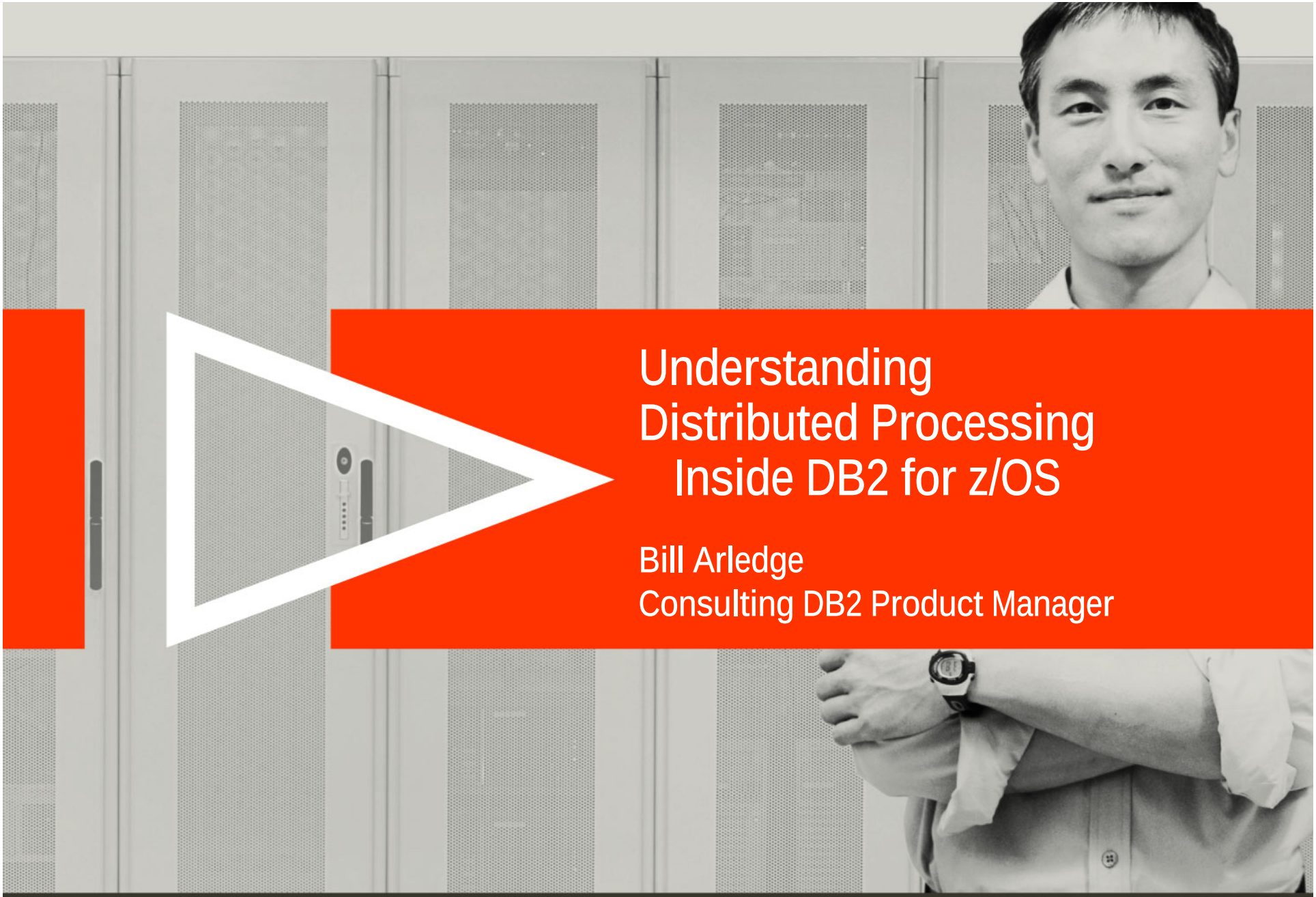


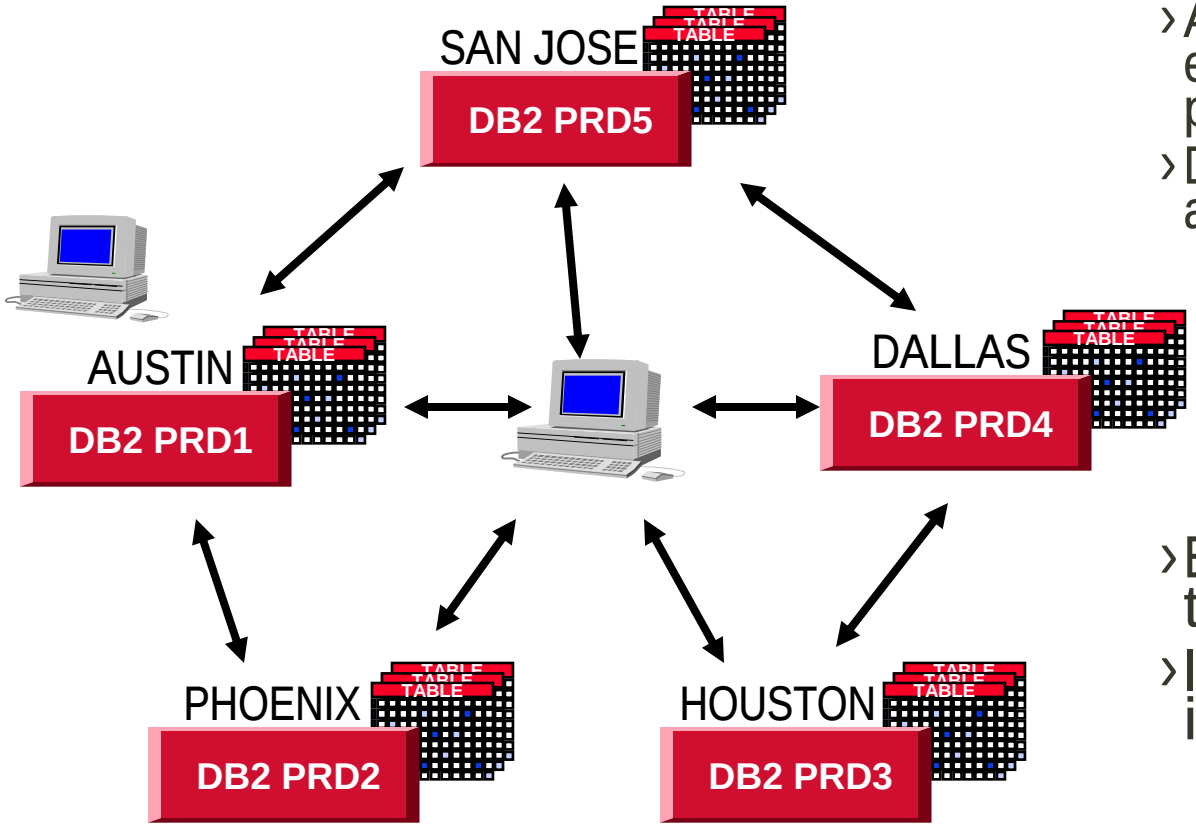
Understanding Distributed Processing Inside DB2 for z/OS

Bill Arledge
Consulting DB2 Product Manager

Overview

- Distributed Processing Fundamentals
- Distributed threads – What can I see?
- WLM, enclaves and SRBs
- DDF and DB2 system considerations
- Impact on critical resources

Distributed Fundamentals
Basic Concepts - Intro



- A distributed database is not entirely stored at a single physical location
- Distributed characteristics and value
  - Location Transparency
  - Autonomy for each location
  - Improved Availability
  - Scalability
  - Technology Agnostic (goal)
- Extension to relational theory and technology
- Initial delivery with DB2 2.2 in late 1980s
  - DB2 on mainframe only
  - Introduced a load of new requirements for DBAs and application developers

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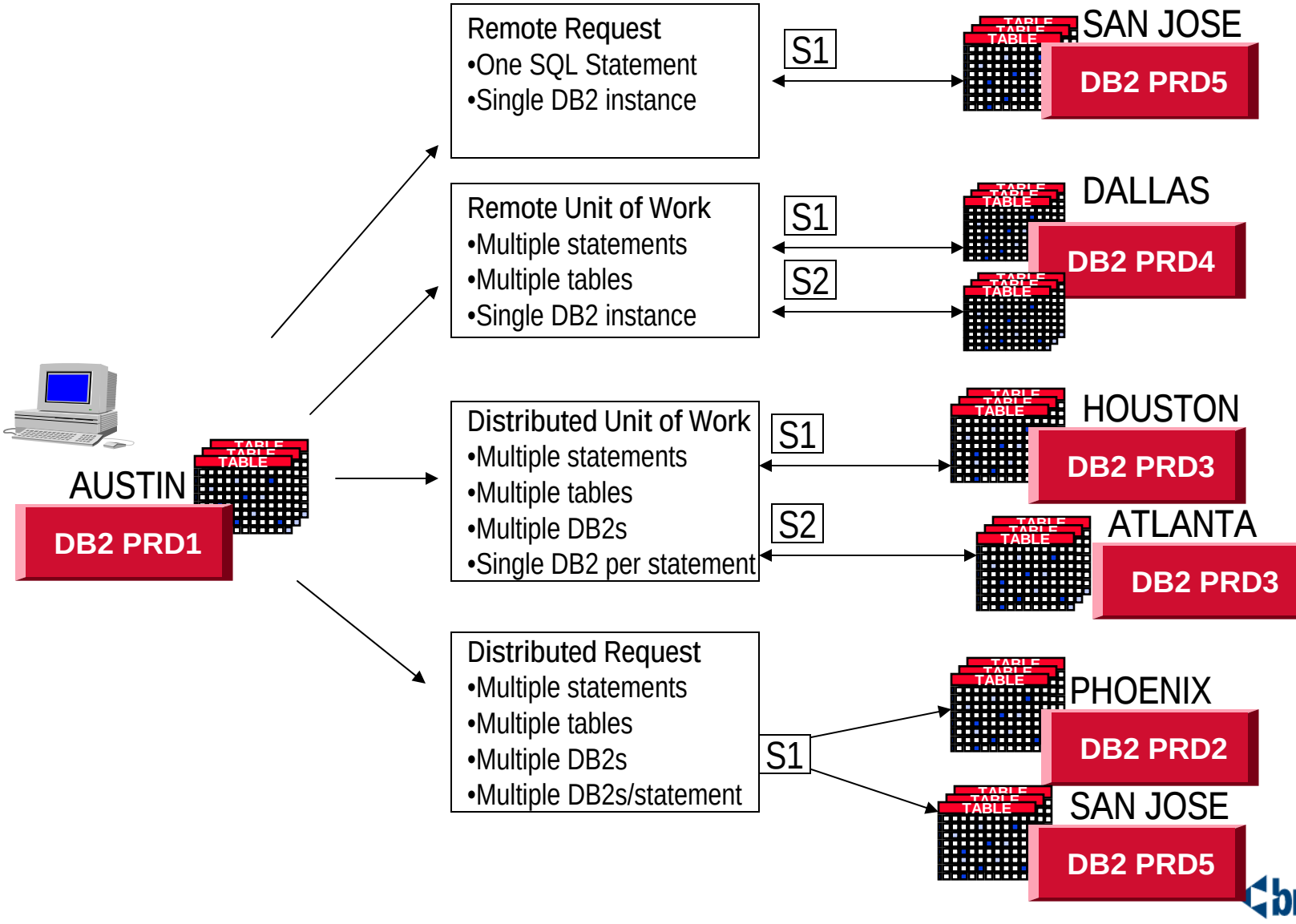
Distributed Fundamentals
Basic Concepts – Units of Work



Distributed Fundamentals
A Tale of Two Protocols

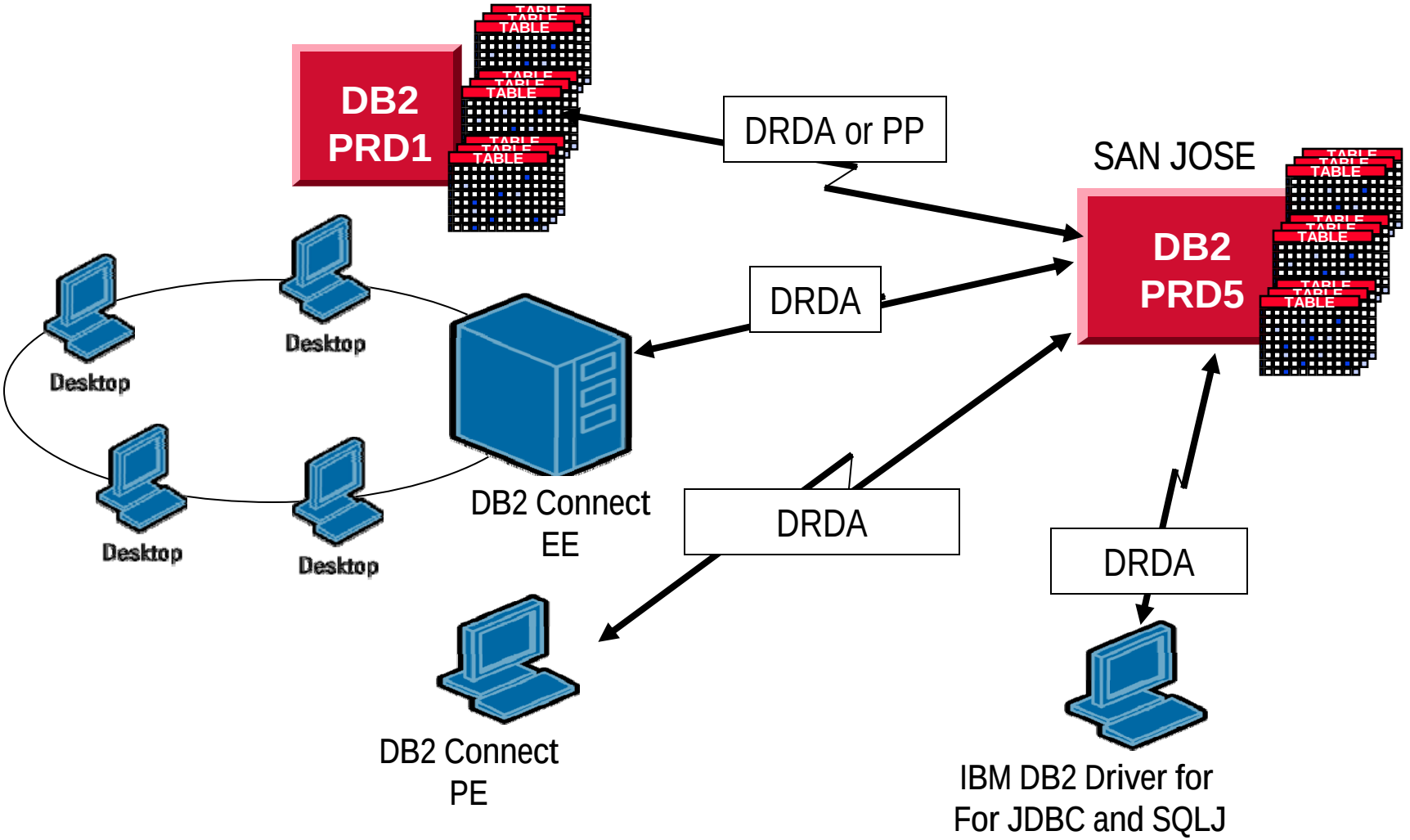
- Private Protocol (PP)
  - First delivered in DB2 2.2
  - Uses 3 part names
    - Select C1,C2,C3 from DB2G.APPL1.TABLE1
  - Dynamic SQL only
    - No remote bind
  - DB2 on z/OS to DB2 on z/OS only
  - No stored procedure support
  - Functionally stabilized and on the way out

Specifying the protocol

- Default can be set at subsystem level using DBPROTCL DSNZPARM value (DRDA or PRIVATE)
  - With DB2 9.1 PRIVATE can no longer be specified
- Can also be specified in the DBPROTOCOL parm of the BIND statement (D or P)
  - Only option in DB2 9

- DRDA (Distributed Relational Database Architecture)
  - Introduced in DB2 2.3
  - Supports 3-part names and explicit CONNECT statements
  - Dynamic and Static SQL
    - Remote bind capabilities
  - Supports stored procedures
  - Supports all RDBMS implemented using DRDA protocol
  - Supports SNA and TCP/IP
  - Is the strategic architecture for distributed

Distributed Fundamentals
Connectivity Options



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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

Distributed Fundamentals
SQL Access

- System Directed Access
  - Three Part Names
  - Alias
  - Supported by DRDA and PP

```
SELECT * FROM PRD1.RNDWDA.ORDER
    WHERE QUANTITY BETWEEN 1 and 100
 or...
CREATE ALIAS RNDWDA.AUSTIN_ORDERS
    FOR PRD1.RNDWDA.ORDER
SELECT * FROM RNDWDA.AUSTIN_ORDERS
```

- Application Directed Access
  - Explicit CONNECT by application
  - Supported by DRDA only
  - Remote BIND required

```
EXEC SQL CONNECT TO PRD1

SELECT * FROM RNDWDA.ORDER
```

- Remote Stored Procedure Call
  - Explicit CONNECT by application
  - DRDA only

```
EXEC SQL CONNECT TO PRD1
EXEC SQL CALL PROCONE
```

```
PROCEDURE PROCONE
EXEC SQL SELECT.....
EXEC SQL UPDATE.....
```

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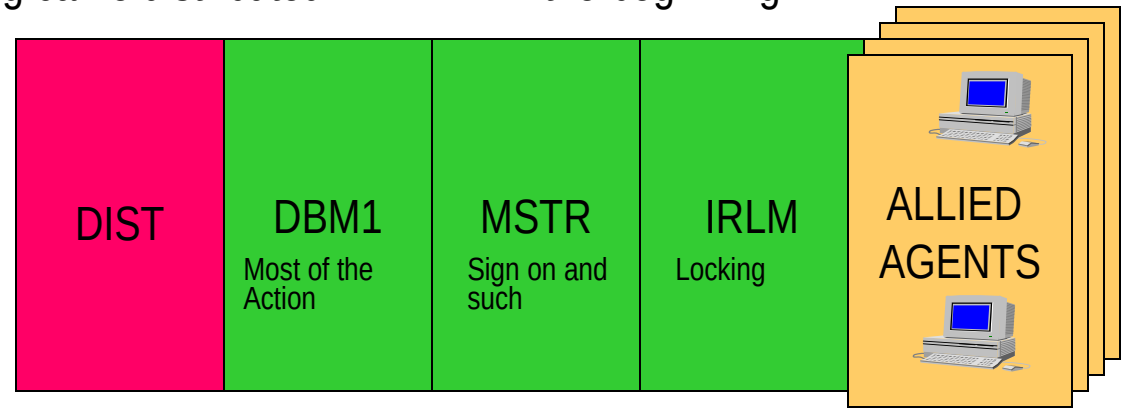
Distributed Fundamentals
DB2 on z/OS Distributed Implementation

Along came distributed

In the beginning



- In the beginning - 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
  - 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 . . .

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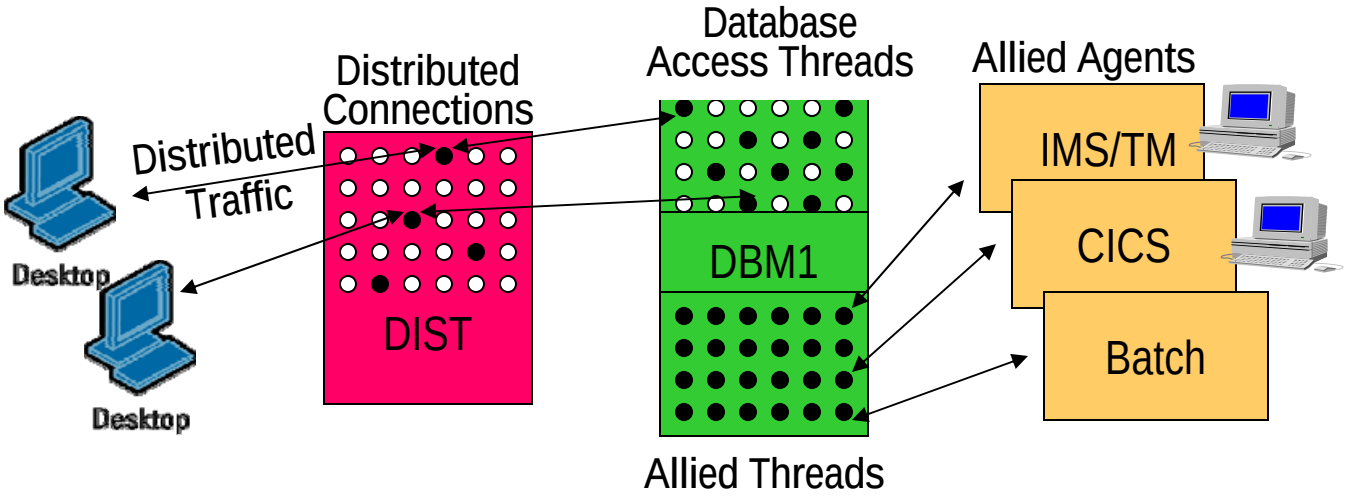
DB2 on z/OS Distributed Implementation
A Word About Threads



Database Access Threads (DBATs)

- Service distributed workloads
- Implemented as an MVS WLM enclave running in preemptive SRBs originating in the DIST address space (more coming)
- 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)

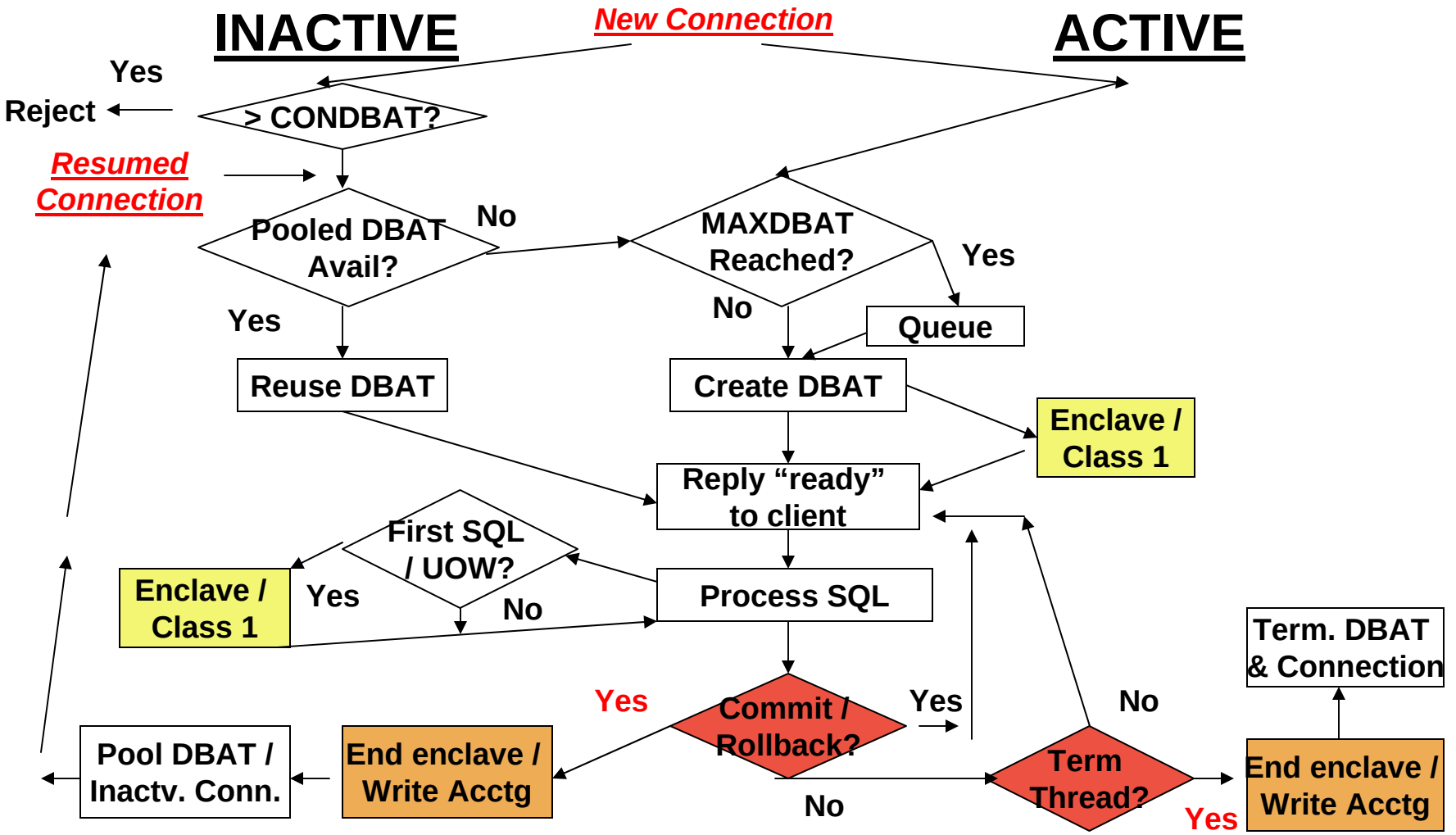
Where are your DBAT Threads Coming From?

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

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
    - Reduced Resource usage
  - ACTIVE
    - DBAT created for each new client application
    - DBAT held through commits
    - Use this only if the applications require it

Processing Diagram



WLM Enclaves

- WLM Enclaves are independent, dispatchable units-of-work that span multiple address spaces and can include combinations of SRBs and TCBs
- DB2 use enclaves for work coming into the system through DDF
  - Controlled by WLM
  - Can run on zIIP processors
- 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)

```
Subsystem Type . : DDF          Fold qualifier names?   Y  (Y or N)
Description  . . . DB2 DDF

Action codes:   A=After      C=Copy        M=Move      I=Insert rule
                B=Before     D=Delete row  R=Repeat    IS=Insert Sub-rule
                                                          More ===>
           --------Qualifier--------                -------Class--------
Action     Type        Name      Start                Service     Report
                                                DEFAULTS: DDF         ________
 ____   1  UI          DB*       ___                  DDF         ________
 ____   1  SSC         DIA       ___                  DDF         ________
 ____   1  PN          CWRPLAN   ___                  DDF         ________
 ____   1  CN          CWR*      ___                  DDF         ________
```

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

DBAT Thread identifiers - Basic

- Connection Type ** WLM CT **
  - 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” Information

- 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 **

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 KEEPDYNAMIC(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

Conversation Processing

- 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)

```
>W1 =THDDBAT==========(DBGK=====*=======)01MAR2007==13:24:15====MVDB2====U====6
CMD Correlation  DB2  Package   Elapsed                DDF Msgs DDF Msgs  Total
--- Id           ID   Name       Time       CPU Time    Sent    Received    SQL
    db2bp.exe    DB2K          00:00:00.00 00:00:00.00        0        0      0
    javaw.exe    DB2K SYSSH200 00:08:32.48 00:00:00.01        1        1    214
    db2bp.exe    DB2K          00:00:00.00 00:00:00.00        0        0      0
    db2bp.exe    DB1K          00:01:08.62 00:00:00.00        2        2      0
    javaw.exe    DB1K SYSSH200 00:01:07.22 00:00:00.00        3        3    123
    db2bp.exe    DB1K SQLC2F0A 00:04:02.51 00:00:06.59        5        5      3
```

Customize with workstation IDs, other values as needed
Scroll right to see more fields

```
+W1 =THDDBAT==========(DBGK=====*=======)01MAR2007==13:24:15====MVDB2====U====6
CMD Correlation  Workstation        Remote          Enclave
--- Id           Name               Location         Token           Auth ID
    db2bp.exe    JBARTHEL-HOU-98    172.18.60.221   0000000000000000 DMRQA01
    javaw.exe    JBARTHEL-HOU-98    172.18.60.221   0000002400000007 DMRQA01
    db2bp.exe    JBARTHEL-HOU-98    172.18.60.221   0000000000000000 DMRQA01
    db2bp.exe    JBARTHEL-HOU-00    172.18.61.200   0000000000000000 DMRQA02
    javaw.exe    JBARTHEL-HOU-00    172.18.61.200   0000002C0000000B DMRQA02
    db2bp.exe    dwitkows-SJC-04    172.23.59.211   0000002800000009 BOLDJW1
```

Hyperlink

Enclave views (MVzOS)

```
>W1 =WMENCLVZ==========SYSBDEMO=*========05APR2007==14:18:45====MVMVS====D====1
 Enclave Token     Service  Owner    Cumulative Exectn  Total  Total  %Idle    %
 ----------------- Class    Jobname    CPU Time Velcty   Dly%   Use% ------ Unkr
 0000002400000087 DDF      DHN1DIST 00:00:22.1  30.00  70.00  30.00
```

```
>W1 =WMENCLAS=WMJINFO==SYSBDEMO=*========05APR2007==14:19:31====MVMVS====D====1
   Timeframe... Interval                                              0....50..10
   Jobname.....  ENCLAVE Sysplex Name INTLPLEX Total Use%..  25.00
   Type........  ENCLAVE System Name.     SYSB %Use CPU....  25.00
   Serv. Class.      DDF SMF I.D.....     SYSB %Use DASD...   0.00
   Rept. Class.          Enclave Cnt.        0 Total Dly...  75.00
   ASID........        0 Velocity....    25.00 %Dly CPU....  75.00
   Dmn.........        0 Velocity 2..    25.00 %Dly DASD...   0.00
   Period No...        2 Using Sampls        3 %Dly Stor...   0.00
   Workload....      DDF Delay Samples       9 %Dly Srvr...   0.00
   Resource....          MPL Delays..        0 %Dly MPL....   0.00
   Trxn RPGN...        0 Swpin Delays        0 %Dly Swapin.   0.00
   Userid RPGN.        0 Idle Samples        0 %Dly Quiesce   0.00
   TrxC RPGN...        0 Unk. Delays.        0     %Idle...   0.00
   Acct RPGN...        0 Sample Count       12 %Dly Unknown   0.00
   Status......   Active Us/Del Count       12
```

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

```
>W1 =THDINACT=========(DBGK=====*=======)01MAR2007==13:22:53====MVDB2====D====2
 Connect  Current       Correlation           Plan          LUW      Workstatio
 Name        Activity   Id           Auth ID  Name     ASID  Token   Name
 SERVER   Inactive DBAT db2bp.exe    DMRQA01  DISTSERV  273     3467 JBARTHEL-H
 SERVER   Inactive DBAT db2bp.exe    DMRQA01  DISTSERV  273     3493 JBARTHEL-H
```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Connection / Conversation Views

```
>W1 =DDFLOC===========DEDM=====*========02MAR2007==12:09:43====MVDB2====U====4
 DB2                                          Product  Tot  Req  Serv Inact Tot
 Target   Remote Location   Link Name         ID       Conn Conn Conn  Conn Cnv
 DEDM     ::172.17.8.86                          1    0    1     0    1
 DEDM     ::172.21.22.183                        4    0    4     1    4
 DEDM     DECE             ::172.17.8.86    DSN08015    2    2    0     0    2
 DEDM     DHH              LUDHH2           DSN08015    2    2    0     0    2
```

Hyperlink on “Tot Conn” to see details

```
>W1 =DDFLOC===DDFTHD===DEDM=====*========02MAR2007==12:14:17====MVDB2====U====4
 DB2      Age         Cnv Workst          Correlation  Latest                Wor
 Target   Typ Status Cnt User ID          ID           Send/Receive Time     Nam
 DEDM     R/S Active   2 boljxo1         db2bp.exe    2007.061 11:14:30.89 joo
 DEDM     R/S Active   2 boljxo1         db2bp.exe    2007.061 11:13:48.06 joo
 DEDM     Srv Active   1 boljxo          db2bp.exe    2007.061 11:12:53.16 joo
 DEDM     Srv Idle     1 boljxo          db2bp.exe    2007.061 11:11:46.91 joo
```

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

```
BMC SOFTWARE -------------  SUMMARY TRACE ENTRY    -------------  RX AVAILABLE
SERV ==> STRAC            INPUT   14:37:25  INTVL=> 3  LOG=> N  TGT==> DECE
PARM ==> DIST,SEQ=1                                 ROW 1 OF 135 SCROLL=> CSR
EXPAND:  MON(WKLD), DETAIL, HISTORY
        ACCOUNTING: ENV, ELAPSED, SQLCOUNTS, BPOOL, LOCKS, PRLL, PKG, RTW, DDF
        SUMMARIES:  SQL, SCANS, IO/LOCK, SORTS
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    IN DB2      IN APPL.       TOTAL       %IN DB2(=)      TOTAL(*)
----------------    --------    --------    --------      0 ...25...50...75..100%
ELAPSED TIME           46 ms       269 ms      315 ms      |==******************  |
CPU TIME            1,437 us       626 us    2,064 us      |<                    |
DB2 WAIT TIME         -none-                                |                     |
ZIIP CPU TIME       1,575 us                 2,223 us      |<                    |
ZIIP-ELIGIBLE CP                                 0 us
- - - - - - ACTIVITY - - - - - -        - - - - - KEY INDICATORS  - - - - - - -
TOTAL SQL.......................6      SQL: SELECT=      0, FETCH=      2
GETPAGES........................4      SQL: DYNAMIC(PREPARE)=      2
SYNC READS (PRLL=00) ...........0      DDF/RRSAF ROLL UP RECORD, COUNT=      2
```

```
- - - - - - - - - - - - - - - ENVIRONMENTAL INDICATORS  - - - - - - - - - - - - - - -
LUWID.........AC173BD3.B912.0703012146160003
RLF TABLE ID..NOT ACTIVE
          - - - - - - - - - -Work Station Data- - - - - - - - - -
  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.)

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 (combined)
    - Private Protocol locations (separate)
- DDF Address Space CPU usage
  - TCB and SRB

Global DDF Statistics - STDISTD

```
W1 =STDISTD==========DECE=====*========01MAR2007==13:33:48====MVDB2
DBAT Statistics Detail.....................

                                                 Interval    Session

Maximums Reached..............................
 New DBATs Queued (MAXDBAT)..................            0          5
 Conversations Deallocated (CONDBAT).........            0          0
 New/Resumed (Type 2) DBATs Queued (MAXDBAT)             1         40
 Connections Terminated (MAXTYPE1)...........            0          0

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          0
  Warm Start Connections......................            0          0
  Resync Attempts.............................            0          0
  Resync Succeeds.............................            0          0

Statistics....................................
Requests that Required a DBAT.................                       4
Requests that Used a Pool Thread..............                      72
```

STDISTD View - Revised

```
W1 =STDISTD==========DECE=====*========01MAR2007==13:36:33====MVDB2==
DDF Global Statistics Detail.....................
  . DDF ZPARMs.....................................
Status - Current and High Water Mark.............  Current        HWM
 Total DBATs - Active & Pooled...................        3          3
 DBATs Pooled for Reuse (Type 2).................        0          1
 Inactive DBATs (Type 1).........................        0          1

 Total Remote Connections........................                  10
 Type 2 Inactive Connections.....................        6          6
 Type 2 Connections Queued for DBAT..............        3          4

Maximums Reached................................. Interval    Session
 Queued for DBAT (MAXDBAT Reached)...............        1          6
 Connections Deallocated (CONDBAT Reached).......        0          0
 Type 1 Connections Terminated (MAXTYPE1 Reached)        0          0

DBAT Usage Statistics............................ Interval    Session
 New DBATs Created...............................       4          4
 Pooled DBATs Reused.............................      72         72
 New/Resumed (Type 2) Requests...................       2         41

Two-Phase Commit Activity........................ Interval    Session
  Cold Start Connections.........................        0          0
  Warm Start Connections.........................        0          0
  Resync Attempts................................        0          0
  Resync Succeeds................................        0          0
  Resync Failures................................        0          0
```

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 ZPARM View

```
W1 =ZPDDFD============DECE=====*========27FEB2007==19:23:12====MVDB2==
                                                                . PREV
   DDF - Dist Data Facility Definitions.....                    . STATS
    Local Location.....                                          DECE
    DDF Startup Facility Name.....                               DDF
    DDF Start Option.....(DDF).....                              AUTO
    Database Protocol for 3-Part Names.....(DBPROTCL)..          DRDA
    DDF Max Number of Facility Entries.....                      1
    DBAT Status after Commit.....(CMTSTAT)...                    INACTIVE
    Idle Thread Timeout (Seconds).....(IDTHTOIN)..               1200
    Minutes between Resync Periods.....(RESYNC)....              2
    TCP/IP KEEPALIVE.....(TCPKPALV)..                            ENABLE
    DDF Interval Cycle Frequency.....(SPRMINT)...                120
    DDF Queued Conversation Time.....(SPRMQCT)...                120
    DDF Receive Buffer Size.....(SPRMDRB)...                     30720
    Max Extra DRDA Query Blocks for DB2 Req....(EXTRAREQ)..      100
    Max Extra DRDA Query Blocks for DB2 Svr....(EXTRASRV)..      100
    Check Connection State.....(PKGLDTOL)..                      n/a
   DBAT Thread Controls.....                                    . STATS
    Max Concurrent Database Access Threads.....(CONDBAT)...      10000
    Maximum Remote Database Access Threads.....(MAXDBAT)...      3
    Maximum Type 1 Inactive Threads.....(MAXTYPE1)..             10
    DDF Pool Thread Timeout Value.....(POOLINAC)..               1200
   DDF-Related Authorization.....
    Extended Security.....(EXTSEC)....                           N
    ID Sent to Second Server.....(HOPAUTH)...                    BOTH
    Accept Already Verified TCP/IP Connects....(TCPALVER)..      Y
    DDF RLF Access Error Parameter.....(RLFERRD)...              NOLIMIT
    DDF RLF Service Unit Limit.....(RLFERRD)...                  0
                                                                . NEXT
```

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

```
W1 =DB2STORD==========DECE=====*========27FEB2007==19:25:03
DBM1 And MVS Storage Usage.............. Quantity in MB

DBM1 Storage Summary Below 2 GB.........
 Storage Available to DBM1..............      1515.32
 Total DBM1 Storage In Use (1)..........        58.27
 Total MVS Storage In Use Below 2GB (5)..      106.67
 Storage Cushion (4)....................      118.61
 Average Thread Footprint...............        0.84
 Maximum Number of Possible Threads.....        1611

1) Total DBM1 Storage In Use............        58.27
 Total Getmained Storage (2)............        32.68
 Total Variable Storage (3).............        17.70
 Total Fixed Storage....................         0.11
 Total Getmained Stack Storage..........         7.78

3) Total Variable Storage...............        17.70
 Total Agent Local Storage..............        15.19
   Total Agent System Storage...........        14.12
     Number of PreFetch Engines.........          135
     Number of Deferred Write Engines...           15
     Number of Castout Engines..........            0
     Number of GBP Write Engines........            0
     Number of P-Lock/Notify Exit engines           0
   Total Agent Non-System Storage.......         1.07
    Total Number Of Active User Threads..           1
    Total Number of Active DBATs........            1
    Thread High Water Mark..............            9
    DBAT High Water Mark................            3
```

Dynamic Cache – STCACHED View

```
W1 =STCACHED==========DECE=====*========27FEB2007==19:31:43
Dynamic SQL Cache Details.............

. SQL Cache Statement Analysis.......
```

SQL Cache in Statement Pool.....		
Total Pages.....		25600
Pages Used.....	0.07	17
Free Pages.....	99.93	25583

Global Cache Usage.....	Interval	Session
Requests.....	0	8
Inserts.....	0	6
Found in Cache(Short Prepare).....	0	2.0
Not Found in Cache(Long Prepare).....	0	6
Global Cache Hit Ratio.....	0.0	25.0
Failures - Data Space Full.....	n/a	n/a
Failures - Statement Pool Full.....	0	0

Local Cache Effectiveness.....	Interval	Session
Avoided PREPARE (Match).....	0	0
Implicit PREPARE (No Match).....	0	0
Local Cache Hit Ratio.....	0.0	0.0
Statement Discarded (>MAXKEEPD).....	0	0
Statement Purged (Drop/Alter/Revoke)	0	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?

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