

z/OS Workload Management (WLM) Update for IBM z13, z/OS V2.2 and V2.1

Session 16818

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Agenda

IBM z13 Support

z/OS V2.2 enhancements

z/OS V2.1 highlights

Other service stream enhancements and recommendations

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IBM z Systems

The innovation continues

Agenda

IBM z13 Support

z13 base support

zIIP SMT support

HiperDispatch and capping enhancements

SAN Fabric I/O priority

z/OS V2.2 enhancements

z/OS V2.1 highlights

Other service stream enhancements and recommendations



IBM z13 Service

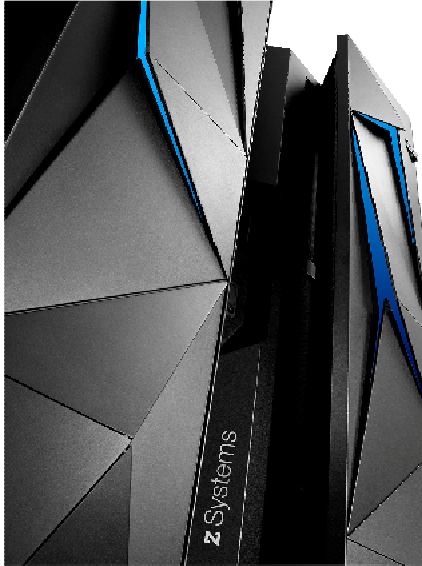
Do not use APAR numbers from this presentation for planning z13 service installation. Refer to the official fix categories:

- IBM.Device.Server.z13-2964.RequiredService
- IBM.Device.Server.z13-2964.Exploitation
- IBM.Device.Server.z13-2964.RecommendedService
- IBM.Device.Server.z13-2964.ParallelSysplexInfiniBandCoupling
- IBM.Device.Server.z13-2964.ServerTimeProtocol
- IBM.Device.Server.z13-2964.UnifiedResourceManager
- IBM.Device.Server.z13-2964.zHighPerformanceFICON
- IBM.Function.zEDC
- IBM.Device.Server.zBX-2458
- IBM.DB2.AnalyticsAccelerator.V2R1

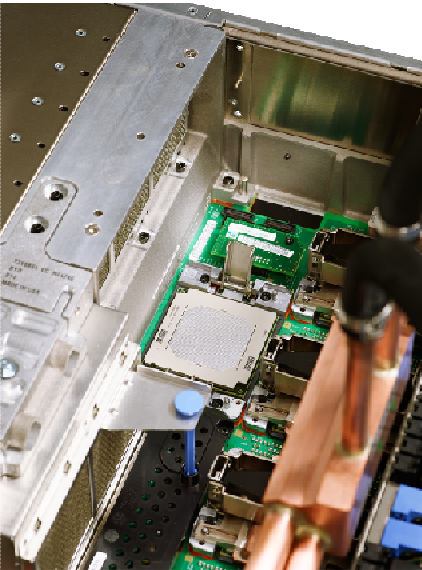
WLM/SRM support overview for IBM z13

<i>z/OS release</i>				
Function		V2.2	V2.1	V1.13
<i>z13 Support (base)</i>		+	OA43622 OA47021	OA43622
<i>zIIP SMT Support</i>		+	OA43622	
<i>Hiper-Dispatch z13 & zEC12</i>	<i>Unpark while capped Unused capacity refinement Prime cycle elimination</i>	+	OA43622	
<i>SRM storage management changes in support of RSM for z13</i>		+	OA44504 OA46396	OA44504
<i>SAN Fabric I/O Priority (Availability planned for 25 September 2015)</i>		+	OA44431 OA44529	OA44431 OA44529

Base z13 support



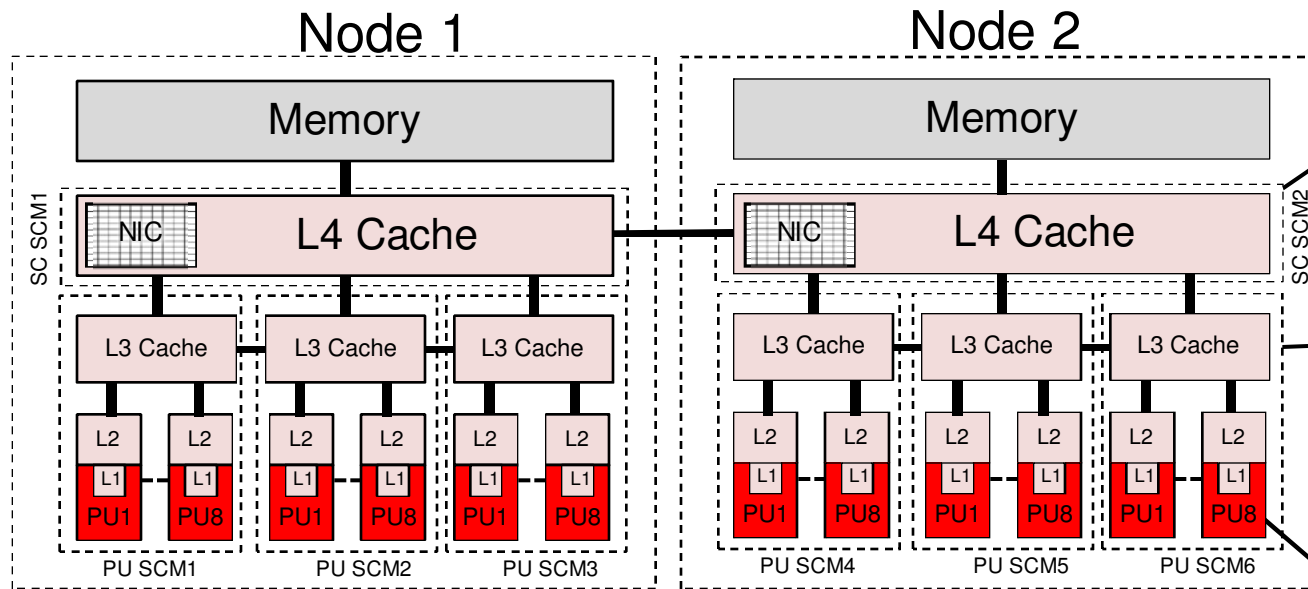
- New limits for z13
 - 85 LPARs
 - Up to 141 processors per CPC
 - Up to 141-way on z/OS V2.1 (non-SMT mode)
 - Up to 128-way on z/OS V2.1 (SMT mode), or z/OS <V2.1
 - Maximum active threads in SMT mode is 213 with zIIP:CP ratio of 2:1



- New Cache topology
 - Chip, node, drawer
 - No longer using “books”
 - z/OS HiperDispatch uses new topology information to place work topologically close – to maximize cache efficiency

z13 CPC Drawer Cache Hierarchy Detail

Single CPC Drawer View (N30 Model) – 2 Nodes



2 SC SCM Chips
(1 per node)



6 PU SCM Chips
(3 per node)



* Up to 8 PU cores per chip



Node 1 - Caches

- L1 private 96k i, 128k d
- L2 private 2 MB i + 2 MB d
- L3 shared 64 MB / chip
- L4 shared 480 MB / node
- plus 224 MB NIC

Node 2 - Caches

- L1 private 96k i, 128k d
- L2 private 2 MB i + 2 MB d
- L3 shared 64 MB / chip
- L4 shared 480 MB / node
- plus 224 MB NIC



Single PU core

* Not all PU's active

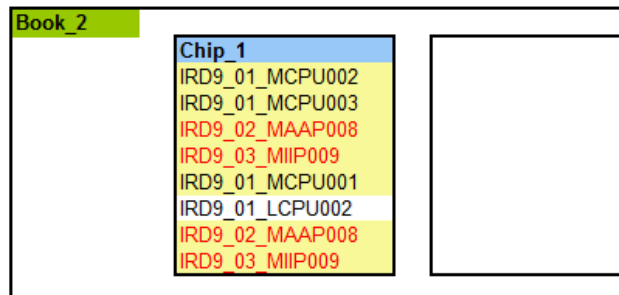
WLM Topology Report Tool (As-is)

- New **as-is** tool available for download from the WLM homepage
 - http://www.ibm.com/systems/z/os/zos/features/wlm/WLM_Further_Info_Tools.html#Topology
- Visualizes mapping of HiperDispatch affinity nodes to physical structure
- Supports IBM zEC10 and later
- To use:
 1. Download from above location
 2. Run installer
 3. Collect SMF99.14 records
 4. Upload Host code to a z/OS system

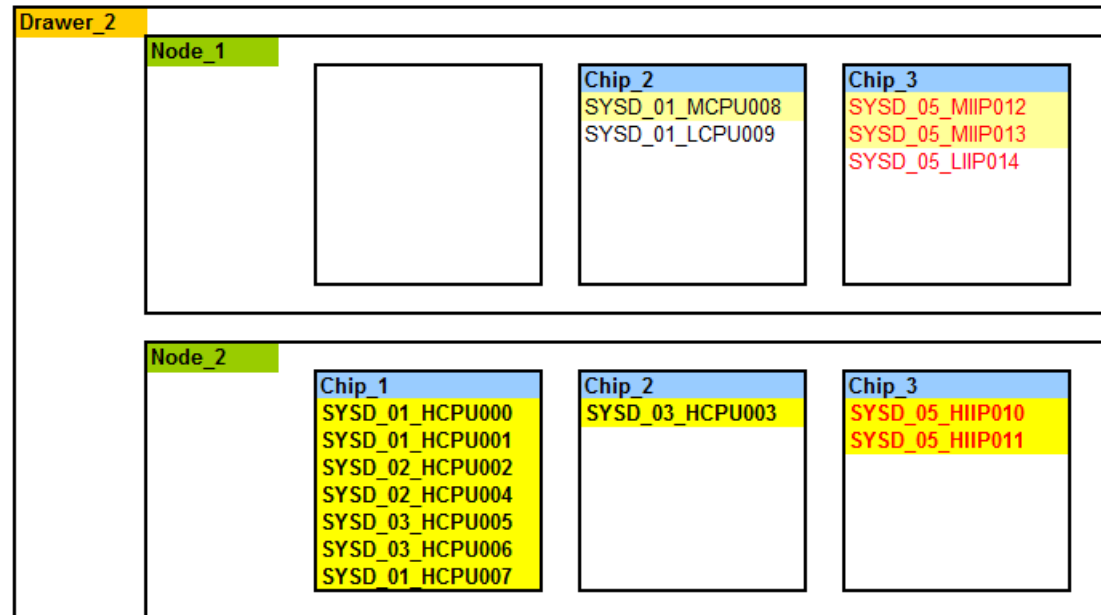
Sample output (z13):

Sample output

(zEC12): Topology for 07-21-2014-13:44:27 , Syst

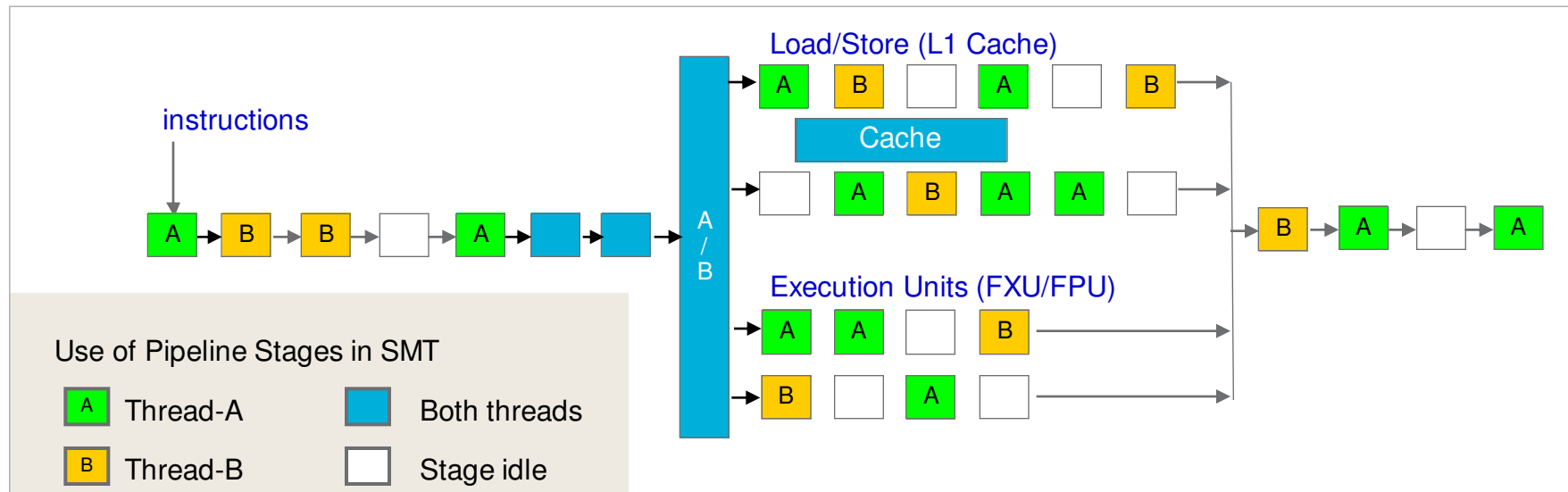


Topology for 01-30-2015-14:08:32 , System: SYSD

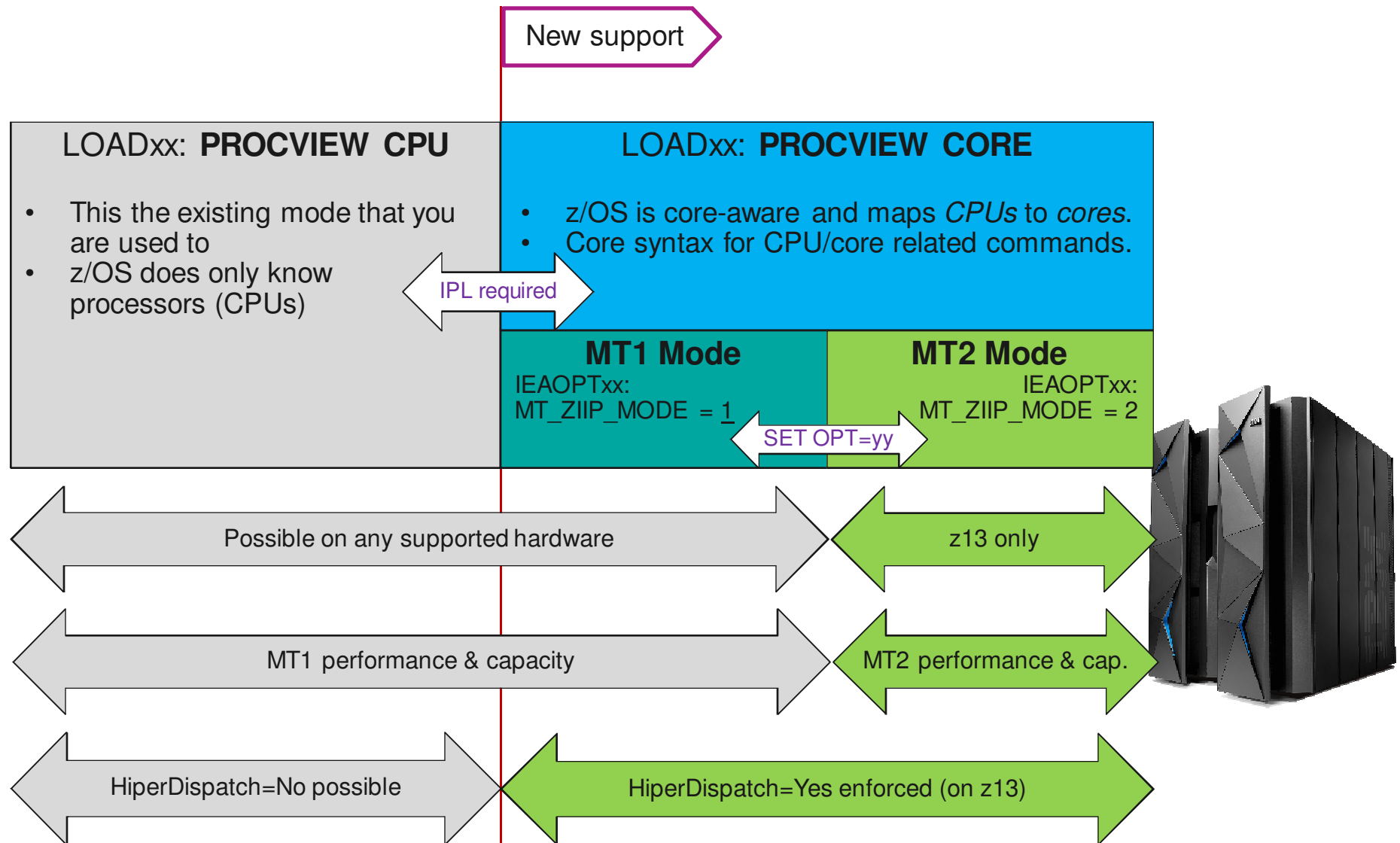


Motivation for Simultaneous Multi Threading

- “Simultaneous multithreading (SMT) permits multiple independent threads of execution to better utilize the resources provided by modern processor architectures.”*
- With z13, SMT allows up to two instructions streams per core to run simultaneously to get better overall throughput
- SMT is designed to make better use of processor hardware units
- On z/OS, SMT is available for zIIP processing:
 - Two concurrent threads are available per core
 - Capacity (throughput) usually increases
 - Performance may be superior using single threading



What is new with multithreading support?



New terminology for SMT...

- z/OS logical processor (CPU) → Thread
 - A thread implements (most of) the System z processor architecture
 - z/OS dispatches work units on threads
 - In MT mode two threads are mapped to a logical core
- Processor core → Core
 - PR/SM dispatches logical core on a physical core
 - Thread density 1 (TD1) - when only a single thread runs on a core
 - Thread density 2 (TD2) - when both threads run on a core
- MT1 Equivalent Time (MT1ET)
 - z/OS CPU times are normalized to the time it would have taken to run same work in MT-1 mode on a CP
 - ASCB, ASSB, ..., SMF30, SMF32, SMF7x, ...
 - You will usually not see the term MT1ET because it is implied
- Several new metrics to describe how efficiently core resources could be utilized...

...and several new metrics for SMT...

- New metrics:
 - WLM/RMF: Capacity Factor (CF), Maximum Capacity Factor (mCF)
 - RMF: Average Thread Density, Core busy time, Productivity (PROD)
- How are the new metrics derived?
 - Hardware provides metrics (counters) describing the efficiency of processor (cache use/misses, number cycles when one or two threads were active...)
 - LPAR level counters are made available to the OS
 - MVS HIS component and supervisor collect LPAR level counters. HIS provides HISMT API to compute average metrics between “previous” HISMT invocation and “now” (current HISMT invocation)
 - HIS address space may be active but is not required to be active
 - System components (WLM/SRM, monitors such as RMF) retrieve metrics for management and reporting

z/OS MT Capacity Factors - used by WLM/SRM

▪ **Capacity Factor (CF)**

- How much work core actually completes for a given workload mix at current utilization - relative to single thread
- Therefore, MT1 Capacity Factor is 1.0 (100%)
- MT2 Capacity Factor is workload dependent
- Describes the actual, current efficiency of MT2

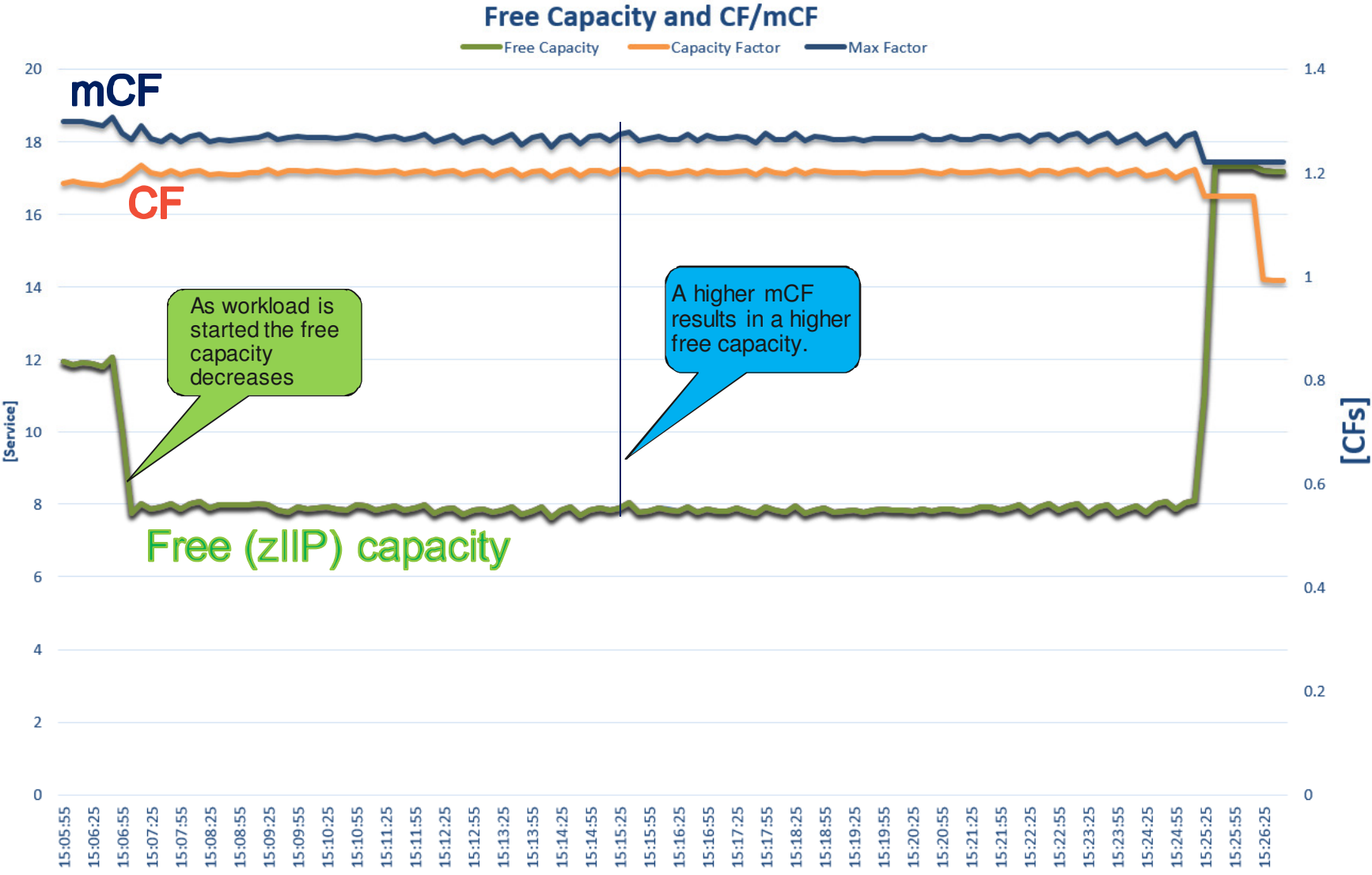
▪ **Maximum Capacity Factor (mCF)**

- How much work a core can complete for a given workload mix at most relative to MT-1 mode
- Used to estimate MT2 efficiency if the system was fully utilized
 - E.g., to derive WLM view of total system capacity or free capacity

▪ Value range of CF and mCF is [0.5 ... 2.0]

- Expect CF in a range of 1.0 -1 .4 (100%-140%) for typical workloads
- Untypical (“pathological”) workloads may see untypical/pathological CF/mCFs, such as <1

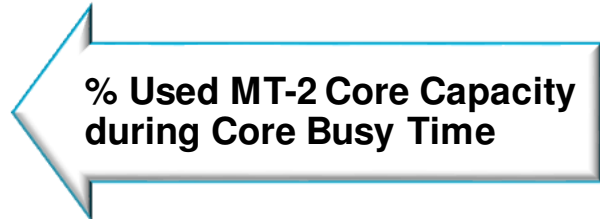
Sample Capacity and maximum Capacity Factor



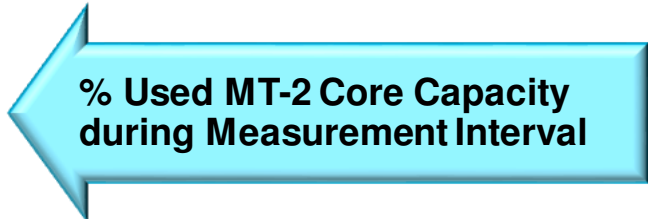
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Additional z/OS MT metrics reported by RMF

- Core Busy Time
 - Time any thread on the core is executing instructions when core is **dispatched to physical core**
- Average Thread Density
 - Average number of executing threads during Core Busy Time (Range: 1.0 - 2.0)
- Productivity
 - Core Busy Time Utilization (percentage of used capacity) for a given workload mix
 - Productivity represents capacity in use (CF) relative to capacity total (mCF) during Core Busy Time.
- Core Utilization
 - Capacity in use relative to capacity total over some time interval
 - Calculated as Core Busy Time x Productivity



**% Used MT-2 Core Capacity
during Core Busy Time**



**% Used MT-2 Core Capacity
during Measurement Interval**

Transitioning into MT mode (Enablement)

- LOADxx PROCVIEW CORE enables use of SMT mode
 - IPL required to switch between PROCVIEW CPU and CORE
 - Causes syntax and semantic to change for [core-aware commands](#).
 - LOADxx CORE,CPU_OK allows using CPU as a synonym of CORE
 - HiperDispatch=YES enforced on SMT capable hardware

```
CORE STATUS: HD=Y   MT=2   MT_MODE: CP=1   zIIP=1
ID      ST   ID RANGE   VP   ISCM   CPU THREAD STATUS
0000    +   0000-0001   M    FC00   +N
0001    -   0002-0003
0002    -   0004-0005
0003    +I   0006-0007   M    0200   +N
0004    -I   0008-0009
0005    -   000A-000B
```

z/OS Commands requiring CORE keyword

- Config Core(x),Online Configs core online for MT Mode
- Config Core(x),Offline Configs all threads on core offline
- Config Member=xx Configs cores according to CONFIGxx
- Config Online or Config Offline Lists eligible cores to config
- Reply to IEE522D accepts CORE(x) to configure
- Display Matrix=Core Displays core status (new message)
- Display Matrix=Config(xx) CONFIGxx vs system differences

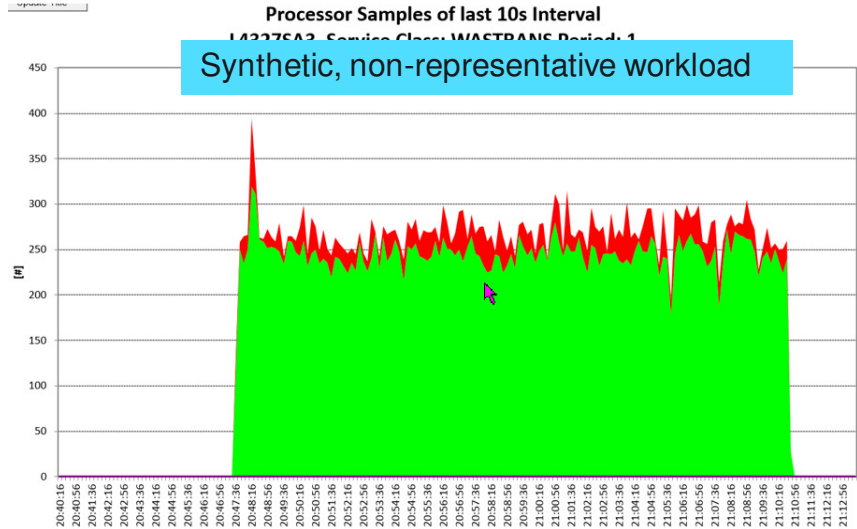
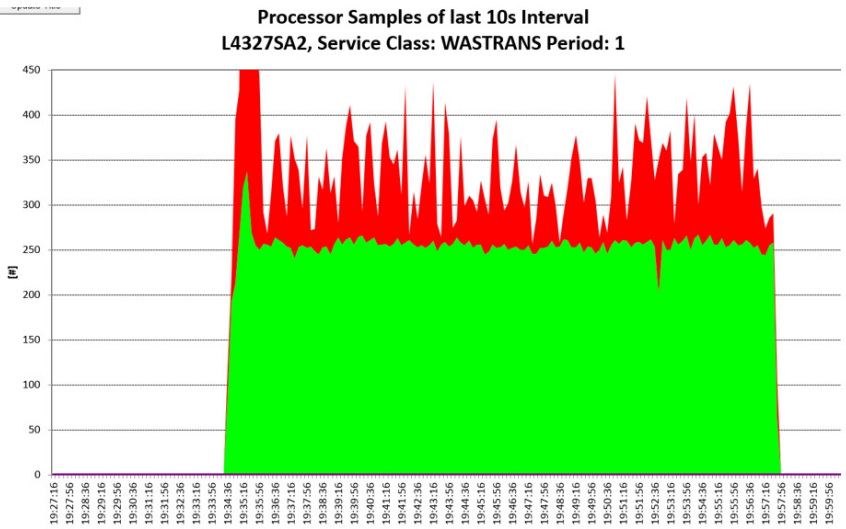
Transitioning into MT mode (Activation)

MT-2 mode Activation and Deactivation

- IEAOPTxx new parameter
 - MT_ZIIP_MODE=1 specifies MT-1 mode for zIIPs
 - MT_ZIIP_MODE=2 specifies MT-2 mode for zIIPs
- Switch dynamically between MT-1 and MT-2 mode via SET OPT=xx
- Performance-wise, MT-1 mode and PROCVIEW CPU are equivalent
- Some WLM considerations...Details later

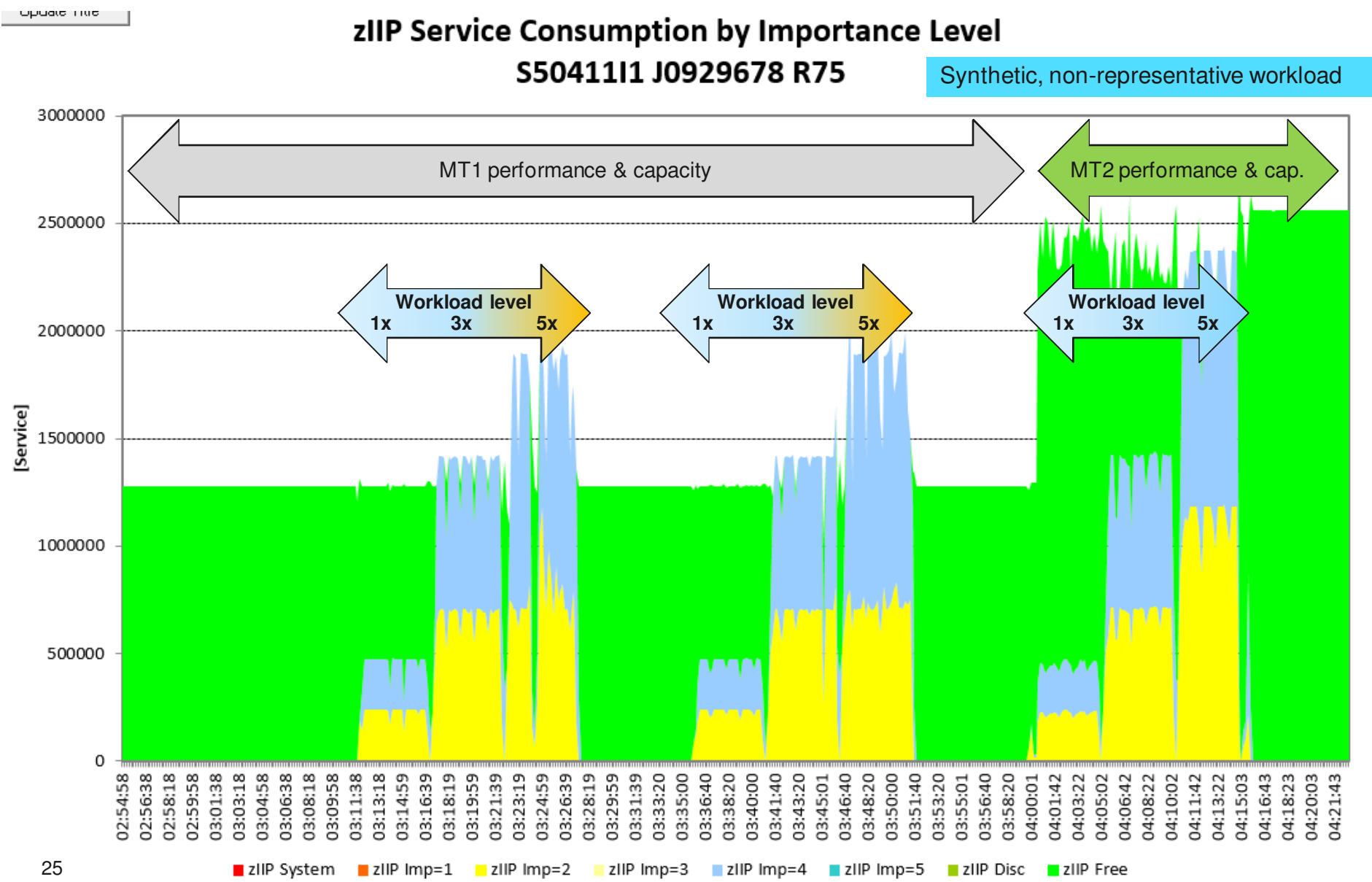
```
IWM066I MT MODE CHANGED FOR PROCESSOR CLASS zIIP. THE MT MODE WAS  
CHANGED FROM 1 TO 2.  
IWM063I WLM POLICY WAS REFRESHED DUE TO A PROCESSOR SPEED CHANGE OR MT  
MODE CHANGE
```

Processor samples may change when going to MT-2 mode

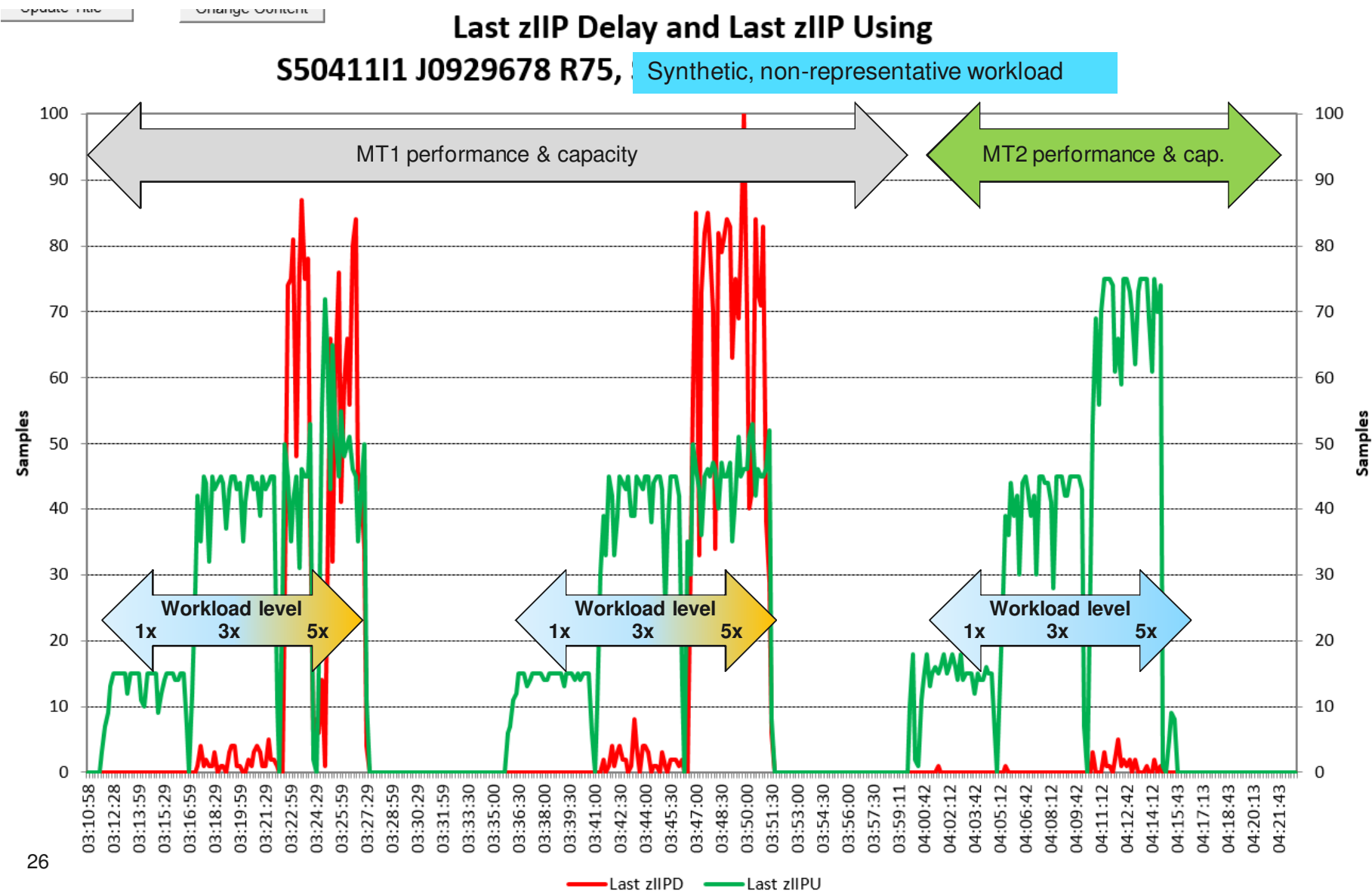


- In MT-2 mode we see less processor delays resulting in a higher execution velocity

Free capacity and service consumption MT-1 vs. MT-2



Sample execution velocity MT-1 vs. MT-2



WLM/SRM message changes ([OA43622](#))

- **IRA866I HIPERDISPATCH=YES FORCED DUE TO PROCVIEW=CORE**
 - HIPERDISPATCH=YES is enforced because PROCVIEW=CORE was specified in the load parameter member (LOADxx) on HW capable of supporting MT.
- **IWM066I MT MODE CHANGED FOR PROCESSOR CLASS zIIP. MT MODE CHANGED FROM nn TO mm.**
 - The System successfully changed the MT Mode for the respective processor class. ProcessorClass specifies the processor for which the MT Mode was changed . nn specifies the previous MT Mode, mm specifies the new effective MT Mode
- **IWM067I SETTING MT MODE FAILED FOR PROCESSOR CLASS zIIP DUE TO THE FOLLOWING: reason, problem.**
 - The System could not change the MT Mode. “problem” can be one of the following
 - SPECIFIED VALUE IS NOT SUPPORTED BY Z/OS
 - SPECIFIED VALUE IS NOT SUPPORTED BY HARDWARE
 - HIPERDISPATCH FUNCTION IS NOT ACTIVE
 - **WAITCOMPLETION=YES IS SET**
 - CONFIGURATION OF PROCESSORS FAILED
 - FUNCTIONAL PROBLEM

SoD: IBM plans to offer only event-driven dispatching (Wait Completion = YES) and not to offer time-driven dispatching (Time Slicing or Wait Completion = NO) on the high end z System server following z13. Event-driven dispatching, the default for many years, better manages processor resource to adjust for fluctuations in demand among partitions.

Control block changes (IRARMCTZ)

OFFSET DECIMAL	OFFSET HEX	TYPE	LENGTH	NAME (DIM)	DESCRIPTION
1264	(4F0)	CHARACTER	12	RMCTZ_MT_AREA	MT section
1264	(4F0)	BIT(8)	1	RMCTZ_MT_FLAGS	MT Flags
		1... ..		RMCTZ_PROCVIEW	1:=core
		.1.. ..		RMCTZ_MT	1:=Multiple threads per core
1268	(4F4)	UNSIGNED	4	RMCTZ_MT_STAT	Current status
1270	(4F6)	UNSIGNED	1	RMCTZ_MT_ZIIP	...for zIIPs
1272	(4F8)	UNSIGNED	4	RMCTZ_MT_OPT	OPT Requested status
1274	(4FA)	UNSIGNED	1	RMCTZ_MT_OPT_ZIIP	...for zIIPs

z13 – SMT: Postprocessor CPU Activity Report

- PP CPU activity report provides new metrics when SMT is active
 - MT Productivity and Utilization of each logical core
 - MT Multi-Threading Analysis section displays MT Mode, MT Capacity Factors and average Thread Density
- Contains core and thread level metrics, e.g.
 - LPAR Busy: PR/SM dispatching logical core to physical
 - MVS Busy: Unparked logical CPU not waiting
 - Parked: Logical CPU parked



% Used MT-2 Core Capacity during Core Busy Time

% Used MT-2 Core Capacity during Measurement Interval

z/OS V2R1		SYSTEM ID CB8B					C P U A C T		DA		INTERVAL 15.00.004	
		RPT VERSION V2R1 RMF					TIME 11.30.00		CYCLE 1.000 SECONDS		--I/O INTERRUPTS--	
---CPU---		----- TIME % -----					--- MT % ---		LOC			
NUM	TYPE	ONLINE	LPAR BUSY	MVS BUSY	PARKED	PROD	UTIL	SHARE	%	RATE	% VIA	TPI
0	CP	100.00	68.07	67.94	0.00	100.00	68.07	100.0	HIGH	370.1	13.90	
1	CP	100.00	46.78	46.78	0.00	100.00	46.78	52.9	MED	5.29	16.93	
... TOTAL/AVERAGE			8.66	54.17		100.00	8.66	152.9		375.3	13.95	
A	IIP	100.00	48.15	41.70	0.00	85.84	41.33	100.0	HIGH			
				35.66	0.00							
B	IIP	100.00	38.50	32.81	0.00	85.94	33.09	100.0	HIGH			
				26.47	0.00							
... TOTAL/AVERAGE			29.48	23.23		86.47	25.39	386.7				
----- MULTI-THREADING ANALYSIS -----												
CPU	TYPE	MODE	MAX CF	CF	AVG TD							
	CP	1	1.000	1.000	1.000							
	IIP	2	1.485	1.279	1.576							

z13 – SMT: Monitor III CPC Report

MT Mode and Productivity for zIIP processors



of 50

RMF V2R1 CPC Capacity Line 1

Samples: 60 System: CB88 Date: 02/02/15 Time: 11.00.00 Range: 60 Sec

Partition: CB88 2964 Model 731
 CPC Capacity: 3935 weight % of Max: 50.1 4h Avg: 138 Group:
 N/A
 Image Capacity: 1777 WLM Capping %: 0.0 4h Max: 177 Limit:
 N/A

MT Mode IIP: 2 Prod % IIP: 80.9

Partition	MSU Def	MSU Act	Cap Def	Proc Num	Logical Effect	Util % Total	Physical LPAR	Util % Effect	Util % Total
*CP				390			0.8	43.7	44.5
CB8B	0	192	NO	10.0	15.0	15.1	0.0	4.8	4.9
CB8D	0	134	NO	15.0	7.0	7.0	0.0	3.4	3.4
CB8E	0	330	NO	14.0	18.4	18.6	0.1	8.3	8.4
CB88	0	182	NO	14.0	10.2	10.3	0.0	4.6	4.6
C05	0	140	NO	14.0	7.9	7.9	0.0	3.5	3.6
C06	0	150	NO	14.0	8.4	8.4	0.0	3.8	3.8
LP1	0	507	NO	4.0	100	100	0.0	12.9	12.9

SMT mode enabled:
 Processor data at logical core granularity

SMT mode disabled:
 Processor data at logical processor granularity

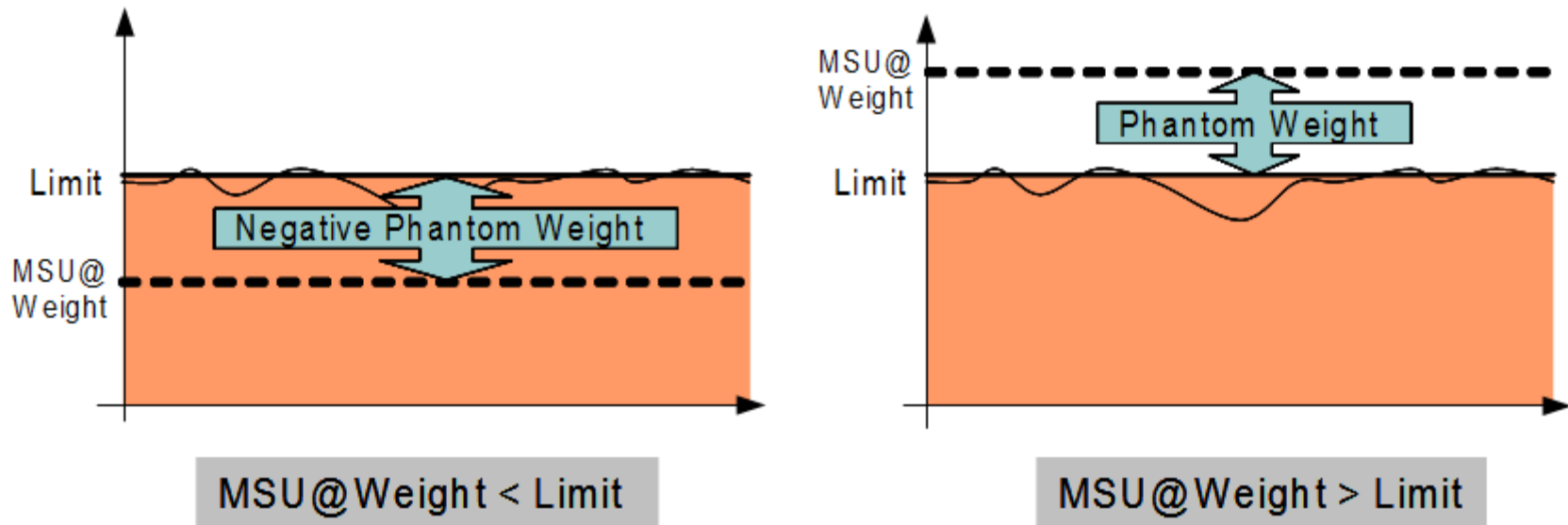
Transitioning into MT2 mode: WLM considerations (1)

- **Less overflow from zIIP to CPs** may occur because
 - zIIP capacity increases, and
 - number of zIIP CPUs double
- CPU time and CPU service **variability may increase**, because
 - Threads which are running on a core at the same time influence each other
 - Threads may be dispatched at TD1 or TD2
 - Unlike other OS, z/OS attempts to dispatch threads densely
- Sysplex workload routing: routing recommendation may change because
 - zIIP capacity will be adjusted with the mCF to reflect MT2 capacity
 - mCF may change as workload or workload mix changes

Transitioning into MT2 mode: WLM Considerations (2)

- **Goals should be verified** for zIIP-intensive work, because
 - The number of zIIP CPUs double and the achieved velocity may change
 - “Chatty” (frequent dispatches) workloads may profit because there is a chance of more timely dispatching
 - More capacity is available
 - Any single thread will effectively run at a reduced speed and the achieved velocity will be lower.
Affects processor speed bound work, such as single threaded Java batch
- MT-2 APPL% numbers can continue to be used to understand relative core utilization in a given interval, at times of comparable maxCFs. However, the maxCF needs to be considered when comparing APPL% across different workloads or times with different maxCF values.

Background: Capping algorithm with negative phantom weight (zEC12 GA2 and later)



The phantom weight instructs PR/SM at what capacity an LPAR needs to be capped.

- A positive phantom weight also lowers the priority of a partition,
- A negative phantom weight caps the partition at a higher defined capacity without changing the priority of the partition.

HiperDispatch “Unpark while capped”

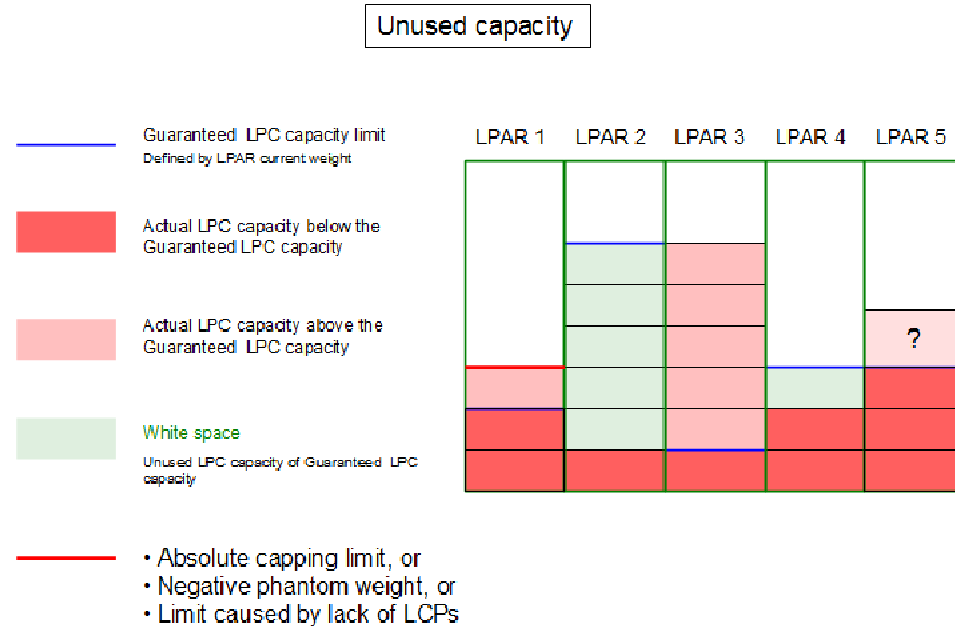
More details on capping in
Session 15719: Capping, Capping, and
Capping - A Comparison of Hard and
Soft-capping Controls
Friday, 8:30 AM-9:30 AM, Jefferson B

- Previously, HiperDispatch
 - Parked all Vertical Low (VL) processors when a system capped via positive phantom weight
 - VLs are used for discretionary capacity and not required to absorb the LPAR weight
 - However, it was seen that, for some workloads, the reduced number of logical processors made it difficult to fully utilize the cap target capacity.
 - Unparked all VL processors when a system was capped by negative phantom weight, or some cases of PR/SM absolute capping
- Now, HiperDispatch can unpark VL processors if the processors can be used efficiently.

HiperDispatch refinement of “unused capacity” use

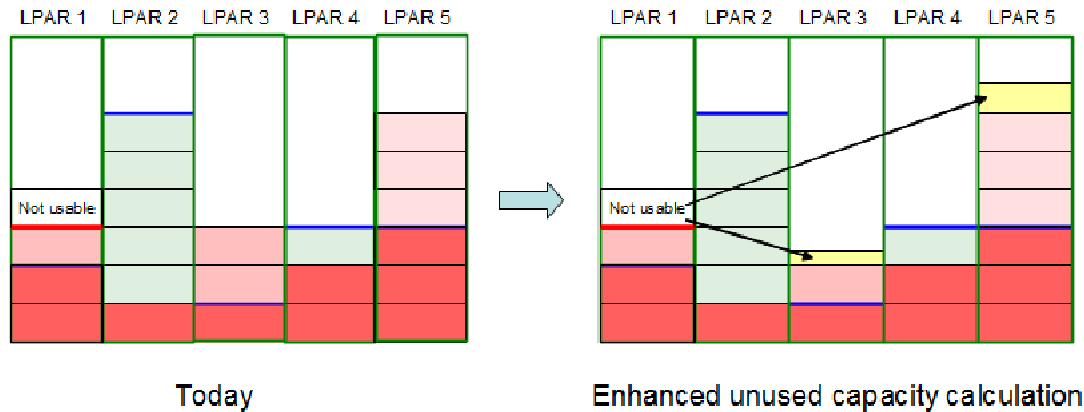
- HiperDispatch decisions consider the CPC-wide ‘unused capacity share’ situation
- The ‘unused capacity share’ calculation was enhanced to also include the LPAR configuration values
 - absolute capping value
 - negative phantom weight
 - number of logical processors
 - effective defined capacity and group capacity limit of possible ‘unused capacity’ receivers

CPC with 5 LPARs. LPAR1 has an absolute capping limit, which is indicated with the red line. LPAR2, and LPAR4 are unused capacity donors, while LPAR1 / 3 / 5 are unused capacity receivers.



HiperDispatch refinement of “unused capacity” use

Enhanced unused capacity calculation



- Figure on the left shows today’s unused capacity calculation, which does not consider LPAR capping limits.
- Unused capacity calculation is only based on the receiver’s weight share.
- Figure on the right shows an example of enhanced unused capacity calculation. It considers the capping limits of the receivers.
- Because LPAR1 is not able to use its total unused capacity share its ‘not usable’ unused capacity share portion increases the unused capacity share of LPAR5.

Fabric I/O Priority

- z/OS V2.2 planned to support additional I/O priority capabilities
 - Like [other I/O priorities](#) already set by IOS and WLM
 - Control unit, Channel subsystem, Tape, or DS8000 I/O Priority Manager importance
 - Used today by channel subsystem and IBM System Storage DS8000 series for both read and write operations
 - Intended to provide end-to-end prioritization according to WLM policy for write operations
- Planned to be extended to provide additional prioritization data for the FICON fabric so that the highest priority write operations can be done first when the fabric becomes congested
- Will require:
 - z13 processor
 - z/OS V2.2; or, z/OS V1.13 or z/OS V2.1 with PTFs for APARs OA44529 and OA44431
- Availability planned for 25 September 2015
- See also [Enhancing Value to Existing and Future Workloads with IBM z13](#)

Agenda

IBM z13 Support

z/OS V2.2 enhancements

- **Support for JES concurrent job execution**
- **API to retrieve IEAOPT keywords and values**
- **Health based routing enhancements**
- **WLM managed DB2 Bufferpool Enhancements**
- **Global Mirror (XRC) exploitation of I/O Priority Manager support**
- **SRM enhancements for large real storage**

z/OS V2.1 highlights

Other service stream enhancements and recommendations

Dependent Job Control for JES2

- JES2 in z/OS V2.2 provides a new job scheduling scheme similar to “JES3’ Dependent Job Control” which in turn allows for a *set of concurrent jobs* to be run

- WLM extends the *demand batch initiator* interface with JES2:
 - WLM returns the most eligible system for starting the demand batch initiators, or indicates that all candidate systems are too constrained

 - If a system is eligible, then
 - WLM reuses drained initiators, or
 - starts demand batch initiators.Both select the concurrent jobs specified by JES2

 - When the jobs are finished, both the reused and the newly started initiators go to the drained state

IWM4OPTQ: Interface to retrieve IEAOPT keywords and values

- Prior to this support it was difficult for a monitoring product to identify
 - what IEAOPTxx parameters are known to the system, and
 - the values for those parameters
- IWM4OPTQ returns a self-describing list of all keywords, and their values.
Return area is mapped by IWMWOPTI
- Exploited e.g. by RMF

```

>>+-----+---IWM4OPTQ-----OPTINFO_BLOCK=optinfo_block----->
    '-name-'

>---,ANSLEN=anslen-----QUERYLEN=querylen----->

>+-----+-----+-----+-----+----->
    '-,RETCODE=ret code-' '-,RSNCODE=rsncode-'

    .-, PLISTVER=IMPLIED_VERSION-.
>+-----+-----+-----+-----+----->
    +-, PLISTVER=MAX-----+
    '-, PLISTVER=0-----'

    .-, MF=S-----.
>+-----+-----+-----+-----+-----><
|                                     .-, 0D---. |
+-, MF=(L-, list addr-+-----+-)-----+
|                                     '-, attr-' |
|                                     .-, COMPLETE-. |
'-, MF=(E-, list addr-+-----+-)-'

```

IWM4HLTH: Extensions for health based routing

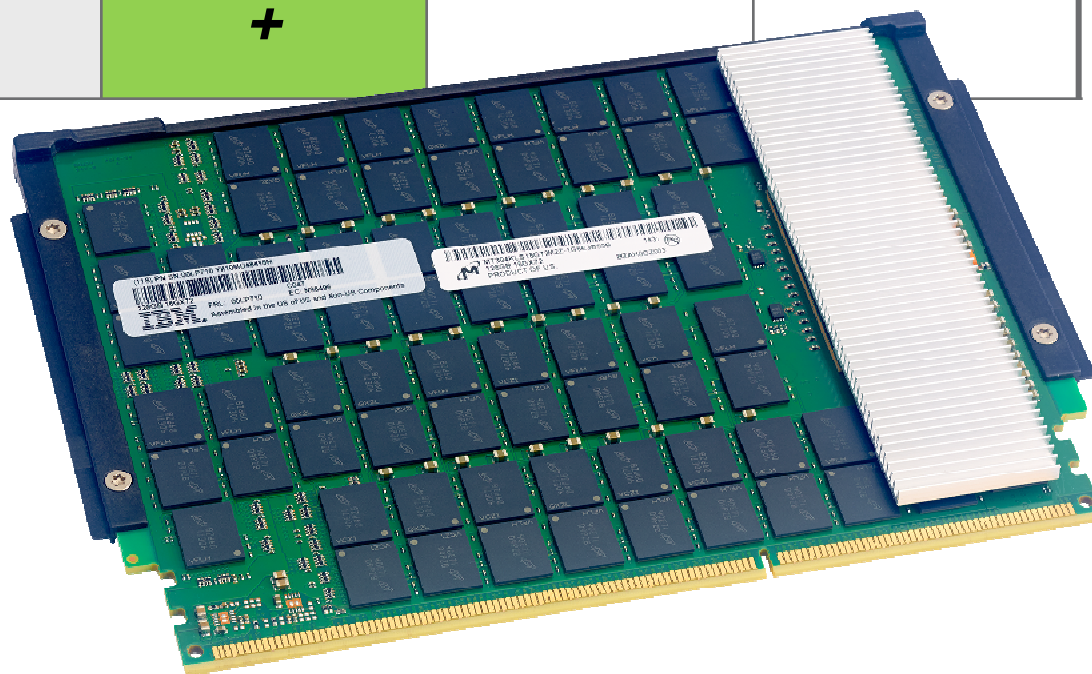
- WLM Sysplex routing services provide advice for routing work within a Sysplex
 - Enable distributed client/server environments to balance work among multiple servers based, on capacity, performance, **server health**
 - Utilized e.g. by Sysplex distributor (SERVERWLM), DB2 DDF
- The IWM4HLTH service allows to modify the health value when the health status of the server changes for the worse or better
- Before z/OS V2.2 the server health value solely is based on self-assessment with only the last value reported is being kept by WLM
- **With z/OS V2.2 the IWM4HLTH service is planned to be extended to work with *multiple* components providing their views of the health of a server address space.**
The new IWM4QLTH service allows to query the health.

XRC Write Pacing

- z/OS Global Mirror (XRC) designed to work with...
 - z/OS WLM; and,
 - DS8000 with the z/OS Global Mirror feature
- ...to throttle low-priority writes when they would cause significant delays that might affect response time
- Will be designed to allow you to specify that write delays be imposed for different classes of work based on WLM definitions
- Exploits WLM support for the DS8000 I/O Priority Manager
- Intended to:
 - Make it unnecessary to adjust write pacing settings and monitor data set residency
 - Improve system responsiveness to more important work
- Requires a DS8870 with an MCL
- Available now for z/OS V1.13 and z/OS V2.1 with the PTFs for APARs OA41906, OA44004, and OA43453

SRM Enhancements for large real storage

<i>Function</i> \ <i>z/OS release</i>	V2.2	V2.1	V1.13
<i>MCCFXPTR Limit</i>	+	OA44668 OA44207(RSM)	
<i>New AUTO keyword for RCCEXTT and RCCFXTT</i>	+		



Service Stream Enhancement: OA44668: SRM – New Function

1. On LPARs with large real storage, lock contention may be seen in SRM and RSM when SRM calls RSM to determine frame counts.
2. The MCCFXTPR keyword in the IEAOPTxx specifies the percentage of online storage that may be page fixed before a pageable storage shortage is detected and message IRA400E is issued.
 - Before OA44668, MCCFXTPR default of 80% requires that 20% (100 minus MCCFXTPR) of storage remain pageable, regardless of the amount of online storage. On systems with large amounts of central storage, the MCCFXTPR default of 80% can result in a pageable storage shortage being detected when there is still plenty of pageable storage.
 - With OA44688 **at most 64GB** of pageable online storage will be required before a pageable storage shortage is recognized.

800G 1TB
80%

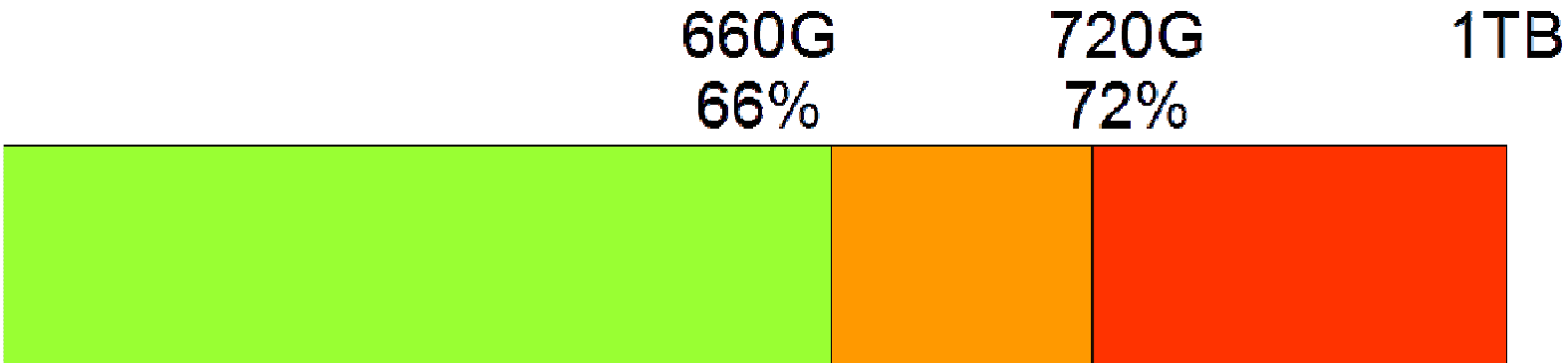


New AUTO keyword for RCCEXTT and RCCFXTT

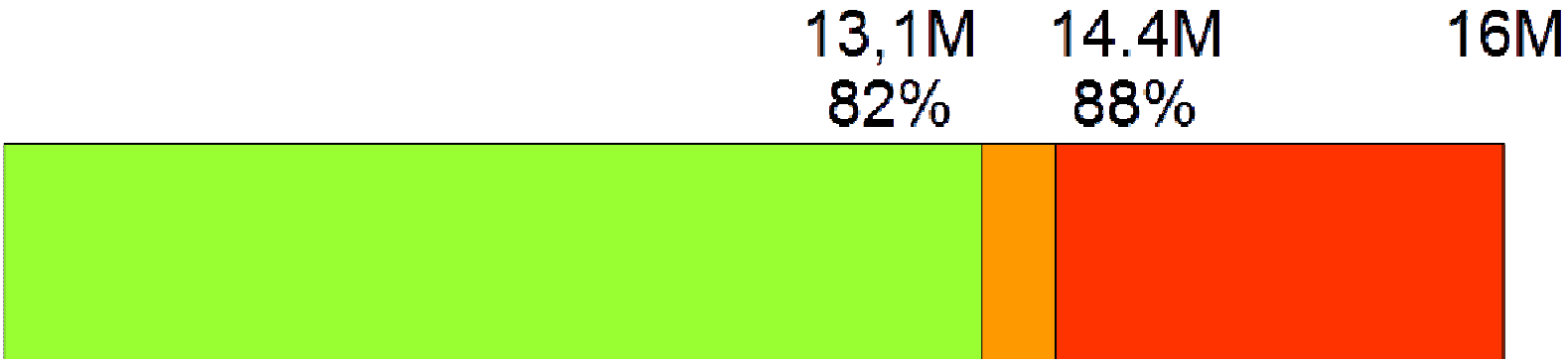
- The IEAOPTxx *RCCFXTT* keyword specifies low and high threshold of fixed real storage:
 - SRM uses these thresholds to determine if the system MPL needs to be increased/decreased. The default is 66% and 72%.
 - On small systems such percentages are not a problem.
 - On a 1TB LPAR these percentages imply that WLM will stop increasing the MPL. when 660G of storage is fixed
- Similarly, *RCCEXTT* specifies the low and high thresholds of fixed real storage below 16M. SRM uses these thresholds to determine if the system MPL needs to be increased/decreased. The default is 82% and 88%.
 - This OPT keyword is also enhanced, mainly for consistency with the *RCCFXTT* keyword. The default is still: *RCCEXTT*=(82, 88)
- Both keywords were enhanced to accept a value of **AUTO**
 - **AUTO** allows SRM to compute thresholds based on available storage.
 - Allows to higher utilize available storage in large systems without risking system shortages
 - **AUTO** needs to be specified in IEAOPTxx (not default)

New AUTO keyword for RCCEXTT and RCCFXTT

Current RCCFXTT thresholds:



Current RCCEXTT thresholds:



Agenda

IBM z13 Support

z/OS V2.2 enhancements

z/OS V2.1 highlights

zEC12 GA2 Support

New Classification Qualifiers and Groups

I/O Priority Groups

Other service stream enhancements and recommendations

IBM zEnterprise EC12 GA2 Support Overview

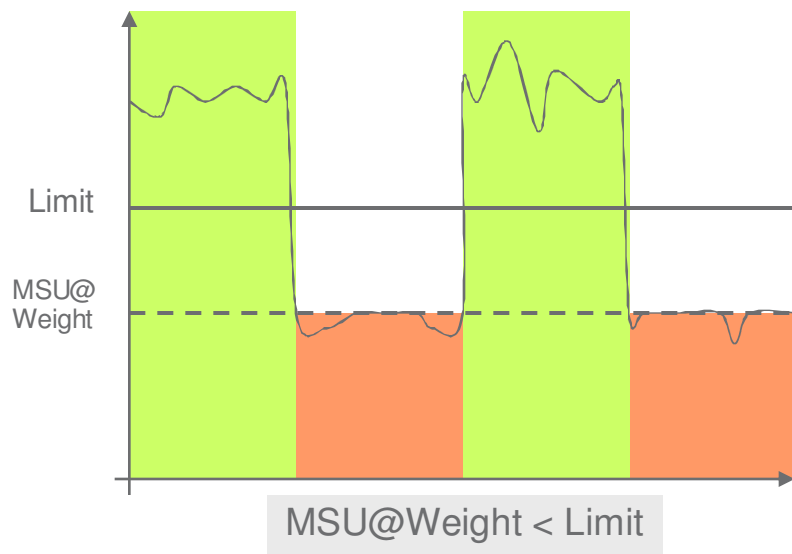
- zEnterprise BC12 and EC12 (zEC12) GA2 (firmware driver 15) offer new functions for hard and soft capping:
 - Smoother capping with WLM managed softcapping
 - When IRD weight management is active the group capacity of an LPAR may be derived by the initial weight
 - New “Absolute Capping Limit” LPAR control

<i>z/OS release</i> <i>Function</i>	<i>V2.1</i>	<i>V1.13</i>	<i>V1.12</i>
<i>Smoother capping</i>	+		
<i>Group capacity to use initial weight</i>	+	OA41125	OA41125
<i>Absolute capping</i>	+	OA41125	OA41125

Capping algorithms for defined capacity prior to zEC12 GA2

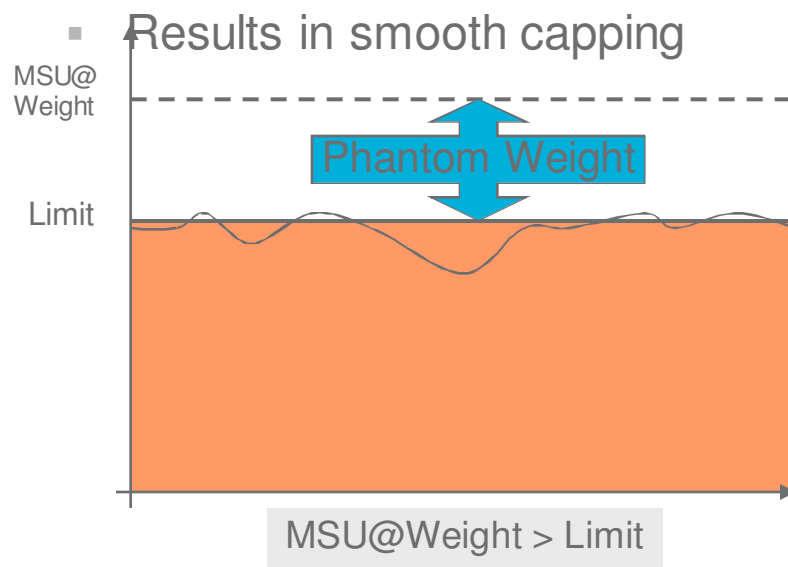
Pattern capping

- 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



zEC12 GA2 Negative Phantom Weight

- zEC12 GA2 allows using a *negative* phantom weight for soft capping
- Therefore, when $MSU@LPARweight < \text{definedLimit}$ 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

With IRD, zEC12 GA2 can use initial weight for group capping

- It is possible to combine Intelligence Resource Director 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 run
 - 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 to define an “absolute capping limit”
 - Primarily intended for non z/OS images
 - Expressed in terms of 1/100ths of a processor
 - Therefore, it is insensitive to LPAR (de)activations and less sensitive to capacity changes
 - Can be specified independently from the LPAR weight
 - Can be specified per processor type in image profile and partition controls panel
- Unlike initial capping it may be used *concurrently* with defined capacity and/or group capacity management
 - The minimum of all specified limits will be used
 - WLM/SRM recognizes new cap, e.g. for routing decisions.
 - $RCTIMGWU = \text{MIN}(\text{absolute cap, defined capacity, group cap})$ 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

Change Logical Partition Controls - P35

Last reset profile attempted:
Input/output configuration data set (IOCDS):A0 198AP35

CPS
zAAPs
IFLs
zIIPs
Processor Running Time

Logical Partitions with Central Processors

--- Select Action ---

Logical Partition	Active	Defined Capacity	WLM	Current Weight	Initial Weight	Min Weight	Max Weight	Current Capping	Initial Capping	Absolute Capping	Number of Dedicated Processors	Number of Not dedicated Processors
IRD6	Yes	10	<input type="checkbox"/>	300	300			No	<input checked="" type="checkbox"/>	3.20	0	3

Customize Image Profiles: IRD8

- IRD8
- IRD8
 - General
 - Processor
 - Security
 - Storage
 - Options
 - Load
 - Crypto

Group Name: IRD6

Logical Processor Assignments

Dedicated processors

Select	Processor Type	Initial	Reserved
<input checked="" type="checkbox"/>	Central processors (CPs)	3	1
<input checked="" type="checkbox"/>	System z application assist processors (zAAPs)	0	1
<input checked="" type="checkbox"/>	System z integrated information processors (zIIPs)	0	1

Not Dedicated Processor Details for :

CPs zAAPs zIIPs

CP Details

Initial processing weight: 1 to 999 Initial capping

Enable workload manager

Minimum processing weight:

Maximum processing weight:

Absolute Capping: None

Number of processors (0.01 to 255.0)

New Classification Qualifiers and Groups: Overview

- With z/OS V2R1, WLM/SRM introduces
 - New types of classification groups, and
 - Some new and modified types of work qualifiers for use in classification rules in the WLM service definition
- Can be used to improve the structure of your WLM service definition when masking or wild-carding are not sufficient to simplify classification rules.
- New and modified qualifier types allow better classification of new DB2 and DDF workload
 - ➔ For use with DB2 11
- More notepad information about a service definition allowed

New Classification Qualifiers and Groups

- z/OS V2.1 extends classification groups to 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.
 - Except: Priority (numeric), zEnterprise Service Class

```
File Utilities Notes Options Help
-----
Functionality LEVEL029          Definition Menu          WLM Appl LEVEL029
Command ==> _____

Definition data set . . . : none

Definition name . . . . . coeffs      (Required)
Description . . . . . Service coefficients

Select one of the
following options. . . . . 5      1. Policies

Classification Group Menu

Select one of the following options.
-----
 1. Accounting Information Groups      14. Plan Name Groups
 2. Client Accounting Info Groups      15. Procedure Name Groups
 3. Client IP Address Groups           16. Process Name Groups
 4. Client Transaction Name Groups     17. Scheduling Environment Groups
 5. Client Userid Groups                18. Subsystem Collection Groups
 6. Client Workstation Name Groups     19. Subsystem Instance Groups
 7. Collection Name Groups              20. Subsystem Parameter Groups
 8. Connection Type Groups              21. Sysplex Name Groups
 9. Correlation Information Groups     22. System Name Groups
10. LU Name Groups                      23. Transaction Class Groups
11. Net ID Groups                       24. Transaction Name Groups
12. Package Name Groups                 25. Userid Groups
13. Perform Groups

F1=Help      F2=Split      F5=KeysHelp      F9=Swap      F12=Cancel
```


WLM ISPF application samples

```

Group  Xref  Notes  Options  Help
-----
Command ==> _____
Modify a Group

Enter or change the following information:

Qualifier type . . . . . : Accounti
Group name . . . . . : SLOWACCT
Description . . . . . :
Fold qualifier names? . . . . . Y (Y or

Qualifier Name  Start  Des
020175
030275
040375

```

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

```

Group  Xref  Notes  Options  Help
-----
Command ==> _____
Modify a Group

Enter or change the following information:

Qualifier type . . . . . : Accounting Information
Group name . . . . . : FASTDEPT
Description . . . . . :
Fold qualifier names? . . . . . Y (Y or N

Qualifier Name  Start  Description
PURCHASE       8
SALES          8
SHIPPING       8
ITDEP*        11
HRDEP*        11

```

Use a start position for each group member to indicate how far to index into the character string for a match. The start position may differ across group members.

Classification via new groups: Examples

```

_____ 1  AIG      SLOWACCT _____
_____ 2   AIG      FASTDEPT  _____
_____ 1  CAI      CLIENTAI  _____
_____ 1  CIP      CLIENTIP  _____
_____ 1  CTN      CLIENTTN  _____
_____ 1  CUI      CLIENTUI  _____

```

```

Accounting Information Group SLOWACCT -
Created by user IBMUSER on 2011/08/23 at
Last updated by user IBMUSER on 2011/08/

Qualifier  Starting  Description
name       position
-----
020175
030275
040375

```

```

Accounting Information Group FASTDEPT -
Created by user IBMUSER on 2011/08/23 at
Last updated by user IBMUSER on 2011/08/

Qualifier  Starting  Description
name       position
-----
PURCHASE   8
SALES      8
SHIPPING   8
ITDEP*     11
HRDEP*     11

```

Accounting Information Group (AIG) example:

- '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

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)”

<i>Function</i> \ <i>z/OS release</i>	V2.1	V1.13 – V1.10
Groups of SPM rules & new classification qualifiers	+	Toleration OA36842

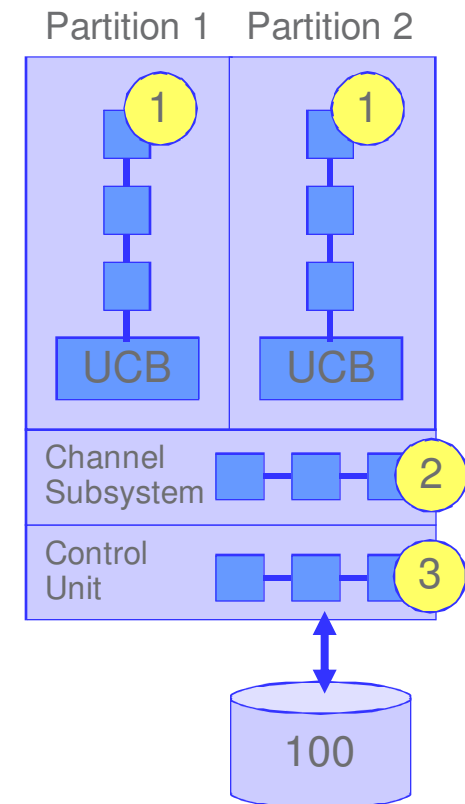
I/O Priority Groups

▪ 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 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 I/O 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

<i>z/OS release</i> <i>Function</i>	V2.1	V1.13	V1.12
<i>I/O Priority Groups</i>	+	Toleration OA37824	Toleration OA37824

I/O Priority Group is specified in the service class definition:

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 HIGH (NORMAL or HIGH)

I/O Priority Groups – Validation

But I/O Priority Group HIGH is only honored by WLM if both “I/O priority management” and “I/O priority groups” are enabled for the service definition:

Service Coefficient/Service Definition Options

I/O priority management	YES	(Yes or No)
Enable I/O priority groups	YES	(Yes or No)
Dynamic alias tuning management	NO_	(Yes or No)

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

Service Definition Validation Results

```
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.
```

I/O Priority Groups – Specification in z/OSMF

z/OSMF Workload Management task provides new option, too.

The screenshot displays the IBM z/OS Management Facility interface in Mozilla Firefox. The main window is titled "Workload Management" and contains a table of "Service Classes". The table has columns for Name, Period, Importance, Duration, Goal Type, CPU Critical, I/O Priority Group, Resource Group, and Workload. The "I/O Priority Group" column is highlighted with a red box, showing values like "High" and "Normal".

Name	Period	Importance	Duration	Goal Type	CPU Critical	I/O Priority Group	Resource Group	Workload
* AK1					* No	* High		* STC
* AK2					* No	* High		* STC
* AK3					* No	* High		* STC
* BTCHDEF					* No	* Normal		* BATCH
* DB2BPI4					* No	* Normal		* BATCH
* DB2BPI5					* No	* Normal		* BATCH
* DB2BPID					* No	* Normal		* BATCH
* DISC					* No	* Normal		* BATCH
* ECP					* No	* Normal	ECP	* BATCH

I/O Priority Groups – RMF: Workload Activity Report

- Postprocessor Workload Activity (WLMGL) report shows I/O priority group
- 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.

```

----- SERVICE CLASS(ES)
REPORT BY: POLICY=WLPOL      WORKLOAD=ONLINE      SERVICE CLASS=ONLTOP      RESOURCE GROUP=*NONE
CRITICAL                    =CPU+STORAGE
DESCRIPTION                  =Batch workload
                                I/O PRIORITY GROUP=HIGH

-TRANSACTIONS-  TRANS-TIME  HHH.MM.SS.TTT  --DASD  I/O--  ---SERVICE---  SERVICE TIME  ---APPL %---  --PROMOTED--  ----STORAGE----
AVG             0.74  ACTUAL          0  SSCHRT  0.0  IOC          0  CPU      6.429  CP      0.66  BLK      0.000  AVG      7663.01
MPL             0.74  EXECUTION      0  RESP   0.0  CPU     287332  SRB      0.000  AAPCP   0.00  ENQ      0.000  TOTAL   5698.61
ENDED          0    QUEUED          0  CONN   0.0  MSO     537297  RCT      0.002  IIPCP   0.00  CRM      0.000  SHARED   0.00
  
```


Use of I/O Priority Ranges

I/O Priority Management=YES		
Priority	I/O PriorityGroups NOT enabled	I/O PriorityGroup enabled
FF	SYSTEM	SYSTEM
FE	SYSSTC	SYSSTC
FD	Dynamically managed	Priority Group = HIGH
FC		
FB		
FA		
F9		
F8		
F7	Discretionary	Priority Group = NORMAL
F6		
F5		
F4		
F3		
F2	Discretionary	Discretionary

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
- Recommend to 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 an WLM Application prior z/OS V2R1
- RMF support is only available with z/OS V2R1

Agenda

IBM z13 Support

z/OS V2.2 enhancements

z/OS V2.1 highlights

Other service stream enhancements and recommendations

Service Stream Enhancements for more aggressive Blocked Workload support (OA44526)

- Problem addressed:
 - The current minimum value that can be specified for the Blocked Workload interval threshold BLWLINTHD is 5 sec.
DB2 could profit from earlier or more frequent trickling.

- More aggressive specifications will be enabled by OA44526
 - New lower limit is 1 sec

 - BLWLINTHD default and BLWLTRPCT remain unchanged
 - Consider lowering BLWLTRPCT with very small BLWLINTHD values if amount of trickle cycles that may be handed out is a concern.

Recent changes for DB2 stored procedures and IDAA environments

- DB2 PM90151
 - In the case where a stored procedure spawns a thread and the spawned thread calls another stored procedure, the inner stored procedure can exceed the STORTIME zparm.
 - With this APAR change, DB2 will use the DEPENDENT(YES) attribute when inserting the WLM request to schedule the stored procedure
 - Provided there are system resources available, WLM will give increased priority to this request. This should help prevent the sqlcode471 rc00E79002.

- WLM OA43538 (z/OS V1.12, z/OS V1.13, V2.1): “Unbound Servers”
 - Server address spaces, such as for DB2 Application Environments were not started due to incorrect assessment of available capacity
 - Symptom could be DB2 stored procedure timeouts with SQLCODE -471
 - Could occur even when minimum number of servers were requested via MNSPAS=n parameter

- WLM OA45658 - DB2 Stored Procedure Timeouts due to capped dependent enclave (triggered by Discretionary Goal Management)

XML Format WLM service definitions recommended

- For several releases WLM has supported to store a service definitions in XML format
 - z/OSMF WLM task
 - ISPF Administrative Application: “Save as XML”...
- XML format avoids particular problems with the ISPF tables format, namely coexistence behavior, when a new functionality level needs to be introduced, and the number of table columns needs to be extended.
- **Recommendation:**
Consider using the XML-format for your WLM service definition data sets.

z/OS Workload Management

- More Information -

- z/OS WLM Homepage:

<http://www.ibm.com/systems/z/os/zos/features/wlm/>

– Inside WLM: <https://ibm.biz/BdF4L4>

- z/OS MVS documentation

– z/OS MVS Planning: Workload Management:

<http://publibz.boulder.ibm.com/epubs/pdf/iea3w101.pdf>

– z/OS MVS Programming: Workload Management Services:

<http://publibz.boulder.ibm.com/epubs/pdf/iea3w201.pdf>

- *IBM Redbooks publications:*

– System Programmer's Guide to: Workload Manager:

<http://publib-b.boulder.ibm.com/abstracts/sg246472.html?Open>

– ABCs of z/OS System Programming Volume 12

<http://publib-b.boulder.ibm.com/abstracts/sg247621.html?Open>



WLM Topology Report Tool (As-is)

- New **as-is** tool available for download from the WLM homepage
 - <https://ibm.biz/BdE74v>
- Visualizes mapping of HiperDispatch affinity nodes to physical structure
- Supports IBM zEC10 and later
- To use:
 1. Download from above location
 2. Run installer
 3. Upload Host code to a z/OS system
 4. Collect SMF99.14 records

Sample output (zEC12):

Topology for 07-21-2014-13:44:27 , System: IRD9

