Agenda

- Workload Manager (WLM) Overview
- How WLM affects DB2
  - Defining DB2 Address Spaces to WLM
  - WLM: [Four] Types of DB2 work
    - Local Attach
    - DDF and Enclaves
      - What is an enclave?
      - Classifying DDF work
    - Sysplex Query Parallelism
    - Stored Procedures and Application Environments
      - External stored procedures in WLM managed address spaces
      - DB2 9 for z/OS and native SQL procedures
  - Other WLM interaction with DB2
    - Autonomic DB2 buffer pool sizing
    - Sysplex Workload Balancing
WLM is the priority and resource manager for z/OS and, therefore, for DB2 on z/OS
DB2 and Workload Manager

• WLM manages DB2 address spaces
  o DB2 subsystem address spaces: MSTR, DBM1, IRLM, DIST
  o DB2 stored procedure address spaces for external stored procedures
  o How WLM manages these address spaces can affect DB2 application performance

• WLM manages DB2 workflow
  o Priority and performance of allied tasks that call DB2
    • CICS, IMS, batch, TSO, WebSphere, MQSeries
  o DB2 distributed and stored procedure workload

• DB2 professional should have a basic understanding of WLM
Service Definition

Address Spaces

Service Definition

Service Policy 1
Service Policy 2
Service Policy 3

Classification Rules

Workload A
Service Class 1
Service Class 2
Report Class a

Workload B
Service Class 4
Service Class 3
Report Class b

Workload C
Service Class 5
Service Class 6
Report Class c

Workload x
Service Class x1

Only 1 Service Policy can be active at any time
WLM Terminology

- A Service Definition
  - Consists of one or more Service Policies

- A Service Policy
  - Contains several Workloads
  - One Service Policy is active at a time in an LPAR or Parallel Sysplex

- Each Workload (arbitrary collection)
  - Consists of one or more Service Classes

- Each Service Class
  - Has at least one Period and each Period has one Goal
  - If more than one period, all but last have a Duration

- A Goal may be one of five types:
  - System, Average Response Time, % Response Time, Execution Velocity, Discretionary

- Address spaces and transactions are assigned to service classes by Classification Rules
WLM Concepts – Service Class and Classification

• Classification
  o Assignment of incoming work to a service class, and optional report class
  o Based on a wide variety of filters, or qualifiers

• Service Class
  o Set or group of related work
    • Production CICS, IMS, and DB2 address spaces might be in same service class: STCHI or PRODHI
    • Separate Report Classes can report on CICS, IMS, DB2
  o A service class can combine goals of different types in multiple periods
    • A Period is the combination of Importance (IMP), Goal and Duration
    • A service class period is the target of WLM measurement and management actions
WLM Classification Rules

- WLM assigns work to a service class based on qualifiers that apply to the subsystem from which the work arrived

Subsystems:
- CICS
- IMS
- TSO
- JES
- DB2
- STC
- CB
- ASCH
- IWEB
- OMVS
- LSFM
- DDF
- MQ

Arriving Work

Qualifiers:
- accounting info
- collection name
- connection type
- correlation info
- LU name
- netid
- package name
- old PGN
- plan name
- priority
- procedure name
- subsystem instance
- subsystem parameter
- transaction class
- transaction name
- userid

Service goals

Service Class
- CPU
- Storage
- Tasks
- I/O

Report Class
Subsystems Types Used for Classification

- Subsystems follow one of three transaction type models
- Need to understand how this affects the value of figures shown in workload activity report
  * SYSH is used for LPAR load balancing

<table>
<thead>
<tr>
<th>Transaction Type</th>
<th>Allowable Goal Types</th>
<th>Allowable # of Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address space oriented</td>
<td>Response Time Execution Velocity Discretionary</td>
<td>Multiple</td>
</tr>
<tr>
<td>Enclave</td>
<td>Response Time Execution Velocity Discretionary</td>
<td>Multiple</td>
</tr>
<tr>
<td>CICS/IMS</td>
<td>Response Time</td>
<td>1</td>
</tr>
</tbody>
</table>

Subsystems follow one of three transaction type models:
- Address space oriented
- Enclave
- CICS/IMS

Need to understand how this affects the value of figures shown in workload activity report.

* SYSH is used for LPAR load balancing.
WLM Concepts – Importance

• For most work, importance 1 (IMP 1) is highest and importance 5 (IMP 5) is lowest.

• WLM applies resources to IMP 1 first.

• If IMP 1 work meets its goals, then WLM will apply resources to IMP 2 work, then IMP 3, etc.

• Some service trickles down to DISCRETIONARY

• SYSTEM and SYSSTC are internal service classes for system tasks and have the highest dispatching priorities

• SYSOTHER is the default service class for unclassified work and runs at a DISCRETIONARY goal

• Note: Not all work is “most important”
WLM Concepts – Goal Types

- **System** goals
  - SYSTEM and SYSSTC service classes have fixed dispatching priorities above IMP 1

- Response time goals
  - **Average response time**, including queue time and execution time
  - **Percentile response time**, reduces impact of outliers
    - E.g. 90% of transactions complete within 0.7 seconds

- **Execution Velocity** goals, or ‘velocity goals’
  - Velocity goals are intended for work for which response time goals are not appropriate, such as address spaces or long running jobs
  - How fast work should run relative to other work requests when ready, without being delayed for CPU, storage, or I/O
  - Expressed as a number, e.g. 60 or 40
    - Value of 60 means ‘ready’ work runs 60% of the time
  - Differentiate velocity goals within an importance level by 10
  - Appropriate velocity goal depends on number of engines (CPs)

- **Discretionary** – appropriate for low priority, long-running work
WLM Concepts and DB2

• Importance
  o Production DB2 address spaces (MSTR, DBM1, DIST, WLM) should be defined with Importance 1 (IMP 1)
  o Non-production DB2 address spaces in a production LPAR should be defined with lower importance: IMP > 1.
    • Consider relative to other production work
  o Production DDF transactions should generally be defined with IMP below that of production DB2 address spaces
  o IRLMs should be defined in SYSSTC

• Goals for DB2 work
  o **System** - IRLM in SYSSTC
  o **Velocity** goals are appropriate for started tasks or long-running work
    • DB2 address spaces should have velocity goals and only a single period in the service class (MSTR, DBM1, DIST, WLMx)
  o Response time goals are appropriate for transactions, including most DDF work
    • **Percentile response time** – e.g. 90% complete in 0.5 seconds
    • **Average response time** – e.g. average response time is 0.5 seconds
  o **Discretionary**: below IMP 5. Not appropriate for DB2 work
WLM Importance Levels and DB2, an example

- Importance 1 is highest priority after SYSSTC
- DB2 address spaces should have velocity goals and a single period defined
- Non-production DB2s could be IMP 2 or IMP 3 or IMP 4 if in same LPAR (or Parallel Sysplex) with production DB2
- Discretionary work gets service after all other importance levels
  - Not appropriate for DB2 address spaces
  - Not recommended for DB2 work
  - Very little service if CPU 100% busy
Service Class: Assigning Types of Goals - example only

**CICS, IMS or TSO transactions**

E.g. average response time goal
Transactions complete < 0.7 seconds

**Production DDF Transactions**

Percentile response time goal, single period
IMP 2; 90% complete < 0.5 seconds

**Non-production DDF**: response time goals in first period, response time or velocity in second period

- Period 1: IMP 3, 90% complete < 0.5 seconds
- Period 2: IMP 4, 90% complete < 4 seconds
- Period 3: IMP 5, Vel = 40

**DB2 Address Spaces**

Velocity goal; IMP 1
Exec Vel = 70
Single period
Service Class: Period Switch – example

- All transactions assigned to this service class start in Period 1
  - WLM manages the transactions in period 1 to the percentile response time goal of 90% completing in half a second, with an importance of 3
- Transactions that accumulate 300 service units (DUR = 300) before completing migrate to Period 2 (a new service class period)
  - WLM manages the transactions in period 2 to the goal of 90% completing in 4 seconds, with an importance of 4. [That is, 90% of those that did not complete in period 1.]
- Transactions that accumulate 900 service units (DUR 300 + DUR 600) before completing migrate to Period 3 (a new service class period).
  - WLM manages the transactions in period 3 to a velocity goal of 40, with an importance of 5.

- “Service units” is a hardware independent measure of CPU consumption. If your transaction consumes 1000 service units on a z9, it should consume 1000 service units on a z196
Service Class Example

- Several goal types defined into periods

```
Service-Class Notes Options Help

--- Period --- -------------------------- Goal --------------------------
Action  #  Duration  Imp.  Description
---  ---  ----  ---  -------------------------------
   ---  300   3  90% complete within 00:00:00.500
   2  600   4  90% complete within 00:00:04.000
   3  ______  5  Execution velocity of 40
```
WLM Managed Delays

- WLM can only affect work by adjusting these resources:
  - Processor (dispatching priority)
  - Non-paging DASD I/O (IOSQ, subchannel pending, control unit queue)
  - Storage (paging, swapping)
  - Tasks (multi-programming level, server address space creation, batch initiation)
    - Example: WLM managed stored procedure address spaces
- WLM cannot manage, for example:
  - User delay (coffee breaks)
  - Network delay
WLM Concepts: Performance Index (PI)

- Service Class periods are compared by calculating a Performance Index (PI) for each
- PI gives WLM a common way to track how well the work is doing regardless of goal type
- Importance parameter
  - Defined as part of the Service Class - 1 (high) to 5 (low)
  - Assigned to a Service Class Period
  - A way to prioritize critical goals
  - For work at the same importance level, WLM attempts to equalize the PIs

<table>
<thead>
<tr>
<th>The PI equals 1</th>
<th>=&gt; The work in the period is meeting its goal exactly</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PI is less than 1</td>
<td>=&gt; The work is doing better than its goal</td>
</tr>
<tr>
<td>The PI is more than 1</td>
<td>=&gt; The work is missing its goal</td>
</tr>
</tbody>
</table>
RMF Workload Activity Report

- Achieving the goal
  - Percentile response time: 80% in 1 second

- PI = 0.5
RMF Workload Activity Report

- Response time distribution
  - Goal is sixth ‘bucket’

<table>
<thead>
<tr>
<th>HH.MM.SS.TTT</th>
<th>CUM TOTAL</th>
<th>IN BUCKET</th>
<th>CUM TOTAL</th>
<th>IN BUCKET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&lt;= 00.00.00.500</td>
<td>296</td>
<td>296</td>
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<tr>
<td>&lt;= 00.00.00.600</td>
<td>299</td>
<td>3</td>
<td>94.6</td>
<td>0.9</td>
</tr>
<tr>
<td>&lt;= 00.00.00.700</td>
<td>300</td>
<td>1</td>
<td>94.9</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;= 00.00.00.800</td>
<td>301</td>
<td>1</td>
<td>95.3</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;= 00.00.00.900</td>
<td>303</td>
<td>2</td>
<td>95.9</td>
<td>0.6</td>
</tr>
<tr>
<td>&lt;= 00.00.01.000</td>
<td>305</td>
<td>2</td>
<td>96.5</td>
<td>0.6</td>
</tr>
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<td>96.8</td>
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</tr>
<tr>
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<td>1</td>
<td>97.2</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;= 00.00.01.300</td>
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<td>0</td>
<td>97.2</td>
<td>0.0</td>
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<tr>
<td>&lt;= 00.00.01.400</td>
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<td>1</td>
<td>97.5</td>
<td>0.3</td>
</tr>
<tr>
<td>&lt;= 00.00.01.500</td>
<td>308</td>
<td>0</td>
<td>97.5</td>
<td>0.0</td>
</tr>
<tr>
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<td>&lt;= 00.00.04.000</td>
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<td>3</td>
<td>99.4</td>
<td>0.9</td>
</tr>
<tr>
<td>=&gt; 00.00.04.000</td>
<td>316</td>
<td>2</td>
<td>100</td>
<td>0.6</td>
</tr>
</tbody>
</table>

- Entries range from less than half of goal to greater than four times goal
RMF Workload Activity Report

- Missing the goal
  - Execution velocity: 60

- PI = 1.8
WLM Performance Heuristic Behavior

2. Compare reality with goal (as stated in WLM policy). Performance Index (PI) > 1 gets attention

1. Measure delays (again, again & again...)

3. Change priorities, based on delays (donor/receiver)

4. Wait 10 seconds for the effect

• Set accurate goals
  o Goals should correspond to how your business runs
  o Goals should be realistic
  o Loose goals (easily achieved) can cause poor performance because WLM sees the goals are met, so takes no action
WLM Service Class Periods

- WLM heuristic behavior is applied to service class periods
- WLM can effectively manage 25-30 **active** service class periods
  - If you have more than 30 active service class periods, WLM may not be able to adjust resources for all of them when the system is busy
  - It is when the system is busy that you want WLM to adjust resources to meet your business goals

- “Loose” goals are performance goals that are too easily achieved
  - Service class periods with loose goals are likely to have a PI < 1, so WLM will always perceive they are meeting their goals.
  - Service class periods with loose goals may have a PI < 0.7, in which case they may become a donor
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Defining DB2 Address Spaces to WLM

- DB2 address spaces are started tasks
  - To WLM, the DB2 address spaces have a subsystem type of “STC”
- IRLMs should be defined in service class SYSSTC
- Remaining DB2 address spaces should be assigned to a service class with a single period, a velocity goal and appropriate importance. For example,
  - Production: IMP 1
  - QA, Development and/or Test in same LPAR/Sysplex:
    - IMP > 1 (i.e. lower importance)
    - Adjust based on other production work, such as production batch
  - DB2 address spaces include ssnmMSTR, ssnmDBM1, ssnmDIST and ssnmWLMx for stored procedures
WLM: Four Types of DB2 Work

• 1: DB2 work that originates in another local subsystem:
  o Examples: CICS, IMS, TSO, WebSphere on z, MQ

• 2: DDF work requests
  o DDF requests use enclave SRBs

• 3: Sysplex Query Parallelism
  o Queries that DB2 creates by splitting a single, larger query and distributing it to other members of the data sharing group in a Parallel Sysplex® (PSX)

• 4: Stored Procedures
  o WLM managed stored procedures, which run in WLM Application Environments, are external stored procedures or DB2 V8 SQL Procedures
  o Native SQL Procedures in DB2 9 for z/OS
First Type - Local Attach

- DB2 SQL activity runs under dispatchable unit of invoker
  - IMS, CICS, TSO, Batch, etc.
  - Inherited classification class of invoker
  - Priority and management of home unit
  - Service attributed back to invoker
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Second Type - DDF and Enclave SRBs

**ssnmDIST (DDF)**

- Enclave SRB
- PC-call to DBM1

**DDF priority requests**

- DDF default requests

**DDF rules**
- Vel = 70
- Imp = 1
- RT = 90%, 0.5 sec, IMP 2
- non-swappable

**STC rules**
- STCHI
- Vel = 70
- Imp = 1

**DDFDEF**
- RT = 5s avg
- Imp = 3

**DDFPRI**
- RT = 90%, 0.5 sec, IMP 2

SMF 30: Common Address Space Work accounting
SMF 72: RMF Workload Activity and Storage Data

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What is an Enclave?

• A "business transaction" without address space boundaries
  o Two types: dependent and independent
  o System or sysplex scope
• Dependent enclaves
  o Logical extension of an existing address space transaction
  o Inherits service class from its owner's address space
• Independent enclave (e.g. DDF)
  o True SRM transaction
  o Separately classified and managed in service class
• Why do we need enclaves?
Why do we need enclaves?

• Prior to DB2 V4, all DDF work ran at the priority of the \textit{ssnmDIST} address space
  
  o No differentiation between high priority work and low priority work
  
  o Unconstrained DDF work could cause \textit{ssnmDIST} to monopolize CPU, affecting CICS, IMS, etc.
  
  o Reducing priority of \textit{ssnmDIST} only partially successful
    
    • Resolved issues for CICS, IMS, etc., but…
    
    • All DDF work affected, even high priority work

• In DB2 V4, introduction of enclave support
  
  o Manage DDF work separately from the \textit{ssnmDIST} address space
  
  o Differentiate between high priority and low priority DDF work
Enclave Characteristics

- Created by an address space (AS)
  - the “owner”; ssnmDIST for DBATs
- One AS can own many enclaves
- One enclave can include multiple dispatchable units (SRBs/tasks) executing concurrently in multiple address spaces (the "participants")
  - Enclave SRBs are preemptible, like tasks
  - All its dispatchable units are managed as a group
- Many enclaves can have dispatchable units running in one participant address space concurrently
- RMF produces separate Type72 SMF records for independent enclaves
  - Both Type72 and Type30 records produced for address spaces
Classifying DDF Work

• Define service classes and appropriate goals for DDF work
• DDF Classification Defaults
  o Defaults apply if you do not provide any classification rules for DDF work
  o Enclaves default to the SYSOTHER service class (i.e. discretionary goal) unless they can be assigned to a service class
• Managing DDF Work (Enclaves)
  o All goals are permitted
  o Transactions are subject to period switch
  o WLM manages an enclave with its own dispatching priority, etc.
  o Production DDF work:
    • Generally importance (IMP) below that of DB2 address spaces
    • Consider a single period goal
What is a DDF Transaction?

**Threads: ZPARM CMTSTAT = Inactive**

<table>
<thead>
<tr>
<th>DRDA unit-of-work 1</th>
<th>DRDA unit-of-work 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue time</td>
<td>Queue time</td>
</tr>
<tr>
<td>Execution time</td>
<td>Execution time</td>
</tr>
<tr>
<td>Idle</td>
<td>Idle</td>
</tr>
<tr>
<td>Active</td>
<td>Inactive</td>
</tr>
<tr>
<td>Enclave transaction managed by SRM</td>
<td>Enclave transaction managed by SRM</td>
</tr>
</tbody>
</table>

**Threads: ZPARM CMTSTAT = Active**

Database thread is active from creation until termination

Enclave transaction managed by SRM exhibits conversational behavior
What Goals Should I Use?

• **CMTSTAT=INACTIVE** **and** DBAT is pooled (Connection inactive)
  o DDF creates one enclave per active interval
  o Response times do not include user think time
  o Response time goals and multiple periods can be used
    • But multiple periods with different importance can lead to issues with locks and latches

• **CMTSTAT=ACTIVE**
  o DDF creates one enclave for the life of the thread
  o Enclave response time includes user think time
  o Response time goals should not be used
  o Multiple periods should not be used
CMTSTAT = INACTIVE

• What if the DBAT cannot be pooled at COMMIT?
  o If only reason is KEEPDYNAMIC = YES
    • Same as top of previous slide: one enclave per interval, response times do not include user think time, response time goals are appropriate
  o If because CURSOR WITH HOLD, DGTT or LOB LOCATOR:
    • Thread stays active after COMMIT
      – Subject to period switching
      – Subject to idle thread timeout (IDTHTION in DSNZPARM)
    • Percentile response time goals may be appropriate
  • What about DB2 10 for z/OS High Performance DBATs?
    o DBAT remains active after commit, but enclave deleted, accounting record cut, and idle thread timer reset
    o One enclave per interval, response time goals are appropriate
DDF Classification Rules, example

• Classification by Subsystem Instance (SI), Process Name (PC - application program), Accounting Information (AI), and Userid (UI)
# DDF Work Classification Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting Information</td>
<td>AI</td>
<td>Can be passed from a DB2 Client via Client Information APIs</td>
</tr>
<tr>
<td>Correlation Information</td>
<td>CI</td>
<td>DB2 Connect assigns application program name by default but application can set via Client Information APIs</td>
</tr>
<tr>
<td>Collection Name</td>
<td>CN</td>
<td>Collection name of the first SQL package accessed by the DRDA requester in the unit of work</td>
</tr>
<tr>
<td>Connection Type</td>
<td>CT</td>
<td>Always 'DIST ' for DDF server threads</td>
</tr>
<tr>
<td>Package Name</td>
<td>PK</td>
<td>Name of the first DB2 package accessed by the DRDA requester in the unit of work</td>
</tr>
<tr>
<td>Plan Name</td>
<td>PN</td>
<td>'DISTSERV' for DDF server threads accessed via DRDA requesters unless requester is another DB2 for z/OS, then requester’s PLAN name</td>
</tr>
<tr>
<td>Procedure Name</td>
<td>PR</td>
<td>Name of the procedure called as the first request in the unit of work</td>
</tr>
<tr>
<td>Process Name</td>
<td>PC</td>
<td>Client application name by default but can be set via Client Information APIs</td>
</tr>
<tr>
<td>Subsystem Collection Name</td>
<td>SSC</td>
<td>Usually the DB2 data sharing group name</td>
</tr>
<tr>
<td>Subsystem Instance</td>
<td>SI</td>
<td>DB2 server’s MVS subsystem name</td>
</tr>
<tr>
<td>Sysplex Name</td>
<td>PX</td>
<td>Name assigned to sysplex at IPL</td>
</tr>
<tr>
<td>Userid</td>
<td>UI</td>
<td>DDF server thread’s primary AUTHID</td>
</tr>
<tr>
<td>Subsystem Parameter</td>
<td>SPM</td>
<td>Beginning in V8: the concatenation of client userid and workstation</td>
</tr>
</tbody>
</table>

- Not very useful
- Widely used, some limitations
- Most granular control; See next page.
Workload Classification Attributes - Client

- ODBC/CLI/VB/ADO ... Applications
  - db2dsdriver.cfg file:
    - Accounting string (AI)
      - <parameter name="ClientAccountingString" value="accounting string"/>
    - Application name (PC)
      - <parameter name="ClientApplicationName" value="application name"/>
    - Client userid (for SPM)
      - <parameter name="ClientUserID" value="userid"/>
    - Client workstation (for SPM)
      - <parameter name="ClientWorkstationName" value="workstation name"/>
  - IBM Data Server Driver for JDBC and SQLJ (Type 2 or Type 4 connectivity)
    - java.sql.Connection.setClientInfo (JDBC 4.0)
      - ApplicationName (PC)
      - ClientAccountingInformation (AI)
      - ClientUser (client userid – for SPM)
      - ClientHostname (client workstation name – for SPM)
Workload Classification Attributes - Client

- ODBC/CLI/VB/ADO ... applications, alternative approach
  - Use SQLSetConnectAttr on:
    - SQL_ATTR_INFO_ACCTSTR - accounting string (AI)
    - SQL_ATTR_INFO_APPLNAME - application name (PC)
    - SQL_ATTR_INFO_USERID - client userid (for SPM)
    - SQL_ATTR_INFO_WRKSTNNAME - client workstation (for SPM)
- Non-ODBC... use sqleseti Administrative API function
“Third Type” – Sysplex Query Parallelism; WLM sees as “DB2”

Complex query originates here

Deprecated in DB2 11 for z/OS
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    - Sysplex Query Parallelism
    - Stored Procedures and Application Environments
      - External stored procedures in WLM managed address spaces
      - DB2 9 for z/OS and native SQL procedures
  - Other WLM interaction with DB2
    - Autonomic DB2 buffer pool sizing
    - Sysplex Workload Balancing
Last Type - DB2 External Stored Procedures

**Task**
- Listens for requests coming from outside of the system
- Creates independent enclave
- Schedules enclave SRB

**Enclave C**
- CALL SP1
- Result

**TCB**
- Enclave SRB

**KEY:**
- TCB
- Enclave SRB

**DB2DIST**
- DB2DBM1
- DB2WLM
- CHARLIE (TSO)

**Stored Procedures**
- execute as TCBs in WLM-managed address space(s)
- TCBs not zIIP-eligible
DB2 and WLM: External Stored Procedures

- Application Environments (AE) defined in WLM policy
  - Describes JCL for stored procedure address spaces
  - WLM starts an address space for each work queue, or unique combination of service class period and AE
    - If DDFPROD transaction issues CALL STPROC1, one address space
    - If DDFTEST transaction issues CALL STPROC1, different address space
  - Determines number of address spaces for a work queue: 1 or ANY
    - If ANY, WLM may start additional server address spaces
    - Depends on whether the service class period is meeting its PI
  - Cross memory from DBM1 to WLMx, plus schedule TCB
  - In data sharing, use symbolic &IWMSSNM in the AE definition.
    - This allows the stored procedure to be executed against any member
Native SQL Procedures (beginning with DB2 9 for z/OS)

The SQL procedure logic runs in the DBM1 address space Enclave SRB mode; DB2PWLMx not involved, no TCB schedule delay

Execution from remote thread eligible for zIIP at same percentage as DDF Enclave SRB
WLM Considerations – Example: Stored Procedures

• The original assumption
  o All work requests inserted by DB2 (example – Stored Procedures) were independent requests

• The reality
  o Procedures may recursively call other procedures
  o The processing may be inter-dependent

• The newer logic
  o DB2 tells WLM about dependent stored procedure requests
  o WLM gives dependent requests priority
    • WLM may make adjustments, if needed
WLM Considerations For Nested Stored Procedure Requests

- Triggers, Stored Procedures, and UDFs actions may be nested, sometimes multiple layers of nesting
- DB2 tells WLM about dependent stored procedure requests
  - WLM may give dependent requests priority, if needed
  - WLM may start server regions more aggressively, if needed
Agenda

- Workload Manager (WLM) Overview
- How WLM affects DB2
  - Defining DB2 Address Spaces to WLM
  - WLM: Four Types of DB2 work
    - Local Attach
    - DDF and Enclaves
      - What is an enclave?
      - Classifying DDF work
    - Sysplex Query Parallelism
    - Stored Procedures and Application Environments
      - External stored procedures in WLM managed address spaces
      - DB2 9 for z/OS and native SQL procedures
  - Other WLM interaction with DB2
    - Autonomic DB2 buffer pool sizing
    - Sysplex Workload Balancing
DB2 and zIIP Processors

- Work on z/OS may have all or a portion of its resource usage on an enclave SRB
  - Enclave SRB work may be directed to the zIIP
- Certain types of DB2 work may take advantage of zIIP, including
  - DRDA - Queries that access DB2 for z/OS via DRDA over TCP/IP
    - Complex parallel queries
    - DB2 utilities for index maintenance
      - LOAD, REORG, and REBUILD
        - DB2 10 for z/OS – Sequential prefetch eligible for zIIP processor
        - DB2 11 for z/OS – most of ssnmMSTR and ssnmDBM1
- WLM and new enclave structures to manage zIIP related workload – work dependent enclave
WLM Contention Management

• WLM Contention Management helps addressing chronic or long lasting contention situations
  o WLM provides interfaces to allow resource managers (for example – DB2) to signal contention situations
  o WLM has had the ability to promote (increase the DP) for a short duration to resolve the issue
• DB2 example scenario
  o Lock/latch contention in DB2 may impact performance
  o Often contention may be resolved with a short boost of resource
  o DB2 may notify WLM if a contention occurs
  o WLM may optionally raise the priority for the holder to complete the work
• WLM can promote units of work for longer periods of time, and promote them to the priority of the highest-priority units of work waiting for a resource they are holding.
• “Blocked Workload Support”
WLM Automatic Buffer Pool Size Adjustment

- PK75626 enables capability as well as the WLM delay monitoring support
- Requires z/OS 1.9 and above with WLM APARs OA18461 and OA32631 applied
- Triggered when buffer pool is defined or altered with AUTOSIZE(YES)
  - VPSIZE at the time of AUTOSIZE setting governs the possible size range for buffer pool
    - e.g. VPSIZE(10000) would allow WLM to adjust its size from 7500 to 12500
    - WLM will only request the alteration if new size within range (minimum size adjustment is 64)
    - WLM can decrease size when real storage demand affected
- Buffer pools adjusted based on WLM goal attainment of service classes that buffer pool size affects, e.g. lots of random I/O.
  - This is a WLM policy adjustment decision
DB2 and WLM: Sysplex Workload Balancing

- WLM monitors DB2 and LPAR: e.g. CPU, CSA, DB2’s PI
- DB2 builds weighted server list of members of the DB2 data sharing group
- On initial connection request to Group DVIPA:
  - Sysplex Distributor (SD) finds an available DB2 member
  - Client connects to that member
- That DB2 member sends weighted server list to client periodically
  - Subsequent connection requests use server list, not SD
  - If that member is stopped (or fails) client users server list to reroute and connect to available DB2 member
Resources

• Redbooks
  o *DB2 9 for z/OS: Distributed Functions*
    • SG24-6952-01
  o *System Programmer’s Guide to: Workload Manager*
    • SG24-6472
  o *DB2 10 for z/OS: Application Programming Guide and Reference for Java*
    • SC19-2970, or
    • http://www-01.ibm.com/support/knowledgecenter/search/java?scope=SSEPEK_10.0.0
  o *IBM Knowledge Center: DB2 for Linux, Unix and Windows*
    for db2dsdriver.cfg (9.7, 10.1 and 10.5)
    • http://www-01.ibm.com/support/knowledgecenter/search/db2dsdriver.cfg?scope=SSEPOLUTION&scope=SSEPOLUTION_10.0.0&scope=SSEPOLUTION_9.7.0
Questions

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  o Brad Snyder, IBM ATS
  o Kathy Walsh, IBM ATS
Top DB2 for z/OS Communities

- World of DB2 for z/OS  [http://db2forzos.ning.com/](http://db2forzos.ning.com/)

- DB2 10 LinkedIn  [http://linkd.in/IBMDB210](http://linkd.in/IBMDB210)

- DB2 for z/OS What’s On LinkedIn  [http://linkd.in/kd05LH](http://linkd.in/kd05LH)

- DB2 for z/OS YouTube  [http://www.youtube.com/user/IBMDB2forzOS](http://www.youtube.com/user/IBMDB2forzOS)

- WW IDUG LinkedIn Group  [http://linkd.in/IDUGLinkedIn](http://linkd.in/IDUGLinkedIn)

- IDUG.ORG  [http://www.idug.org](http://www.idug.org)

- DB2 for z/OS Exchange Forum  [http://ibm.co/DB2zHotline](http://ibm.co/DB2zHotline)
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