Understanding Distributed Processing Inside DB2 for z/OS

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Overview

› Distributed Processing Fundamentals

› Distributed threads – What can I see?

› WLM, enclaves and SRBs

› DDF and DB2 system considerations

› Impact on critical resources
Along came distributed

３ DB2 operational address spaces in the beginning
  - Plus all the allied agent address spaces
    - CICS, IMS, TSO Attach
    - TSO Batch, Call Attach Facility
  - Distributed Data Facility (DDF) in DB2 V2R2
    - Private protocol only
    - Access using 3 part names or aliases
  - DRDA (Distributed Relational Database Architecture) first implemented in DB2 V2R3
  - Enhancements delivered in every release
    - DRDA support of stored procedures
    - DBAT user priority
    - TCP/IP, ODBC, CLI, JDBC
    - Much more . . .
  - DDCS grows up into DB2 Connect
  - Web-based access comes of age
    - Java, JDBC Universal Driver, Websphere . . .

In the beginning

DIST
MSTR
DBM1
IRLM
ALLIED AGENTS

Signon and Such
Most of the action
Locking
What Do They Mean?

A few examples of terminology confusion

› Type 2 inactive DBATs (not DBATs at all)
› Type 1 inactive DBATs (never seen one?)
› “Active” DBATs (not quite)
› Clients, connections, conversations
  – (Simple one to one?)
› Idle vs. pool thread timeout (what and when)
Basic Terminology Definitions

› Application Server (AS) / Application Requester (AR)
  – DB2 for z/OS? DB2 Connect? ** Both!
› 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
    • Either a client or a thread could have more than one
› 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
    • Private protocol – may have more, one per open cursor
More DB2 Terminology

› Thread types
  – Allied / DBAT (server),
    Allied Dist (requester) / DBAT Dist (both)

› “Connect type” used to identify the remote location
  – System-directed: 3-part names or aliases
  – Application-directed: CONNECT statement

› Database access protocol
  – DRDA
    • Usually application-directed, can be system-directed
    • Mostly TCP/IP, can be SNA (security)
    • Requires remote bind
  – Private Protocol (PP) – gradually disappearing
    • Always system-directed, always SNA, always DB2-DB2
    • No bind required, only dynamic SQL, limitations
Where are your DBAT Threads Coming From?

› Other DB2 for z/OS subsystems
› Primarily workstation clients or web users
› Many connection possibilities:
  – DB2 Connect PE
  – DB2 Universal Driver for SQLJ and JDBC
  – Connection managers and “concentrators’ to reduce resources required in DB2 for z/OS
    • DB2 Connect EE – Enterprise Edition
    • Websphere Application Server, SAP, others . . .
DBAT Thread identifiers - Basic

- **Connection Type**
  - DRDA or Private Protocol

- **Other IDs for DB2 to DB2 work (DRDA or PP)**
  - All come from the remote requester thread
  - Even with a “hop”, they come from the requester

- **Other IDs for non-z/OS DRDA clients**
  - Two unique identifiers
    - Connection Name = “SERVER”
    - Plan = “DISTSERV” **WLM PN**
More Identifiers from non-z/OS Clients

- Clients can flow other identifiers to DB2 for z/OS
  - ODBC/CLI/VB (SQLSetConnectionAttr)
  - Non-OBDC (sqleseti)
  - JDBC (DB2Connection)
  - DRDA (ACCRDB prddta / sqlstt in EXCSQLSET)

- Most important IDs supported in V8 with special registers
  - Client Accounting (see QMDA below)
  - Workstation Userid **WLM SPM 1-16**
  - Workstation Name **WLM SPM 17-34**
  - Workstation Application **WLM PC 1-32**
Other Differences – DRDA Clients

› **Package / Collection**  **WLM CN/PK**
  • First package accessed

› **Stored procedure name**  **WLM PR**
  • If First SQL is a CALL

› **AUTHID of client**  **WLM UI**
  • Often not unique for non-z/OS clients

› **Original primary AUTHID**
  • Used to make initial connection to server

› **Correlation ID**  **WLM CI**
  • DDM external name (EXTNAME) for client

› **Accounting correlation token**
  • 22-byte token
More “Accounting” IDs

› Special section for thread “accounting” data
  – Used for additional client identification
  – Only in the accounting record IFCID 03

› Product ID - shows the client source product
  – SQL – DB2 for LUW / DB2 Connect
  – JCC – Universal JDBC Driver
  – DSN – DB2 for z/OS requester

› DSN accounting string (z/OS)
  – A repeat of the QWHC identifiers, except:
  – MVS accounting string (QMDAACCT)
Non-z/OS Accounting IDs

- **SQL or JCC Accounting**
  - Client platform
  - Client application name
  - Client AUTHID of an application process
  - Accounting String **WLM AI**

- **Also, IDs from the DB2 for z/OS server**
  - Subsystem instance **WLM SI**
  - Subsystem collection name  
    (Data sharing group) **WLM SSC**
  - Sysplex name **WLM PX**
DBAT Processing Modes

- **Mode is defined with the ZPARM CMTSTAT**
  - “DDF Threads” on panel DSNTIPR

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

 › DDF threads are executed under enclave SRBs
   – Controlled by WLM

 › Thread priority set by WLM workload classification
   – Providing good DDF classifications is vital

 › Enclave completes = accounting data is ready
   – Defines class 1 elapsed times of a thread
   – (Not affected by rollup option)

 › Different for INACTIVE and ACTIVE modes
WLM Enclaves

› INACTIVE mode
  – 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
  – Can use multi-period response time or velocity goals

› ACTIVE mode
  – End user “think time” is included
  – Enclave is created when the DBAT is created
  – Enclave is only deleted at thread termination
  – Only one enclave, no reclassification
  – Can only use a single-period velocity goal
Processing Diagram

INACTIVE

> CONDBAT?

Yes

Reject

New Connection

Pooled DBAT Avail?

No

Yes

Reuse DBAT

MAXDBAT Reached?

Yes

Queue

No

Create DBAT

Reply "ready" to client

Enclave / Class 1

First SQL / UOW?

Yes

Process SQL

No

Commit / Rollback?

Yes

Term Thread?

No

Term. DBAT & Connection

No

End enclave / Write Acctg

Yes

Term. DBAT

& Connection

Yes

End enclave / Write Acctg

Yes

Enclave / Class 1

No

Pool DBAT / Inactv. Conn.

End enclave / Write Acctg

INACTIVE

New Connection

ACTIVE

Yes

Reject

Resumed Connection

Yes
DBATs and Accounting

› **ACTIVE mode**
  – Only cut at thread termination, not at commit

› **INACTIVE mode**
  – DRDA – at “clean” COMMIT or ROLLBACK
    • “Type 2 inactive”
  – DRDA with KEEP_DYNAMIC(YES)
    • At “clean” commit (DB2 V8 and above)
  – PP DBAT – at commit or termination
    • At commit, if “Type 1 Inactive” (MAXTYPE1) allowed
    • Else only at termination

› **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 in DB2 V8 to reduce accounting volume
  – Turned on if ZPARM ACCUMACC > 1
› Data accumulated for specified # of threads
  – For matching IDs, based on ACCUMUID
  – Combination of the 3 workstation IDs
› 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
Connection and Thread Processing  
- Review of INACTIVE Mode

› (1) A new connection (in DIST) is established
› (2) DB2 attempts to allocate a DBAT
  – Use a pooled DBAT if possible
  – Allocate a new DBAT if possible (expensive)
  – Queue if MAXDBAT reached (RQ)
    • DBAT shows as pooled until SQL is received (DA)
› (3) UOW processes SQL (RA)
  – Idle thread timeout can cause it to be canceled
› (4) “Clean” commit or rollback completes the UOW
  – Frees the DBAT to be pooled, connection goes inactive (R2)
    • KEEPDYNAMIC(YES) keeps the DBAT until termination
› (5) New SQL “resumes” the connection and a new UOW
› (6) Disconnect frees the connection
“Real” DBAT Thread Status (#1)

- **Assigned to a remote client (RA or RX)**
  - Actively processing executing SQL
  - Active but idle waiting for more SQL
  - Waiting for more work after “clean” commit, if:
    - INACTIVE mode – only:
      - **KEEPDYNAMIC(YES)** – all resources & DBAT kept
      - **Type 1 inactive** – PP only / some resources freed
    - ACTIVE mode – even after commit
      - All resources & DBAT kept until thread termination
  - Suspended to connect (PP only, temporary) (RN)
“Real” DBAT Thread Status (#2)

› **Pooled** (DA)
  › DRDA clients only, with INACTIVE mode
    – Freed or newly created DBATs are pooled
      • Also referred to as “DBAT slots”
  › Available for reuse by any new / resumed request
    • (Still somewhat in “standby” for previous client)
  › Still uses resources (esp. DBM1 storage)!
    – Occasionally terminated to free storage
  › Still shown and counted as “active threads”
    – But connection name is “DISCONN”
    – Can be terminated if not used (POOLINAC)
Where are the Inactive Type 2 DBATs?

› They are referenced often in various manuals
  – Pooled DBATs? Not DBATs at all!

› Actually, they are the inactive connections
  – Associated with a remote requester
  – Waiting for more work
  – This speeds up response to additional SQL
  – Tracked in DIST, and use less storage (7.5K)

› Shown only with DIS THREAD TYPE(INACTIVE)
  – Connection name is now “SERVER”
  – “Thread” status (R2)
And Inactive Type 1 DBATs?

› These are real DBATs
› Idle between UOWs
› Only Private Protocol
   – Old style of inactive processing
› The DBAT is still assigned
   – But resources are reduced
› This can only occur if MAXTYPE1 > 0
   – And limit is not reached
Understanding Thread Status

› **Active thread displays**
  – Show both assigned and pooled DBATs
  – Even though pooled DBATs aren’t really “active”

› **Inactive thread displays**
  – Show the inactive **connections** in DIST
    • While still “associated” with a pooled DBAT
      – Looks like the same requester is both active and inactive
  – When pooled DBAT is terminated or reassigned
    • The requester “disappears” from active
    • Still shows as inactive until connection terminated
Conversations are used for actual traffic on a connection between two remote partners.

When processing, the conversation is
- Shown under the active thread

Otherwise, the conversation is
- Shown under the inactive connection
  - After the initial connection until the first SQL
  - After a successful commit
Viewing Active Threads

› Assigned DBATs are identified with SERVER
› Pooled DBATs with DISCONN
  – Only the number is interesting (see statistics)
› Extra DDF activity counts
› Data sharing considerations
  – Various routing mechanisms across members
  – Need a group view of DBATs
    • To see complete distributed workload
    • In MVDB2, use SSI mode with a group context
Active DBATs (Data Sharing Members)

<table>
<thead>
<tr>
<th>CMD</th>
<th>Correlation</th>
<th>DB2</th>
<th>Package</th>
<th>Elapsed</th>
<th>DDF Msgs</th>
<th>DDF Msgs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>-----------</td>
<td>ID</td>
<td>Name</td>
<td>Time</td>
<td>CPU Time</td>
<td>Sent</td>
<td>Received</td>
</tr>
<tr>
<td>db2bp.exe</td>
<td>DB2K</td>
<td>00:00:00.00</td>
<td>00:00:00.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>javaw.exe</td>
<td>DB2K</td>
<td>SYSSH200</td>
<td>00:08:32.48</td>
<td>00:00:00.01</td>
<td>1</td>
<td>1</td>
<td>214</td>
</tr>
<tr>
<td>db2bp.exe</td>
<td>DB2K</td>
<td>00:00:00.00</td>
<td>00:00:00.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>db2bp.exe</td>
<td>DB1K</td>
<td>00:01:00.62</td>
<td>00:00:00.00</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>javaw.exe</td>
<td>DB1K</td>
<td>SYSSH200</td>
<td>00:01:07.22</td>
<td>00:00:00.00</td>
<td>3</td>
<td>3</td>
<td>123</td>
</tr>
<tr>
<td>db2bp.exe</td>
<td>DB1K</td>
<td>SQLC2F0A</td>
<td>00:04:02.51</td>
<td>00:00:06.59</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Customize with workstation IDs, other values as needed
Scroll right to see more fields
## Enclave views (MVzOS)

### Table 1: Enclave Token Details

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclave Token</td>
<td>0000002400000087</td>
</tr>
<tr>
<td>Service</td>
<td>DDF</td>
</tr>
<tr>
<td>Owner</td>
<td>DHN1DIST</td>
</tr>
<tr>
<td>Cumulative Exectn</td>
<td>00:00:22.1</td>
</tr>
<tr>
<td>Total CPU Time</td>
<td>30.00</td>
</tr>
<tr>
<td>Total Velcty</td>
<td>70.00</td>
</tr>
<tr>
<td>%Idle</td>
<td>30.00</td>
</tr>
</tbody>
</table>

### Table 2: Timeframe Interval Details

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobname</td>
<td>ENCLAVE</td>
</tr>
<tr>
<td>Type</td>
<td>ENCLAVE</td>
</tr>
<tr>
<td>Serv. Class.</td>
<td>DDF</td>
</tr>
<tr>
<td>Rept. Class.</td>
<td>Enclave Cnt.</td>
</tr>
<tr>
<td>ASID</td>
<td>0 Velocity 1</td>
</tr>
<tr>
<td>Dmn.</td>
<td>0 Velocity 2</td>
</tr>
<tr>
<td>Period No.</td>
<td>2 Using SampS</td>
</tr>
<tr>
<td>Workload</td>
<td>DDF Delay SampS</td>
</tr>
<tr>
<td>Resource</td>
<td>MPL Delays</td>
</tr>
<tr>
<td>Trxn RPGN.</td>
<td>0 Swpin Delays</td>
</tr>
<tr>
<td>Userid RPGN.</td>
<td>0 Idle Samples</td>
</tr>
<tr>
<td>TrxC RPGN.</td>
<td>0 Unk. Delays</td>
</tr>
<tr>
<td>Acct RPGN.</td>
<td>0 Sample Count</td>
</tr>
<tr>
<td>Status</td>
<td>Active</td>
</tr>
<tr>
<td>Total Use%</td>
<td>25.00</td>
</tr>
<tr>
<td>Total %Dly CPU</td>
<td>75.00</td>
</tr>
<tr>
<td>Total %Dly DASD</td>
<td>75.00</td>
</tr>
</tbody>
</table>

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Checking Client Connections

- Many will be inactive connections
  - Shown as inactive threads (with client IDs)
- Some have active DBATs
  - In-flight accounting data is available
- Conversation is with DBAT or inactive connection and shows:
  - Whether the conversation is active in the network or suspended in DB2 waiting for a response
  - Last send/receive time stamp
  - Whether it is receiving or sending
  - The remote location (IP address) and “Sessid” - local and partner ports (for TCP/IP)
### Inactive Thread (Connection) View

```plaintext
>W1 =THDINACT=========DBGK=========01MAR2007==13:22:53====MVDB2====D====E====2

<table>
<thead>
<tr>
<th>Connect</th>
<th>Current</th>
<th>Correlation</th>
<th>Plan</th>
<th>LUW</th>
<th>Workstation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Activity</td>
<td>Id</td>
<td>Auth ID</td>
<td>Name</td>
<td>ASID</td>
</tr>
<tr>
<td>SERVER</td>
<td>Inactive</td>
<td>DBAT db2bp.exe</td>
<td>DMRQA01</td>
<td>DISTSERV</td>
<td>273</td>
</tr>
<tr>
<td>SERVER</td>
<td>Inactive</td>
<td>DBAT db2bp.exe</td>
<td>DMRQA01</td>
<td>DISTSERV</td>
<td>273</td>
</tr>
</tbody>
</table>
```
### Connection / Conversation Views

<table>
<thead>
<tr>
<th>DB2</th>
<th>Target</th>
<th>Remote Location</th>
<th>Link Name</th>
<th>ID</th>
<th>Product</th>
<th>Tot Conn</th>
<th>Req Conn</th>
<th>Serv Conn</th>
<th>Inact Conn</th>
<th>Tot Conn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DEDM</td>
<td>::172.17.8.86</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DEDM</td>
<td>::172.21.22.183</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>DEDM</td>
<td>DECE</td>
<td>::172.17.8.86</td>
<td>DSN08015</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>DEDM</td>
<td>DHH</td>
<td>LUDHH2</td>
<td>DSN08015</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Hyperlink on “Tot Conn” to see details

<table>
<thead>
<tr>
<th>DB2</th>
<th>Age</th>
<th>Cnv</th>
<th>Workst</th>
<th>Correlation</th>
<th>Latest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Correlation</td>
<td>Latest</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ID</td>
<td>Send/Receive Time</td>
</tr>
<tr>
<td>DEDM</td>
<td>R/S</td>
<td>Active</td>
<td>2</td>
<td>boljxo1</td>
<td>db2bp.exe</td>
</tr>
<tr>
<td>DEDM</td>
<td>R/S</td>
<td>Active</td>
<td>2</td>
<td>boljxo1</td>
<td>db2bp.exe</td>
</tr>
<tr>
<td>DEDM</td>
<td>Srv</td>
<td>Active</td>
<td>1</td>
<td>boljxo</td>
<td>db2bp.exe</td>
</tr>
<tr>
<td>DEDM</td>
<td>Srv</td>
<td>Idle</td>
<td>1</td>
<td>boljxo</td>
<td>db2bp.exe</td>
</tr>
</tbody>
</table>
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

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**SUMMARY TRACE ENTRY**

<table>
<thead>
<tr>
<th>SERV =&gt;</th>
<th>STRAC</th>
<th>INPUT</th>
<th>14:37:25</th>
<th>INTVL=&gt;</th>
<th>3</th>
<th>LOG=&gt;</th>
<th>N</th>
<th>TGT=&gt;</th>
<th>DECE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARM =&gt;</td>
<td>DIST,SEQ=1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPAND:</td>
<td>MON(WKLD), DETAIL, HISTORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACCOUNTING: ENV, ELAPSED, SQLCOUNTS, BPOOL, LOCKS, PRLL, PKG, RLF, CFR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SUMMARIES: SQL, SCANS, IO/LOCK, SORTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STOP** 01MAR 13.50.46.11 PLAN...DISTSERV TYPE............ALLIED
**START** n/a-ROLLUP AUTHID......BOlDJW1 CONNECT......SERVER/DRDA
**ELAPSED** 315 ms ORIG PRIM AUTH......BOlDJW1 CORR ID......db2bp.exe
**TERM** DDF/RRSAF LIMIT COMMITS.............2 ROLLBACKS.............0

**RUNTIME ANALYSIS**

<table>
<thead>
<tr>
<th></th>
<th>IN DB2</th>
<th>IN APPL.</th>
<th>TOTAL</th>
<th>%IN DB2(=)</th>
<th>TOTAL(*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELAPSED TIME</td>
<td>46 ms</td>
<td>269 ms</td>
<td>315 ms</td>
<td>===========</td>
<td></td>
</tr>
<tr>
<td>CPU TIME</td>
<td>1,437 us</td>
<td>626 us</td>
<td>2,064 us</td>
<td>===========</td>
<td></td>
</tr>
<tr>
<td>DB2 WAIT TIME</td>
<td>-none-</td>
<td></td>
<td></td>
<td>===========</td>
<td></td>
</tr>
<tr>
<td>ZIIP CPU TIME</td>
<td>1,575 us</td>
<td>2,223 us</td>
<td></td>
<td>===========</td>
<td></td>
</tr>
<tr>
<td>ZIIP-ELIGIBLE CP</td>
<td>0 us</td>
<td></td>
<td></td>
<td>===========</td>
<td></td>
</tr>
</tbody>
</table>

**ACTIVITY**

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
**KEY INDICATORS**

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

**TOTAL SQL** 6
**GETPAGES** 4
**SYNC READS (PRLL=00)** 0

**ENVIRONMENTAL INDICATORS**

**LUWID** AC173BD3.B912.0763012146160063
**RLF TABLE ID** NOT ACTIVE

**WORKSTATION USER ID** bolDJW1
**WORKSTATION NAME** dwitkows-SJC-04
**WORKSTATION TRANSACTION ID** db2bp.exe
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)
    • In V9, DB2 also allows qualification by these IDs

› Exception Filters can be used to keep only threads that may need analysis (high In-DB2 elapsed, etc.)
Start Trace Options

```
BMC SOFTWARE -------------- REPLICATE DB2 TRACE REQUEST ----- PERFORMANCE MGMT
COMMAND ==>

TGT ==>
TIME ==>

PARAM ==>
(Trace Identifier)

TYPE ==>
(S-Summary, D-Detail)

STORAGE ==>
(Display buffer size)

LOGTRAC ==>
(Y/N log trace)

TITLE ==>
(DBAT TRACE BY REQ. LOC

Specify Selection Criteria:

- DB2PLAN ==>
- DB2AUTH ==>
- DB2LOC ==>
  '172.23.59.211'
- DB2CONN ==>
- DB2CORR ==>
- DB2PKG ==>
- CONNTYPE ==>
  DRDA
- Additional Selection ==>
  Y  (Y/N)

Specify Exception additional trace options:
  (*=processed)

- Exception filters  ==> Y  (Y/N)
- Detail Trace Options ==> Y  (Y/N)
- Trace Log Data Set Options ==> Y  (Y/N)

Specify End User Work Station Criteria:

- DB2UID ==>
- DB2UTX ==>
- DB2UWN ==>

ENTER to process; END to cancel
```
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**
Sample DTRAC View

<table>
<thead>
<tr>
<th>EVENT</th>
<th>AT</th>
<th>ELAPSED</th>
<th>CPU</th>
<th>DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKG-ALLOC</td>
<td>0.000</td>
<td></td>
<td></td>
<td>*SQLC2F0A ISO=CS ACQ=USE REL=COMMIT</td>
</tr>
<tr>
<td>PREPARE</td>
<td>0.000</td>
<td>6,033 us</td>
<td>157 us</td>
<td>*RC( 0) C=SQLCUR201</td>
</tr>
<tr>
<td>SQL-TEXT</td>
<td>0.006</td>
<td></td>
<td></td>
<td>*TYPE=DYNAMIC TEXT=select * from sys</td>
</tr>
<tr>
<td>OPEN</td>
<td>0.049</td>
<td>33 us</td>
<td>30 us</td>
<td>*RC( 0) C=SQLCUR201</td>
</tr>
<tr>
<td>FETCH</td>
<td>0.049</td>
<td>270 us</td>
<td>227 us</td>
<td>*RC( 100) C=SQLCUR201 D PS( 2)</td>
</tr>
<tr>
<td>SEQ-SCAN</td>
<td>0.049</td>
<td>142 us</td>
<td>102 us</td>
<td>*DB=DSNDB06 TS=SYSSDF TB=LOCATIO+</td>
</tr>
<tr>
<td>SERV-DTH</td>
<td>0.138</td>
<td></td>
<td></td>
<td>*TYPE=COMMIT MESSAGE RECEIVED</td>
</tr>
<tr>
<td>LOCK-SUMMARY</td>
<td>0.174</td>
<td></td>
<td></td>
<td>*MAXPG(0) ESCL(0) TS( 1)</td>
</tr>
<tr>
<td>COMMIT-LSN</td>
<td>0.174</td>
<td></td>
<td></td>
<td>*LOCK-AVOID=Y PAGESETS=1</td>
</tr>
<tr>
<td>PKG-ALLOC</td>
<td>1.163</td>
<td></td>
<td></td>
<td>*SQLC2F0A ISO=CS ACQ=USE REL=COMMIT</td>
</tr>
<tr>
<td>PREPARE</td>
<td>1.164</td>
<td>226 us</td>
<td>108 us</td>
<td>*RC( 0) C=SQLCUR201</td>
</tr>
<tr>
<td>SQL-TEXT</td>
<td>1.164</td>
<td></td>
<td></td>
<td>*TYPE=DYNAMIC TEXT=select * from sys</td>
</tr>
<tr>
<td>OPEN</td>
<td>1.210</td>
<td>47 us</td>
<td>44 us</td>
<td>*RC( 0) C=SQLCUR201</td>
</tr>
<tr>
<td>FETCH</td>
<td>1.210</td>
<td>192 us</td>
<td>176 us</td>
<td>*RC( 100) C=SQLCUR201 D PS( 2)</td>
</tr>
<tr>
<td>SEQ-SCAN</td>
<td>1.211</td>
<td>87 us</td>
<td>73 us</td>
<td>*DB=DSNDB06 TS=SYSSDF TB=LOCATIO+</td>
</tr>
<tr>
<td>SERV-DTH</td>
<td>1.302</td>
<td></td>
<td></td>
<td>*TYPE=COMMIT MESSAGE RECEIVED</td>
</tr>
<tr>
<td>LOCK-SUMMARY</td>
<td>1.302</td>
<td></td>
<td></td>
<td>*MAXPG(0) ESCL(0) TS( 1)</td>
</tr>
<tr>
<td>COMMIT-LSN</td>
<td>1.302</td>
<td></td>
<td></td>
<td>*LOCK-AVOID=Y PAGESETS=1</td>
</tr>
</tbody>
</table>

*************** END OF DETAIL TRACE ENTRIES ***********************
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 (combined)
  - Private Protocol locations (separate)

DDF Address Space CPU usage
- TCB and SRB
## Global DDF Statistics - STDISTD

<table>
<thead>
<tr>
<th>Statistics Details</th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximums Reached</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>New DBATs Queued (MAXDBAT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversations Deallocated (CONDBAT)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New/Resumed (Type 2) DBATs Queued (MAXDBAT)</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Connections Terminated (MAXTYPE1)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Status Values

- **Remote Connections - Maximum**: 10
- **Active DBATs - Current**: 3
  - **Maximum**: 3
- **DBAT Slots Not Used - Current**: 0
  - **Maximum**: 1
- **Type 1 Inactive DBATs - Current**: 0
  - **Maximum**: 1
- **Type 2 Inactive DBATs - Current**: 6
  - **Maximum**: 6
- **Type 2 Queued (New/Resumed) - Current**: 2
  - **Maximum**: 4

### Two-Phase Commit Activity

- **Cold Start Connections**: 0
- **Warm Start Connections**: 0
- **Resync Attempts**: 0
- **Resync Succeeds**: 0

### Statistics

- **Requests that Required a DBAT**: 4
- **Requests that Used a Pool Thread**: 72
## STDISTD View - Revised

### DDF Global Statistics Detail

<table>
<thead>
<tr>
<th>Status - Current and High Water Mark</th>
<th>Current</th>
<th>HWM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total DBATs - Active &amp; Pooled</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>DBATs Pooled for Reuse (Type 2)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Inactive DBATs (Type 1)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total Remote Connections</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Type 2 Inactive Connections</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Type 2 Connections Queued for DBAT</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximums Reached</th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queued for DBAT (MAXDBAT Reached)</td>
<td>1</td>
<td>6</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>
</tbody>
</table>

### DBAT Usage Statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Interval</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>New DBATs Created</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pooled DBATs Reused</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>New/Resumed (Type 2) Requests</td>
<td>2</td>
<td>41</td>
</tr>
</tbody>
</table>

### Two-Phase Commit Activity

<table>
<thead>
<tr>
<th>Statistic</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>
<tr>
<td>Resync Failures</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

› **Accounting**
  – Focus on DDF service levels
    • Filter for DBATs / most important work
    • Elapsed time / CPU usage
DDF-Related ZPARM Review

- CMTSTAT – DDF Threads
- IDTHTOIN – Idle Thread Timeout
- TCPKPALV – TCP/IP Keepalive
- POOLINAC – Pool Thread Timeout
- ACCUMACC and ACCUMUID
- MAXTYPE1 (PP) – Max Inactive DBATs
- KEEPDYNAMIC(YES) / MAXKEEPD
- EXTRAREQ / SRV – Extra Blocks REQ / SRV
- And of course:
  - MAXDBAT – Max Remote Active
  - CONDBAT – Max Remote Connected
## DDF ZPARAM View

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Location</td>
<td></td>
</tr>
<tr>
<td>DDF Startup Facility Name</td>
<td></td>
</tr>
<tr>
<td>DDF Start Option</td>
<td></td>
</tr>
<tr>
<td>DDF Database Protocol for 3-Part Names</td>
<td></td>
</tr>
<tr>
<td>DDF Max Number of Facility Entries</td>
<td></td>
</tr>
<tr>
<td>DBAT Status after Commit</td>
<td>INACTIVE</td>
</tr>
<tr>
<td>Idle Thread Timeout (Seconds)</td>
<td></td>
</tr>
<tr>
<td>Minutes between Resync Periods</td>
<td></td>
</tr>
<tr>
<td>TCP/IP KEEPALIVE</td>
<td></td>
</tr>
<tr>
<td>DDF Interval Cycle Frequency</td>
<td></td>
</tr>
<tr>
<td>DDF Queued Conversation Time</td>
<td></td>
</tr>
<tr>
<td>DDF Receive Buffer Size</td>
<td></td>
</tr>
<tr>
<td>Max Extra DRDA Query Blocks For DB2 Req</td>
<td></td>
</tr>
<tr>
<td>Max Extra DRDA Query Blocks For DB2 Surv</td>
<td></td>
</tr>
<tr>
<td>Check Connection State</td>
<td>n/a</td>
</tr>
<tr>
<td>DBAT Thread Controls</td>
<td></td>
</tr>
<tr>
<td>Max Concurrent Database Access Threads</td>
<td></td>
</tr>
<tr>
<td>Maximum Remote Database Access Threads</td>
<td></td>
</tr>
<tr>
<td>Maximum Type 1 Inactive Threads</td>
<td></td>
</tr>
<tr>
<td>DDF Pool Thread Timeout Value</td>
<td></td>
</tr>
<tr>
<td>DDF-Related Authorization</td>
<td></td>
</tr>
<tr>
<td>Extended Security</td>
<td>N</td>
</tr>
<tr>
<td>ID Sent to Second Server</td>
<td>BOTH</td>
</tr>
<tr>
<td>Accept Already Verified TCP/IP Connects</td>
<td>Y</td>
</tr>
<tr>
<td>DDF RLF Access Error Parameter</td>
<td>NOLIMIT</td>
</tr>
<tr>
<td>DDF RLF Service Unit Limit</td>
<td></td>
</tr>
</tbody>
</table>

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DDF Resource Usage

› **CPU – TCB and SRB**
  – In the DIST address space
    • Management of the DBATs and connections
  – For the threads themselves (enclave SRBs)

› **DBM1 storage (MAXDBAT, and CTHREAD)**
  – Management of thread storage is critical

› **DIST address space**
  – Storage likely not an issue (CONDBAT)

› **Dynamic SQL cache**
  – Most distributed SQL is still dynamic
  – The cache is critical for good performance
  – Aim for an 80% or better hit ratio for SQL reuse
### DBM1 Storage – DB2STORD View

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity in MB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DBM1 Storage Summary Below 2 GB</strong></td>
<td></td>
</tr>
<tr>
<td>Storage Available to DBM1</td>
<td>1515.32</td>
</tr>
<tr>
<td>Total DBM1 Storage In Use (1)</td>
<td>58.27</td>
</tr>
<tr>
<td>Total MVS Storage In Use Below 2GB (5)</td>
<td>106.67</td>
</tr>
<tr>
<td>Storage Cushion (4)</td>
<td>118.61</td>
</tr>
<tr>
<td>Average Thread Footprint</td>
<td>0.84</td>
</tr>
<tr>
<td>Maximum Number of Possible Threads</td>
<td>1611</td>
</tr>
<tr>
<td><strong>1) Total DBM1 Storage In Use</strong></td>
<td></td>
</tr>
<tr>
<td>Total Getmained Storage (2)</td>
<td>32.68</td>
</tr>
<tr>
<td>Total Variable Storage (3)</td>
<td>17.70</td>
</tr>
<tr>
<td>Total Fixed Storage</td>
<td>0.11</td>
</tr>
<tr>
<td>Total Getmained Stack Storage</td>
<td>7.78</td>
</tr>
<tr>
<td><strong>3) Total Variable Storage</strong></td>
<td></td>
</tr>
<tr>
<td>Total Agent Local Storage</td>
<td>15.19</td>
</tr>
<tr>
<td>Total Agent System Storage</td>
<td>14.12</td>
</tr>
<tr>
<td>Number of Prefetch Engines</td>
<td>135</td>
</tr>
<tr>
<td>Number of Deferred Write Engines</td>
<td>15</td>
</tr>
<tr>
<td>Number of Castout Engines</td>
<td>0</td>
</tr>
<tr>
<td>Number of GBP Write Engines</td>
<td>0</td>
</tr>
<tr>
<td>Number of P-Lock/Notify Exit engines</td>
<td>0</td>
</tr>
<tr>
<td>Total Agent Non-System Storage</td>
<td>1.07</td>
</tr>
<tr>
<td><strong>Total Number Of Active User Threads..</strong></td>
<td>1</td>
</tr>
<tr>
<td>Total Number of Active DBATs</td>
<td>1</td>
</tr>
<tr>
<td>Thread High Water Mark</td>
<td>9</td>
</tr>
<tr>
<td>DBAT High Water Mark</td>
<td>3</td>
</tr>
</tbody>
</table>
Dynamic Cache – STCACHED View

```
SQL Cache in Statement Pool
Total Pages: 25600
Pages Used: 0.07
Free Pages: 99.93

Global Cache Usage
Requests: 0
Inserts: 0
Found in Cache (Short Prepare): 0
Not Found in Cache (Long Prepare): 0
Global Cache Hit Ratio: 0.0
Failures - Data Space Full: n/a
Failures - Statement Pool Full: 0

Local Cache Effectiveness
Avoided PREPARE (Match): 0
Implicit PREPARE (No Match): 0
Local Cache Hit Ratio: 0.0
Statement Discarded (>MAXKEEPD): 0
Statement Purged (Drop/Alter/Revoke): 0
```
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
- MVzOS provides online views as well as reports
Questions?