WLM and Enclaves for DB Servers
DB2 and Oracle

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Thanks To:

- John Arwe
- Peter Yocom
- Gail Whistance

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Agenda

• What is an enclave?
• What problems are being solved?
  – DB2 distributed requests (DDF)
  – Oracle distributed requests (Oracle NET)
• Some Examples of Workload Classification
  – Oracle Apps Benchmark
    • Classify Oracle Net client work
• CPU Accounting considerations
  – Enclave CPU reporting

What is an enclave?

• A "business transaction" without address space boundaries
  – Two types
  – Exist in both goal and compatibility mode
• Independent enclave
  – True SRM transaction
  – Separately classified and managed in service class or performance group
• Dependent enclaves
  – Logical extension of an existing address space transaction
  – Inherits srvclass/pgn from its owner's address space
How do enclaves behave?

- Created by an address space (the "owner")
- One address space 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

Oracle Net and DDF

- Problems
  - No way to manage individual transactions. Everything runs with the address space controls of the ssnmDIST or NET address space controls
  - Heavy loads can prevent entry of new requests
- Solution
  - Make the transactions visible to SRM as independent enclaves
    - Individually classified, managed, and reported
    - Subject to period switch
  - Run existing work at a dprty lower than the network atsk that creates new work
**Independent Enclave Accounting**

- Each enclave represents an individual SRM transaction.
- Transaction counts and resource usage are recorded in the SMF 72 record for the enclave's service class and report class.
- No SMF 30 records or equivalent for enclaves themselves. Transaction counts and resource usage are recorded in the SMF 30 of the owning address space.
- CPU time consumed by enclaves is recorded in the SMF 89 records of home address space for usage-based pricing.

**Classifying Transactions**

- All independent enclaves are classified using the active MVS WLM policy in both compatibility and goal modes.
- In compat mode, the ICS can be used to map a service class to a performance group, and likewise for reporting.
- Can classify using new attributes for each subsystem.
- Defaults if you do not classify in WLM policy:
  - Goal mode: enclaves default to the SYSOTHER service class which has a discretionary goal.
  - Compat mode: any enclaves run in the pgn/rpgn of the owning address space as they did before.
Managing Independent Enclaves

- Transactions are subject to period switch
- Goal mode:
  - All goal types allowed
- Compat mode:
  - Performance group and report performance group can be assigned using SRVCLASS=xxx in the IEAICSxx parmlib member
  - Limit of one report performance group
  - Time slicing, domain is ignored

WLM Support in Oracle OSDI 8.1.7 Net

- Define Net Service
  - DEFINE SERVICE ORANETW TYPE(NET) PROC(ORANET) -
  - DESC(‘Oracle Network Supporting WLM’) -
  - SID(NETW) -
  - PARM(’HPNS PORT(1521) ENCLAVE(CALL)’)
- ENCLAVE(CALL)
  - new behaviour, dynamic enclaves
- ENCLAVE(SESS)
  - old behaviour, static enclaves (default)
WLM Support in Oracle ODI 8.1.7 Net

- **Enclave(Sess)**
  - Classification done once at Logon
  - Enclave deleted at Logoff
  - Entire session is a single WLM transaction
  - Only Velocity Goals are appropriate

- **Enclave(Call)**
  - Classification done every time a request arrives from client
  - Enclave deleted when NET has to wait for next request
  - Each client request is a separate WLM transaction
  - Response Time or Percentile Goals should be used

**NET Behaviour with Enclave(sess)**
**DDF Behaviour with Threads=Active**

<table>
<thead>
<tr>
<th>Client request 1</th>
<th>Client request 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclave Active</td>
<td>Idle</td>
</tr>
<tr>
<td></td>
<td>Active</td>
</tr>
<tr>
<td>Enclave exists from Logon until Logoff</td>
<td>State can be running, waiting for I/O, ...</td>
</tr>
</tbody>
</table>

Enclave transaction
Managed by SRM
Only Velocity Goals are appropriate
NET Behaviour with Enclave(call)

DDF Behaviour with Threads=Inactive

Client request 1

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclave Active</td>
</tr>
<tr>
<td>Enclave exists until end of this DB request</td>
</tr>
<tr>
<td>Enclave transaction</td>
</tr>
<tr>
<td>Managed by SRM</td>
</tr>
<tr>
<td>Response Goals are recommended</td>
</tr>
<tr>
<td>Response time reported by RMF</td>
</tr>
</tbody>
</table>

Client request 2

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Enclave Active</td>
</tr>
<tr>
<td>State can be running, waiting for I/O, …</td>
</tr>
<tr>
<td>Enclave transaction</td>
</tr>
<tr>
<td>Managed by SRM</td>
</tr>
</tbody>
</table>

What Goals Should I Use?

- THREADS=Inactive and RELEASE(Commit) for DDF
- ENCLAVE(Call) for Oracle Net
  - One enclave per active interval
  - Response times do not include think time
  - Response time goals and multiple periods can be used

- THREADS=Active or RELEASE(Deallocate) for DDF
- ENCLAVE(Sess) for Oracle Net
  - One enclave for the life of the thread/session
  - Enclave response time includes think time
  - Response time goals should not be used
  - Multiple periods should not be used
New Management Capabilities

- Recommend ENCLAVE(Call) or Threads=Inactive
- Establish Response Goal at high importance for first period
- Migrate to less importance for second period
- Third Period for very low importance
  - This allows you to maintain high response for trivial work
  - Treat heavier, less sociable work at an appropriate priority

CPU Service has Changed

- Philosophical refinement, compatible with the existing definition
- CPU time/service are no longer synonymous with "task time/service"
- CPU time/service now includes contributions from all preemptible dispatchable units: tasks, client SRBs, enclave SRBs
- SRB time/service is unchanged – local and global SRBs
SMF Type 30 Record

- No changes are required to existing accounting packages
- Existing CPU time and service fields include enclave contributions
- For all enclaves created by DDF or Oracle NET, new fields contain:
  - enclave active time
  - transaction count
  - CPU time and service
  - I/O times and I/O count

SMF Type 72 Record

- No changes are required to existing accounting packages
- Existing CPU service fields include enclave contributions
- Other existing fields include data from enclave transactions:
  - Active time
  - Response time
  - Transaction count
  - Number of address spaces (now: plus enclaves) sampled
  - I/O times and I/O count
- Resources consumed by the DDF or NET transactions are no longer reported with DDF or NET
Enclave System Effects

- (Lots) more transactions. Each DDF or NET transaction used to be part of the DDF or NET address space SRM transaction; now SRM sees each transaction.
- Increased active time since more transactions exist
- Large decrease in SRB time/service in SMF 30 record
- Corresponding increase in CPU time/service in the service classes/performance groups where enclaves are running
- MSO and I/O service is unchanged

Classification of Oracle NET Enclaves

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>OSDI subsystem name</td>
</tr>
<tr>
<td>UI</td>
<td>User ID from the client. For Oracle Applications this is the UID of the user running the application server on the middle-tier processor</td>
</tr>
</tbody>
</table>
| NET       | If SNA: client Network Name from VTAM  
|           | If TCP: First eight characters of dotted IP address. (ex.100.024.) |
| LU        | If SNA: The client LU name.  
|           | If TCP: Last eight characters of dotted IP address. Note that the IP address requires leading zeros to be specified. |
| CT        | Protocol from connect, TCP or LU6.2 |
| SPM       | Position 1 to 8. Oracle Service Name for this connection. The service name is defined in the parameters used to initialize the Oracle ODSI subsystem. |
| SPM       | Position 9 to 89. TCP/IP hostname (left justified) |
Classification of DDF Enclaves

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>Subsystem name of the DB2 Subsystem</td>
</tr>
<tr>
<td>UI</td>
<td>The DDF thread’s AUTHID</td>
</tr>
<tr>
<td>AI</td>
<td>Accounting Information for DB2 thread</td>
</tr>
<tr>
<td>LU/NET</td>
<td>The client LU name and NETid</td>
</tr>
<tr>
<td>CT</td>
<td>“DIST”</td>
</tr>
<tr>
<td>CI</td>
<td>DB2 Correlation ID of the DDF thread</td>
</tr>
<tr>
<td>CN</td>
<td>DB2 Collection Name</td>
</tr>
<tr>
<td>PK</td>
<td>DB2 Package Name</td>
</tr>
<tr>
<td>PN</td>
<td>DB2 Plan name</td>
</tr>
<tr>
<td>PR</td>
<td>Called procedure name if first statement is a CALL, else blank</td>
</tr>
</tbody>
</table>

Stored Procedures

- **DB2**
  - Procedures written in Cobol, Pl/I, C, …
  - Executed in Application Environment (APPLENV) defined in WLM
  - WLM manages queue
- **Oracle**
  - Procedures written in PL/SQL
  - Handled like any other SQL
    - No separate address space, same enclave as ordinary SQL requests
DB2 Stored Procedures

- Single reported transaction
- Multiple Dispatchable Units
- Mixture of TCB and SRB work
- No address space boundaries on transaction
- Single Goal and Management Actions

IBM @server. For the next generation of e-business.
Oracle Stored Procedures

Oracle Net A/S

Network Task

Enclave 1
SRB

Enclave 2
SRB

Ind. Enc 2

Ind. Enc 1

Net SMF 30 CPU

Net SMF 72 CPU time

Oracle Server A/S

PC to deliver SQL to server

Rows returned

Enclave SMF 72 CPU time

Oracle Data Base

Oracle Applications Benchmark

Oracle Application Server
Mid Tier#1 10.100.1.80

S/390 Database Server

Oracle Application Server
Mid Tier#3 10.100.3.81

Oracle Support Server
Mid Tier#2 10.100.2.82

Business Logic
- Stored Procedures
- Triggers

Communications
- TCP/IP
- Net

Concurrent Managers
Reports Engine
### Classification Rules for ORANET

<table>
<thead>
<tr>
<th>Subsystem-Type</th>
<th>Xref</th>
<th>Notes</th>
<th>Options</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fold qualifier names? Y (Y or N)

**Description:** ORACLE Subsystem

**Action codes:**
- A=After
- C=Copy
- M=Move
- I=Insert rule
- B=Before
- D=Delete row
- R=Repeat
- IS=Insert Sub-rule

**More ===>

<table>
<thead>
<tr>
<th>Action</th>
<th>Type</th>
<th>Name</th>
<th>Start</th>
<th>Service</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEFAULTS: ORACLES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SI</td>
<td>ORAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NET</td>
<td>010.100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>LU</td>
<td>001.080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>LU</td>
<td>002.082</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>LU</td>
<td>003.081</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

--- Period --- --------------- Goal ---------------------

<table>
<thead>
<tr>
<th>Action</th>
<th>#</th>
<th>Duration</th>
<th>Imp.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>50</td>
<td>1</td>
<td>Average response time of 00:00:00.015</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>500</td>
<td>3</td>
<td>Average response time of 00:00:00.500</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>Execution velocity of 10</td>
</tr>
</tbody>
</table>

--- Bottom of Data ---

### Service Class Goal for Important Work

<table>
<thead>
<tr>
<th>Service-Class</th>
<th>Xref</th>
<th>Notes</th>
<th>Options</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description:** Oracle Mid Tier #1

**Workload Name:** ORACLE (name or ?)

**Base Resource Group:** ORACLE (name or ?)

Specify BASE GOAL information. Action Codes: I=Insert new period, E=Edit period, D=Delete period.

--- Period --- --------------- Goal ---------------------

<table>
<thead>
<tr>
<th>Action</th>
<th>#</th>
<th>Duration</th>
<th>Imp.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>50</td>
<td>1</td>
<td>Average response time of 00:00:00.015</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>500</td>
<td>3</td>
<td>Average response time of 00:00:00.500</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>Execution velocity of 10</td>
</tr>
</tbody>
</table>

--- Bottom of Data ---
# Goal for Concurrent Manager Work

<table>
<thead>
<tr>
<th>Service-Class</th>
<th>Xref</th>
<th>Notes</th>
<th>Options</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modify a Service Class</td>
<td>Row 1 to 2 of 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Command ====>**

<table>
<thead>
<tr>
<th>Service Class Name</th>
<th>Description</th>
<th>Workload Name</th>
<th>Base Resource Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORAMT2</td>
<td>Oracle Mid Tier #2</td>
<td>ORACLE</td>
<td>(name or ?)</td>
</tr>
</tbody>
</table>

Specify BASE GOAL information. Action Codes: I=Insert new period, E=Edit period, D=Delete period.

<table>
<thead>
<tr>
<th>Action Code</th>
<th>#</th>
<th>Duration</th>
<th>Imp.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Discretionary</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---Period--- ---Goal---

**Effect of Enclaves**

- RMF III Enclave report only shows “active” enclaves
  - Many fewer in display
  - Use the RMFPP reports for the service class data

- RMF now has transaction rate, and related stats
  - “Transaction” is a network interaction with new code
  - Better definitions will come in later releases of Oracle
    - This code available today
  - With DDF transaction is DRDA request
RMF Monitor III Enclave Report

RMF 2.10.0 Enclave Report
Command ===> Scroll ===> CSR
Samples: 100 System: MVS4 Date: 02/20/02 Time: 17.18.20 Range: 100 Sec
Current options: Subsystem Type: ALL -- CPU Util --
Enclave Owner: Class/Group: 13.4 69.0
Enclave Attribute CLS/GRP P Goal % D X EAppl% TCPU USG DLY IDL
*SUMMARY ENC00001 ORAMT1 3 28.78 71.79 49 41 0.0

RMF Monitor III Sysplex Summary

2.10.0 Sysplex Summary - ORACLE
Command ===> Scroll ===> CSR
WLM Samples: 400 Systems: 2 Date: 02/20/02 Time: 16.41.40 Range: 100 Sec
Service Definition: ORACLE1 Installed at: 02/20/02, 15.55.26
Active Policy: POLORA1 Activated at: 02/20/02, 15.56.09
-------- Goals versus Actuals ------- Trans --Avg. Resp. Time--
Name  T  I  Goal Act  ---Goal--- --Actual-- Indx Rate Time Time
ORACLE W 23 1897 0.000 0.004 0.004
ORACLES S D 29 0.000 0.000 0.000 0.000
ORAMT S 15 1897 0.000 0.004 0.004
1 1 14 0.015 AVG 0.003 AVG 0.23 1895 0.000 0.003 0.003
2 3 64 0.050 AVG 0.025 AVG 0.50 1.390 0.000 0.025 0.025
3 D 33 .490 0.000 0.071 0.071
SYSTEM W 82 0.010 0.000 46.8M 46.8M
SYSTC S N/A 82 N/A 0.010 0.000 46.8M 46.8M
SYSTEM S N/A 91 N/A 0.000 0.000 0.000 0.000
Comments and Recommendations

• New code with old WLM policy will not hurt
  – Velocity still appropriate
• Old code with response time goals not appropriate
  – Enclave goes to last period shortly after Logon
• Must have subsystem OSDI or DDF defined, with a default service class specified
  – Mistake in classification rules will result in SYSOTHER being used, which has a discretionary goal. *Very Bad*
• Use ENCLAVE(CALL) in Oracle Net Service
• THREADS=INACTIVE in DDF
  – Establish a short 1st period importance 1 to maintain response for trivial requests
  – Lower importance for 2nd period
  – Importance 5 or discretionary 3rd period

Summary

• Enclave support in DDF and Oracle OSDI unique to zSeries
  – Consolidation of multiple smaller DB instances on single S/390 now possible
    • Either multiple or single instance of DB on MVS
  – Each client's transactions can be separately managed
    • The most important work gets the resources
    • Unsociable work can be segregated
  – Resource group can be used to guarantee minimum (or maximum) service
  – New response time and transaction rate recording in RMF
Thank you – Any Questions?

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