WLM and Enclaves for DB Servers DB2 and Oracle

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November 14, 2002
Toronto, Ontario

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

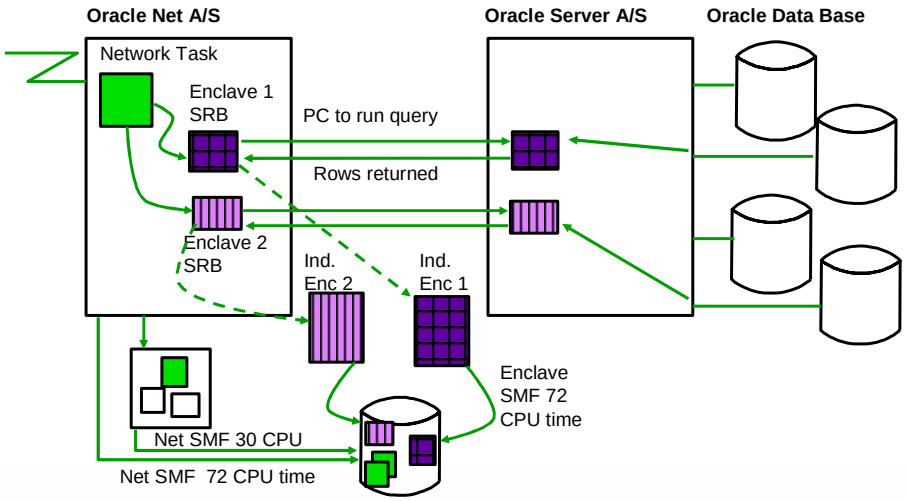
How do enclaves behave?

- 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

Oracle NET Structure



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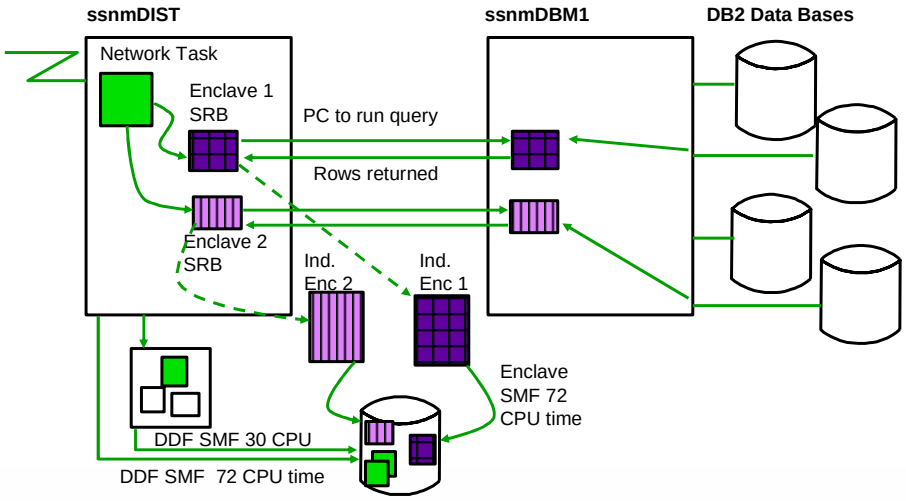
DDF Structure



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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 subssytem
- 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

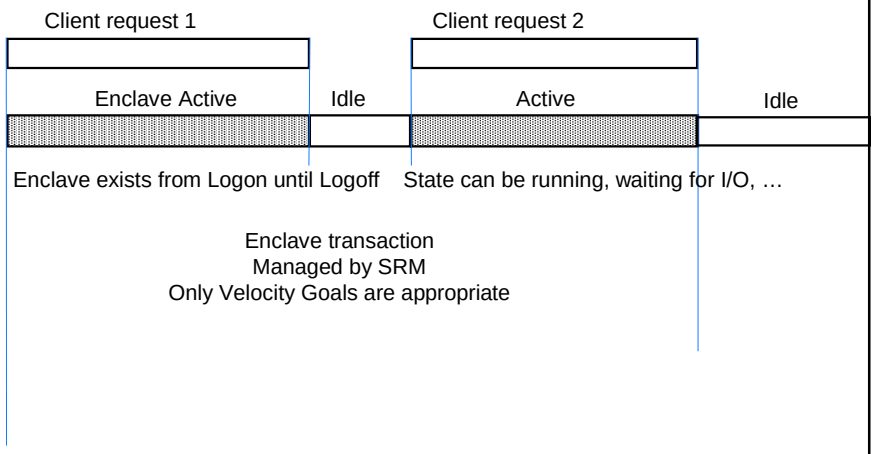
WLM Support in Oracle OSDI 8.1.7 Net

- 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)

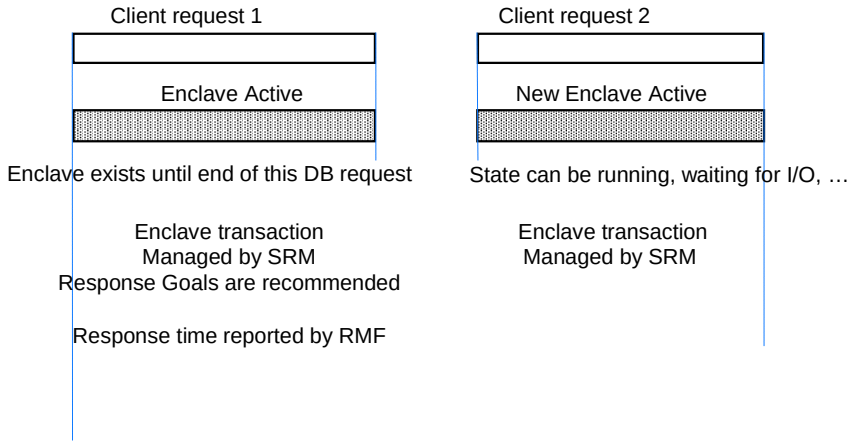
WLM Support in Oracle OSDI 8.1.7 Net

- 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



NET Behaviour with Enclave(call)
DDF Behaviour with Threads=Inactive



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 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

Attribute	Value
SI	OSDI subsystem name
UI	User ID from the client. For Oracle Applications this is the UID of the user running the application server on the middle-tier processor
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)

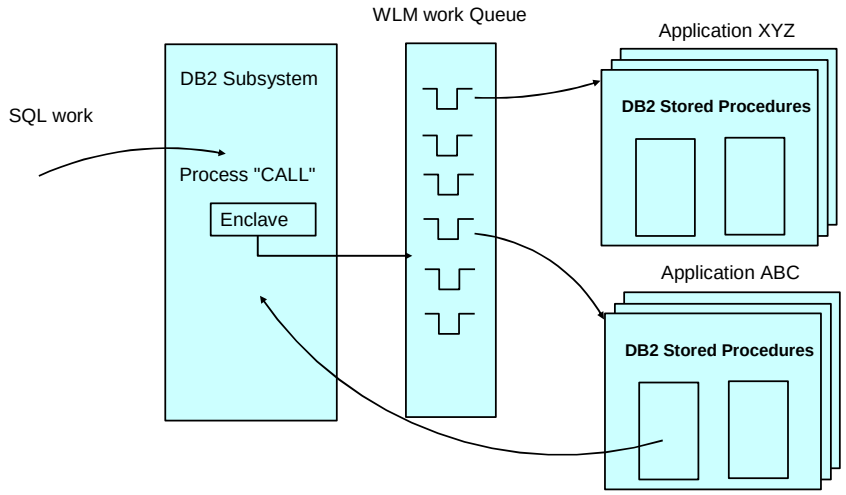
Classification of DDF Enclaves

Attribute	Value
SI	Subsystem name of the DB2 Subsystem
UI	The DDF thread's AUTHID
AI	Accounting Information for DB2 thread
LU/NET	The client LU name and NETid
CT	"DIST "
CI	DB2 Correlation ID of the DDF thread
CN	DB2 Collection Name
PK	DB2 Package Name
PN	DB2 Plan name
PR	Called procedure name if first statement is a CALL, else blank

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



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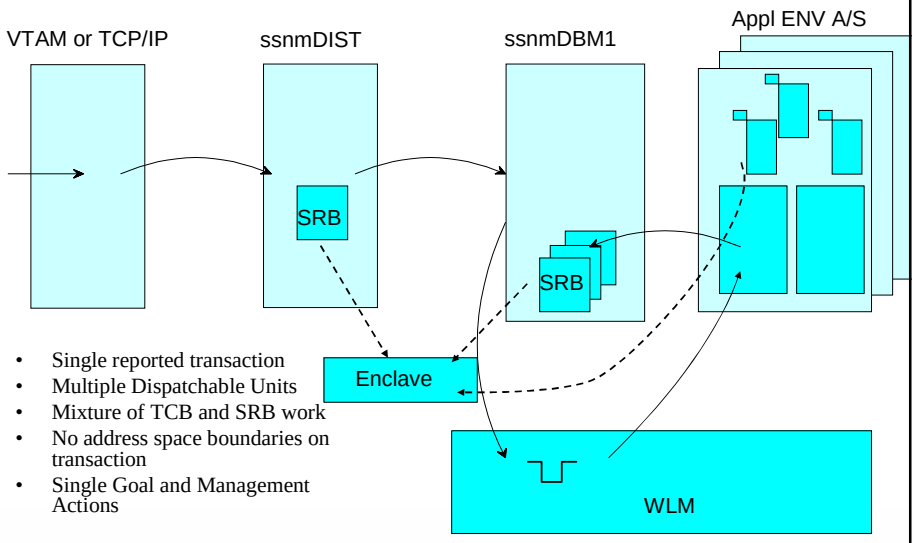
DB2 Stored Procedures …



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

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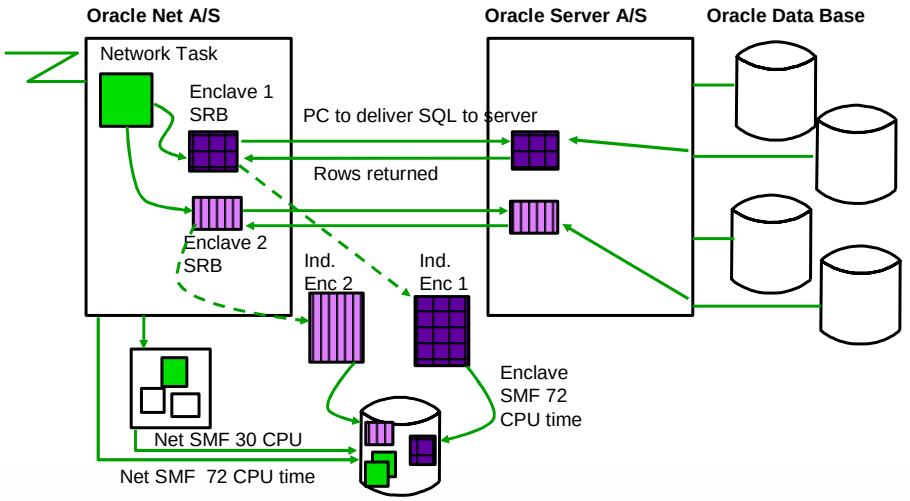
Oracle Stored Procedures



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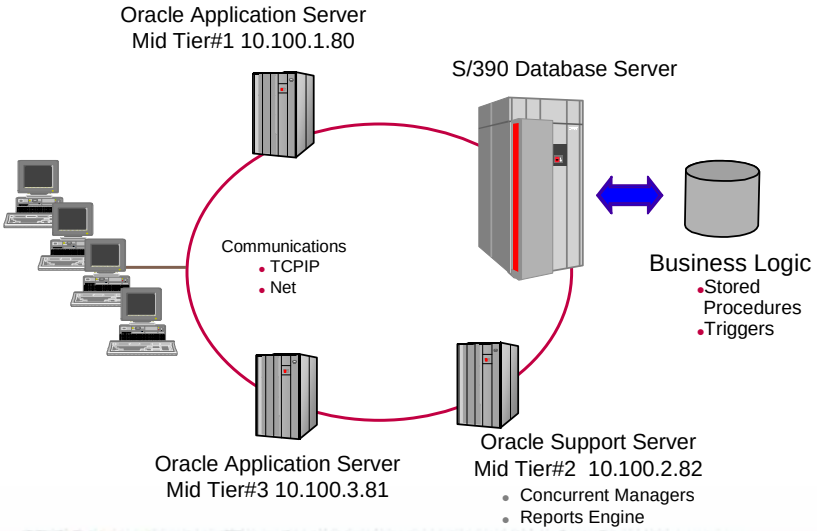
Oracle Applications Benchmark



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Classification Rules for ORANET

```
Subsystem-Type  Xref  Notes  Options  Help
-----------------------------------------------------------------------
           Modify Rules for the Subsystem Type        Row 1 to 5 of 5
Command ===> ___________________________________________ SCROLL ===> PAGE

Subsystem Type . : OSDI        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 ===>
         -------Qualifier-------------             -------Class--------
Action    Type       Name     Start                Service   Report
                                             DEFAULTS: ORACLES    ________
 ____  1  SI         ORAC     ___                  ________  ________
 ____  2    NET        010.100. ___                 ________  ________
 ____  3      LU         001.080  ___              ORAMT1    ________
 ____  3      LU         002.082  ___              ORAMT2    ________
 ____  3      LU         003.081  ___              ORAMT3    ________
***************************** BOTTOM OF DATA ************************
```

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Service Class Goal for Important Work

```
. Service-Class  Xref  Notes  Options  Help
-----------------------------------------------------------------------
                Modify a Service Class             Row 1 to 2 of 2
Command ===> ___________________________________________________________

Service Class Name . . . . . : ORAMT1
Description  . . . . . . . . . Oracle Mid Tier #1
Workload Name  . . . . . . . . ORACLE    (name or ?)
Base Resource Group  . . . . . ________  (name or ?)

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

        ---Period---  ---------------------Goal---------------------
Action  #  Duration   Imp.  Description
  __
  __    1  50          1    Average response time of 00:00:00.015
  __    2  500         3    Average response time of 00:00:00.500
  __    3             5    Execution velocity of 10
****************************** Bottom of data **********************
```

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Goal for Concurrent Manager Work

```
. Service-Class  Xref  Notes  Options  Help
 ------------------------------------------------------------------------
            Modify a Service Class             Row 1 to 2 of 2
 Command ===> ____________________________________________________________

 Service Class Name . . . . . : ORAMT2
 Description  . . . . . . . . . Oracle Mid Tier #2
 Workload Name  . . . . . . . . ORACLE    (name or ?)
 Base Resource Group  . . . . . ________  (name or ?)

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

         ---Period---  ---------------------Goal---------------------
 Action  #  Duration   Imp.  Description
   __
   __    1                   Discretionary
 ****************************** Bottom of data ********************
```

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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

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RMF Monitor III Enclave Report

```
RMF 2.10.0 Enclave Report                  Line 1 of 2
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:                                  Appl%   EAppl%
Class/Group:                                     13.4     69.0

Enclave   Attribute  CLS/GRP  P Goal    % D X   EAppl%   TCPU    USG  DLY  IDL

*SUMMARY                                           28.78
ENC00001             ORAMT1   3                    28.78  71.79     49   41  0.0
```

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RMF Monitor III Sysplex Summary

```
2.10.0 Sysplex Summary - ORACLE          Line 1 of 18
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-
               Exec Vel  --- Response Time ---  Perf  Ended  WAIT EXECUT ACTUAL
Name     T  I  Goal Act  ---Goal--- --Actual--  Indx  Rate   Time   Time   Time

ORACLE   W           23                                 1897 0.000  0.004  0.004
ORACLES  S  D        29                                0.000 0.000  0.000  0.000
ORAMT1   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
SYSSTC   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
```

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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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