Installation and Migration Guide
  - (GC19-4056).
- DB2 9 for z/OS: Distributed Functions
  - (SG24-6952-01)
- DB2 9 for z/OS Data Sharing: Distributed Load Balancing and Fault Tolerant Configuration.
  - (REDP-4449)
Questions?