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Dock into the Dark Side

WLM –
Not All Address Spaces are Managed Alike

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Session LD

EPS

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

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During these workshops you will be analyzing your own data!

- Essential z/OS Performance Tuning
  - Instructor Scott Chapman
  - 2020 Dates to be decided

- Parallel Sysplex and z/OS Performance Tuning
  - Instructor Peter Enrico
  - Via the internet, November 12 -14, 2019

- WLM Performance and Re-evaluating Goals
  - Instructor Peter Enrico
  - 2020 Dates to be decided

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- We would love to bring these z/OS performance workshops to the UK in 2020!
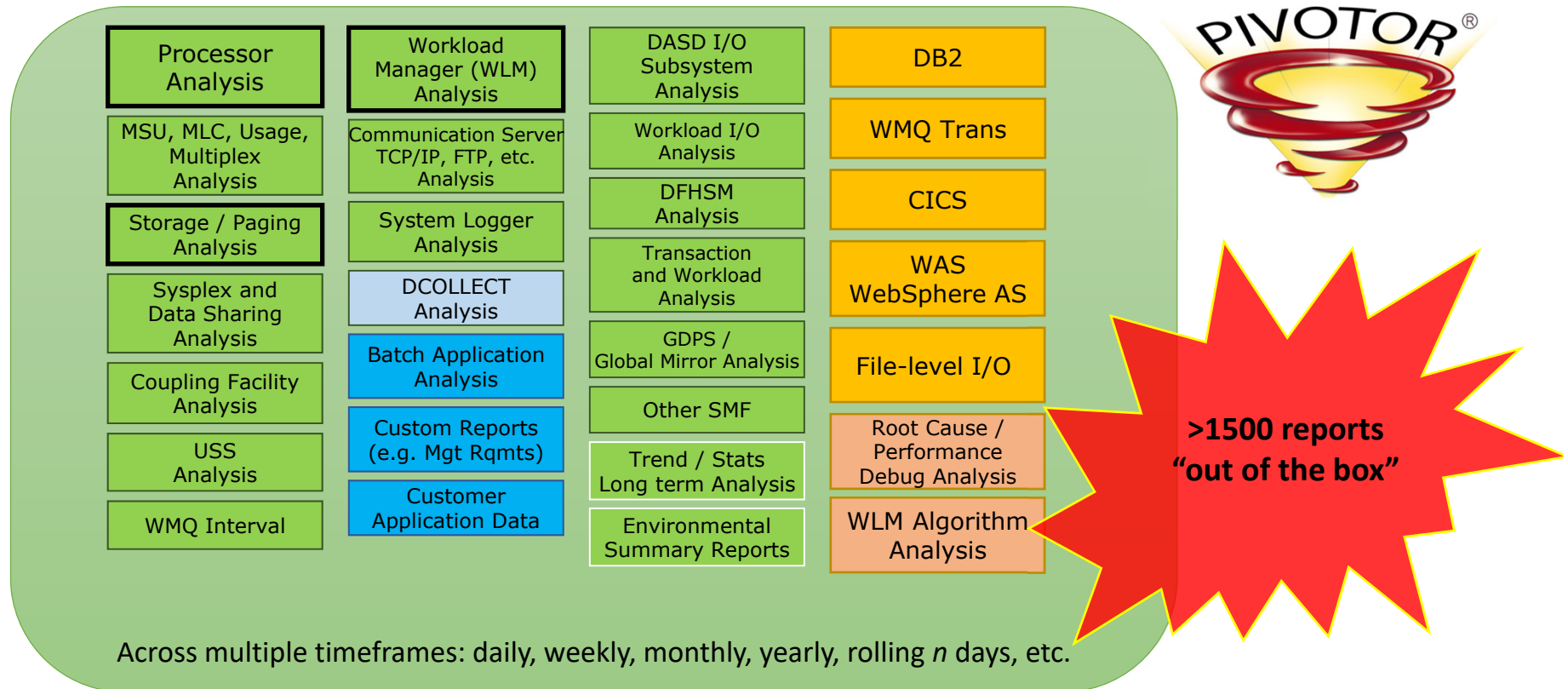
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- We also have a free Pivotor offering available as well
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  - That still encompasses over 100 reports!

Presentation Overview

- ☐ **WLM on z/OS manages a wide assortment of address spaces**
  - ■ But not all address spaces are alike
  - ■ So not all address spaces are managed by WLM the same way

- ☐ **WLM performance analysts need to gain an understanding of the way WLM views address spaces**
  - ■ Needed to set an effective goal
  - ■ Needed to interpret measurements

- ☐ **Peter philosophy**
  - ■ A clearer understanding of the different address space types should
    - ☐ Help you to intelligently set the proper goals for work
    - ☐ Help you to better understand why WLM is managing work a certain way
    - ☐ Better enable you to interpret measurements

Formatting XML Version of WLM Service Definition

First – I want to let you know we have updated our 'WLM to HTML' tool on our website

- For many years we helped you convert your WLM GML to HTML

- Now we can help you to convert your WLM XML to HTML

WLM Service Definition in XML Format

☐ New Function: the WLM service definition can be save in two formats

- ISPF Tables or XML format (*the XML is relatively new function*)

☐ Today, it is recommended to save the WLM service definition in XML format

- The ISPF tables are automatically updated when they are touched by new APARs or z/OS releases. This then makes then ineligible to be updated if the APARs or z/OS releases are rolled back, or if an older release needs to edit or access.

☐ Select

- File
- -> Save as

Use Save as to save the currently displayed service definition in a PDS as ISPF tables or in a PS as XML

```
File  Utilities  Notes  Options  Help
-------------------------------------------------------------------------
Functionality LEVEL025 Definition Menu WLM Appl LEVEL025
Command ===> _____

Definition data set . . : none

Definition name . . . . . _____  (Required)
Description . . . . . . . _____

Select one of the following options.
___  1. Policies                        12. Tenant Resource Groups
     2. Workloads                        13. Tenant Report Classes
     3. Resource Groups
     4. Service Classes
     5. Classification Groups
     6. Classification Rules
     7. Report Classes
     8. Service Coefficients/Options
     9. Application Environments
    10. Scheduling Environments
    11. Guest Platform Management Provider
```

After you save WLM Service Definition to XML file…

☐ The XML file will look crazy!

Updated WLM to HTML Tool

☐ Once saved as XML, a tool is available to nicely format the XML file into a easy to read format to assist during your WLM analysis

☐ Visit www.pivotor.com or www.epstrategies.com

☐ Select 'Free!' option

☐ Select WLM TO HTML

☐ Provide your XML file and email address

  ■ HTML formatted WLM service definition emailed to you in seconds!
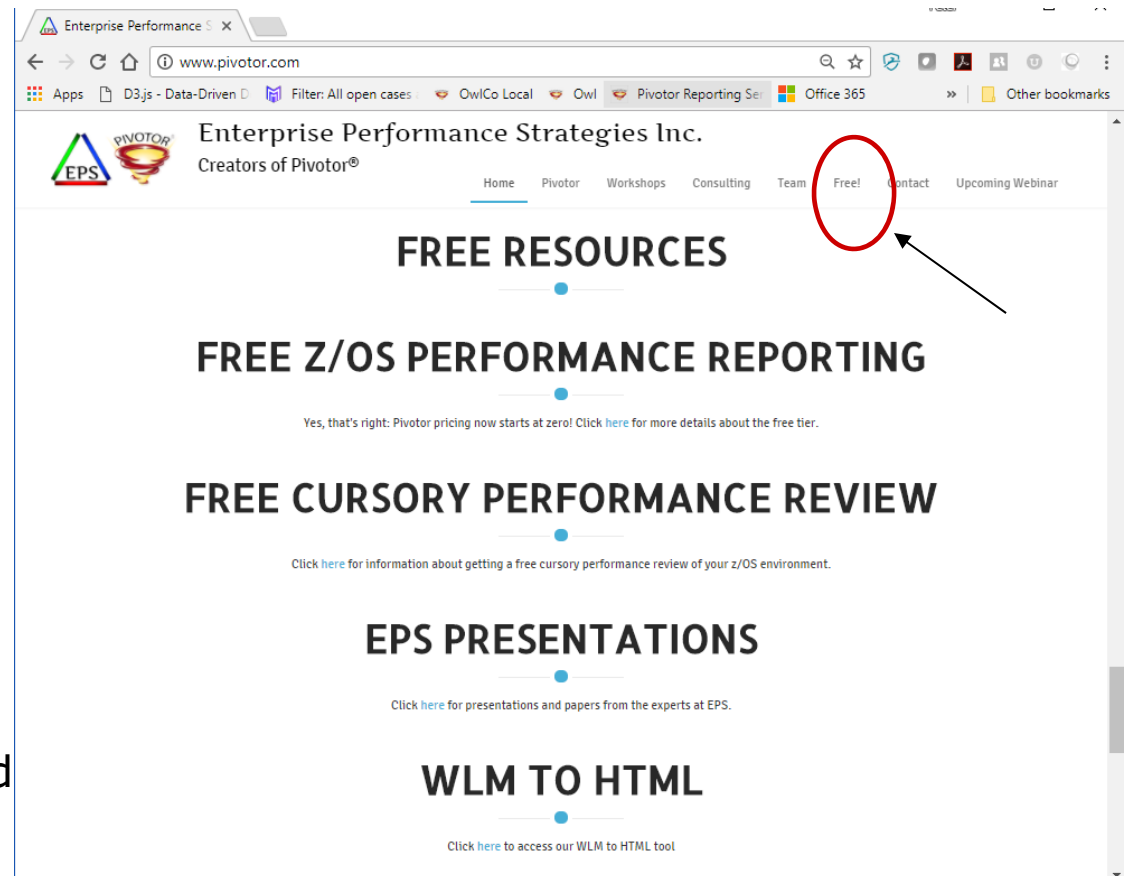
Example of HTML Formatted Service Definition

☐ **Not only is the XML file nicely formatted**

But there is some analysis built into the file to help you with your service definition cleanup.

OK… Now let's talk about Address Spaces

z/OS Workload Management Participants

- ☐ **Not all work running on the z/OS operating system is managed the same by WLM**
  - ■ The types of WLM goals that a subsystem supports depends on the sets of WLM services that the subsystem exploits

- ☐ **The following broad categories of work are recognized and managed by WLM**
  - ■ Thus, any goal type can be specified for the following types of work
  - ■ They all, also, support multi-period service classes

Subsystems that have address space oriented transactions:
- APPC
- JES2 (*)
- JES3 (*)
- UNIX System Services
- TSO/E
- Started Tasks (*)

Subsystems that use independent enclaves:
- Component Broker
- DDF
- IBM HTTP Server
- MQSeries Workflow
- TCP
- NetView
- LSFM
- SOMobjects
- WebSphere

Note: CICS and IMS subsystems do not use enclaves, but use a different set of services to support transactions to WLM.

(*) Catch all subsystem types for different types of servers

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

VTAM

CICS TOR

CICS AOR

DB2

Batch Job

??? (Transaction server of some sort)

TCP/IP

WebSphere Controller Region

WebSphere Servant Region
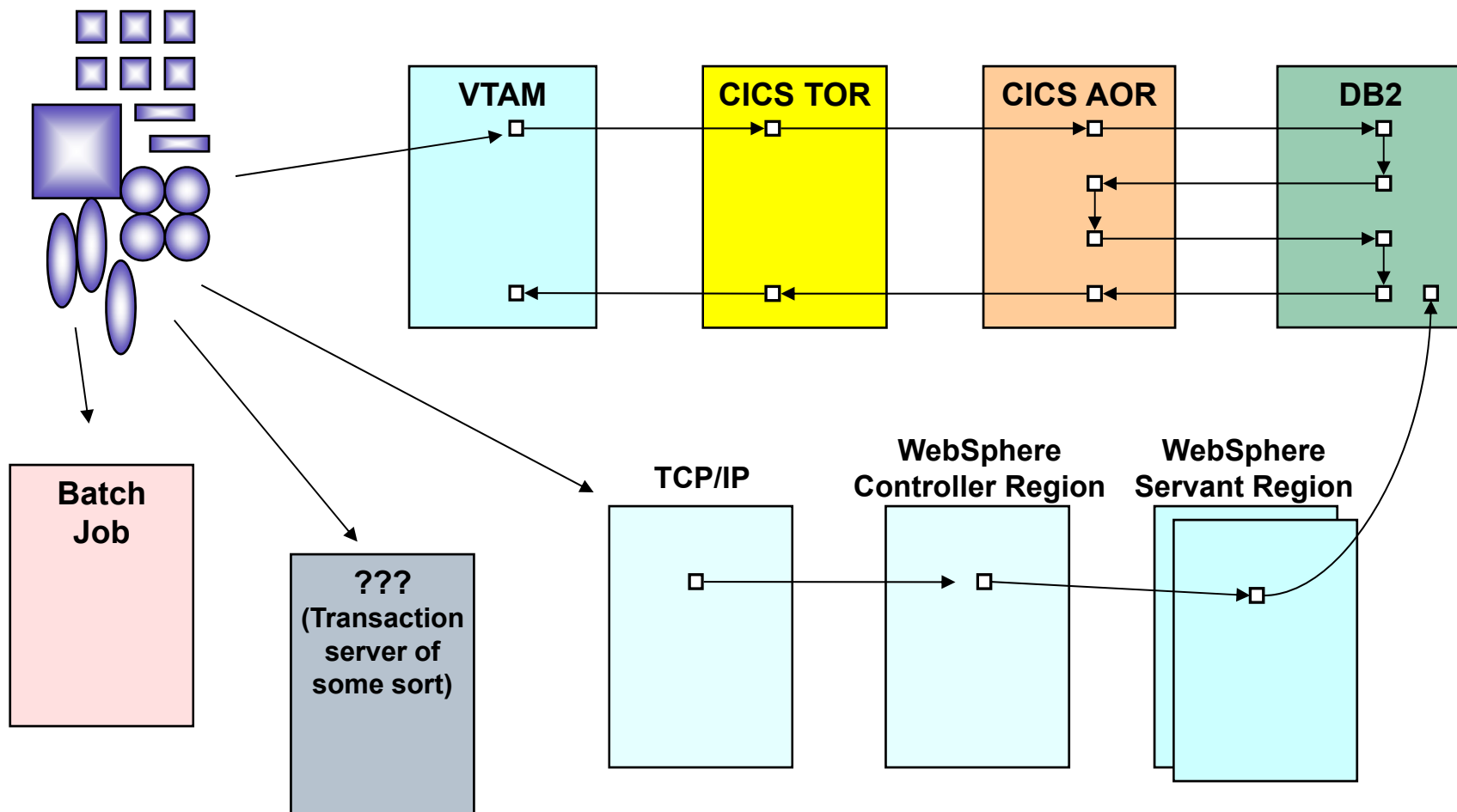
WLM's Interest in Servers

☐ 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?

Server A   **Server B**   **Server C**

z/OS System Resources
CPU, Storage, Access to I/O
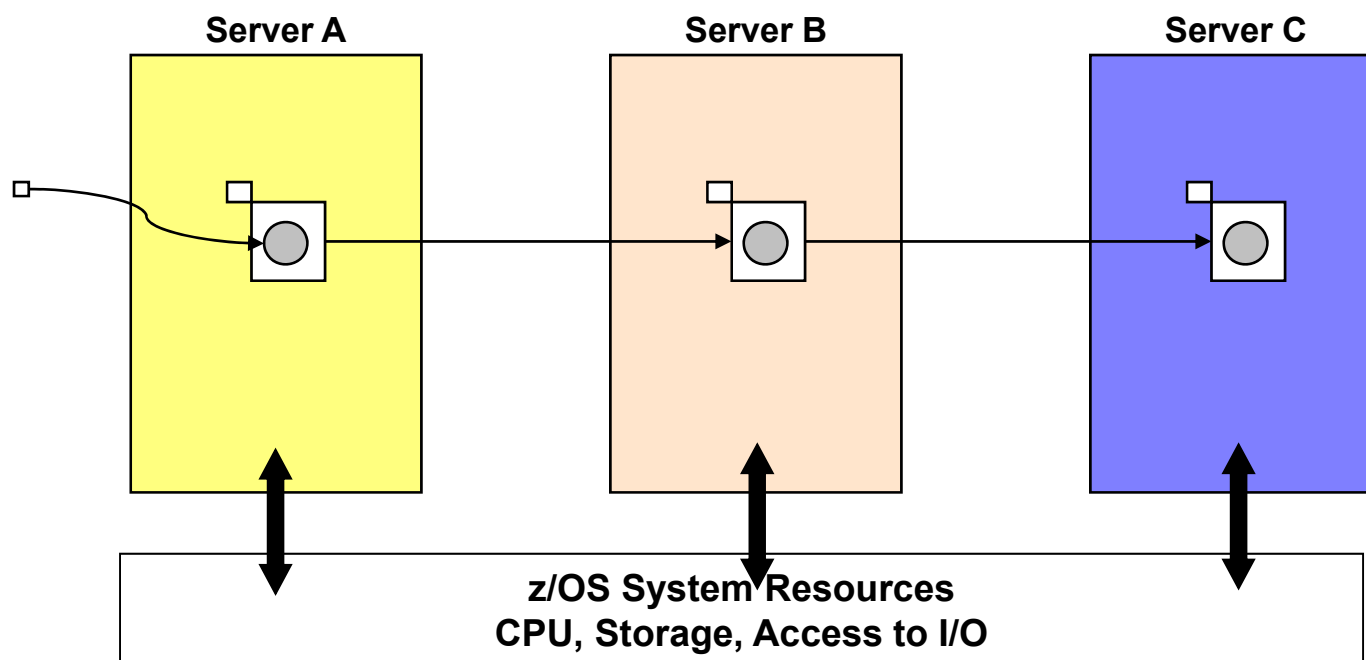
Why should you care?

- For many years, two of my strongest recommendations have been:

  1) **Always try to classify like work with other like work**
  2) **Always try to classify unlike work away from other unlike work**

- Since not all address space are alike, then it means we need to group like, and separate unlike

- Why?
  - WLM Management
  - Goals
  - Importance
  - Classification
  - Measurements (such as CPU times and MSUs)

Types of Address Spaces
(From Peter's Point-of-View)

Please note that these are names and groupings are made up by me (Peter Enrico) to help you

Group 1 – Self Serving Address Spaces
- Server address spaces whose transactions **are not** distinguishable from their host
- Examples include TSO/E, Batch, OMVS, System started tasks, Monitors, etc.

Group 2 - Non participant servers
- Server address Spaces whose transactions **are not** distinguishable from their host, but these address spaces are hosting transactions of multiple users
- Examples include ADABAS, IDMS, VSAM RLS, OLTP regions managed toward region goal

Group 3 - Enclave servers
- Server address spaces whose transactions **are** distinguishable from their host and managed at the enclave level
- Examples include WebSphere, Stored Procedure Servers, etc

Group 4 – Client SRB Servers and Cross Memory Servers
- Server address spaces whose units of work run in client SRBs or cross memory, but the transactions are really running as an extension of the caller
- Examples include DB2 DBM1, DIST, WAS Controllers

Group 5 – CICS and IMS Online Transaction Processing servers (OLTP Servers)
- Server address spaces whose transactions **are** distinguishable from their host but are still managed as part of the address space
  - Examples include CICS and IMS regions managed towards transaction goals

Group 1 – Self Serving Address Spaces

Self Server Address Spaces

- ☐ Self Server address spaces
  - ■ Do work on behalf of themselves
  - ■ Or do work on behalf of the entire system and all workloads
- ☐ They are managed towards their own goals

TSO

DP=240

CMD

Monitor / Tool

DP=245

DP=245

System Started Task

DP=254

DP=254

Job Select

Batch Queue

INIT

DP=255

Batch

DP=240

DP=240
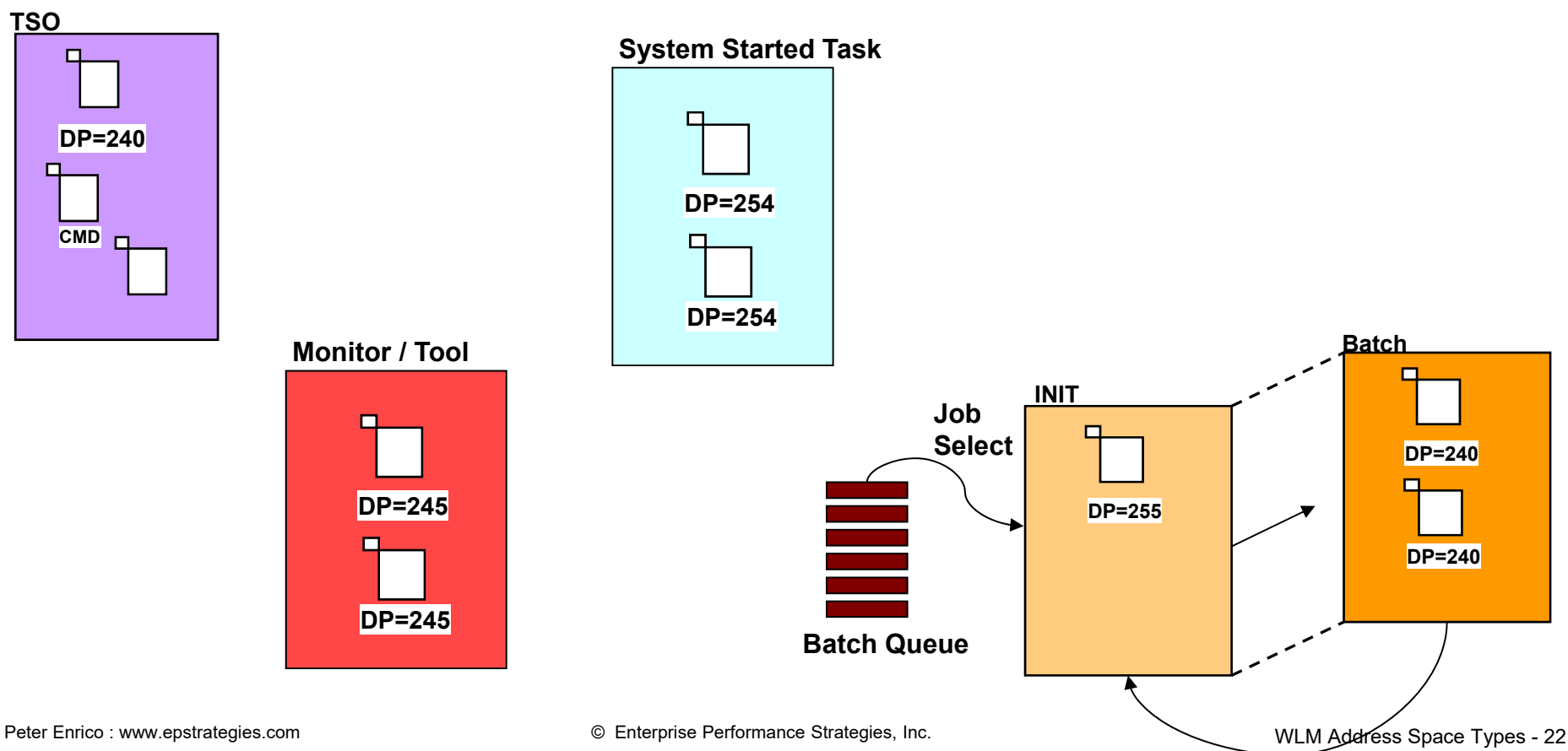
Examples of Self Serving Address Spaces

☐ Any non 'traditional server' address space that does work on behalf of itself or the entire system

☐ Examples of the more popular self servers include
- Interactive workload address spaces such as TSO or USS interactive forked child
- Regular batch (i.e. not other server types started as batch)
- System address spaces
- Started tasks and batch jobs that do work on behalf of the entire system
  - ☐ Such as monitors, system facilities,

☐ These address spaces may call other server types
- But transactions usually originate within themselves
- Or the address space, itself, is the transaction

☐ VTAM and TCP/IP are sort of unique in that they are processing the work on behalf of many different users
- I choose to categorize these as self-serving address spaces

WLM Notes: Self Servers Address Spaces

☐ **WLM Management**
  - ■ Self servers are always managed towards their own goal
  - ■ So all WLM controls are set at the server level or server's service class period level

☐ **Goals**
  - ■ Self Servers goals need to be appropriate for the subsystem type and workload
  - ■ All goal types are possible and reasonable, but relative to the subsystem type

☐ **Importance**
  - ■ Importance should be appropriate for the workload relative to other workloads
  - ■ Self servers that call the other server types should generally be lower importance than the servers they are calling or utilizing

☐ **Classification**
  - ■ Classification is relative to the type of work (ie. TSO via the TSO rules, etc.)

☐ **CPU Time and MSU summary**
  - ■ CPU time and MSUs consumed by these spaces are accumulated to the SMF 30 and service class records of these address spaces
    - ☐ Example: Time consumed by a self server is accumulated to the address space's service class period
  - ■ If these servers are processing dependent enclaves or calling client SRB, than CPU time is accumulated back to the self servers address space

Group 2 - Non Participant Servers

Non-Participant Servers

- Non-participant servers are processing transactions on behalf of users
  - Don't take advantage of services to allow them to be managed as OLTP servers
  - Don't take advantage of services to allow their transactions to be managed in enclaves

- Non-participant servers are managed towards their own goal regardless of what transactions they are processing
  - WLM will not help a non-participant server if the transactions these address spaces are serving are missing their goals

ADABAS
IDMS
VSAM RLS
Etc.
(Non-participant)

Server A   **Server B**
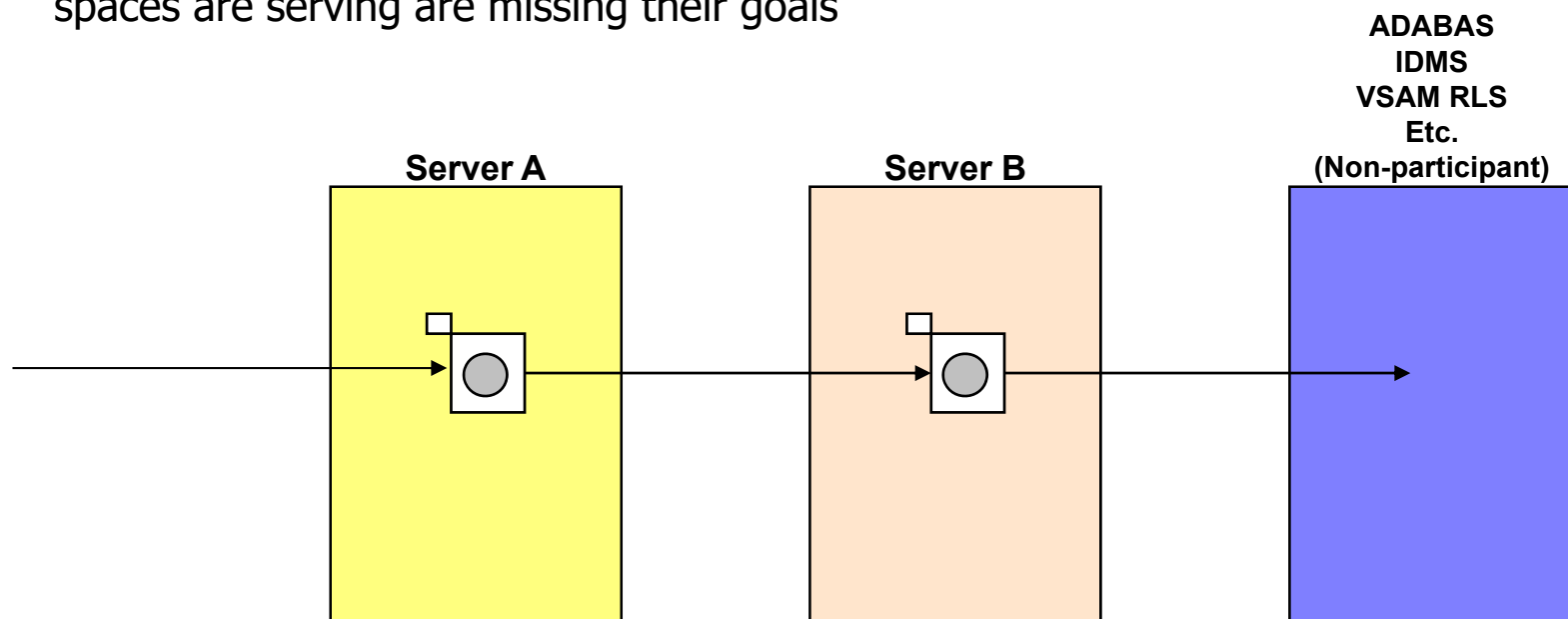
Examples of Non Participant Servers

- ☐ **Any subsystem that processes work on behalf of multiple users**
  - ■ but are not enclaves servers (although they may exploit enclaves)
  - ■ or WLM execution delay monitoring services (such as CICS and IMS managed towards transaction goals)
  - ■ or client SRBs

  is an Non Participant server

- ☐ **Examples of the more popular Non Participant servers includes**
  - ■ ADABAS
  - ■ IDMS
  - ■ VSAM RLS
  - ■ CICS Transaction Gateway (CTG)
  - ■ CICS and IMS if not managed towards transaction response time goal
  - ■ Any database manager that does not support the above referenced services
  - ■ Others such as WebSphere MQ, XCOM, DBMS, etc.

- ☐ **These address spaces process transactions**
  - ■ Could be called by any address space or transaction type
  - ■ May even call another address space or transaction type

WLM Notes: Non Participant Servers

- ☐ **WLM Management**
  - ■ Server is always managed towards it own goal
  - ■ So all WLM controls are set at the server level or server's service class period level

- ☐ **Goals**
  - ■ Non Participant Servers goals need to be healthy to ensure that the transactions they are processing are able to meet their response time objectives
  - ■ Unlike other server types, we have no way to relate the performance of the server directly back to the goal of the transactions they are serving

- ☐ **Importance**
  - ■ Importance should be high
  - ■ But do not put into SYSSTC or SYSTEM since usually storage sensitive

- ☐ **Classification**
  - ■ Non Participant servers are usually started tasks, but they could also be started as batch jobs

- ☐ **CPU Time and MSU summary**
  - ■ SMF 30 Record
    - ☐ CPU consumed by server is accumulated to the server's SMF 30 record
  - ■ SMF 72 Record
    - ☐ CPU consumed by server is accumulated to servers Service Class Period

Group 3 - Enclave Servers

Enclave Server

- ☐ **Enclave server**
  - ■ Address space that hosts dispatchable units which run in enclaves
- ☐ **Enclave servers are managed towards the goal of the transactions**
  - ■ To help enclave transactions, WLM helps the address spaces that hosts the enclaves
  - ■ But the enclaves are also managed towards goal of transaction
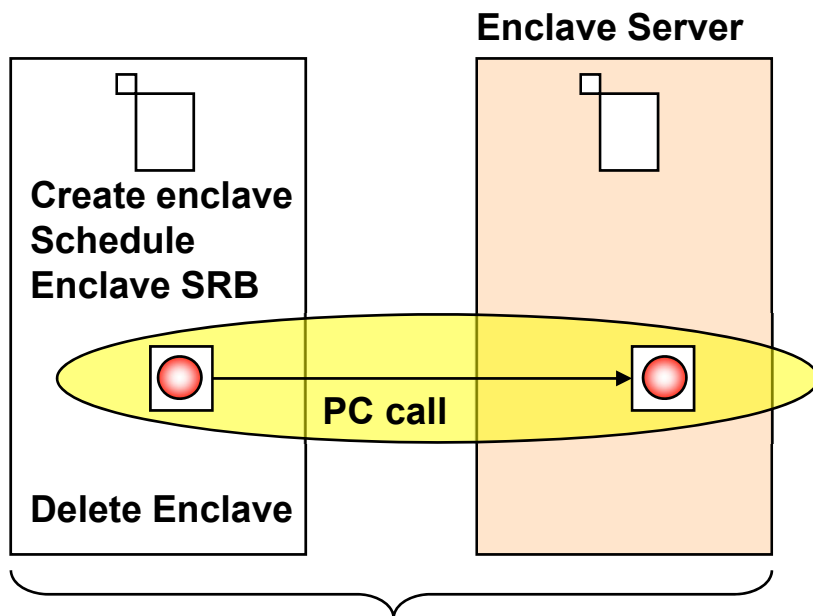
An enclave SRB is running in the address space and SRB has been notified of the relationship
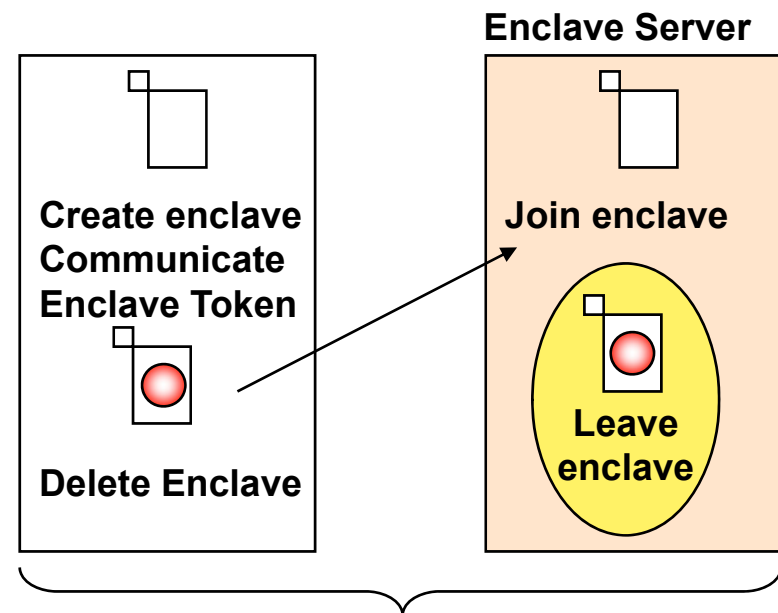
At least one task has joined the enclave

Examples of Enclave Servers

□ **Any subsystem that exploit enclaves and is managed towards**
- ■ Goal of enclave (if independent enclave)
- ■ Goal of caller (if dependent enclave)

□ **The most common Enclave Servers you will deal with on a daily basis include:**

- ■ WLM Stored procedure address spaces
  - □ Run dependent enclaves

- ■ WAS servant regions (but not WAS controller regions)
  - □ Run independent enclaves

- ■ There are some others, but not commonly used

WLM SPAS
Like Address Space

ApplEnv WLMSTP1

DP=245
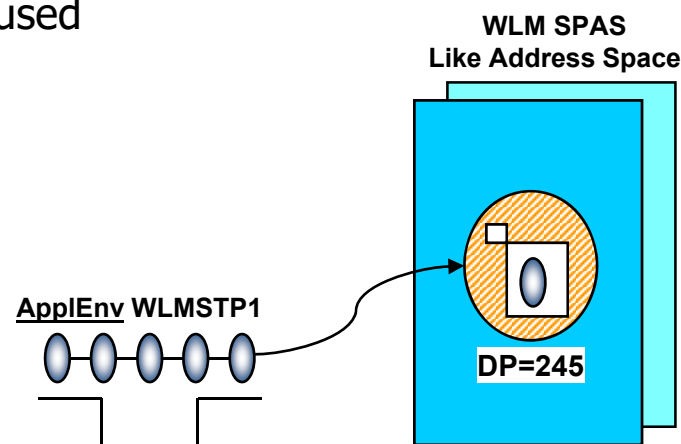
Example of WLM Management of WAS Regions

- **Installation classifies WebSphere transactions and regions as follows**
  - Controller regions classified to WASREGS (WASP1R and WASP2R)
  - Servant regions classified to WASREGS (WASP1RS, WASP2RS)
  - Transactions processed by WASP1R and WASP1RS regions classified to CBHIGH
  - Transactions processed by WASP2R and WASP2RS regions classified to CBMED

WASP1R — CB Rules

WASP1RS / WASP1RS

WASP2R — CB Rules

WASP2RS / WASP2RS / WASP2RS

CBHIGH

IMP 1
RT 0.5 sec, 90%

CBMED

IMP 3
RT 0.25 sec 95%

WASREGS

IMP 1
Velocity 65

WASP2RS / WASP2RS / WASP2R

WASP1RS / WASP1RS / WASP1R
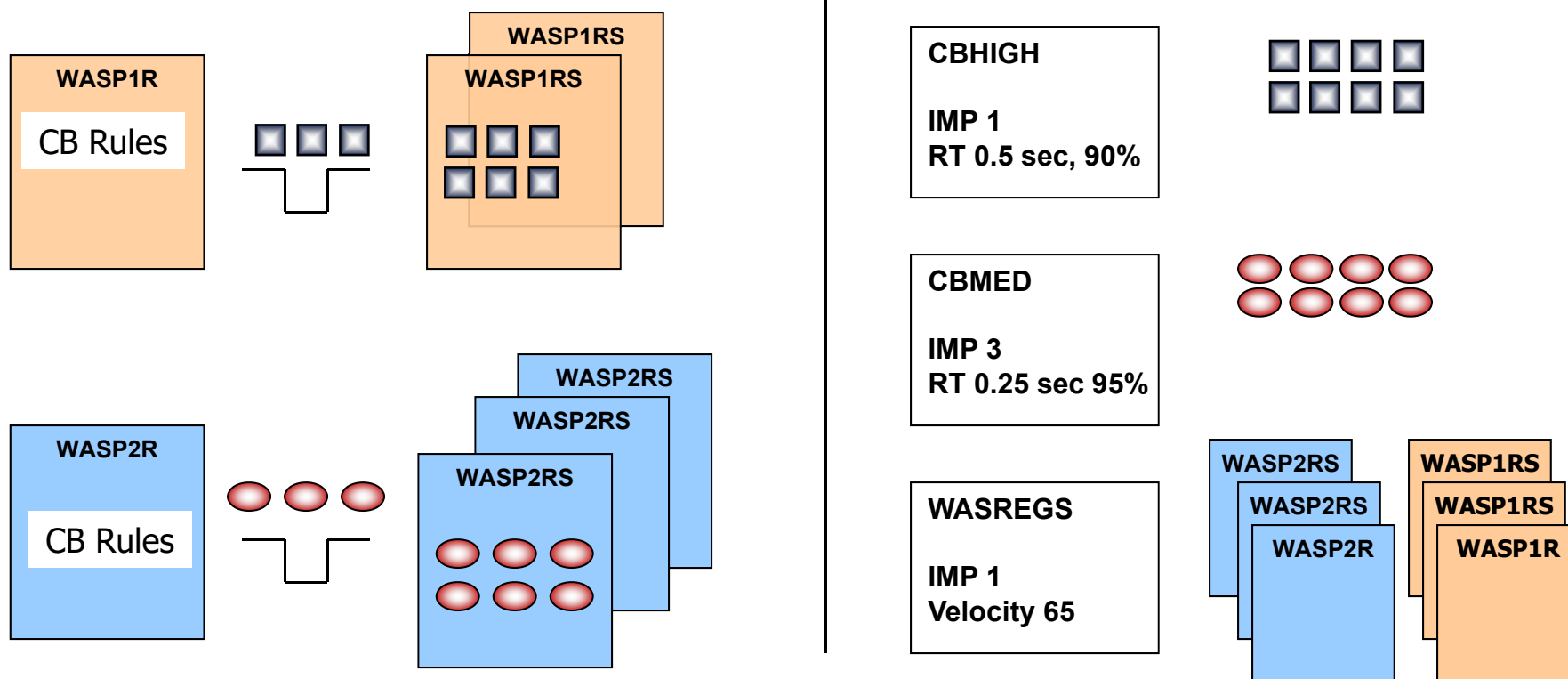
Maps Server Topology For Enclave Servers

- ☐ **WLM is able to determine a server topology for enclave servers**
  - ☐ Map of server to served relationship
  - ☐ WLM creates internal periods and manages the work managers in these periods
  - ☐ Resets servants from goal period (WASREGS in this example) to $SRMSxxx period
    - ■ WASREGS now only contains the controller regions
    - ■ WLM does not manage servant regions towards WASREGS goal

WASP1RS	WASP1RS	**$SRMS001** **Imp n/a** **Goal n/a**	⟷	**CBHIGH** **IMP 1** **RT 0.5 sec, 90%**	

WASP2RS	WASP2RS	WASP2RS	**$SRMS002** **Imp n/a** **Goal n/a**	⟷	**CBMED** **IMP 3** **RT 5 sec 85%**	

Moved out of
WASREGS period

WASP1RS   WASP2RS   **WASREGS**

IMP 1
Velocity 65   **WASP2R**   **WASP1R**

Peter Enrico : www.epstrategies.com
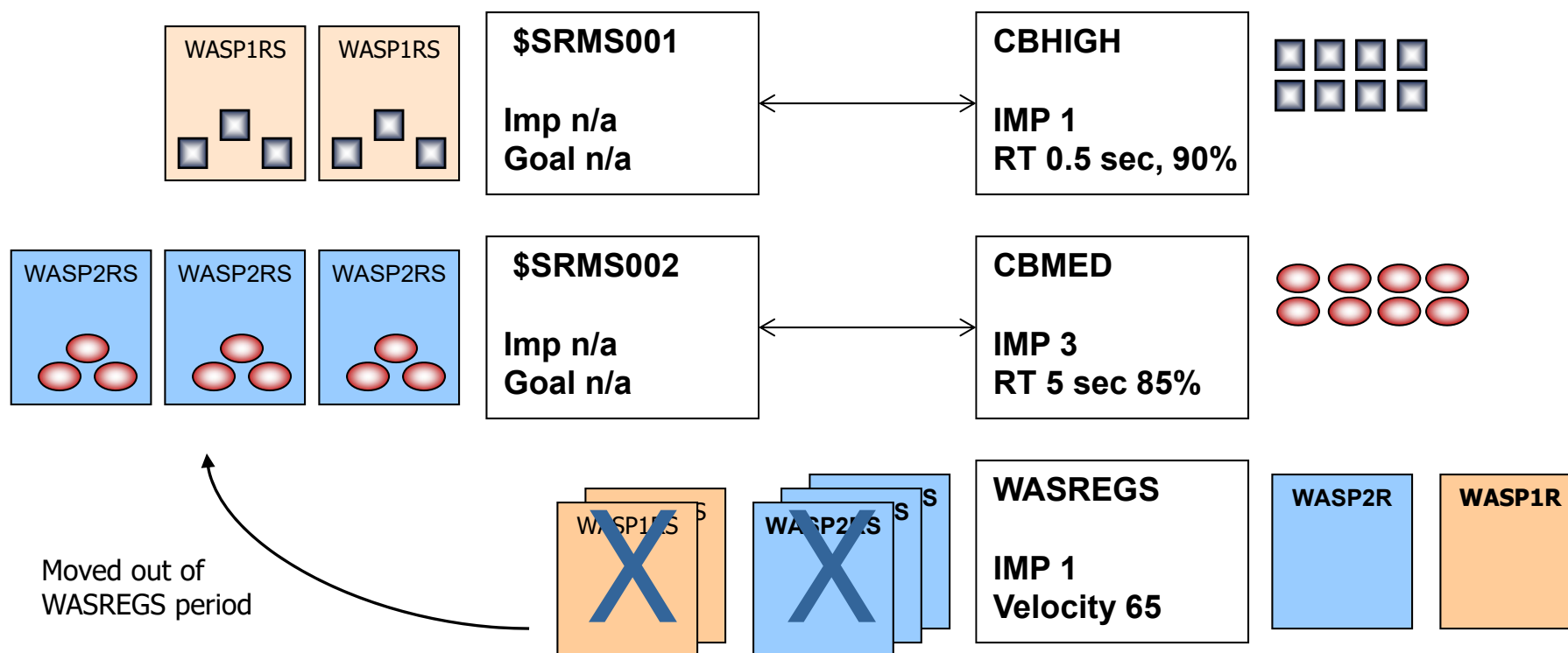
WLM Notes: Enclave Servers

☐ **WLM Management**
- ■ At address space initialization, server is managed towards it own goal
- ■ When server is found processing enclave transactions, it is managed toward the goal of the transactions it is serving (See next foil)

☐ **Goals**
- ■ Enclave Servers goals need to be healthy for initialization, termination, and periods of inactivity… otherwise goal ignored
  - ☐ Segregate to their own service class.

☐ **Importance**
- ■ Importance should be higher than the enclave transactions it is serving
- ■ But do not put into SYSSTC or SYSTEM since it is storage sensitive

☐ **Classification**
- ■ Enclave servers are usually started as started tasks, but they could also be started as batch jobs
- ■ In some cases (such as IHS) the server could be started via a USS command
- ■ Put to a server class where all address spaces are potentially 'server = yes'

☐ **CPU Time and MSU Summary**
- ■ SMF 30 Record
  - ☐ CPU consumed by server on behalf of itself is accumulated to the server's SMF 30 record
  - ☐ CPU accumulated by enclaves is accumulated to the enclave server that created the enclave
- ■ SMF 72 Record
  - ☐ CPU consumed by server on behalf of itself is accumulated to servers Service Class Period
  - ☐ CPU consumed by enclaves running in server is accumulated to enclave's Service Class Period
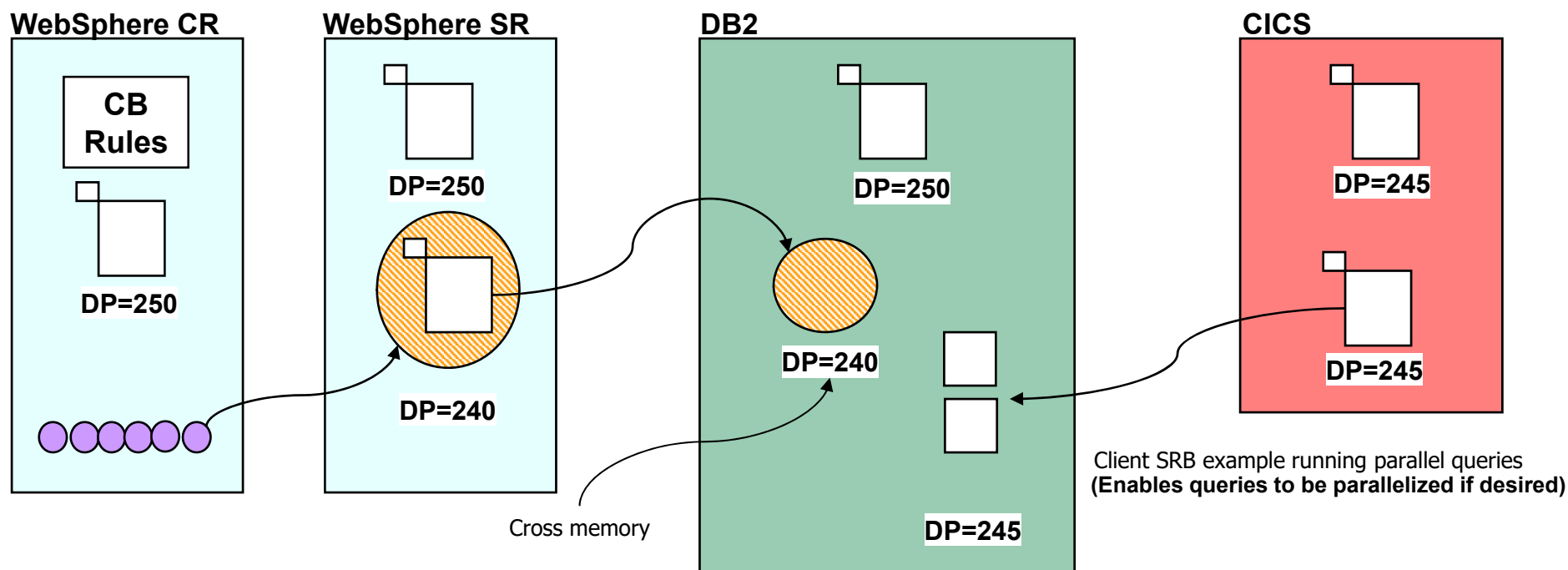
Group 4

– Client SRB Server Spaces
– Cross Memory Server Spaces
– Address spaces that create enclaves

Group 4 Examples

☐ **Address spaces whose dispatchable units managed as extensions of other address spaces, but still do work on behalf of the subsystem**

- **DB2 xxxxDBM1**

☐ **Address spaces that may create enclaves, but are not managed as enclave servers**

- **DB2 xxxxDIST**
- **WAS Controllers**

WebSphere CR

CB Rules

DP=250

DP=250

WebSphere SR

DP=250

DP=240

DB2

DP=250

DP=240

DP=245

CICS

DP=245

DP=245

Cross memory

Client SRB example running parallel queries
(Enables queries to be parallelized if desired)

WLM Notes: Client SRB Servers , Cross Memory Servers, enclave creators

- ☐ **WLM Management**
    - ■ Address space is managed towards it own goal, but queries running in client SRBs are running as an extension of the client address spaces

- ☐ **Goals**
    - ■ Client SRB Servers (such as DB2 DBM1) are near the top of the feeder CPU food chain
    - ■ The same is true for enclave creators such as DB2 DIST and WAS controller regions
    - ■ Need to make sure that the goal is healthy so that it has a good CPU DP
        - ☐ Although client SRBs (queries) run at the DP of the client, the server still needs to do work on behalf of all requests. If it does badly, the server may 'dry up'

- ☐ **Importance**
    - ■ Should be high since so much work depends on this type of server
    - ■ But do not put into SYSSTC or SYSTEM since it is storage sensitive

- ☐ **Classification**
    - ■ DB2 is usually classified via the STC rules

- ☐ **CPU Time and MSU summary**
    - ■ SMF 30 Record CPU is accumulated to the caller's address space
    - ■ SMF 72 Record CPU is accumulated to the caller's Service Class Period
   - ■ But DB2 DBM1 address spaces still have a lot of CPU accumulated back to the address space

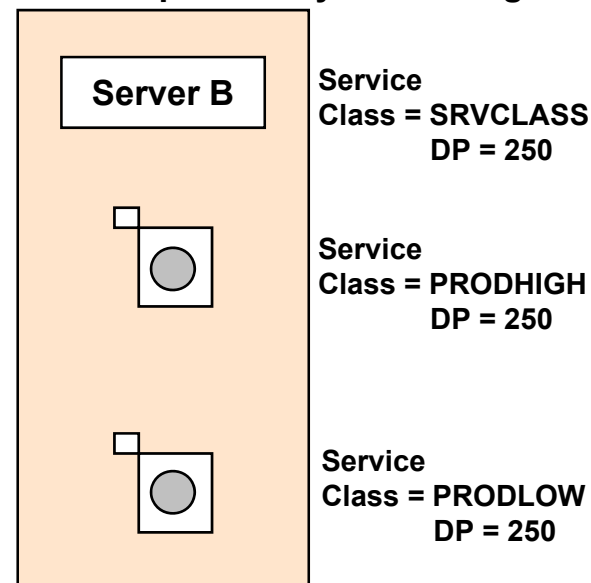# Group 5 – CICS and IMS Online Transaction Processing Servers (OLTP) Managed Towards Transaction Goals

Execution Delay Monitoring

- ☐ Exploited by the following subsystems
  - ■ CICS
  - ■ IMS

- ☐ **Because they don't use enclaves, controls, such as CPU dispatch priority, are obtained from the home address space**
  - ■ The best WLM can do is manage the region to help the transactions

Work Manager
With Enclaves

Server A

Service
Class = SRVCLASS
DP = 250

Service
Class = PRODHIGH
DP = 245

Service
Class = PRODLOW
DP = 192
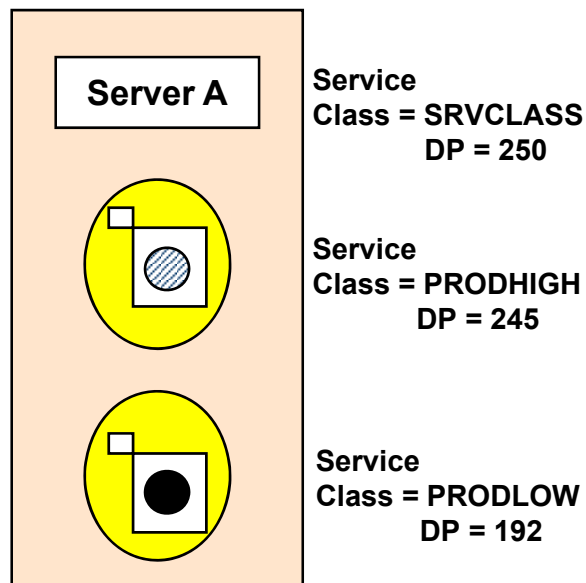
Work Manager Without Enclaves
But Exploit Delay Monitoring Services

Server B

Service
Class = SRVCLASS
DP = 250

Service
Class = PRODHIGH
DP = 250

Service
Class = PRODLOW
DP = 250

Maps Server Topology For Management

☐ **Work managers use Classify, Notify, Report, and PB services**

☐ **WLM sampler samples PBs, tallies Report and Notifies and gains an understanding**

    ■ Which transactions are being processed by which regions

    ■ Frequency that each transaction was processed by each region

Service

Class	**Goal**

CICSTRXA = IMP 1, RT .5 sec, 90%

CICSTRXB = IMP 3, Avg RT 3 sec

CICSTRXC = IMP 5, RT 20 sec, 85%

CICS TORs

TOR-B
TOR-A

CICS AORs

AOR-A   AOR-B

AOR-C   AOR-D

CICS FOR

FOR-A

Server Histories – One per server

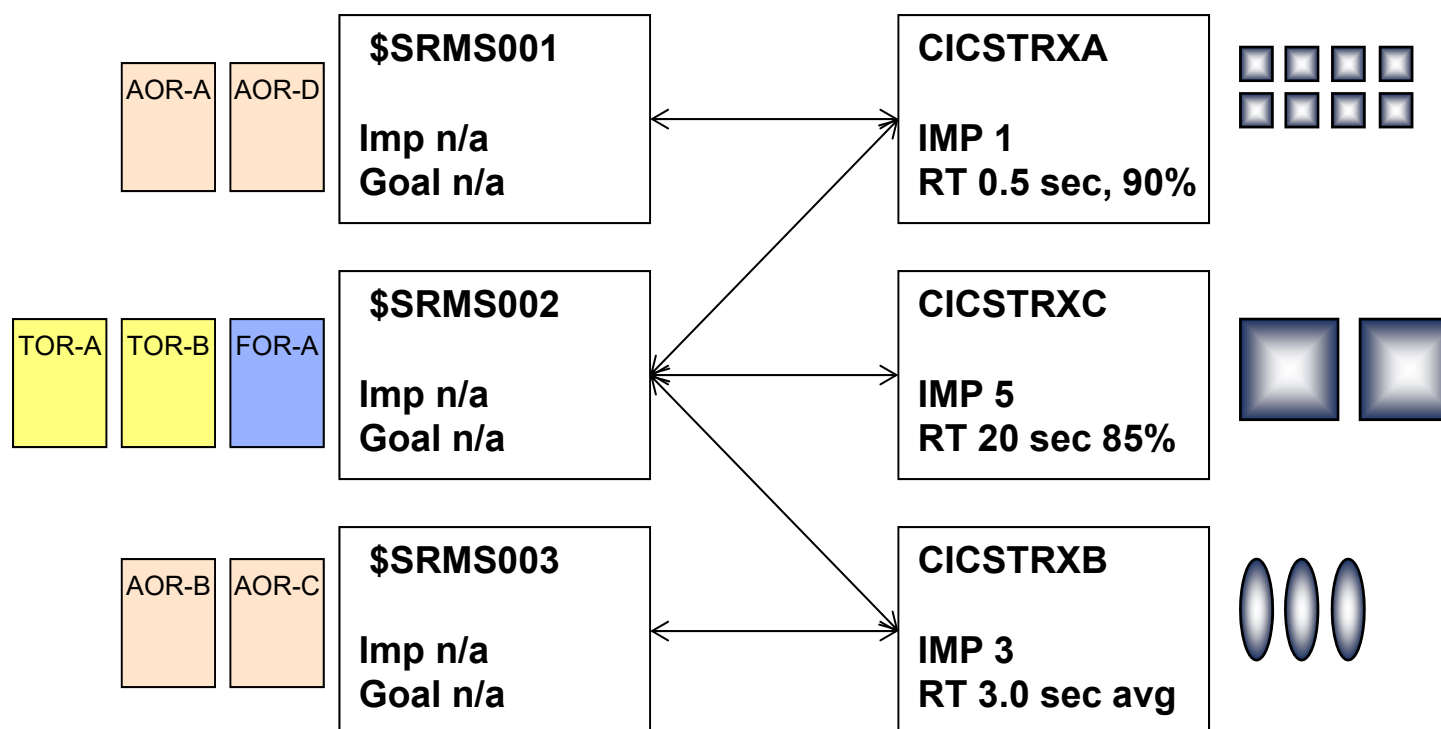| TOR-A served:	AOR-A served:
• CICSTRXA = 1000 times	• CICSTRXA = 400 times
• CICSTRXB = 400 times	• CICSTRXB = 0 times
• CICSTRXC = 50 times	• CICSTRXC = 0 times

Etc..
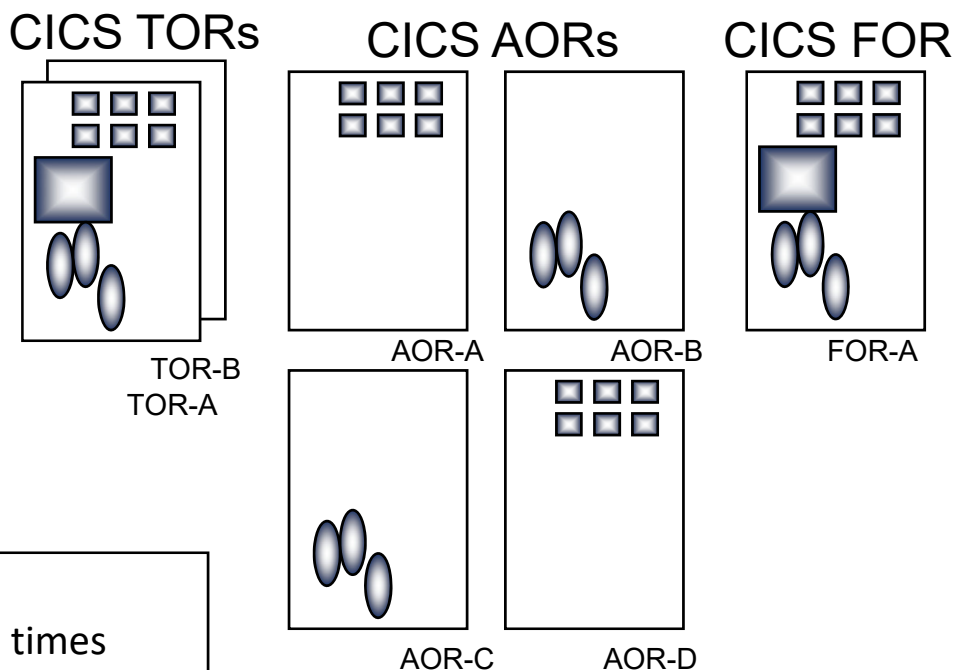
Maps Server Topology For Management

☐ With server histories WLM is able to map out the server topology
  ■ Map of which servers are processing which transactions
  ■ Map of which transactions are being processed by which servers

☐ WLM creates internal periods and manages the work manages in these periods
  ■ Assign goal is ignored

AOR-A	AOR-D

$SRMS001

Imp n/a
Goal n/a

CICSTRXA

IMP 1
RT 0.5 sec, 90%

TOR-A	TOR-B	FOR-A

$SRMS002

Imp n/a
Goal n/a

CICSTRXC

IMP 5
RT 20 sec 85%

AOR-B	AOR-C

$SRMS003

Imp n/a
Goal n/a

CICSTRXB

IMP 3
RT 3.0 sec avg

WLM Notes:
CICS & IMS Towards Transaction Goals

☐ **WLM Management**

- At address space initialization, server is managed towards it own goal
- When server is found processing the transactions, it is managed toward the goal of the transactions it is serving
- Note: Server could be serving transactions assigned different goals

☐ **Goals**

- The goals CICS and IMS Servers managed towards their transactions' goals need to be healthy for initialization, termination, and periods of inactivity… otherwise goal ignored

☐ **Importance**

- Importance should be higher than the transactions it is serving
- But do not put into SYSSTC or SYSTEM since it is storage sensitive

☐ **Classification**

- Could be started as either batch or started task (so JES rules or STC rules)

☐ **CPU Time**

- SMF 30 Record
  - ☐ All CPU time consumed by server on behalf of itself or its transactions is accumulated to the server's SMF 30 record
- SMF 72 Record
  - ☐ All CPU time consumed by server on behalf of itself or its transactions is accumulated to the server's Service Class Period

Presentation Summary

☐ For many years, two of my strongest recommendations have been:

    1) **Always try to classify like work with other like work**
    2) **Always try to classify unlike work away from other unlike work**

☐ Review the classification of your address space
- Self Serving Address Spaces
- Non-Participant Transaction Server Address Spaces
- Enclave Server Address Spaces
- CICS and IMS Transaction Server Address Spaces
- Client SRB Host Address Spaces

☐ Remember the key differences
- WLM Management
- Goals
- Importance
- Classification
- Measurements (such as CPU times and MSUs)

Conclusion

☐   I know this was a lot to take in…

☐   Contact me if you have any questions:
- ■   Email: peter.enrico@epstrategies.com

☐   Consider attending my WLM workshop later this fall
- ■   You will learn a great deal about WLM, and you will conduct an WLM analysis of our own service definition and data

☐   Sign-up to be notified of our monthly z/OS performance and capacity planning educational webinars