Managing CICS with Workload Manager

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Agenda

- WLM Concepts
- CICS Classification
- CICS/WLM Subsystem Awareness
- CICS Transaction Reporting
- CICS Server Management
- Sample RMF Reports
- Summary
WLM Concepts

- **Service Definition**
  - Saved in PDS
  - Installed in WLM Couple Data Set
  - Managed via WLM ISPF Application
    - New capabilities to manage via z/OS Management Facility

- **Policy**
  - Multiple pre-defined Policies
  - One active Policy per Parallel Sysplex

- **Service Class**
  - Period Switched
  - Expectation of Arrival rate, resource use, and response time
  - Recommend maximum of 30-35 ACTIVE Service Class Periods

- **Report Class = Reporting Performance Group**
  - z/OS V1R11 allows 2,047 Report Classes

- **Resource Group**
  - Software Capping with a Sysplex Scope
WLM Classification

Classify to Service Class

Work Enters the System
WLM Classification Options

- **Identify work as CPU Critical**
  - Lower importance work cannot be set to higher dispatching priority

- **Identify work as Storage Critical**
  - Work will lose storage only to work of equal or greater importance

- **CICS/IMS Transaction or Region management**
  - Allows work to be managed to either the region or transaction goal
  - Transaction management is default when transaction goals are set
## Service Classes

<table>
<thead>
<tr>
<th>Name</th>
<th>Goal Type</th>
<th>Value</th>
<th>IMPORTANCE</th>
<th>CPU Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;SHBAT&quot;</td>
<td>Velocity</td>
<td>50</td>
<td>Low (5)</td>
<td>NO</td>
</tr>
<tr>
<td>&quot;ADTSO&quot; Periods</td>
<td>Avg. Response Time</td>
<td>1.2 Seconds</td>
<td>Medium (3)</td>
<td>NO</td>
</tr>
<tr>
<td>&quot;PAYROLL&quot;</td>
<td>Percentile Response Time</td>
<td>90% in less than a second</td>
<td>High (1)</td>
<td>YES</td>
</tr>
<tr>
<td>&quot;LONGBAT&quot;</td>
<td>Discretionary</td>
<td>N/A</td>
<td>N/A</td>
<td>NO</td>
</tr>
</tbody>
</table>
Setting CPU Critical

- WLM May not react quickly enough to keep a critical workload happy in the face of major workload change
  - ie. Stock Market Open

- Assigned at the service class level
  - Restricted to single period service classes with velocity or response time goals

- CPU CRITICAL = YES means work runs at higher dispatching priority than all lower importance work even if this priority is not required to meet goals

- Provides guaranteed CPU access to most critical work

<table>
<thead>
<tr>
<th>Modify a Service Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Class Name</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Workload Name</td>
</tr>
<tr>
<td>Base Resource Group</td>
</tr>
<tr>
<td>CPU Critical</td>
</tr>
</tbody>
</table>
Service Class Goal Types

- **Percentile Response Time**
  - Provides best control
    - Needs decent transaction rate to make statistics valid
  - Set the percentile to the most repeatable portion of the workload
    - ie. 70% in 0.25 seconds

- **Average Response Time**
  - Work is managed to worst performing transactions
    - Best used only if very few outliers among all transactions

- **Velocity**
  - Work with few response times, large amounts of queue times, and variable response times

- **Discretionary**
  - Work with no business importance

- **WLM Defined Service Classes**
  - SYSTEM
  - SYSSTC
  - SYSOTHER
Setting Goal Importance

- **Range of Very Important (1) to Desirable (5)**
  - Relative Value, not absolute value

- **Significance of meeting goal says nothing about how easy or difficult the goal is to achieve**
  - Example: a batch service class with velocity of 5 but IMP=1

- **Used by WLM to**
  - Identify critical workloads
  - Make tradeoffs to protect critical workloads
  - React to changing capacity. Scarce resources will cause WLM to degrade work equally within importance

- **Goals measured using Performance Index (PI)**
  - PI = 1.0 means work is meeting goal
  - PI < 1.0 means work is beating the goal
  - PI > 1.0 means work is missing the goal
WLM Structure

- **WLM does require a sysplex, but not a parallel sysplex**
  - Require a WLM couple data set, and an active policy
  - Single system would be defined as a monoplex

- **WLM manages:**
  - CPU access
  - Storage controls, and MPL levels

- **WLM optionally manages:**
  - I/O priority
  - JES type Initiators
  - DB2 Stored Procedure Address Spaces
  - Websphere Scalable Address Spaces
  - Parallel I/O Access
  - LPAR Weight Management
  - Logical CP Management (replaced with HIPERDISPATCH=YES)
  - Channel Subsystem Priority Management
WLM Classification Rules
CICS Regions and Transactions

For the Region's Service Class

For the Trans Service Class

STC Rules
JES Rules
CICS Rules
CICS and WLM Classification Overview

- **Must classify the regions**
  - Generally set to high velocity goal with a high importance
  - Rules used, (JES or STC), depends on how CICS is started

- **Optionally classify the transactions**
  - WLM Classify is done in the arrival region
  - Classification flows in the FMH5 via MRO

- **Region managed or transaction managed?**
  - The classification rule for the region determines if region is managed by the region's velocity goal or to the transaction's response time goals
  - If not specified, default is to use the transaction goals
CICS and WLM Classification Overview

- Allows easier migration of CICS/IMS regions from velocity goal management to transaction response time management
- Allows test CICS to remain managed by velocity goals
  - Lower system overhead
  - Simplifies WLM policy

Subsystem Type . . . . : STC
Description . . . . . . Classification Rules for STCs

<table>
<thead>
<tr>
<th>Action Type</th>
<th>Name</th>
<th>Start</th>
<th>Service</th>
<th>Report</th>
<th>Manage Regions to Goals Of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CICSP*</td>
<td></td>
<td>ONLHIGH</td>
<td>______</td>
<td>TRANSACTION</td>
</tr>
<tr>
<td></td>
<td>CICSPU*</td>
<td></td>
<td>ONLMED</td>
<td>______</td>
<td>REGION</td>
</tr>
<tr>
<td></td>
<td>CICST*</td>
<td></td>
<td>ONLMED</td>
<td>______</td>
<td>REGION</td>
</tr>
<tr>
<td></td>
<td>CICSA*</td>
<td></td>
<td>ONLHIGH</td>
<td>______</td>
<td>TRANSACTION</td>
</tr>
</tbody>
</table>
CICS and WLM Classification Overview

- Transaction Classification attributes are:
  - SI - subsystem instance (APPLID)
  - SIG - subsystem instance group
  - UI - userid
  - UIG - userid group
  - TN - transaction name
  - TNG - transaction name group
  - LU - LU name
  - LUG - LU name group
  - PX - Sysplex name

- A transaction or region may match multiple classification rules
  - First match found in classification rules will be used
CICS Address Spaces – Goal Setting

- Assign a velocity Goal

- Classify regions to different service classes from transactions
  - Even if WLM is managing regions to transactions goals, region goals are needed for startup, shutdown, idle periods
  - Recommend a report class for each region for reporting purposes

- To cap CICS or IMS work, regions must be in a resource group, not the transactions
CICS Transactions – Goal Setting

- Only a response time goal can be specified
  - Average or Percentile
  - Must be single period

- Keep it simple, use a few service classes for CICS work
  - Keep it realistic, specify achievable goals

- CICS dispatcher doesn't use WLM goals so fine granularity is not critical. WLM controls only the address space

- Group transactions in service classes which have similar characteristics
  - Unlike types of work will impact response time data
  - May wish to put mission critical work in a separate service class
  - May want to manage pseudo-conversational transactions
### CICS Subsystem Types

Listed below are the various work qualifiers which are valid for a CICS subsystem type.

<table>
<thead>
<tr>
<th>Qualifier Selection</th>
<th>Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command ==&gt;</td>
<td></td>
</tr>
<tr>
<td>Select a type with &quot;/&quot;</td>
<td></td>
</tr>
</tbody>
</table>

- **LU**: LU Name
- **LUG**: LU Name Group
- **PX**: Sysplex Name
- **SI**: Subsystem Instance
- **SIG**: Subsystem Instance Group
- **TN**: Transaction Name
- **TNG**: Transaction Name Group
- **UI**: Userid
- **UIG**: Userid Group

#### DEFAULTS: _____ ________

<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>____ 1 <em>?</em> _________</td>
<td>________</td>
<td>________</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**LU NAME**

The CICS terminal name, or TERMID, which is a 4-character identifier.

**SUBSYSTEM INSTANCE**

The VTAM applid for the subsystem instance, or the CICS region name.
WLM Management

- Subsystem awareness
- Resources are consistently applied to important work
- Dynamic, on-going tuning and workload characteristics
- Sysplex management scope
- Ability to share goal information with other products
- CPSM
- Performance reporting of subsystem delays which got in the way of goal attainment
WLM Management - cont.

- **WLM uses samples to determine how well work is progressing**
  - WLM will not react to every CICS transaction
  - Important to:
    - Keep like work with like work to not affect sampling
    - Have enough work in a service class to get enough samples to allow WLM to make good, responsive decisions

- **WLM sets dispatch priority and access to other resources, for the **CICS region**, based on Performance Index and Importance Levels**
  - **WLM does not control dispatching of CICS tasks, CICS does**
WLM Server Management with Transaction Rules

- **WLM Server Management when doing transaction classification**
  - PI of CICS region is ignored when determining access to resources
  - WLM builds internal service classes to manage CICS topology
  - Based on detected WLM services calls being made by the different CICS regions on behalf of different service classes
  - WLM manages regions based on PI of transaction service classes being served
  - All regions in the internal WLM service class are managed together
Cross Sybsystem Management

Work Arrival

Work Departure

VTAM

CICS TOR

CICS AOR

DB Mgr.

z/OS System Resources

RESPONSE TIME

BTE - Begin to End Time

EXE - Execution Time (CICS)

EXE - Execution Time (DB)
Performance Blocks

- **z/OS control block**
  - Created and deleted by subsystem work managers like CICS
    - Associated with transactions not service classes
  - Does not contain response time information or counters
  - Used by WLM to:
    - Assist SRM in determining the topology
    - Report delays (no action is taken on delays by either WLM or CICS)
  - Scanned on an interval basis by WLM
    - Region management only: PB's are scanned every 10th interval
    - Transaction management: PB's are scanned every interval (250 ms)

- **For CICS:**
  - Contains classification token
  - Number of PB's per region is based on maxtask (don't overestimate)
  - CICS updates PBs via 'change state' service
# CICS and WLM Services

## ASID Startup

<table>
<thead>
<tr>
<th>ASID</th>
<th>WLM Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tor</td>
<td>IWM4CON</td>
<td>PB's created, # determined by MAXTASK</td>
</tr>
<tr>
<td></td>
<td>IWM4MCRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOR PB Token</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AOR</td>
<td>IWM4CON</td>
<td>PB's created, # determined by MAXTASK</td>
</tr>
<tr>
<td></td>
<td>IWM4MCRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AOR PB Token</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AOR</td>
<td>IWM4CON</td>
<td>PB's created, # determined by MAXTASK</td>
</tr>
<tr>
<td></td>
<td>IWM4MCRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AOR PB Token</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBCTL</td>
<td>IWM4MCRE</td>
<td>DL/I PB created</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## CICS and WLM Services

### Transaction Processing

<table>
<thead>
<tr>
<th>ASID</th>
<th>WLM SERVICE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOR</td>
<td>IWMCLSFY</td>
<td>Obtain Service Class for transaction</td>
</tr>
<tr>
<td></td>
<td>IWM4MINI</td>
<td>Supply WLM with a PB for the tran, BTE phase starts</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>(change state(s))</td>
</tr>
<tr>
<td></td>
<td>IWMMSWCH</td>
<td>Tran switch, (image, sysplex, network)</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>Supply WLM with a PB - CICS EXE starts</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>(change state)</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>(change state)</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>(change state - go to DB manager)</td>
</tr>
</tbody>
</table>

**Diagram:**

- **CPSM**
- **TOR**
- **AOR**
- **DBCTL**

- **PB**
- **AOR**

- **T1**

- **ASID**
- **WLM SERVICE**
- **DESCRIPTION**
## CICS and WLM Services

### Transaction Processing

<table>
<thead>
<tr>
<th>ASID</th>
<th>WLM SERVICE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL/I</td>
<td>IWMMRELA</td>
<td>Relate DL/I PB (dependent) with AOR PB (parent)</td>
</tr>
<tr>
<td></td>
<td>IWMMXFER</td>
<td>Real state of tran in DL/I PB, IMS EXE starts</td>
</tr>
<tr>
<td></td>
<td>IWM4MCHS</td>
<td>(change state(s))</td>
</tr>
<tr>
<td></td>
<td>IWMMXFER</td>
<td>Real state of tran not in DL/I PB. PBs still related for future transfers, IMS EXE ends</td>
</tr>
<tr>
<td></td>
<td>IWMMRELA</td>
<td>Breaks relationship, CICS EXE starts again</td>
</tr>
</tbody>
</table>

[Diagram of CICS and WLM Services]
CICS and WLM Services

Transaction Processing

<table>
<thead>
<tr>
<th>ASID</th>
<th>WLM SERVICE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOR</td>
<td>IWM4MCHS</td>
<td>(No longer switched)</td>
</tr>
<tr>
<td></td>
<td>IWMMNTFY</td>
<td>Inform WLM CICS EXE phase is over</td>
</tr>
<tr>
<td></td>
<td>IWMRPT</td>
<td>Inform WLM BTE is over</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return to TOR</td>
</tr>
</tbody>
</table>

The diagram illustrates the flow of transaction processing in CICS and WLM services. The ASIDs (AOR, TOR) and WLM services (IWM4MCHS, IWMMNTFY, IWMRPT) are marked with their corresponding actions and descriptions.
WLM Management

- **WLM uses samples to determine how well work is progressing**
  - WLM will not react to every CICS transaction
  - Important to:
    - Keep like work with like work to not affect sampling
    - Have enough work in a service class to get enough samples to allow WLM to make good, responsive decisions

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  - WLM does not control dispatching of CICS tasks, CICS does
WLM Server Topology

- **WLM Server Management when doing transaction classification**
  - PI of CICS region is ignored when determining access to resources
  - WLM builds internal service classes to manage CICS topology
    - Based on detected WLM services calls being made by the different CICS regions on behalf of different service classes
    - WLM manages regions based on PI of transaction service classes being served
    - All regions in the internal WLM service class are managed together

- **Address Space is a server if:**
  - Associates with a PB which represents a transaction. Done via WLM execution monitoring services
  - Issues either a WLM REPORT or NOTIFY for a transaction
WLM Server Topology

- **Internal Service Classes**
  - Dynamically created
  - Set of address spaces which serve a given external service class and belong to the same resource group
    - It is this set of address spaces which will be given resources
  - Called $SRMSnnn
  - Number depends upon:
    - Number of external service classes
    - Combination of server address spaces
    - In CICS the PB samples are used as weighting factors
  - Rebuilt potentially once per minute
  - Multiple Transaction Service Classes can be served by single ISC
Internal Service Class Example

- If Online High is missing its goal, ISC2 will be modified
  - Highest number of PB's based on number of transactions running in ISC2
  - Test CICS transactions may begin seeing better response times
  - Diagram is modified version of one in “ABCs of z/OS System Programming Volume 12”
### Displaying Server Topology

- **Use SDSF DA commands to display information about Server status**

```plaintext
<table>
<thead>
<tr>
<th>NP</th>
<th>JOBNAME</th>
<th>WORKLOAD</th>
<th>SRVCLASS</th>
<th>SERVER</th>
<th>DP</th>
<th>CPU%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICSP1</td>
<td>ONLPRD</td>
<td>ONLHIGH</td>
<td>YES</td>
<td>F9</td>
<td>12.00</td>
<td></td>
</tr>
<tr>
<td>CICSP2</td>
<td>ONLPRD</td>
<td>ONLHIGH</td>
<td>YES</td>
<td>F9</td>
<td>37.00</td>
<td></td>
</tr>
<tr>
<td>CICSP3</td>
<td>ONLPRD</td>
<td>ONLHIGH</td>
<td>YES</td>
<td>F9</td>
<td>10.20</td>
<td></td>
</tr>
<tr>
<td>CICSP4</td>
<td>ONLTST</td>
<td>ONLLOW</td>
<td>NO</td>
<td>F7</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>CICSP5</td>
<td>ONLTST</td>
<td>ONLLOW</td>
<td>NO</td>
<td>F7</td>
<td>0.20</td>
<td></td>
</tr>
</tbody>
</table>
```

* Or use RMF reports to see topology
### RMF Workload Activity Service Class Report

**REPORT BY:** POLICY=WSCPLEX  WORKLOAD=STC  **SERVICE CLASS=ONLHIGH**  RESOURCE GROUP=*NONE

<table>
<thead>
<tr>
<th>CRITICAL</th>
<th>=NONE</th>
<th>DESCRIPTION</th>
<th>=ONLINE Service class</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TRANSACTIONS</th>
<th>TRANS.-TIME</th>
<th>HHH.MM.SS.TTT</th>
<th>--DASD I/O--</th>
<th>---SERVICE-----</th>
<th>--SERVICE RATES--</th>
<th>PAGE-IN RATES</th>
<th>----STORAGE----</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG</td>
<td>14.00</td>
<td>ACTUAL</td>
<td>0</td>
<td>SSCHRT 16.5</td>
<td>IOC 7916</td>
<td>ABSRPTN 4</td>
<td>SINGLE 0.0</td>
</tr>
<tr>
<td>MPL</td>
<td>14.00</td>
<td>EXECUTION</td>
<td>0</td>
<td>RESP 3.4</td>
<td>CPU 439993</td>
<td>TRX SERV 4</td>
<td>BLOCK 0.0</td>
</tr>
<tr>
<td>ENDED</td>
<td>0</td>
<td>QUEUED</td>
<td>0</td>
<td>DISC 1.7</td>
<td>SRB 50959</td>
<td>SRB 5.0</td>
<td>HSP 0.0</td>
</tr>
<tr>
<td>END/S</td>
<td>0.00</td>
<td>R/S AFFINITY</td>
<td>0</td>
<td>Q+PEND 0.4</td>
<td>TOT 498868</td>
<td>RCT 0.0</td>
<td>HSP MISS 0.0</td>
</tr>
<tr>
<td>#SWAPS</td>
<td>0</td>
<td>INELIGIBLE</td>
<td>0</td>
<td>IOSQ 0.1</td>
<td>/SEC 554</td>
<td>IIT 0.2</td>
<td>EXP SNGL 0.0</td>
</tr>
<tr>
<td>EXCTD</td>
<td>0</td>
<td>CONVERSION</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVG ENC</td>
<td>0.00</td>
<td>STD DEV</td>
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<td></td>
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<tr>
<td>REM ENC</td>
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<tr>
<td>MS ENC</td>
<td>0.00</td>
<td></td>
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</tbody>
</table>

---

```
SERVICE CLASSES BEING SERVED
```

CICSPROD  CICSTRAN  CICSTEST
CICS Transaction Service Class

SYSRPTS(WLMGL(SCPER)))

<table>
<thead>
<tr>
<th>REPORT BY: POLICY=WSCPLEX WORKLOAD=CICS SERVICE CLASS=CICSTRAN CRITICAL =NONE RESOURCE GROUP=*NONE PERIOD=1 IMPORTANCE=1</th>
</tr>
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<tbody>
<tr>
<td>TRANSACTIONS TRANS.-TIME HHH.MM.SS.TTT</td>
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<tr>
<td>AVG 0.00 ACTUAL 610</td>
</tr>
<tr>
<td>MPL 0.00 EXECUTION 369</td>
</tr>
<tr>
<td>ENDED 1485 QUEUED 0</td>
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<tr>
<td>END/S 0.24 R/S AFFINITY 0</td>
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<tr>
<td>#SWAPS 0 INELIGIBLE 0</td>
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<tr>
<td>EXCTD 1257 CONVERSION 0</td>
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<tr>
<td>AVG ENC 0.00 STD DEV 1.014</td>
</tr>
<tr>
<td>REM ENC 0.00</td>
</tr>
<tr>
<td>MS ENC 0.00</td>
</tr>
</tbody>
</table>

| SUB P TIME --ACTIVE-- READY IDLE STATE SAMPLES BREAKDOWN (%) WAITING FOR SWITCHED SAMPL(%) |
|---------------------------------------------------------------|-----------------------------------------------|
| TYPE             (%)   SUB APPL CONV PROD I/O CONV LOCK LTCH   |-------STATE-------| LOCAL SYSPL REMOT |
| CICS             BTE  96.6   2.5   0.1   0.0  97.4  0.0  0.0  0.0  0.0  0.0  0.0  97.4   0.0   0.0 |
| CICS             EXE  29.2  48.6   0.0  14.0  0.1  0.0  23.6 13.7  0.0  0.0  0.0  0.0  0.0  0.0  0.0 |
| DB2              EXE  43.7  92.2   0.0   0.0   0.0   0.0   0.0   0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0 |

VELOCITY MIGRATION: I/O MGMT N/A INIT MGMT N/A

---RESPONSE TIME--- EX PERF HH.MM.SS.TTT VEL INDX
GOAL 00.00.00.500 90.0%
ACTUALS
*ALL 96.2% N/A 0.5
WCS1 93.4% N/A 0.7
WSC2 97.7% N/A 0.5
WSC3 92.0% N/A 0.5

Service Class Goal vs Actual Information
Summary

- WLM provides ability to classify CICS work at either the region or transaction level

- Provides cross subsystem management and reporting of CICS work throughout system and / or sysplex

- WLM knowledge of CICS topology and WLM goals allows dynamic ongoing tuning and workload characteristics

- Enhanced reporting of CICS delays via RMF (z/OS 1.2)

- Increased WLM functionality to improve management of CICS environment