z/OS Workload Management (WLM) Update for z/OS V2.1 and V1.13

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z/OS Workload Management

August, 2013

Session 14211
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<td>DS8000*</td>
<td>Language Environment*</td>
<td>SystemPac*</td>
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<td>BladeCenter*</td>
<td>FICON*</td>
<td>Parallel Sysplex*</td>
<td>System Storage</td>
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<td>DataPower*</td>
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<td>POWER7*</td>
<td>System z</td>
<td>z10 EC</td>
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<td>DB2*</td>
<td>Hyperwap</td>
<td>PrintWay</td>
<td>System z9</td>
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<td>IBM eServer</td>
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<td>ibm.com</td>
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<td>z9*</td>
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<td>Infiniband*</td>
<td>ServerPac*</td>
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Agenda

- z/Enterprise EC12 GA2 Support
- New Classification Qualifiers and Groups
- I/O Priority Groups
- Other z/OS V2.1 Enhancements
- Manage CICS Regions Using Goals Of: “BOTH”
- Response Time Distribution for Velocity Goals
- HiperDispatch Enhancements
IBM zEnterprise EC12 GA2 Support Overview

- zEnterprise EC12 (zEC12) offers new functions for hard and soft capping with GA2 (firmware driver 15):
  - Smoother capping with WLM managed softcapping
  - When IRD weight management is active the group capacity of an LPAR may be derived by the initial weight
  - New “Absolute Capping Limit” LPAR control

<table>
<thead>
<tr>
<th>Function</th>
<th>V2.1</th>
<th>V1.13</th>
<th>V1.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoother capping</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group capacity to use initial weight</td>
<td>+</td>
<td>OA41125</td>
<td>OA41125</td>
</tr>
<tr>
<td>Absolute capping</td>
<td>+</td>
<td>OA41125</td>
<td>OA41125</td>
</tr>
</tbody>
</table>

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Capping algorithms today

**Pattern capping**
- Must be used when \( MSU@LPARweight < \text{definedLimit} \)
- Periods with LPAR capped at weight and running uncapped
- Can result in “pulsing” potentially impacting online workloads

**Phantom weight capping**
- Is used when \( MSU@LPARweight \geq \text{definedLimit} \)
- Internally PR/SM uses an additional weight to limit LPAR consumption below weight
  - Phantom weight must be non-negative pre-zEC12 GA2
- Results in smooth capping

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zEC12 GA2 Negative Phantom Weight

- zEC12 GA2 allows using a negative phantom weight for soft capping

- Therefore, when $MSU@LPARweight < definedLimit$
  WLM can now use a negative phantom weight instead of pattern capping
  - I.e., phantom weight capping becomes the only mechanism

- z/OS V2.1 will exploit this feature
  - Eliminates pulsing effects caused by cap patterns
zEC12 GA2 can use initial weight for group capping

- It is possible to combine IRD weight management with capacity groups
  - IRD changes the –current- weight in order to shift capacity within an LPAR cluster

- However, IRD weight management gets suspended when capping is in effect
  - Because entitlement of an LPAR within a capacity group is currently derived from the current weight the LPAR might get stuck at a low weight
    - Consequently, a low group capacity entitlement can result

- On zEC12 GA2 the initial LPAR weight will be used for group capacity
  - Only if all systems in a capacity group are
    - z/OS V2.1, or
    - z/OS V1.12, V1.13 with OA41125 applied.
  - Results in more predictive and better controllable group capacity entitlement
zEC12 GA2 Absolute Capping Limit

- zEC12 GA2 allows specification of an “absolute capping limit”
  - Primarily intended for non z/OS images
  - Expressed in terms of 1/100ths of a processor
  - Can be specified independently from the LPAR weight
    - But recommended to specify absolute cap above weight
  - Therefore, it is insensitive to LPAR (de)activations and less sensitive to capacity changes
  - Can be specified per processor type in image profile and partition controls panel

- Unlike initial capping absolute capping may be used concurrently with defined capacity and/or group capacity management
  - The respective minimum becomes effective.
  - WLM/SRM recognizes new cap, e.g. for routing decisions.
  - RCTIMGWU = MIN(absolute cap, defined capacity, group cap) when all capping types are in effect
    - RMF provides RCTIMGWU in SMF70WLA
    - In addition, SMF70HW_Cap_Limit value in hundredths of CPUs
zEC12 GA2 Absolute Capping Limit - Examples

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- 3000 Application Environments
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- HiperDispatch Enhancements
New Classification Qualifiers and Groups: Overview

- With z/OS V2R1, WLM/SRM introduces
  - New classification group types, and
  - Some new and modified work qualifier types for use in classification rules in the WLM service definition

- These can be used to improve readability of the WLM service definition for work when there is no naming convention that allows masking or wild-carding

- New and modified qualifier types allow better classification of new DB2 and DDF workload

- More notepad information about a service definition allowed
New Classification Qualifiers and Groups

- z/OS V2.1 extends classification groups for all non-numeric work qualifier types.
- For long qualifier types, a start position for group members, and nesting is allowed.
- **New Groups:**
  - Accounting Information Group
  - Client Accounting Information Group
  - Client IP Address Group
  - Client Transaction Name Group
  - Client Userid Group
  - Client Workstation Name Group
  - Collection Name Group
  - Correlation Information Group
  - Procedure Name Group
  - Process Name Group
  - Scheduling Environment Group
  - Subsystem Collection Group
  - Subsystem Parameter Group
  - Sysplex Name Group
New Classification Qualifiers and Groups

- Subsystems (DB2) require longer and additional work qualifiers:
  - Work qualifier type “Package Name”: 128 characters (instead of 8)
  - Work qualifier type “Procedure Name”: 128 characters (instead of 18)

- New work qualifier types:
  - Client Accounting Information (max. 512 characters)
  - Client IP Address (max. 39 characters)
  - Client Transaction Name (max. 255 characters)
  - Client User ID (max. 128 characters)
  - Client Workstation Name (max. 255 characters)

- The maximum number of “Notepad” lines the has been increased from 500 to 1000 lines

- Note: New and modified work qualifier types are only supported by the new 64-bit classify IWM4CLSY (planned to be used by DB2 V11).
WLM ISPF application enhancements

- Option 5 Classification Groups: Groups can be defined for all non-numeric work qualifier types.
- Exceptions: Priority (numeric), zEnterprise Service Class

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WLM ISPF application samples

Use to group work when there is no naming convention that allows for masking or wild-carding.

Use a start position for each group member to indicate how far to index into the character string for a match. The start position needs not be the same for all group members.
Use of New Groups and Qualifiers in the WLM Administrative Application

Groups of long work qualifier types can be nested

New work qualifier types:
• Client Accounting Information
• Client IP Address
• Client Transaction Name
• Client User ID
• Client Workstation Name

Increased maximum length for work qualifier types
Package Name and Procedure Name.
Classification via new groups: Examples

- '040375,SHIPPING' → FAST.
- '030275,D71ITDEP' → FAST.
- '020175,CONTROL' → SLOW, because the department is not contained in the FASTDEPT group.
- '020177,SALES' → MEDIUM, because the account number does not match group SLOWACCT, and therefore no sub-rules are checked.
How WLM matches qualifier values

• When matching on qualifier values shorter than 8 characters, WLM treats long and short qualifier types differently:

  • **Short qualifier types:** Value padded with blanks to be 8 characters, blanks used for matching
  
  • **Long qualifier types with start position:** Value padded with blanks to be 8 characters, blanks used for matching
  
  • **Long qualifier types without start position:** Value matched according to the number of characters specified

• Example:

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>DIRS</td>
<td>0</td>
</tr>
<tr>
<td>AI</td>
<td>DIRS*</td>
<td>8</td>
</tr>
<tr>
<td>AI</td>
<td>0201</td>
<td>___</td>
</tr>
<tr>
<td>UI</td>
<td>HUGO</td>
<td>___</td>
</tr>
</tbody>
</table>

- 1st rule matches accounting information with the 8 characters 'DIRS_____' starting in the 8th position
- 2nd rule matches accounting information with the 4 characters 'DIRS' starting in the 8th position
- 3rd rule matches accounting information starting with the 4 characters '0201'
- 4th rule matches user ID equal to the 8 characters 'HUGO_____'

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Coexistence and migration considerations for new classification qualifiers and groups

- Apply toleration APAR OA36842 to z/OS V1.10 through V1.13 to handle service definitions with functionality level 29 introduced by use of z/OS V2R1 functionality
  - Service definitions with functionality level 29 cannot be extracted, displayed, modified, installed or activated in a back-level WLM Administrative Application
  - But they can be activated in a mixed z/OS V1.10 through V2.1 Sysplex using
    - The WLM Administrative Application on the z/OS V2.1 system
    - Console command “v wlm,policy=<pol>” on the z/OS V2.1 system
    - WLM service IWMPACT on the z/OS V2.1 system
  - WLM then runs with this service definition on all systems
  - However, the new groups and new and modified qualifier types are not honored for workload classification on pre-z/OS V2.1 systems
Coexistence and migration considerations for new classification qualifiers and groups

- If you plan to use more than 500 lines of notepad information, re-allocate the WLM couple data set on the z/OS V2R1 system before installing the service definition
  - By using z/OS V2.1 to allocate the WLM couple data set, the space allocated is sufficient for the increased notepad size
  - Else you may receive error message “WLM couple data set is too small to hold the service definition. (IWMAM047)”

<table>
<thead>
<tr>
<th>Function</th>
<th>V2.1</th>
<th>V1.13 – V1.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups of SPM rules &amp; new classification qualifiers</td>
<td>+</td>
<td>Tolerance OA36842</td>
</tr>
</tbody>
</table>
Agenda

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- Manage CICS Regions Using Goals Of: “BOTH”
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I/O Priority Groups

• Rationale
  • I/O Priority is used to control DASD I/O queuing.
  • WLM dynamically adjusts the I/O priority based on goal attainment and whether the device can contribute to achieve the goal.
  • Every 10 minutes, WLM determines which service classes use which devices and builds so called device sets.
  • Typically, different workloads use distinct device sets and WLM changes I/O priorities between service classes using the same device set.
  • If a workload starts to use a device outside from its previously used device sets and experiences significant I/O delay, it may take up to 10 minutes until WLM refreshes the device sets and adapts the I/O priority of the corresponding service class.

• Solution:
  • Important service classes which are sensitive to I/O delay can now be assigned to priority group HIGH which ensures that they get always higher I/O priorities than the service classes assigned to group NORMAL.
I/O Priority Groups Specification in WLM ISPF Application

Specify the I/O Priority Group in the WLM ISPF Administrative Application:

Create a Service Class

Command ==> _____________________________________________________________________
Service Class Name ........ _________ (Required)
Description ........ _________
Workload Name ........ _________ (name or ?)
Base Resource Group ........ _________ (name or ?)
Cpu Critical ........ NO_ (YES or NO)
I/O Priority Group ........ NORMAL (NORMAL or HIGH)
I/O Priority Groups – Validation

Group HIGH is only honored by WLM if “I/O priority management” and “I/O priority groups” are enabled:

<table>
<thead>
<tr>
<th>Service Coefficient/Service Definition Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O priority management . . . . . . . . . . . NO_ (Yes or No)</td>
</tr>
<tr>
<td>Enable I/O priority groups . . . . . . . YES (Yes or No)</td>
</tr>
<tr>
<td>Dynamic alias tuning management . . . . . NO_ (Yes or No)</td>
</tr>
</tbody>
</table>

The “Validate definition” option can be used to check whether service classes assigned to I/O priority group HIGH although I/O priority management is not enabled.

<table>
<thead>
<tr>
<th>Service Definition Validation Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>IWMAM918W Service class(es) assigned to I/O priority group HIGH but I/O priority management or I/O priority groups are not enabled. The I/O priority group will not be honored.</td>
</tr>
</tbody>
</table>
I/O Priority Groups – Specification in z/OSMF

z/OSMF Workload Management task provides new option, too.
I/O Priority Groups – Callable Services

- The WLM services **IWMDEXTR** or **IWMDINST** allows extracting or installing a service definition in XML format.
- The layout of the XML service definition (DTD) is extended as follows. The entire DTD is described in Appendix C of the WLM Services Guide.

```xml
<!ELEMENT ServiceClass ( Name, Description?, CreationDate, CreationUser, ModificationDate, ModificationUser, CPUCritical?, IOPriorityGroup?, ResourceGroupName?, Goal ) >

<!ELEMENT ServiceClassOverride ( ServiceClassName, CPUCritical?, IOPriorityGroup?, ResourceGroupName?, Goal ) >

<!ELEMENT IOPriorityGroup ( #PCDATA ) >

<!ELEMENT ServiceOptions ( IOPriorityManagement, DynamicAliasManagement?, IOPriorityGroupsEnabled? ) >

<!ELEMENT IOPriorityGroupsEnabled ( #PCDATA ) >
```
I/O Priority Groups – Callable services

- The RASD parameter list of SYSEVENT REQASD and REQFASD is extended to return information about the I/O priority group of the address space. Additional flags are added to field RASDFLAGS1.

- IWMRQRY is the interface reporting products should use to obtain address space related general execution delays. The answer area mapped by IWMWRQAA is enhanced according to REQFASD. An additional flag is added to field RQAEFLG1.

- IWMPQRY is the interface to return a representation of the active policy. The answer area mapped by IWMSVPOL is extended. An additional flag is added to SVPOLCFL of the service class definition section SVPOLC.
I/O Priority Groups – SMF record type 72.3

RMF's record types 72 subtype 3 and SMF 79 subtypes 1 and 2 are extended to indicate assignment to the I/O priority group.

<table>
<thead>
<tr>
<th>Offsets</th>
<th>Name</th>
<th>Len</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0</td>
<td>R723MSCF</td>
<td>1</td>
<td>Binary</td>
<td>Service/Report class flags. Bit 0-6: Meaning not changed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bit 7: Indicator for I/O priority group HIGH</td>
</tr>
</tbody>
</table>
RMF's record types 72 subtype 3 and SMF 79 subtypes 1 and 2 are extended to indicate assignment to the I/O priority group.

<table>
<thead>
<tr>
<th>SMF record 79 subtype 1 (Address space state data) – ASD data section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Offsets</strong></td>
</tr>
</tbody>
</table>
| 236  | R791FLG3 | 1 | Binary | Additional flags.  
Bit 0: Service class assigned by classification or RESET SRVCLASS belongs to I/O priority group HIGH in the active policy  
Bit 1: I/O priority group HIGH was assigned either to the address space or to transaction service classes served by the space  
Bit 2-7: Reserved |

<table>
<thead>
<tr>
<th>SMF record 79 subtype 2 (address space resource data) – ARD data section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Offsets</strong></td>
</tr>
</tbody>
</table>
| 224  | R792FLG3 | 1 | binary | Additional flags.  
Bit 0: Service class assigned by classification or RESET SRVCLASS belongs to I/O priority group HIGH in the active policy  
Bit 1: I/O priority group HIGH was assigned either to the address space or to transaction service classes served by the space  
Bit 2-7: Reserved |
I/O Priority Groups – RMF: Workload Activity Report

- Postprocessor Workload Activity (WLMGL) report is extended.
- If service class is assigned to I/O priority group HIGH, an indication is displayed in the SERVICE CLASS(ES) and SERVICE CLASS PERIODS sections.

<table>
<thead>
<tr>
<th>TRANSACTION</th>
<th>TRANS-TIME</th>
<th>I/O PRIORITY GROUP</th>
<th>SERVICE CLASS</th>
<th>RESOURCE GROUP</th>
<th>AVG</th>
<th>ACTUAL</th>
<th>SSCHRT</th>
<th>IOC</th>
<th>CPU</th>
<th>CP</th>
<th>BLK</th>
<th>AVG</th>
<th>MPL</th>
<th>EXECUTION</th>
<th>RESP</th>
<th>CPU</th>
<th>SRB</th>
<th>AAPCP</th>
<th>ENQ</th>
<th>CRM</th>
<th>SHARED</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG</td>
<td>0.74</td>
<td>EXECUTION</td>
<td>ONLTOP</td>
<td>CPU+STORAGE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
<td></td>
<td>287332</td>
<td>SRB</td>
<td>0.000</td>
<td>0.00</td>
<td>0.00</td>
<td>0.000</td>
<td>5698.61</td>
</tr>
<tr>
<td>MPL</td>
<td>0.74</td>
<td>QUEUED</td>
<td>WLMPOL</td>
<td>ONLINE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td></td>
<td></td>
<td>537297</td>
<td>RCT</td>
<td>0.002</td>
<td>0.00</td>
<td>0.00</td>
<td>0.000</td>
<td>5698.61</td>
</tr>
</tbody>
</table>

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I/O Priority Groups require some migration and coexistence considerations

- Toleration APAR OA37824 required on z/OS V1R12 and z/OS V1R13 systems because dynamic I/O priority management is a sysplex-wide function.
- Turn on I/O priorities only if all systems sharing disk systems run on z/OS V2R1 or on z/OS V1R12 / R13 with OA37824.
- When the Enable I/O Priority Groups option is turned on in one sysplex, turn it also on in other sysplexes even if they do not exploit I/O priority group HIGH.
  - Ensures that all systems sharing a disk system work with an identical range of I/O priorities.
- Assigning service classes to I/O priority group HIGH is only possible with the z/OS V2R1 WLM ISPF Application or z/OSMF V2R1.
- If a service class is assigned to I/O priority group HIGH, the functionality level of the service definition is increased to LEVEL029.
  - A service definition at functionality level 29 cannot be extracted, displayed, modified, installed, or activated by a WLM Application prior z/OS V2R1.
- RMF support is only available with z/OS V2R1.
Agenda

• z/Enterprise EC12 GA2 Support
• New Classification Qualifiers and Groups
• I/O Priority Groups

Other z/OS V2.1 Enhancements
  • Improved granularity for resource groups
  • 3000 Application Environments
• Manage CICS Regions Using Goals Of: “BOTH”
• Response Time Distribution for Velocity Goals
• HiperDispatch Enhancements
Improved granularity for resource group capping

- To enforce resource group capping dispatchable units are marked non-dispatchable or dispatchable (awake slice) for some time
- Smallest resource group limit and granularity that can be enforced depends on
  - Processor speed/capacity
  - Number logical processors in system or Sysplex, and number of dispatchable units of the work to be capped
  - Service consumed at higher priority than capped work
- With z/OS V2.1 the number of time slices for resource group management was quadrupled
  - From 1/64th to 1/256th of elapsed time
  - Allows for more fine grain control of resource groups
More than 999 Application Environments

- A static application environment is a named entity in the WLM service definition that allows WLM to start server address spaces for scalable client/server type applications.
  - One of the main exploiters of this function are DB2 Stored Procedures

- Large DB2 installations may have a requirement to define more than 999 static Application Environments
  - Typically, these are SAP installations where the WLM service definition is shared across many systems and Sysplexes

- With z/OS V2.1 WLM increases the limit from 999 to 3000.
More than 999 Application Environments: Coexistence considerations

- As soon as more than 999 AEs are defined, the functionality level of the service definition is raised to **LEVEL029**
  - Can use z/OS V2.1 WLM ISPF Application or z/OSMF V2.1
  - Any service definition at functionality level 29 cannot be extracted, displayed, modified, installed, or activated by an WLM ISPF Application prior z/OS V2R1
  - If a service definition at LEVEL029 is installed to the WLM Couple Data Set by z/OS V2R1, systems with z/OS V1R12 and V1R13 of the same Sysplex can activate the policy

- APAR OA36842 for toleration of level 29 policies required on z/OS V1R12 and V1R13
More than 999 Application Environments: Migration considerations

• Customers with a need for more than 999 AEs must allocate a Couple Data Set for WLM which can hold the required number of AE objects
  • This is achieved by performing the *Allocate couple data set using CDS values* task in the WLM ISPF application
    • If a service definition with more AEs than allowed for the current WLM couple data set would be installed, the WLM ISPF application displays message IWMAM047 *WLM couple data set is too small to hold the service definition*
  
• Alternatively, it is possible to allocate a WLM couple data set by running a job as provided in SYS1.SAMPLIB(IWMFTCDS)
Agenda

- z/Enterprise EC12 GA2 Support
- New Classification Qualifiers and Groups
- I/O Priority Groups
- Other z/OS V2.1 Enhancements
- Manage CICS Regions Using Goals Of: “BOTH”
- Response Time Distribution for Velocity Goals
- HiperDispatch Enhancements
Manage Regions Using Goals Of: “BOTH”:
New management option for CICS environments

- **Problem:**
  In environments with pre-dominant CICS workloads it is possible to observe contention problems as described in the following sample test scenario

- **Example:**
  Workload: Websphere → CICS → DB2
  - Websphere receives work, sends it to CICS TORs which send it to AORs which execute DB2 calls
  - Classification: Websphere Imp=2 and all CICS Imp=3, managed towards response time goals

- **Symptoms:**
  - Low system throughput
  - Relatively high response times
  - System utilization can hardly be increased beyond (in this scenario) 80%
• Problem Analysis
  • TORs and AORs run at the same dispatch priority
  • AORs heavily consume CPU. TORs compete against AORs and need to wait too long to receive work and return results to the caller fast enough
  • Hiperdispatch can amplify the situation because it runs the work at higher utilization
Manage Regions Using Goals Of: “BOTH”
Sample test results

<table>
<thead>
<tr>
<th></th>
<th>Completed Transactions/sec</th>
<th>Avg. RespTime/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/o &quot;BOTH&quot;</td>
<td>9765</td>
<td>0.197</td>
</tr>
<tr>
<td>&quot;BOTH&quot;</td>
<td>12463</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>+27%</td>
<td>-86%</td>
</tr>
</tbody>
</table>

Throughput enhancement and significant response time reduction.
Manage Regions Using Goals Of: “BOTH”

• **Two possible alternatives:**
  (Move TORs to a service class with higher importance than AORs)

  • **Option 1**: Exempt all regions from being managed by response time goals and classify TORs to a service class with higher importance than AORs.

    Disadvantage: No response time data present

  • **Option 2**: Exempt only AORs and move them to a service class with lower importance than the CICS service classes with response time goals.

    Disadvantage: Response time data cover only a small portion of the execution path because AORs consume much more than TORs.
Define STC service class for TORs which has a higher importance than the CICS service class with response time goals for the CICS work and AORs

TOR: “Manage Regions by Goals Of: BOTH” option in WLM service definition

AOR: “Manage Regions by Goals Of: TRANSACTION” (the default)

Result:

- WLM will manage the TORs towards the goals of the STC service class
- **And** WLM will ensure bookkeeping of transaction completions to the correct CICS response time service class
- The CICS transactions are managed towards CICS response time goals and the AORs are also managed towards these goals like today
Agenda

• z/Enterprise EC12 GA2 Support
• New Classification Qualifiers and Groups
• 3000 Application Environments
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• Response Time Distribution for Velocity Goals
• HiperDispatch Enhancements
Response Time Distribution for Velocity Goals

- Before this support, WLM reporting did not provide a response time distribution (ended transactions) for workloads with velocity goals.

- Sometimes it is desirable to have a response time distribution for all transactional workloads, even if they have a velocity goal:
  - More data to analyze workload behavior and to detect problems.
  - Better support for migration of goal definitions to response time goals.

- With z/OS V1.13:
  - the IWMRCOLL answer area IWMWRCAA provides also a response time distribution for service class periods with an execution velocity goal.
  - the RMF Postprocessor Workload Activity report (WLMGL) displays the new response time distributions.
Response Time Distribution for Velocity Goals

- Response Time goals use the goal as "reference" (bucket 6)
- Velocity goals do not have a "reference" response time
- The mid-point (MP) is calculated based on workload
RMF Postprocessor Workload Activity Report:

Response Time Distribution for Velocity Goals

---TRANSACTIONS- TRANS-TIME HH.MM.SS.SS BBB----SERVICE---- SERVICE TIME ---APL ---PROMOTED-- ----STORAGE----
AVG 1.70 ACTUAL 4.06.826 SSCHRT 1467 IOC 133593 CPU 64.577 CP 8.94 BLK 0.000 AVG 1217.86
MPF 1.70 EXECUTION 28.632 RESP 0.1 CPU 1770K SRB 8.644 AAPCP 0.00 ENQ 1.480 TOTAL 2074.61
ENDED 44 QUEUED 1.639 CONN 0.0 MSO 0.000 RCT 0.007 IOC 0.000 11.66
END/S 0.05 R/S AFFIN 0.0 DISC 0.1 SRB 236535 IOC 7.204 LCK 1.167
#SWAPS 2 INELIGIBLE 3.36.554 Q+PEND 0.1 TOTAL 2140K AAP 2074.61
EXCTD 0 CONVERSION 47 IOSQ 0.0/sec 0.0/sec 0.000 0.000
AVG ENC 0.00 STD DEV 5.35.053 AQRPCP 0.00 AAP 0.000 SHARED 0.0
REM ENC 0.00 TRX SERV 1396
MS ENC 0.00

GOAL: EXECUTION VELOCITY 20.0% VELOCITY MIGRATION: I/O MGMT 81.2% INIT MGMT 78.2%

----------RESPONSE TIME DISTRIBUTIONS----------

SYSTEM: SYS1 ----INTERVAL: 00.15.00.000 ---MRT CHANGES: 0 ---

---TIME---- NUMBER OF TRANSACTIONS- IN BUCKET CUM TOTAL IN BUCKET
< 00.00.16.994 21 21 84.0 84.0
<= 00.00.20.393 22 1 88.0 4.0
<= 00.00.23.792 24 2 96.0 8.0
<= 00.00.27.191 24 0 96.0 0.0
<= 00.00.30.590 24 0 96.0 0.0
<= 00.00.33.989 25 1 100 4.0
<= 00.00.37.387 25 0 100 0.0
<= 00.00.40.786 25 0 100 0.0
<= 00.00.44.185 25 0 100 0.0
<= 00.00.47.584 25 0 100 0.0
<= 00.00.50.983 25 0 100 0.0
<= 00.01.07.978 25 0 100 0.0
<= 00.02.15.956 25 0 100 0.0
> 00.02.15.956 25 0 100 0.0

SYSTEM: SYS2 ----INTERVAL: 00.15.00.000 ---MRT CHANGES: 0 ---

---TIME---- NUMBER OF TRANSACTIONS- IN BUCKET CUM TOTAL IN BUCKET
< 00.00.05.32.317 4 4 21.1 21.1
<= 00.00.06.38.781 4 0 21.1 0.0
<= 00.00.07.45.244 4 0 21.1 0.0
<= 00.00.08.51.708 5 1 26.3 5.3
<= 00.00.09.58.171 5 0 26.3 0.0
<= 00.11.04.635 6 1 57.9 31.6
<= 00.12.11.098 15 4 78.9 21.1
<= 00.13.17.562 17 2 89.5 10.5
<= 00.14.24.025 17 0 89.5 0.0
<= 00.15.30.489 17 0 89.5 0.0
<= 00.16.36.952 18 1 94.7 5.3
<= 00.22.09.270 19 1 100 5.3
<= 00.44.18.540 19 0 100 0.0
> 00.44.18.540 19 0 100 0.0
IWMRCOLL enhancements for Service and Report Class Periods

- **RCAEIRCT**
  - Is reset to 0 after each policy activation/refresh/IPL
  - Is incremented each time the report class period becomes heterogeneous (when RCAEPLSC and RCAEPMCI are updated)
  - Is incremented each time a transaction is reported with a new mid-point/timestamp
  - The 14 buckets of the report class period's response time distribution are reset to 0 when RCAEIRCT is updated
  - RCAEIMID is copied from the current service class period's RCAEIMID each time the report class period's RCAEIRCT is incremented
  - RCAEITST is copied from the current service class period's RCAEITST each time the report class period's RCAEIRCT is incremented

---

**Table:**

<table>
<thead>
<tr>
<th>Section</th>
<th>Field</th>
<th>Response time goals</th>
<th>Execution velocity goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCAEIHDR (RCAE period header)</td>
<td>RCAEIMID (mid-point in milliseconds)</td>
<td>Same as goal value (milliseconds)</td>
<td>0 after policy activation/refresh/IPL&lt;br&gt;New value computed when WLM detects that current workload distribution deviates too much from RCAEIMID for a too long time</td>
</tr>
<tr>
<td>RCAEIRCT (running count)</td>
<td>N/A (value always 0)</td>
<td>Total number of RCAEIMID changes since last policy activation</td>
<td></td>
</tr>
<tr>
<td>RCAEITST (timestamp of last change)</td>
<td>Policy activation time</td>
<td>Time of last RCAEIMID change or time of last policy activation</td>
<td></td>
</tr>
<tr>
<td>RCAEDIST</td>
<td>RCAEDENT</td>
<td>No change Distribution centered around goal value</td>
<td>Centered around RCAEIMID Reset after each RCAEIMID change</td>
</tr>
</tbody>
</table>
Agenda

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• HiperDispatch Enhancements
Symptom: On very large systems HiperDispatch may utilize affinity nodes unevenly:
- Some nodes may be “overloaded” showing an MVS busy near 100%, others have plenty of free capacity.
- Can typically be seen only with very stable workloads utilizing ≥ 50 CPs.

WLM HiperDispatch balancing algorithms are responsible for assigning work to affinity nodes every 2 sec.

z/OS dispatcher responsibility is to schedule the work units on the logical processors that make up the affinity node. Overloaded processors can receive help from less loaded processors.

The WLM algorithms were changed to more aggressively balance the work unit as the number of processors grow - resulting in a more even distribution of work across nodes.
- Note: It is perfectly fine to see uneven processor utilization within nodes, for I/O enabled processors and also some uneven utilization across nodes (without overloading nodes, though)
HiperDispatch Enhancements for “Unused Capacity”
OA37736 ( z/OS V1R12, z/OS V1R13 )

• Problem addressed:
  • If a large LPAR consumes below its weight-entitlement it is possible that a low-weight LPAR unparks many Vertical Low (VL) processors
  • Therefore a small LPAR could “dominate” larger LPARs because those could not unpark their VLs (additional VL would appear to be inefficient)

• Solution:
  • HiperDispatch considers now also the “unused” capacity share for a partition to unpark VLs
    • This share is calculated by dividing the unused capacity (guaranteed but not used) of all partitions in the CEC by the share of the partitions which can use more capacity

Consideration of Unused Capacity

Complete your sessions evaluation online at SHARE.org/BostonEval
z/OS Workload Management - More Information -

• z/OS WLM Homepage:
  
  http://www.ibm.com/systems/z/os/zos/features/wlm/

• z/OS MVS documentation
  • z/OS MVS Planning: Workload Management:
    http://publibz.boulder.ibm.com/epubs/pdf/iea2w1c0.pdf
  • z/OS MVS Programming: Workload Management Services:
    http://publibz.boulder.ibm.com/epubs/pdf/iea2w2c0.pdf

• IBM Redbooks publications:
  • System Programmer's Guide to: Workload Manager:
  • ABCs of z/OS System Programming Volume 12