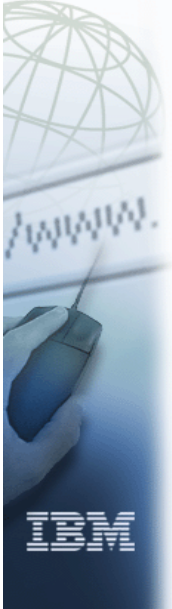


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Powerful and secure infrastructures with WebSphere Application Server for z/OS

WAS 5 WLM considerations



Redbooks

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Unit Objectives

- Repetition: WLM Basics
- Understand the relationship between WebSphere and WLM
 - Application Environments
 - Workload Classification
 - Classification inheritance
- Learn about the performance problems that can occur if WLM is not tuned correctly for WebSphere
- Identify the configuration changes that should be in place for WLM to provide the desired levels of service



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Overview

Workload Manager (WLM) Overview

- Component of z/OS that allocates system resources
- Operates based on rules you define
 - You classify similar business applications into workloads
 - You define importance (priority) goals for each workload
- WLM allocates resources based on priority goals

WLM Service Classes

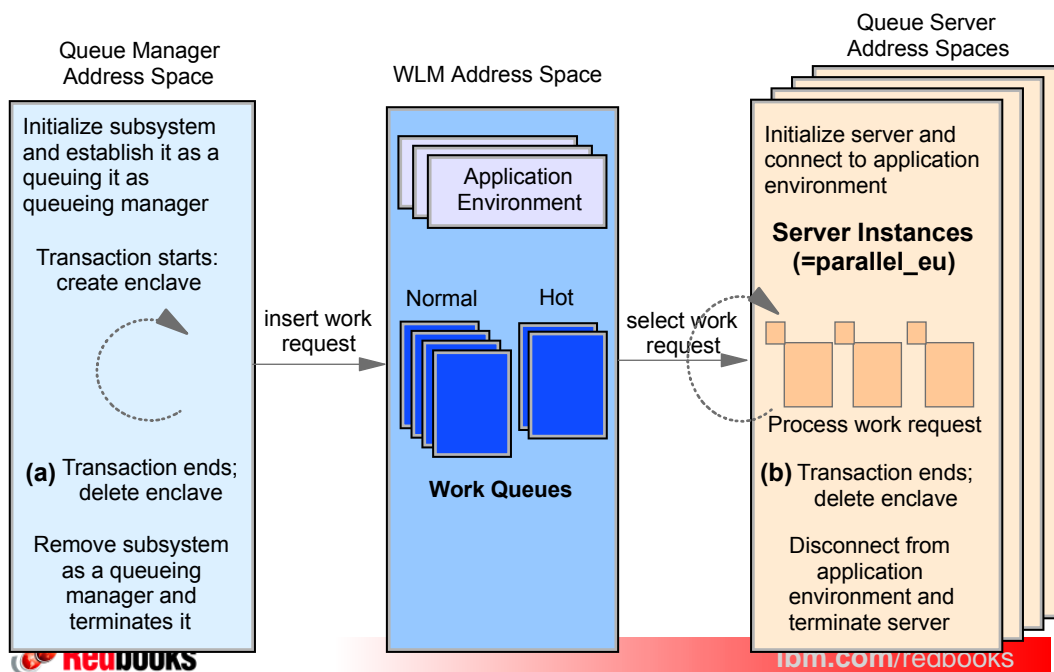
- Classification rules assign a workload to a Service Class
- Service Class priority can be assigned as:
 - Percentage Response Time (transaction-based work)
 - Velocity (non-transaction-based work)
 - Discretionary (low priority)
- Supports multiple performance periods with unique priorities



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WLM Application Environment Overview



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WLM Application Environments

- A feature of WLM used by WAS and other subsystems
- Composed of a Queuing Manager and Server Managers
- Queuing Manager
 - Usually only one
 - Receives work and passes it to WLM
 - WLM passes work on to a Queue Server
- Queue Server (servant)
 - Usually multiple; running in separate address spaces
 - Accepts work from Queuing Manager and WLM
 - WLM will start the first one when work arrives
 - WLM will start/stop others to meet Service Class goals
 - May be started across the Sysplex
- Implemented using Enclaves
- Two types of application environments:
 - static
 - dynamic



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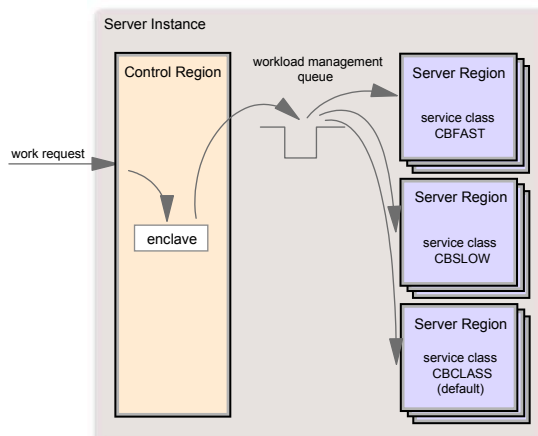
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WLM Application Environments

- ▶ The WLM application environment definition tells WLM how it can start servant address spaces in order to manage the number of servants for the environment. The administrator defines a name, the subsystem type of the application, the name of the start procedure for the server address spaces and optionally parameters which are passed to the application server.
- ▶ WLM manages the Servants within the environment. (i.e., starts new Servants when the workload gets heavy; distributes work evenly across available Servants; etc.)

Queue
Manager

Queue
Server



Application Environment Definition consists of a Name, Subsystem Type, a JCL Start procedure, and any parms for the Start procedure.



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Static Application Environments

■ Defining static ApplEnvs for WAS:

- Defined in WebSphere and WLM
- Application Environment name = WAS Server name
- The subsystem type will always be CB
- Must specify the PROC name to be started by WLM
- Set number of servers to 'No limit'
 - May want to specify '1' just during new application testing
 - Required if you need more than one server region per system
 - Required if you have multiple Service Classes for that J2EE Server defined

Service Class Recommendation

- Within the type CB classification rules...
- Define a default Service Class with high priority
 - Avoids problems during classification
 - Otherwise, default is SYSOTHER (low priority)

```
Application Environment Name . : HAOASR2
Description . . . . . WAS HA J2EE Application Server
Subsystem Type . . . . . CB
Procedure Name . . . . . HAOASR2S
Start Parameters . . . . . IWMSSNM=&IWMSSNM
```

Limit on starting server address spaces for a subsystem instance:

- ```
1 1. No limit
 2. Single address space per system
 3. Single address space per sysplex
```



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# Dynamic Application Environments (DAE)

- Provided with fix for APAR OW54622
- Definitions made only in WebSphere
- Changes SERVER class profiles from

- ▶ <subsys\_type>.<subsys\_name>.<appl\_envir\_name> to ..
- ▶ <subsys\_type>.<subsys\_name>.<appl\_envir\_name>.<cell\_name>

## ■ WAS Environment needs additional variables, defined automatically

- ▶ server\_region\_dynapplenv\_jclproc
- ▶ server\_region\_dynapplenv\_jclparms
- ▶ daemon\_group\_name ( == cell\_short\_name)
  - BBOM0001I server\_region\_dynapplenv\_jclparms: JOBNAME=&IWMSSNM.S,ENV=CELD.F.NODDF.&IWMSSNM
  - BBOM0001I server\_region\_dynapplenv\_jclproc: WAS5DSF .

## ■ does it work?

- ▶ server\_generic\_sh
- ▶ MVS Commands:

```
DISPLAY WLM,DYNAPPL=CLUDEF
IWM029I 17.49.41 WLM DISPLAY 457
DYNAMIC APPL. ENVIRON. NAME STATE STATE DATA
CLUDEF AVAILABLE
ATTRIBUTES: PROC=WAS5DSF SUBSYSTEM TYPE: CB
SUBSYSTEM NAME: WASDF NODENAME: CELDF
```

```
BBOM0001I wlm_dynapplenv_single_server: 0.
BBOM0001I wlm_maximumSRCount: 3.
BBOM0001I wlm_minimumSRCount: 1.
```



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- ▶ check log

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## static vs dynamic

| Characteristic | Static AE definitions                                                                                                 | Dynamic AE definitions                                                          |
|----------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Definition     | by the user through the WLM administrative application. available on the system of a sysplex after policy activation. | by the queue manager address space of the application.                          |
| Scope          | all systems of a sysplex                                                                                              | is the queue manager which defined it subsystem_type, node_name, subsystem_name |
| Stored         | WLM Couple Dataset after Policy Install WLM ISPF dataset of the end user                                              | (responsibility of the application, not saved by WLM.)                          |
| Existence      | until the user deletes it from the WLM service definition by activating a service definition without the definition   | as long as the queue manager instance is up and running.                        |



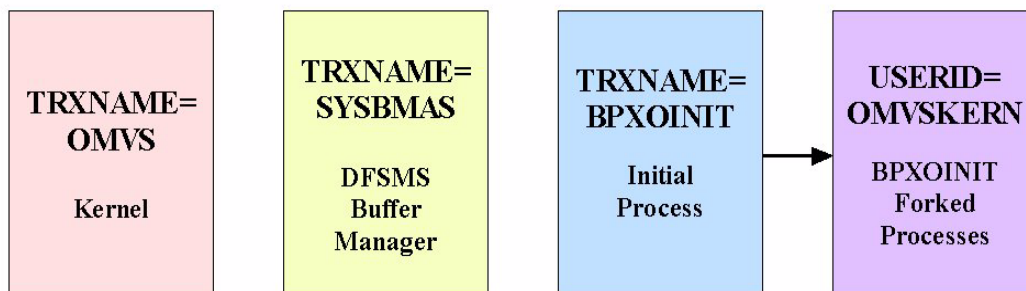
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## WLM definitions for z/OS UNIX

### Assign a High-Priority Started Task (STC) Service Class

- Kernel (TRXNAME=OMVS)
- DFSMS Buffer Manager (TRXNAME=SYSBMAS)
- Initial process (TRXNAME=BPXOINIT)
- BPXOINIT forked processes (USERID=OMVSKERN)



All of these should be assigned high-priority, velocity-based Service Classes



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# WLM Tuning Considerations

## Service Class Assignments for WAS Controllers

- Use a high-velocity Service Class (such as SYSSTC)
- Assign Service Class to all WebSphere related address spaces as
  - Run-time servers
    - Daemon
    - Deployment MGR
    - JMS...
  - Application servers
    - J2EE Server Controllers



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## Service Class Assignments for WAS Servants

- Use a high-velocity Service Class for startup
- Classify work into Service Class based on
  - Application Server name (CN) – This is the “server\_generic\_short\_name” or “Cluster Transition Name” (which is also the application environment name.)
  - The Server instance name (SI) – This is the “server\_specific\_short\_name”. This is usually not very useful because you cannot control which server instance runs a transaction within a cluster.
  - User ID assigned to the transaction (UI)
  - Transaction class (TC) - This can be assigned to a transaction using the transaction class mapping file for the server.
- Transaction Service Class should be response-time based
- Work running under server regions
  - Subsystem type=CB
  - Percentage response time goal is recommended
    - Ex. 80% of transactions < 0.5 seconds
- SUBSYS IWEB is gone



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## Default Service Class Assignments for WAS Servants

- ▶ Server Startup
- ▶ Java garbage collection runs under this classification. Java GC is a CPU and storage intensive process, so if you set the velocity goal too high GC could consume more of the system resources than desired. On the other hand, if your Java heap is correctly tuned, GC for each server region should run no more than 5% of the time. Also, providing proper priority to GC processing is necessary since other work in the server region is stopped during much of the time GC is running.
- ▶ JSP compiles run under this classification. If your system is configured to do these compiles at run-time, setting the velocity goal too low could result in longer delays waiting for JSP compiles to complete.

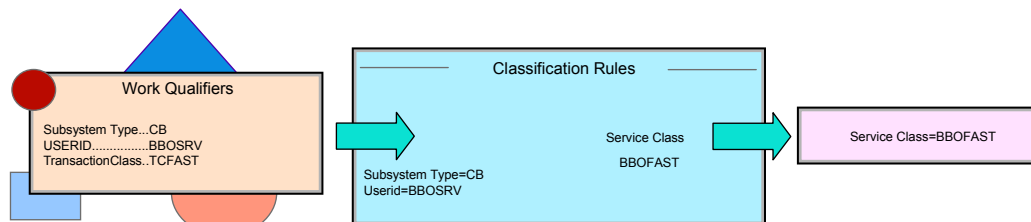


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## Workload Classification

- CB (IWEB is gone) subsystem classification rules (option 6 WLM panels)
- WLM CB rules use three ways to classify
  - by generic server name (J2EE server)
  - by USERID
  - Transaction class (protocol(s)\_http\_transaction\_class; HTTP Transport Handler)
- Enclave
  - A "business transaction" without address space boundaries



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# WLM Address Space Management & Replication

- WLM manages performance at Address Space level
- SRs are assigned to "internal queues" based on the SC
  - For each internal queue, WLM will assign a number of SRs equivalent to MIN\_SRS (ex wlm\_minimumSRCount=2)
  - Each of these SRs will have the same SC
- wlm\_maximumSRCount=2 may interfere with WLM management
  - MAX has to be at least MIN\*#SCs
  - #SCs - number of expected Service Classes
  - If MAX less than MIN\*#SCs, situation illustrated in example 2 may occur
  - Consider having MAX=multiple of (MIN\_SRS\*#SCs) to give WLM more room to work




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## GUI: Setting Min/Max for WAS5

[Application Servers](#) > [wdfndfcdfsc59](#) >

### Server Instance

Configuration settings for servers which may dynamically have more than one servant process (such as on z/OS). 

| Configuration                                                                                                                                     |                                     |                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General Properties                                                                                                                                |                                     |                                                                                                                                                                                                                                                                                                                   |
| Multiple Instances Enabled                                                                                                                        | <input checked="" type="checkbox"/> |  Specifies whether multiple server instance feature is enabled for this server. This field is ignored on platforms that do not include multiple server instance support. An example of where this is typically enabled is z/OS |
| Minimum Number of Instances                                                                                                                       | <input type="text" value="1"/>      |  The minimum number of server instances that may be created dynamically.                                                                                                                                                       |
| Maximum Number of Instances                                                                                                                       | <input type="text" value="3"/>      |  The maximum number of server instances that may be created dynamically.                                                                                                                                                       |
| <input type="button" value="Apply"/> <input type="button" value="OK"/> <input type="button" value="Reset"/> <input type="button" value="Cancel"/> |                                     |                                                                                                                                                                                                                                                                                                                   |

The Maximum should be at least as large as the number of different service classes that might be used by transactions run in the server. Don't forget to account for the "default CB-type service class" and encaves that may originate outside WebSphere servers and are classified by other classification rules such as the "JHS"




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# Transport Handler Classification


[Application Servers](#) > [wdfndfcdfsc59](#) > [Web Container](#) >


## Advanced Settings

Advanced settings for the Web Container. 

**Configuration**

**General Properties**

|                           |                                                                                                         |
|---------------------------|---------------------------------------------------------------------------------------------------------|
| Network QoS               | NONE                                                                                                    |
| Transaction Class Mapping |  /u/wunder/tclass.conf |

Note: If you enable TC mapping via this file WAS will disable your default TC mapping. 

### Transaction Class Mapping file, EBCDIC

protocol\_http\_transport\_class\_mapping\_file=/u/wunder/tclass.conf

protocol\_https\_transport\_class\_mapping\_file=/u/wunder/tclass.conf

#### Syntax

- TransClassMap <host>:<port> <uritemplate> <tclass>

```
TransClassMap *.ibm.com:* /SuperSnoop* TCLASS
TransClassMap *:80* /SuperSnoop* TCLASS
TransClassMap *:80* /SuperSnoop* TCLASS
TransClassMap *:80 /SuperSnoop* TCLASS
TransClassMap * * BBTESTU2
```



defaults: protocol\_http(s) transactionClass=

oks

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## Transaction Class - > Service Class

TransClassMap \* \* BBTESTU1

Subsystem Type CB - WAS V4 Series classification

Created by user ANDRE on 2001/10/02 at 14:54:45

Last updated by user ANDRE on 2002/11/18 at 01:54:03

#### Classification:

Default service class is WASDFLTH  
There is no default report class.

| # | Qualifier type | Qualifier name | Starting position | Service Class | Report Class |
|---|----------------|----------------|-------------------|---------------|--------------|
| 1 | CN             | BBPROD         |                   | WASPROD       |              |
| 1 | CN             | BBTEST         |                   | WASTESTH      | 0285BBT      |
| 1 | TC             | BBTESTU1       |                   | WASTESTH      | BBTESTU1     |
| 1 | TC             | BBTESTU2       |                   | WASTESTH      | BBTESTU2     |

Results reported in RMF monitor I workload activity report

- Transactions per second (not always the same as client tran rate)
- Response times (Goal achieved ?)
- How much of the machine you are using



OVERVIEW(REPORT)  
SYSRPTS(WLMGL(SCPER))  
SYSRPTS(WLMGL(RCPER))

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# RMF WLM Report

REPORT BY: POLICY=WEB\_RAL

REPORT CLASS=BBTESTU2  
HETEROGENEOUS

| TRANSACTIONS | TRANS.-TIME  | HHH.MM.SS.TTT | --DASD I/O-- | ---SERVICE--- | ---SERVICE RATES--- | PAGE-IN RATES | ---STORAGE--- |
|--------------|--------------|---------------|--------------|---------------|---------------------|---------------|---------------|
| AVG 0.00     | ACTUAL       | 39.495        | SSCHRT 0.0   | IOC 0         | ABSRPTN 50618       | SINGLE 0.0    | AVG 0.00      |
| MPL 0.00     | EXECUTION    | 210           | RESP 10.7    | CPU 21310     | TRX SERV 50618      | BLOCK 0.0     | TOTAL 0.00    |
| ENDED 2      | QUEUED       | 39.284        | CONN 7.1     | MSO 0         | TCB 0.2             | SHARED 0.0    | CENTRAL 0.00  |
| END/S 0.00   | R/S AFFINITY | 0             | DISC 3.3     | SRB 0         | SRB 0.0             | HSP 0.0       | EXPAND 0.00   |
| #SWAPS 0     | INELIGIBLE   | 0             | Q+PEND 0.3   | TOT 21310     | RCT 0.0             | HSP MISS 0.0  |               |
| EXCTD 0      | CONVERSION   | 0             | IOSQ 0.0     | /SEC 24       | IIT 0.0             | EXP SNGL 0.0  | SHARED 0.00   |
| AVG ENC 0.00 | STD DEV      | 54.482        |              |               | HST 0.0             | EXP BLK 0.0   |               |
| REM ENC 0.00 |              |               |              |               | APPL % 0.0          | EXP SHR 0.0   |               |
| MS ENC 0.00  |              |               |              |               |                     |               |               |

## SDSF Enclave Report

```
SDSF ENCLAVE DISPLAY SC59 ALL LINE 1-1 (1)
COMMAND INPUT ==> - SCROLL ==
NP TOKEN SStype Status SrvClass Per PGN RptClass ResGroup
2800000D1D CB ACTIVE WASTESTH 1 BBTESTU2
```

Enclave 2400000D3B on System SC59

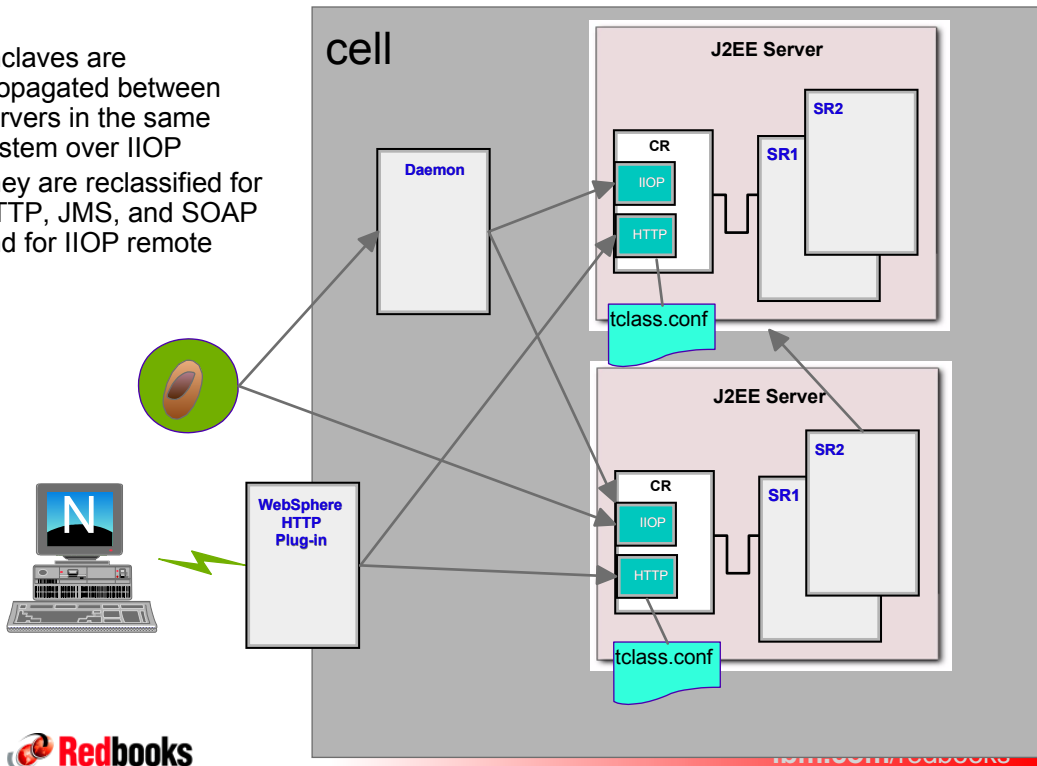
```
Subsystem type CB Plan name
Subsystem name WASDF Package name
Priority Connection type
Userid WDCFSTU Collection name CLUDF
Transaction name Correlation
Transaction class BBTESTU2 Procedure name
Netid Function name BOSS
Logical unit name Performance group
Subsys collection Scheduling env
Process name
```



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## CB Classification

- ▶ enclaves are propagated between servers in the same system over IIOP
- ▶ they are reclassified for HTTP, JMS, and SOAP and for IIOP remote



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## WLM - Table of Possibilities 1

|   | coming                     | WLM Enclave                                    | Service Class chosen<br>(example) | Server Region |
|---|----------------------------|------------------------------------------------|-----------------------------------|---------------|
| 1 | from IHS/WAS plugin in     | created under CB subsys rules (a)              | CB01                              | SR1           |
| 2 | HTTP Transport Handler (b) | created under CB subsys rules (a)              | CB02                              | SR3           |
| 3 | HTTP Transport Handler (c) | created using value from variable CB03 (c)     | CB03                              | SR4           |
| 4 | IIOp local/sysplex         | created under callers token or CB subsys rules | CB04                              | SR5           |
| 5 | IIOp remote                | created under CB subsys rules (a)              | CB05                              | SR6           |

- MIN=1
- MAX not set
- Multiple Instances enabled

- (a) generic J2EE server name or USERID  
 (b) TRANSACTION\_CLASS not set  
 (c) HTTP\_TRANSACTION\_CLASS=CB03

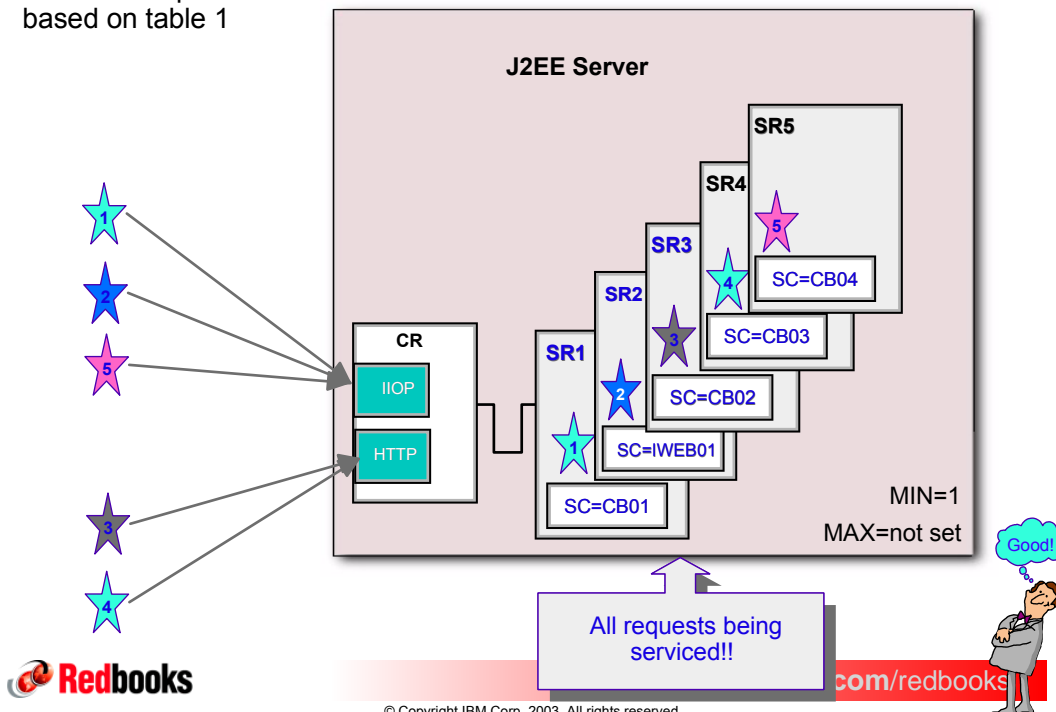


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## WLM - Classification - example 1

obs.: example  
based on table 1



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## WLM - Table of Possibilities 2

|   | coming                     | WLM Enclave                                    | Service Class chosen (example) | Server Region |
|---|----------------------------|------------------------------------------------|--------------------------------|---------------|
| 1 | from IHS/WAS plugin in     | created under CB subsys rules (a)              | CB01                           | SR1           |
| 2 | HTTP Transport Handler (b) | created under CB subsys rules (a)              | CB02                           | SR2           |
| 3 | HTTP Transport Handler (c) | created using value from variable CB03 (c)     | CB03                           | SR3           |
| 4 | IIOp local/sysplex         | created under callers token or CB subsys rules | CB04                           | SR4           |
| 5 | IIOp remote                | created under CB subsys rules (a)              | CB05                           | ?             |

- MIN=1
- MAX=4
- Multiple Instances enabled "

- (a) generic J2EE server name or USERID
- (b) HTTP\_TRANSACTION\_CLASS not set
- (c) HTTP\_TRANSACTION\_CLASS=CB03

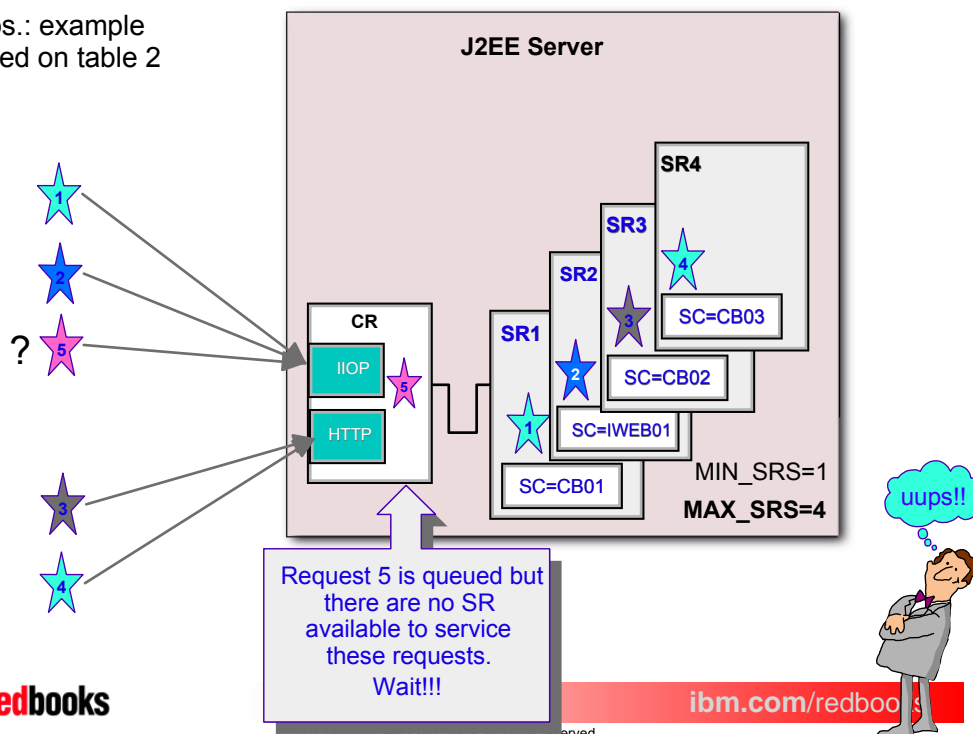


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## WLM - Classification - example 2

obs.: example based on table 2



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## How many Server Regions ?

Only one:

- ▶ Cannot recycle servers for leaking memory

More than one:

- ▶ session externalization or session affinity

To many:

- ▶ high warm-up and JITting times
- ▶ High storage consumption (1 JVM heap per SR)
- ▶ Unnecessary resource consumption

Not enough:

- ▶ Queuing at a high arrival rate (see also # threads)
- ▶ Not enough heap for keeping sessions in memory
- ▶ Cannot connect address space to WLM queue



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## One tran or multiple trans?

You also have a choice of running server regions with an isolation policy of one tran per server region or multiple trans per server region. From a performance perspective, running more threads in a server region will consume less memory but at the cost of thread contention. This contention is application-dependent. We generally recommend the use of multiple trans unless you run into contention problems.

Specify the threads setting using the `server_region_workload_profile`. The variables include:

ISOLATE - sets the value to 1 thread.

CPUBOUND

IOBOUND - default

LONGWAIT - 40



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## Summary

- WebSphere works very closely with WLM, and tuning WLM is vital for good WebSphere performance
- Proper WLM configuration can also provide valuable WebSphere performance and capacity data
- The WebSphere system tasks should run at a high priority, but WLM delivers application service based upon business needs
- Tuning WLM for USS is also important, because many components of WebSphere also rely on USS
- Transport Handler now delivers fine granular classification rules



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## Notes

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