

# WLM Management of CICS and IMS Workloads

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z/OS Performance  
Education, Software, and  
Managed Service Providers



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  - Instructor: Peter Enrico and Tom Beretvas
- ☐ [Parallel Sysplex and z/OS Performance Tuning \(Web / Internet Based!\)](#)
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## Abstract

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### □ [Introduction to WLM Management of CICS and IMS Workloads](#)

- CICS and IMS transactions can either be managed by the velocity goals assigned to the regions, or managed towards the response time goals assigned to the transactions. WLM management of the regions toward the goals of the transactions is known as WLM server management.

During this presentation Peter Enrico will introduce the concepts of WLM server management, and provide guidelines to ensure an optional WLM setup for CICS and IMS transaction workloads. Guides and recommendation are a key ingredient of this presentation.



## Options for Setting Up WLM Management for CICS and IMS Workloads

- Installation's have several choices for how WLM will manage their CICS and IMS workloads
  - Region Management:
    - Allow all regions to be managed towards velocity goals and importance levels
    - Response time goals of transactions have no influence
  - Transaction Management:
    - Allow all regions to be managed to meet the response time goals of the transactions they are serving.
    - The goals and importance levels of the regions are ignored.
  - Combination of Region and Transaction Management
    - Allows certain workloads to manage with 'Region Management' and other workloads to be managed with 'Transaction Management'
    - Usually used when Transaction Management is not effective for certain workloads
  - Transaction Management with Region Importance
    - Same as Transaction Management
    - Region's goal is ignored, but region's assigned importance level is considered

## Key Lessons

- There is no right / best solution or option
  - For some installations transaction management is best
  - But for other installations, transaction management could be a disaster
- Keep your WLM setup for CICS and IMS workloads simple
  - Overly complicated setups could be a waste of time and lead to unpredictable WLM management
- If you choose to implement WLM transaction management, put thought into which transactions you classify, and what goals and importance levels you give these transactions
  - Guidelines are provided later in this presentation
- WLM management of CICS and IMS servers (via Transaction Management) is
  - Not as straight forward as WLM management of enclave servers,
  - but a whole lot better than the management of non-participant servers
    - such as IDMS, ADATABASE, VTAM, DB2, VSAM RLS, CICS CTG, etc.

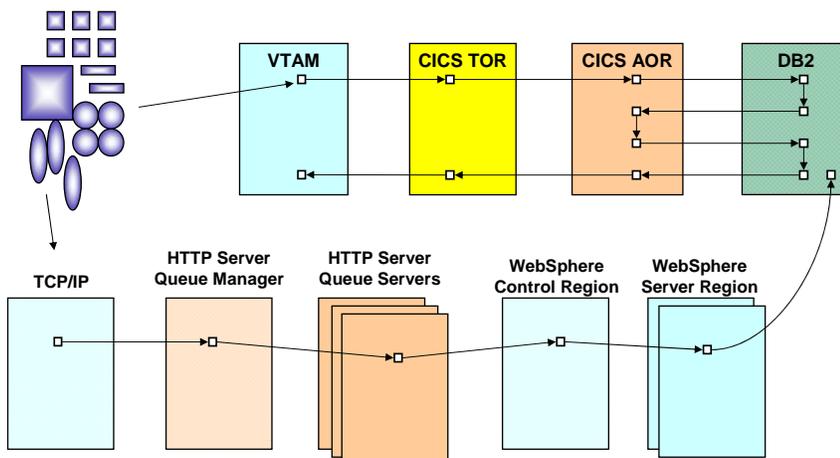


## Key Lessons

- All WLM will ever know about CICS and IMS transactions is as follows:
  - Transaction end (so WLM knows number ended, and the rate of ended)
  - The response time of the transactions
  - Which regions processed the transactions
  - WLM never knows about resource consumption such as CPU, storage, and I/O
- Always separate WLM managed servers and non-WLM managed servers into separate service classes
  - This is true for CICS and IMS address spaces managed via Transaction Management
  - This is true for enclave servers as well
    - Such as WAS Servant regions
    - Such as WLM Stored Procedure address spaces
- WLM transactions management of CICS and IMS are basically the same
  - True... there are slight differences, but concepts very close
  - This presentation uses WLM management of CICS as the primary example
  - But remember that WLM management of IMS works pretty much the same way

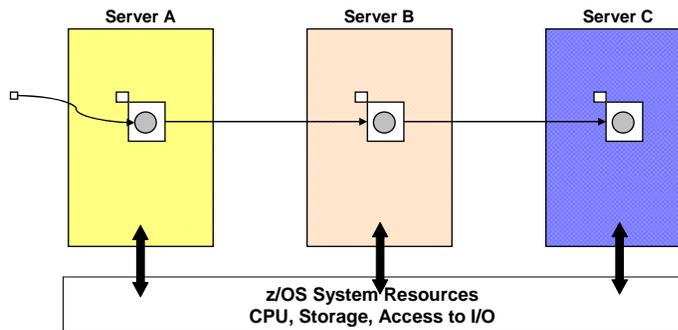
## What are Servers (From WLM's Point of View)

- From WLM's point of view, Servers are address spaces are processing distinct requests on behalf of clients



## WLM's Interest in Servers

- Installations need the ability to set goals for the their transactions
- WLM needs a way to manage these servers according to the performance goals of the transactions that these regions are serving
  - If transaction X is missing its goal, should WLM help the address space or task?



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## Objective of WLM Management of CICS & IMS

- Allow assignment of goals to the transactions and let the WLM determine which regions need the resources to meet these goals.

### Region Goals



IMP 1, Velocity 60

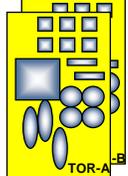
### Transaction Goals

- IMP 1, RT .5 sec, 90%
- ▬ IMP 1, RT .75 sec, 90%
- IMP 3, RT 2 sec, 90%
- IMP 3, Avg RT 3 sec
- IMP 5, RT 20 sec, 85%

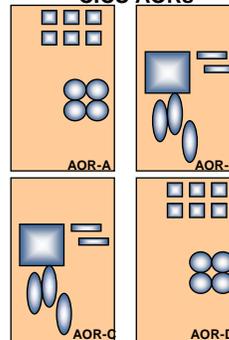
To meet the RT goals of ■ the following regions must be managed:

- CICS TOR-A, TOR-B
- CICS AOR-A, AOR-D
- CICS FOR-A

### CICS TORs



### CICS AORs



### CICS FORs



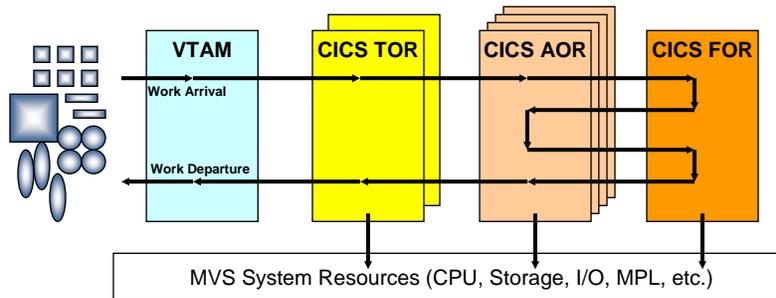
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## What is WLM Server Management?

- The ability of WLM to manage CICS and IMS regions according to the performance goals of the transactions that these regions are serving
  
- CICS and IMS use services to let WLM know
  - Transaction Start
  - Which address spaces are involved in processing a transaction
  - Transaction End



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## Option 1 - Region Management

Manage regions towards their assigned goal

CICS and IMS transactions are not assigned goals

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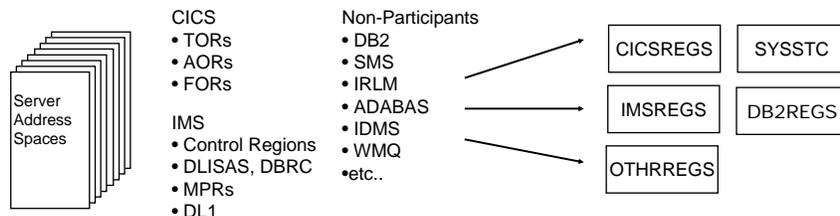
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## Option 1 - Region Management

- Assign velocity goals to regions, but  
Do not assign goals to any CICS or IMS transactions
  - Regions will be managed toward velocity goals
  - Transaction goals are ignored
  - Regions are not seen as 'servers', but are seen as long running address spaces
  
- WLM will manage regions according to the assigned velocity goal
  - Your job is to ensure that goals for regions are sufficient to meet the response time objectives of the transactions they serve
  
- Can still assign transactions to report classes

## Option 1 - Region Management

- Assign regions appropriate velocity goals and importance levels
  - Do not use response time goals for regions
  - Do not assign regions to SYSTEM or SYSSTC service classes
  
- Typical setup : Separate into different service classes...
  - the CICS regions from IMS regions
  
  - the regions of different workloads (example: Test versus production)
  
  - the CICS and IMS regions from other server regions
    - Away from DB2, ADABASE, IDMS, VTAM, CICS CTG, WMQ, WAS, etc.



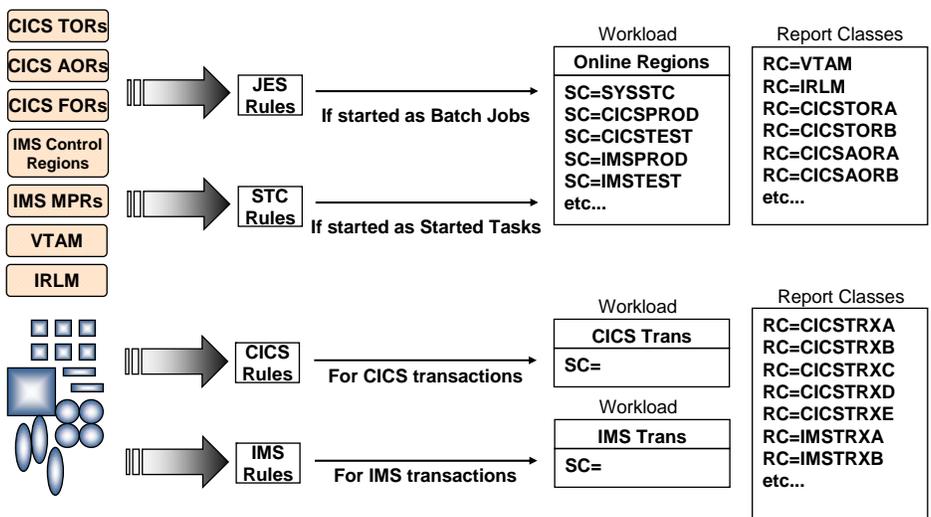


## Option 1 - Guidelines & Recommendations

- Always assign velocity goals to regions
- Group regions together into service classes
  - May want to assign more aggressive goals or higher importance levels to CICS TORs and IMS control regions
- Use report classes
  - Assign each region to its own unique report classes
  - Assign transactions to their own unique report classes
    - But setup service classes for the transactions
- Monitor and Tune
  - Monitor address spaces performance
    - Tune region velocity goals to help ensure transaction objectives are met
  - Using appropriate CICS and IMS transaction measurements, monitor performance of transactions
    - Use these measurements to tune region velocity goals
    - Use these measurements as possible goals if you later decide you want to manage the regions those transaction goals.

## Summary Option 1 - Region Management

- Assign goals to regions, but don't assign goals to their transactions



## Option 2 - Transaction Management

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Assign regions velocity goals for management during startup,  
shutdown, and periods of inactivity

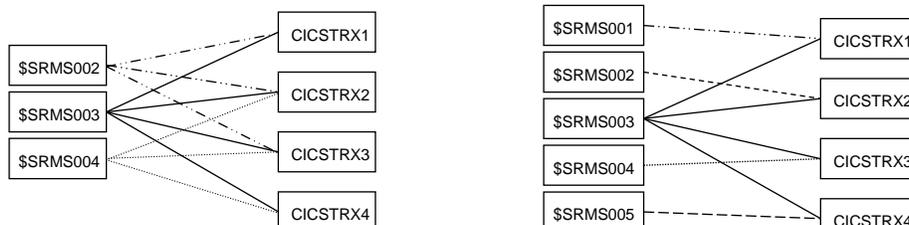
Assign transactions response time goals

WLM manages regions to meet the response time goals of the  
transactions they are serving, and ignores the goals of the regions

## Option 2 - Transaction Management

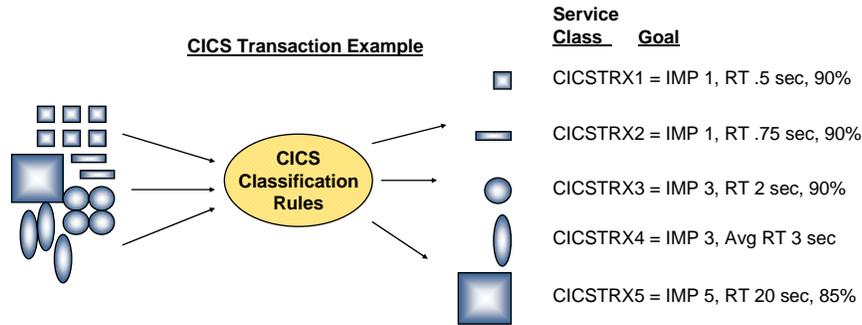
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- Assign velocity goals to regions, and  
Assign response time goals to CICS or IMS transactions
  - Initially, regions will be managed toward assigned velocity goals
  - When WLM 'sees' regions processing transactions
    - Ignores assigned goal of region
    - Instead manages region towards response time goal of transactions region is serving
  
- WLM will manage regions to meet the goals of the transactions
  - Your job is to ensure that goals for transactions are sufficient so regions can be managed to meet the response time objectives of the transactions they serve



## Classification of CICS & IMS Transactions

- CICS and IMS transactions can be classified to service classes
  - Use either average or percentile response time goals



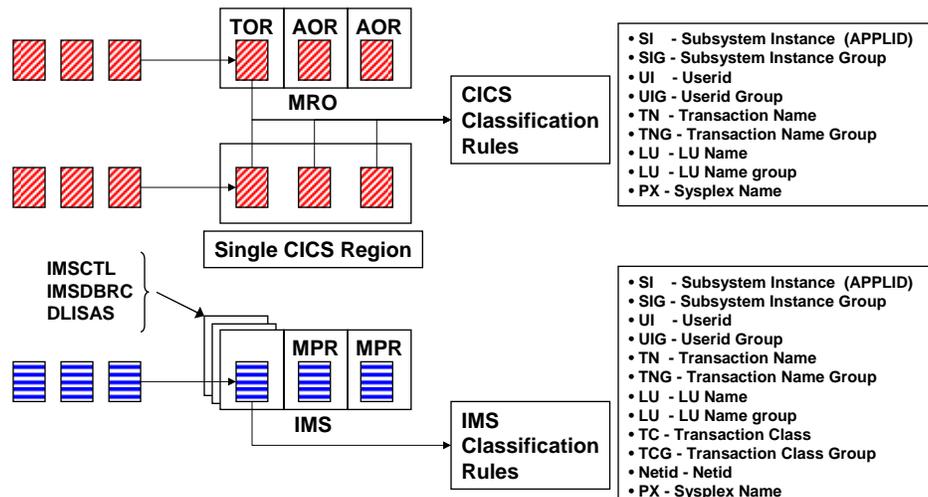
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## Guidelines for CICS and IMS Transactions

- Classifying CICS and IMS transactions
  - Where transactions start is where the transactions are classified



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## Option 2 – Transaction Classification Example

- Below is an example of the CICS classification rules
  - Note the service class column is not blank
  - You can get as fancy as you like with the classification rules and the report class column, but make sure the service class column is simple. Do not break the transactions up into too many service classes

```

Subsystem-Type Xref Notes Options Help
-----
Modify Rules for the Subsystem Type      Row 1 to 3 of 3
Command ==> _____ SCROLL ==> PAGE

Subsystem Type . . : CICS      Fold qualifier names? Y (Y or N)
Description . . . : CICS Transactions

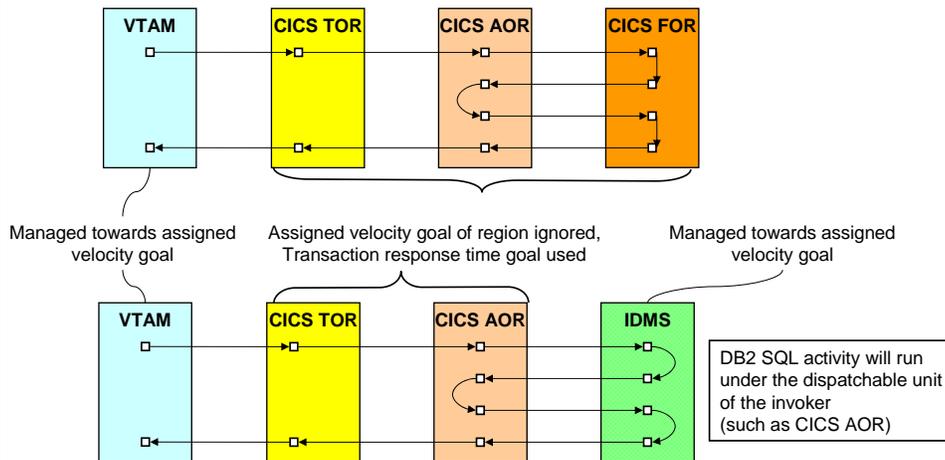
Action codes:  A=After      C=Copy      M=Move      I=Insert rule
                B=Before     D=Delete row R=Repeat  IS=Insert Sub-rule
                More ==>

-----Qualifier-----
Action  Type      Name      Start      Service      Report
-----
_____ 1 SI      CICP*     _____  DEFAULTS: CICSDEF  RCCICSA
_____ 1 SI      CICT*     _____  CICSPROD  RCCICSP
_____ 1 SI      CICD*     _____  CICSDEV   RCCICST
_____ 1 SI      CICSDEV  RCCICSD

***** BOTTOM OF DATA *****
    
```

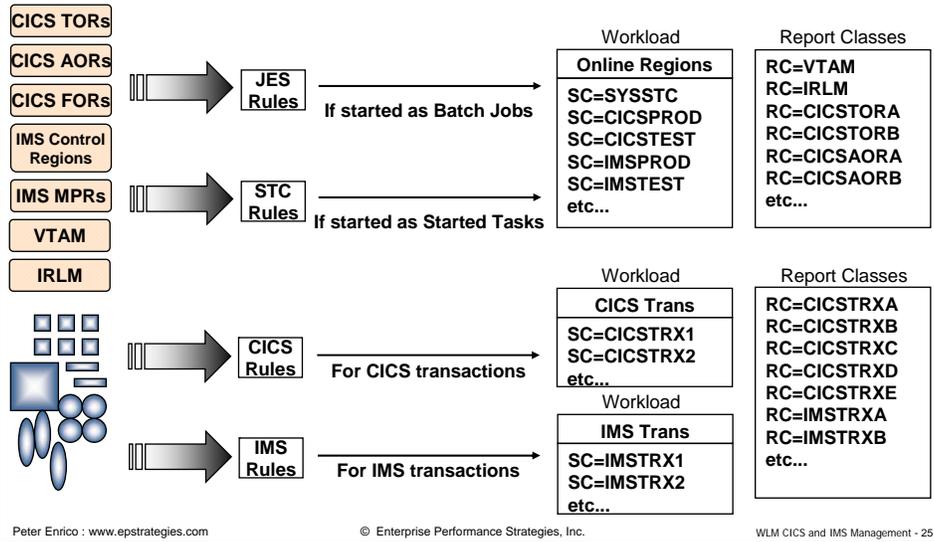
## Transaction Flow and Management

- DB2 and other subsystems are 'non participants', but may be in the flow
  - When transaction management turned 'on', WLM will not manage address spaces other than CICS or IMS towards CICS and IMS transaction goals



## Summary Option 2 - Transaction Management

- Assign goals to regions, but assign goals to their transactions



## Option 3 - Combination of Region and Transaction Management

Use Region Management for some workloads

Use Transaction Management for other workloads

Controlled by WLM classification options

## Option 3 - Mixture of Approaches 1 and 2

- You have the ability to choose if a region is to be managed towards region's goal or goals of the transactions being served
- Can optionally allow regions to be exempt from transaction response time management
  - Classification rule for region determines if regions is to be managed towards region's velocity goal, or to the transaction's response time goal
  - 'Manage Region Using Goals of...' control
    - Default is to use the transaction's response time goal
- History
  - When WLM was first introduced, migration to transaction management was an 'all or nothing' migration
  - When support for compatibility mode (i.e. non-WLM mode) was being phased out, some customers forced IBM to give them the option to not use transaction management.

## Manage Regions Using Goals of....

- 'TRANSACTION' or 'REGION' classification rule control
  - Only valid for STC and JES classification rules
  - Only applies to CICS and IMS regions
- When regions are classified as 'TRANSACTION'
  - WLM will manage regions towards goals of the transactions regions serve
- When regions are classified as 'REGION'
  - WLM will manage regions towards assigned velocity goal of region

```

Modify Rules for the Subsystem Type          Row 1 to 2 of Command
====> _____ SCROLL ==> PAG

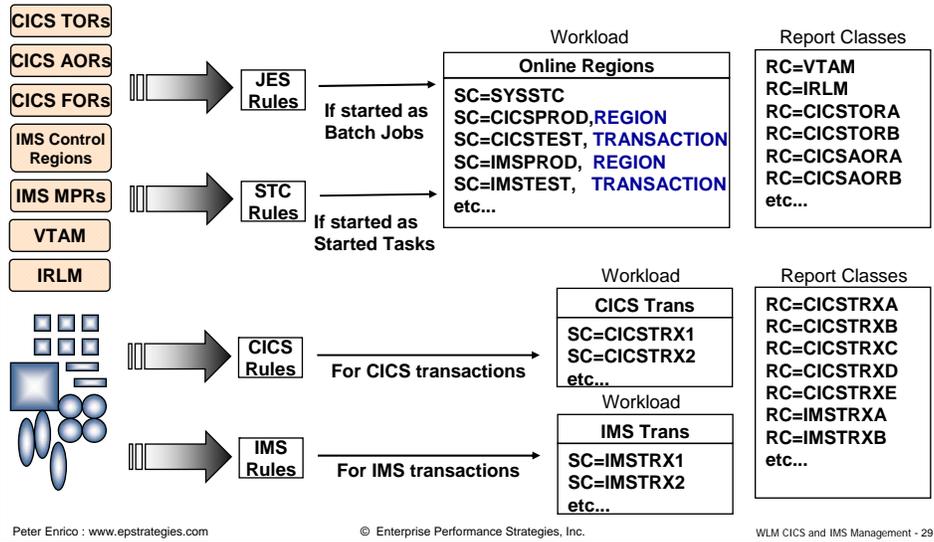
Subsystem Type . : STC                      Fold qualifier names?  Y (Y or N)
Description . . . IBM-defined subsystem type
Action codes:  A=After  C=Copy  M=Move  I=Insert rule
               B=Before  D=Delete row  R=Repeat  IS=Insert Sub-rule

-----Qualifier-----
Action  Type      Name      Start      Service  Report  Storage  Manage Region
-----Type-----Name-----Default:-----Service Report  Critical  Using Goals Of
_____ 1  SY       SYS1      _____  STCLOW  _____  NO       TRANSACTION
_____ 2  TN       CICSTEST  _____  ONLPROD  _____  NO       REGION
_____ 2  TN       CICS*    _____  ONLPROD  _____  YES      TRANSACTION
    
```



## Summary Option 3 - Combination of Region and Transaction Management

- Assign goals to both regions and their transactions



## Option 4 - Transaction Management with Region Importance

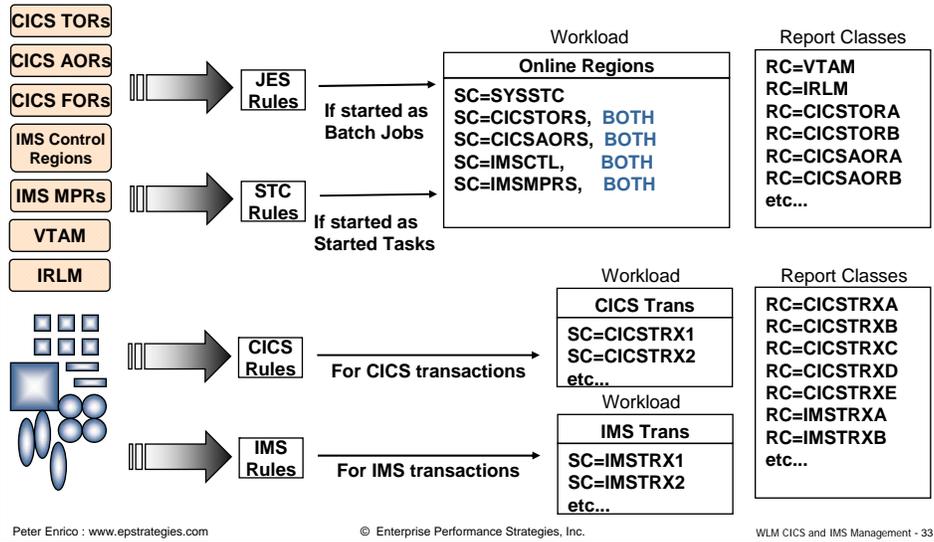
Manage regions to meet the response time goals of the transactions they are serving, but consider the assigned importance level of the regions

So full Transaction Management, but region importance level is used, but region goal is ignored



## Option 4 – Transaction Management with Region Importance

- Assign goals to both regions and their transactions



## Nuts and Bolts

When CICS and IMS Transaction Management is used, regions are managed to meet the goals of the transaction they are serving, the goals of the CICS and IMS regions are

**ignored!**

Region's importance level may be considered if 'BOTH' option used

## Objective of WLM Management of CICS & IMS

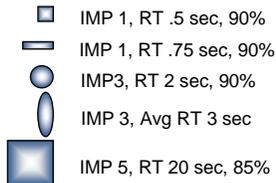
- Allow assignment of goals to the transactions and let the WLM determine which regions need the resources to meet these goals.

### Region Goals



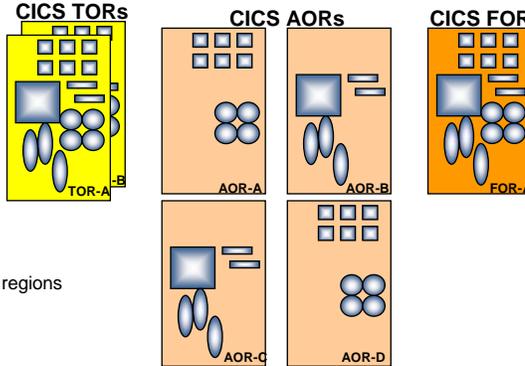
IMP 1, Velocity 60

### Transaction Goals



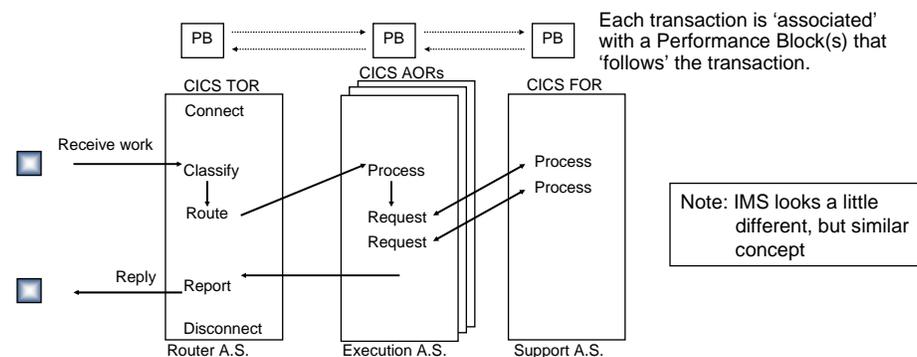
To meet the RT goals of [IMP 1, RT .5 sec, 90%] the following regions must be managed:

- CICS TOR-A, TOR-B
- CICS AOR-A, AOR-D
- CICS FOR-A



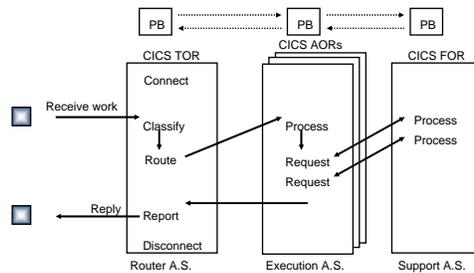
## WLM needs an awareness of which regions are processing which transactions, and how often

- CICS and IMS exploit WLM Work Manager services
  - Regions '**Connect**' (ie 'register') to WLM during startup & obtain current service policy
  - At transaction startup, region uses WLM '**Classify**' to associate incoming transaction with a service class
  - At transaction end, region uses WLM '**Report**' to signal end and report response time
  - Other important services to make this all work



## WLM Sampling and CICS MAXTASK Parameter

- ❑ Beware of excess sampling overhead due to CICS MAXTASK parameter!
  - In a CICS environment, one PB is pre-allocated for each possible task as set by the CICS MAXTASK parameter
- ❑ All PBs are sampled every 1/4 second
  - ❑ Could cause lots of WLM sampling overhead!
- Check CICS MAXTASK parameter to make sure it is not set unnecessarily high
  - ❑ Set to your system's true high water mark
- Mostly resolved, but still watch MAXTASK



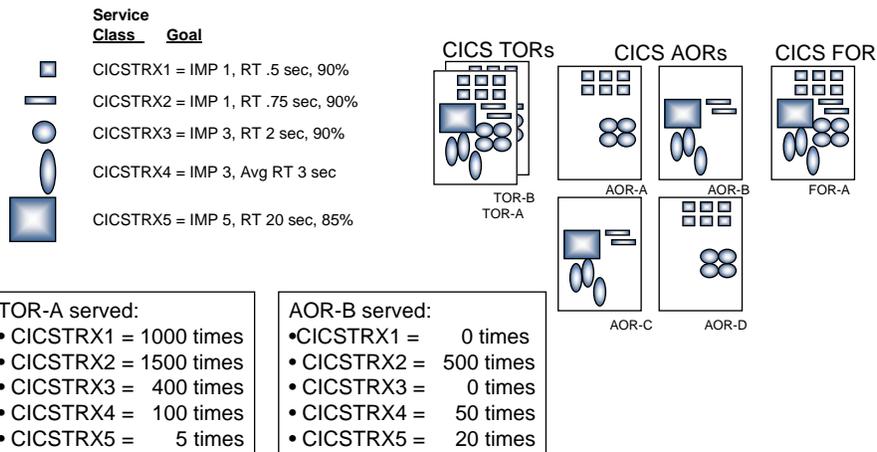
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## WLM Maintains a Server History

- ❑ Used to establish which transactions each region is processing



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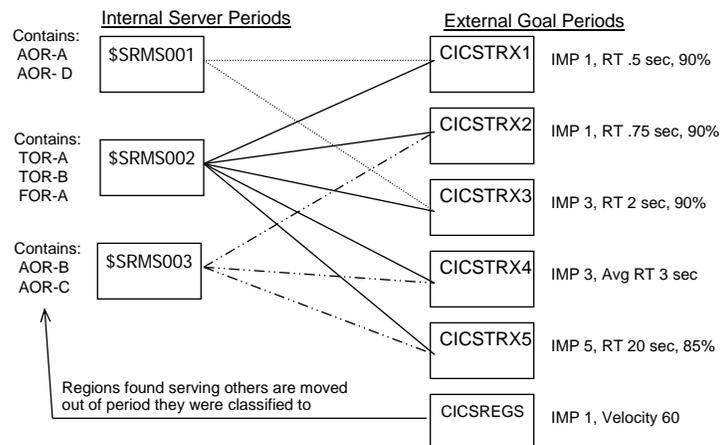
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## WLM Builds the Server Topology

- WLM maintains a 'server topology' reflecting what regions are serving which transactions
  - Allows WLM to always understand
    - Which address spaces to help in order to meet the goals of the transactions
    - Which transaction goals will be helped/hurt by giving/taking resources to/from servers
  
- WLM CICS and IMS server topology consists of
  - 'External goal periods'
    - Transaction response time periods being served
  
  - 'Internal Server periods' (a.k.a. dynamic internal periods)
    - Internal periods created by WLM to 'hold' the serving address space
    - Named \$SRMSxxx
  
  - Lots of counts and relationship indicators
    - How often external goal period was served by an dynamic internal period
    - How often dynamic internal period was serving a external period
    - Aggregation of state samples
    - more...

## WLM Server Topology CICS Example

- Server Topology - CICS Example



## What SERVER = YES / NO means

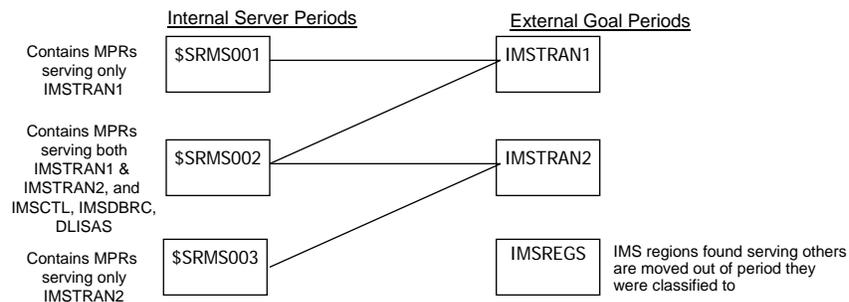
- ❑ Many real time reporting tools will report if an address space is being treated as a server in using these topology algorithms
  - SERVER = Yes
    - ❑ Server goal is ignored and address space is being managed towards goal of served transactions
  - SERVER = No
    - ❑ Server address space's goal is being honored
- ❑ Example of SDSF Report

```

SDSF DA SYSA SYSA PAG 0 SIO 0 CPU 28 / 27 LINE 1-138 (138)
COMMAND INPUT ==>> SCROLL ==>> PAGE
NP JOBNAME STEPNAME PROCSTEP JOBID OWNER C SYSNAME POS SR DP WORKLOAD SRVCLASS SP RESGROUP SERVER
CICSPA CICSPA CIC130 STC00001 $SCICPA SYSA NS P7 STC CICSTC 1 YES
CICSPC CICSPC CIC130 STC04298 $SCICPC SYSA NS P7 STC CICSTC 1 YES
CICS9G CICS9G CIC130 STC04312 $SCIC9G SYSA NS P7 STC CICSTC 1 YES
CICS CICS CIC130 STC04314 $SCIC0 SYSA NS P7 STC CICSTC 1 YES
CICSPB CICSPB CIC130 STC01919 $SCICPB SYSA NS P7 STC CICSTC 1 YES
DB2PDBM1 DB2PDBM1 IEFPROC STC00640 DB2PDBM1 SYSA NS FD ONLINE DBPROD 1 NO
DB2PSPAS DB2PSPAS IEFPROC STC00675 DB2PSPAS SYSA NS FD ONLINE DBPROD 1 NO
CICSPD CICSPD CIC130 STC00467 $SCICPD SYSA NS FD STC CICSTC 1 YES
DB2PDIST DB2PDIST IEFPROC STC00660 DB2PDIST SYSA NS FD ONLINE DBPROD 1 NO
DB2PIRLM DB2PIRLM STC00634 DB2PIRLM SYSA NS FD ONLINE DBPROD 1 NO
DB2PMSTR DB2PMSTR IEFPROC STC00632 DB2PMSTR SYSA NS FD ONLINE DBPROD 1 NO
    
```

## WLM Server Topology IMS Example

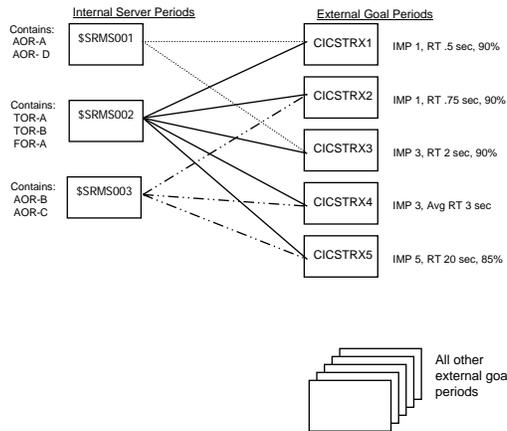
- ❑ Server Topology - IMS Example



## WLM Policy Adjustment Example

### □ Policy Adjustment - Example

1. 'Select receiver' picks CICSTRX1
2. 'Find bottleneck' sees CICSTRX1 has no delay samples (because no address spaces in period)
3. 'Find bottleneck' looks at \$SRMSnnn periods serving CICSTRX1 for largest delay
4. 'Find bottleneck' determines that largest delay state is in \$SRMS002
  - Goal receiver = CICSTRX1
  - Resource receiver = \$SRMS002
5. Policy adjustment gives resources (CPU, I/O, storage, etc..) to address spaces in \$SRMS002 to help CICSTRX1



## WLM Measurement Reporting Notes

### □ CICS Transactions

- The only WLM measurements available for CICS transactions will be
  - ENDED, ENDED per second, Response Times, Response Time distribution
- No resource measurements at the transaction level available
  - So no CPU, Storage, or out measurements

### □ CICS Regions

- Even though the goals for the regions are ignored, and the regions are actually managed in separate \$SRMSxxx service class periods, all measurements are still accumulated to the service class they are classified to
  - This is why it is strongly recommended you classify 'Server = Yes' regions to different service classes not managed as WLM servers
  - Measurement screwed up or miss leading

# CICS and IMS Report Example

WORKLOAD ACTIVITY

z/OS VIRI2      SYSPLEX EPSPLEX      DATE 07/09/2012      INTERVAL 09.59.886      MODE = GOAL      PAGE 16  
RPT VERSION VIRI2 RMF      TIME 09.20.00

POLICY ACTIVATION DATE/TIME 06/28/2012 06.15.08

---

REPORT BY: POLICY=WLMPEPS      WORKLOAD=CICS      SERVICE CLASS=CICSHIGH RESOURCE GROUP=\*NONE      PERIOD=1 IMPORTANCE=2  
CRITICAL =NONE

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	
AVG	0.00	ACTUAL	48
MPL	0.00	EXECUTION	0
ENDED	3841	QUEUED	0
END/S	6.40	R/S AFFIN	0
#SNAPS	0	INELIGIBLE	0
EXCTD	0	CONVERSION	0
AVG ENC	0.00	STD DEV	293
REM ENC	0.00		
MS ENC	0.00		

} Good data, but no resource data  
State Data usually garbage and useless... Ignore!

---

RESP      STATE SAMPLES BREAKDOWN (%)      STATE

SUB	P	TIME	ACTIVE	READY	IDLE	I/O	PROD	MISC	LOCK	CONV	WAITING FOR	SWITCHED	SAMPL	LOCAL	SYSPL	REMO
CICS	BTE	20.1K	0.2	0.0	0.0	0.0	62.2	37.4	0.0	0.2		0.2	0.0	0.0		
CICS	EXE	88.8	11.3	0.0	0.2	85.6	2.9	0.0	0.0	0.0		3.1	0.0	0.0		
DB2	BTE	11.3	8.4	0.0	0.0	0.0	56.6	0.0	9.6	25.3		0.0	0.0	0.0		
DB2	EXE	3.8	17.9	0.0	0.0	0.0	75.0	0.0	3.6	3.6		0.0	0.0	0.0		

GOAL: RESPONSE TIME 000.00.01.000 FOR 95%

SYSTEM	RESPONSE TIME	EX	PERF
	ACTUAL%	VEL%	INDX
SYS1	100	N/A	0.5

Valid Response Time Distribution Data

---

RESPONSE TIME DISTRIBUTION

TIME	NUMBER OF TRANSACTIONS	PERCENT
HH.MM.SS.TTT	CUM TOTAL	IN BUCKET
< 00.00.00.500	3812	99.2
<= 00.00.00.600	3821	99.5

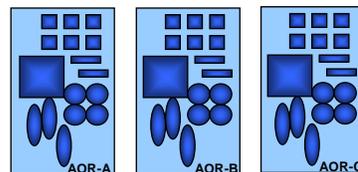
## CICS Regions Processing All Transactions

- Common scenario: an environment when all transactions are processed by all regions
  - Usually stand-alone CICS regions
  - Could be MRO when all regions process all transaction

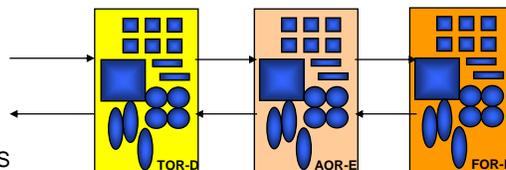
- Many users mistakenly take care in setting goals for each type of transaction

- IMP 1, RT .5 sec, 90%
- IMP 1, RT .75 sec, 90%
- IMP3, RT 2 sec, 90%
- IMP 3, Avg RT 3 sec
- IMP 5, RT 20 sec, 85%

### Stand Alone CICS Regions



### CICS MRO Flow

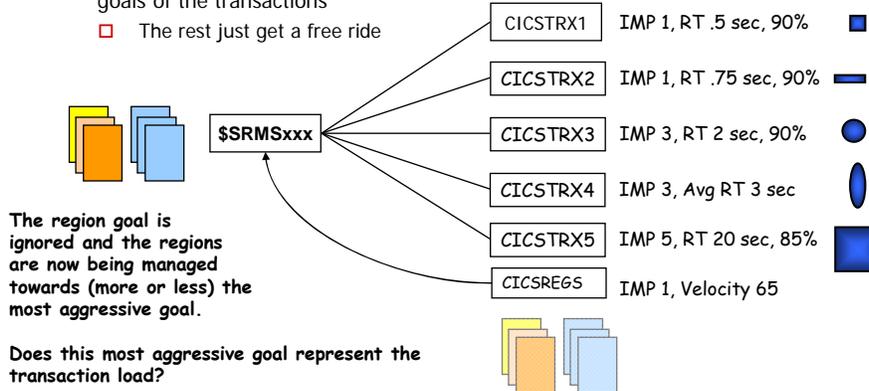


To meet the RT goals of ■ all the CICS regions need to be managed



## Example of this Misadventure

- CICS regions that processes all transactions
  - WLM admin categorizes and classifies the different transactions and assigns goals
  - Then it turns out that all regions process all transactions
  - The net effect is that WLM will just manage the regions to the most aggressive goals of the transactions
    - The rest just get a free ride



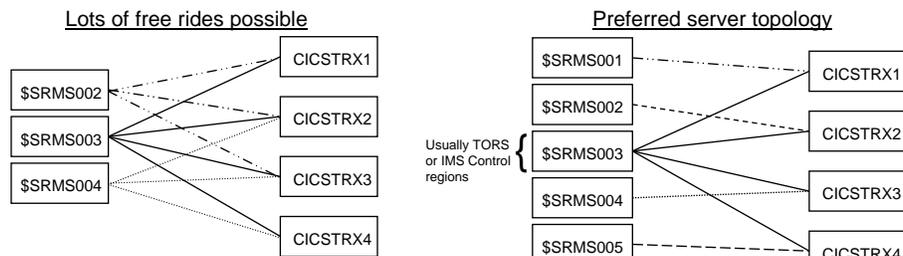
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## Additional Considerations

- Heterogeneous versus homogeneous transaction mix in regions
  - IMS or CICS MRO when regions serving heterogeneous set of service classes
    - Lose the true benefit of WLM server management - managed to strictest goal
  - Best if can separate transactions into different regions
    - Decreases free rides
  - AOR cloning with dynamic transaction routing is very effective



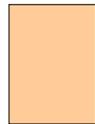
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## Additional Considerations

- When Importance level assigned to regions is considered, WLM will consider this importance level when managing the regions in the \$SMFSxxx periods

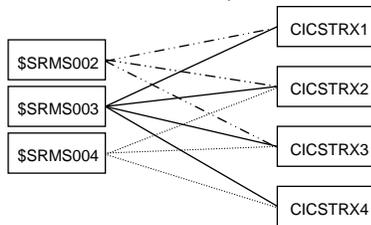


CICSTORS  
Velocity 60  
Importance 1

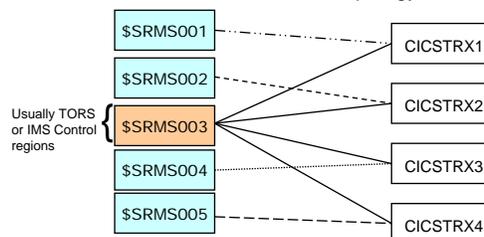


CICAORS  
Velocity 60  
Importance 2

### Lots of free rides possible

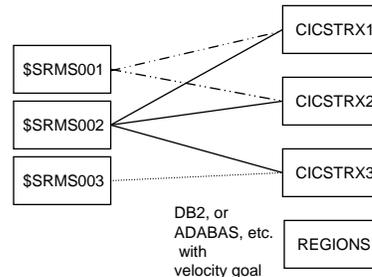
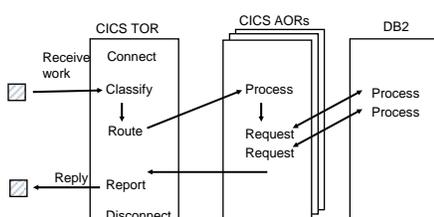


### Preferred server topology



## Additional Considerations cont...

- Transaction still affected by what other goal periods achieve
  - Non-participant (non-exploiters) of WLM server management services
    - ADATABASE, IDMS, WMQ, CICS CTG, etc.
    - Note: DB2 runs XMEM so gets regions CPU DP
  - Performance Index reflects system response time achieved (including time spent in database region)
    - Yet no \$SRMSnnn period to give resources to if delay in database region



## Key Classification Recommendations

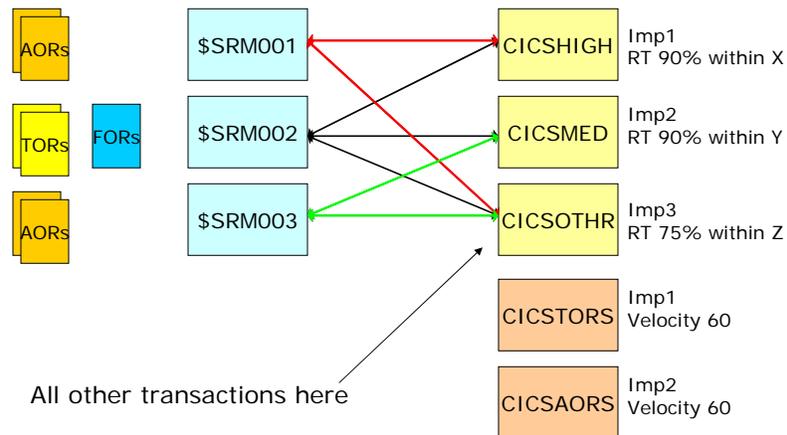
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## Best Way to Setup for Transaction Management

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- Carefully choose a set of transactions to influence WLM's management of the regions
  - Hopefully a set of high importance transactions
- Carefully choose a second set of transactions to influence WLM's management of the regions
- Classify all other transactions to a lower importance response time goal service class and let them be 'drag along' for management
- Make heavy use of WLM report classes

## Example of a Topology



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## Number One Recommendation

- Start simple, and grow to just a few transaction service classes
  - Unless you are using report classes, use few classification rules
    - Could use TNG if many transactions are to be classified alike
  - Setup in a way that makes the most business sense
  - Could set up using a 'production' versus 'test' approach
- Create just a few service classes for your CICS and/or IMS transactions
- Have 1, 2, or 3 of these service classes contain transactions that you want WLM to use to manage the CICS and/or IMS workload
- Then classify all other transactions to some 'OTHRTRAN' type service class
  - Simple goal, low importance
- This way WLM will manage the workloads towards the goals of the key transactions and all others get a 'free ride'

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## Guidelines for Transaction Classification

- A successful migration to CICS or IMS transaction goals will depend on your understanding of these characteristics of your CICS or IMS workload.
  - Transactions of interest?
  - Transactions that are predictable / repeatable
  - Transactions for which there are 'enough' of them and which have a consistent / regular flow during periods of interest
  - Transactions that are not long running or never ending
  - Transactions that are CPU sensitive transactions
  - Transactions that are indicative of the health of the workload
  - Transactions that are not mirror transactions
  - Transactions that are not distributed, flow to different systems, or have a lot of unknown time
  - Transactions that flow through the regions (i.e. at least one transaction per region)
  - Transactions that are part of your workload / application, and not CICS or IMS system or internal transactions

## Guidelines for Transaction Classification

- Use percentile response time goals (over average response time goals) when possible
- Assign transactions to single period service classes assigned response time goals
  - Cannot assign transactions velocity or discretionary goals
  - Average RT goals enable CICS CP/SM to route base on goals
  - Percentile goals enable CP/SM to revert to shortest queue routing algorithm
- Period durations are meaningless. Transactions will never transition to second period
  - Transactions do not use up service; the regions do! So they are unable to transition
  - Multiple period service classes are useless
- Unless additional changes are made to classification of regions
  - Classification of transactions is 'all or nothing'
  - Cannot just turn on transaction classification for some transactions
- Make use of report classes!
  - Great for monitoring individual types of transactions

## Conclusion

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- There is no right / best solution or option
  - For some installations transaction management is best
  - But for other installations, transaction management could be a disaster
  
- Keep your WLM setup for CICS and IMS workloads simple
  - Overly complicated setups could be a waste of time and lead to unpredictable WLM management
  
- If you choose to implement WLM transaction management, put thought into which transactions you classify, and what goals and importance levels you give these transactions