z/OS Performance "Hot" Topics

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AIX*  
AIX 5L*  
BladeCenter  
Chipkill  
DB2  
DB2 Universal Database  
Domino  
Enterprise Storage Server*  
e-business logo*  
GDPS*  
Geographically Dispersed Parallel Sysplex  

HiperSockets  
IBM*  
IBM eServer  
IBM logo*  
iSeries  
Lotus*  
OnForever*  
Parallel Sysplex*  
POWER  
POWER5  
Predictive Failure Analysis*  
pSeries*  
S/390  
ServerProven*  
Tivoli*  
TotalStorage*  
TotalStorage Proven  
Virtualization Engine  
X-Architecture  
xSeries*  
z/OS*  
z/VM*  
zSeries*  
System z9*  
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Agenda

- New Performance Support
  - z/OS 1.10
  - z/OS 1.11
- Performance and Capacity Planning Topics
  - RSU Information
  - WLM Routing
  - zIIP and zAAP Information
  - zPCR Info
  - Compression Information
  - Hardware Instrumentation
  - Hiperdispatch
  - WLM Information
- Addendum
  - Older APARs or Performance Information
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z/OS 1.10 Performance Items

- Contention Management Phase 3
  - Promote units of work identified by exploiters for longer periods of time
  - Promote to priority of highest-priority unit of work waiting for the held resource
  - Info on promoted workloads recorded in RMF, SDSF DA and ENC panels

- CPU Management of zIIPs
  - WLM algorithms for adjusting dispatch priorities extended to zIIP workloads

- Manage selected components in service class SYSTEM
  - Prevent inadvertent misclassification of system address spaces regardless of the WLM Policy and protect system at high utilization
    - XCFAS, GRS, SMSPDSE, SMSPDSE1, CONSOLE, IEFSCHAS, IXGLOGR, SMF, and CATALOG

- Support for 10 additional PB delay types and naming by subsystem

- Extract the WLM service definition in XML format
  - Install and activate a WLM service definition in XML format via a CIM Server
z/OS 1.11 Performance Items

- HiperDispatch improvements for zIIP processors
  - Will park/unpark zIIPs
- New zAAP on zIIP support
- z/OS CIM server processing will be eligible to run on the System z zIIPs
  - Java based CIM client apps on z/OS can already use zAAPS
- New prefetch capability to provide perf improvements for XL C/C++ applications on z10
  - Reduce effects of memory latency by beginning to fetch data before it is known to be needed
- VSCR improvements in the base z/OS
  - GRS STAR mode sysplex-wide query requests
  - XML code page support
  - TCP/IP sockets processing
  - Allocation changed to significantly reduce the storage required by the Eligible Device Table (EDT) for many I/O configurations
  - New SMF fields to record more information on use of virtual, real, and aux storage above 2 GB and can help with capacity planning, performance management, and accounting
- DFSMS support is planned for solid state drives (also called flash memory) on DS8000
RSU settings on z10

- The storage increment size on the z10 has increased from 64 to 256.
- RSU specifies the number of central storage units to be made available for storage reconfiguration.
- Storage increment size is hardware dependent, based on hardware model, and possibly on amount of real storage installed on the CEC.
- An unqualified value of 1-9999 (no M, G, T, or %) can have unexpected results.
  - LPARs with RSU values should ensure the change in storage increment size does not adversely impact system performance.
- Over specification of the RSU parameter in IEASYSxx may cause significant performance overhead.
  - During IPL system will issue messages IAR004I and IAR013I to warn of over specification.
  - Might receive later message IAR005I to further warn of the potential performance impact.
RSU APAR - OA27801

- A new informational message IAR026I is added and will be issued during early IPL to notify of an RSU over-specified condition.
  - Message will be issued when the RSU value specified is greater than the amount of real storage in the system.
  - New message followed by existing message IAR006A to identify invalid RSU value and prompt for a valid RSU or to hit enter to accept the default.
  - Message will indicate the amount of real storage in the system.
- A large RSU value which is less or equal to the amount of real storage available in the system can still cause system performance problems, and the new message IAR026I will not be issued in this case.
- The new message is as follows:

  IAR026I THE RSU VALUE SPECIFIED EXCEEDS THE TOTAL AMOUNT OF REAL STORAGE AVAILABLE ON THIS SYSTEM: xxxxxxxxM
### Sysplex Routing - IWMSRSRS Function=Specific

#### Effect of PI on WLM Routing Recommendations

<table>
<thead>
<tr>
<th>System</th>
<th>Available Capacity</th>
<th>Original Server Weight</th>
<th>PI</th>
<th>WLM Weight</th>
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<tbody>
<tr>
<td>SYS1</td>
<td>110</td>
<td>18</td>
<td>1.3</td>
<td>14</td>
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<tr>
<td>SYS2</td>
<td>100</td>
<td>16</td>
<td>0.8</td>
<td>16</td>
</tr>
<tr>
<td>SYS3</td>
<td>95</td>
<td>15</td>
<td>1.0</td>
<td>15</td>
</tr>
<tr>
<td>SYS4</td>
<td>95</td>
<td>15</td>
<td>2.0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>64</td>
<td></td>
<td>53</td>
</tr>
</tbody>
</table>

#### Example:
- Example assumes a 4-way Sysplex
- If the server specific weight is >1, the weight is divided by the PI
- Consequently, the sum of all weights is no longer normalized to 64
- WLM server weight influences the distribution of work across the sysplex by the subsystem

SYS1 = 110/400 = 0.275 * 64 = 18 = 18 / 1.3 = 14
WLM Routing Services

- **OA27940**
  - PI Factor used for WLM Routing service IWMSRSRSRS Function=SPECIFIC can have a negative impact on the routing recommendation if a very aggressive but almost unachievable goal is set
    - This type of goal has a PI which indicates the work is missing its goal even if the work is receiving very good service
    - The PI>1 can cause the routing service to route work away from the server
  - New IEAOPTxx parameter introduced called **RTPIFACTOR**
    - Specified as a value from 0-100
    - RTPIFACTOR=0 PI is not considered
    - RTPIFACTOR=100 PI is fully considered
    - RTPIFACTOR=(1:99) PI impact is reduced accordingly
  - Recommend rework the goals of the affected service classes rather than use this parameter
    - Use this setting only if a negative effect is seen, otherwise do not code in the IEAOPTxx
    - This is a global setting and applies to all users of IWMSRSRSRS Function=SPECIFIC
WLM Routing Services

- OA27063 - Doc APAR
  - For z/OS v1.9 and v1.10 IEAOPTxx parameter WASROUTINGLEVEL has incorrect default specified in the MVS Init & Tuning, SA22-7592-xx
  - WASROUTINGLEVEL = 0| 1
    - Specify 0
      - This is the default
      - WLM uses most advanced routing algorithm supported by ALL systems in the sysplex
    - Specify 1
      - WLM uses the round robin algorithm
      - This option if chosen should be the same for all systems in the sysplex
z/VM-Mode LPAR Support for IBM System z10

- New LPAR type for IBM System z10: z/VM-mode
  - Allows z/VM V5.4 users to configure all CPU types in a z10 LPAR
- Offers added flexibility for hosting mainframe workloads
  - Add IFLs to an existing standard-engine z/VM LPAR to host Linux workloads
  - Add CPs to an existing IFL z/VM LPAR to host z/OS, z/VSE, or traditional CMS workloads
  - Add zAAPs and zIIPs to host eligible z/OS specialty-engine processing
  - Test integrated Linux and z/OS and z/VSE solutions in the same LPAR
- No change to IBM software licensing
  - Software continues to be licensed according to CPU type
zIIP Assisted HiperSockets for Large Messages

- In z/OS 1.10 HiperSockets has been enhanced for zIIP exploitation

- Specifically, z/OS Communications Server allows the HiperSockets Multiple Write operation for outbound large messages (originating from z/OS) to be performed by a zIIP
  - Both sending and receiving LPAR experience fewer I/O interrupts
  - Allows the receiving LPAR to process much more data per I/O interrupt
  - Asynchronously moves data without blocking the sending application
  - May help reduce general CPU utilization even without zIIP

- This capability helps make highly secure, available, virtual HiperSockets networking more attractive
  - Application workloads based on XML, HTTP, SOAP, Java, etc. as well as traditional file transfer, can benefit from this function by helping to lower general purpose processor utilization of such traffic

- Available on z/OS V1.10 and System z10 only
**zAAPs on zIIPs**

- When a **processor** has no zAAPs installed but the LPAR has zIIP(s), treat zAAP-eligible work instead as zIIP-eligible work
  - Exception: Under z/VM can define a guest without zAAPs, on a processor with zAAPs, to allow testing

- **IEASYSxx** system parm indicates whether zAAP on zIIP is enabled
  - ZZ=NO | YES for z/OS 1.9 and z/OS 1.10
  - ZAAPZIIP=NO | YES for z/OS 1.11 (also supports alias of ZZ)
  - The enablement state of zAAP on zIIP cannot be changed after IPL

- Timing fields within SMF will show offload time under zIIP
  - No method to determine what portion of zIIP time originated due to a zAAP request
  - Accounting and Capacity planning may need updating to use zIIP fields
  - If neither zIIP nor zAAP are installed then projection data will show as AAPCP time

- Possible Migration Actions: Some software may be sensitive to presence of zAAPs

- **APAR OA27495** for z/OS 1.9 and 1.10
OA28156 - Job Exceeds Job Wait Time

- Work receives incorrect ABEND522 while executing DB2 query
  - Batch job issued a DB2 query which used parallelism, which caused DB2 to create a dependent enclave
  - Problem is the only work being done on behalf of the batch address space was an enclave SRB running in a dependent enclave
  - The enclave CPU time was accumulated in the enclave block and ASSBPTHM of the SRB home space, which in this case is DBM1
  - So it looked like the batch address space was in a wait and it times out with an ABEND522

- SRM will now store the current CPU time into the ASCBEWST field of an address space if the address space owns a dependent enclave

- Dependent enclave CPU time is already included in the SMF30CPT time so most accounting packages will not need to be changed
PK90804 - Job Exceeds Job Time - OPEN

- Work receives incorrect ABEND322 while executing DB2 query
  - When a batch job issues a Stored Procedure call, a dependent enclave is created and both the job's TCB and the TCB that runs the Stored Procedure join the enclave
    - Job's TCB remains joined to the dependent enclave for the remainder of the job
    - CPU time at the z/OS level being reported as enclave CPU time
    - Looping Jobs after the first Stored Procedure call will not be eligible for S322
    - Enclave CPU time is intentionally not included when the test for CPU time exceeded is done
  - DB2 is changed to have only the Stored Procedure TCB join the enclave, not the job's TCB
  - Stored Procedure enclave is still 'kept alive' for duration of the job
DB2 parallelism, WLM, and zIIPs - History

- For SQL statements eligible for parallel execution DB2 may create new independent enclaves
  - Newly created enclaves must be classified using subsystems DB2
  - Independent enclave is considered a new transaction
  - Must replicate existing classification rules for every subsystem which may run a stored procedure with the potential for exploiting CPU Parallelism

- DB2 Parallelism and zIIPs
  - Controlled by a CPU threshold. Once the threshold is met all child tasks are zIIP eligible
  - Parents are not zIIP eligible
  - Parent and child CPU time contribute to the CPU threshold
  - Can see any kind of work, CICS, IMS, TSO, batch using zIIP resources
**z/OS 1.11 New Support for WLM Enclaves**

- **IWM4ECRE TYPE=WORKDEPENDENT**
  - Resulting enclaves will be part of the creating TCB/SRB's transaction
  - Can now process parallel queries as a single transaction
  - If called while joined to an independent enclave a new type of enclave called work dependent is created:
    - Adopt owner address space and classification from the owning independent enclave
    - Extends an independent enclave's transaction
      - Work accumulates service as a group, and goes through period switch as a group

- Depending upon the environment the UOW is executing in when it calls IWM4ECRE with TYPE=WORKDEPENDENT the resulting enclave can be:
  1. Common dependent enclave
  2. Enclave of type work dependent
  3. Dependent enclave, which adopts owner address space and classification from the enclave out of which the service was called

- **APAR OA26104** for releases 1.8 and beyond
Addr Space A
TCB/SRB

IWM4ECRE
TYPE=INDEPENDENT

Addr Space A
TCB/SRB

IWM4ECRE
TYPE=INDEPENDENT

Addr Space A
TCB/SRB

IWM4ECRE
TYPE=DEPENDENT

TCB/SRB running in any address space, joins IE1, calls IWM4ECRE with TYPE=WORKDEPENDENT

IE1
ENCLAVE

TYPE= INDEPENDENT
OWNER = A
New Transaction
Own Classification

WD1

IE1
ENCLAVE

TYPE= WORKDEPENDENT
OWNER = A
Extended Transaction: IE1
Classification: IE1

DE1
ENCLAVE

TYPE=DEPENDENT
OWNER = A
Extended Transaction: A
Classification: A

DE2

DE3

TCB/SRB running in any address space, joins DE1, calls IWM4ECRE with TYPE=WORKDEPENDENT

IWM4ECRE
TYPE=WORKDEPENDENT

IWM4ECRE
TYPE=WORKDEPENDENT

IWM4ECRE
TYPE=WORKDEPENDENT
Management of Work - xxFHonorpriority=YES

Bucket captures GCP time spent providing help AAPCP, or IIPCP

GCPs will help in priority order, but won't help zIIP or zAAP work with a discretionary goal
SMF23 Enhancements

- OA22414 - New Function
  - For z/OS 1.8 and beyond
  - Supported on any IBM System z or IBM zSeries Processor

- Adds new workload characterization counters to SMF 23 records
  - TCB and SRB dispatches per CPU
  - RSM Services intensity by tracking number of getmains, first reference page faults, non first reference faults, page fixes, etc.
  - Overall I/O rates

- Better workload profiling data to enhance workload-mix selection for LSPR and zPCR
z10 CPU Measurement Facility

- New hardware instrumentation facility available on z10 GA2
  - New z/OS component - Hardware Instrumentation Facility (HIS)
  - Requires APARs OA25755, OA25750, and OA25773
  - Generates SMF 113.2 records
- CPU MF provides support built into the processor hardware
- Potential Future Uses:
  - Better workload characterization
  - ISV Product Improvements
  - Application Tuning

- OA27623
  - New fields added to SMF 113.2 records
    - Processor Speed for which the hardware counters are recorded, in terms of cycles/microsecond
    - New information on sampling frequency relative to processor speed
HiperDispatch Mode

- **PR/SM**
  - Supplies topology information/updates to the z/OS guest
  - Ties high priority logicals to physicals (gives 100% share)
  - Distributes remaining share to medium priority logicals
  - Distributes any additional service to unparked low priority logicals

- **z/OS**
  - Associates tasks with a small subsets of logical processors
  - Dispatches work to associated subset of logicals when possible
  - Dispatches work to some other CPU when necessary
  - Parks low priority processors that are not needed or will not get service

- The combination provides the processor affinity that maximized the efficiency of the hardware caches
z/OS HiperDispatch Mode

- Improved dispatching can help reduce the effects of memory latency to improve performance and reduce CPU time
  - Better access to hardware cache
  - Manage work across fewer logical CPs
    - Correct dispatch priorities are critical

- Processors will not have equal logical share, but rather a vertical share:
  - High: 100% share
  - Medium: 0-100% share, the remainder after Vertical High share
  - Low: 0-100% share, not needed for weight and is discretionary

- IRD Vary CPU management is disabled and replaced
  - Logical CPs provided based on weight, workload demand, and available capacity

- Recommendation is to enable with the installation of the z10
  - If HD=NO ensure sufficient capacity to handle the loss of performance

- Not supported for z/OS guests under z/VM
OA26789 - z/OS HiperDispatch

- z/OS 1.7 and beyond

- Running with HiperDispatch=YES a partition is running at or close to 100% busy, a vertical low processor may not be unparked even if the CEC is not 100% busy

- The range of the IEAOPT keywords ZAAPAWMT and ZIIPAWMT has been extended to 1600-499999 which corresponds to a timeframe from 1.6 to 500 ms
  - IEAOPTxx parms ZAAPAWMT and ZIIPAWMT control the wait time before a standard processor will help an assist processor
  - If HIPERDISPATCH=YES, the maximum value was 3200 which equates to 3.2 ms.
  - GCPs may help zIIPs or zAAPs earlier than desired
    - Value of 3200 may be too short and may result in GCP helping an assist processor instead of a vertical low zIIP or zAAP processor being unparked
    - Increased AAPCP/IIPCP time when zIIP/zAAP CPs are parked
zPCR Latest Status

- Latest version is 6.1 (7/16/2009)

- New Functions:
  - GCP/zAAP/zIIP capacity and the LPAR Configuration Capacity Planning function changes
  - New Advanced-Mode capability has been implemented
    - Multiple LPAR configurations (currently limited to two) can be created and analyzed within a single zPCR invocation
  - Using drag and drop with a zPCR Study File or an RMF.txt file new configurations can be defined and existing configurations can be modified
  - The primary windows in the LPAR Configuration Capacity Planning function now have HTML output capability
Hiperdispatch and zPCR

- When building the zPCR model from an RMF report zPCR cannot determine the number of actual logical processors unparked in an LPAR when running hiperdispatch=YES
  - Requires the user to manually determine the number of unparked CPs
  - Using the number reported in the RMF report would overstate the number of logicals
  - Cannot determine the unparked values for other LPARs

- IRD users and hiperdispatch=NO environment the logical CPs are correctly determined by zPCR
  - IRD uses the config CPU command and so the actual environment is changed
  - The SMF70 record from any LPAR on a CEC can determine the actual logical CPs defined for all LPARs

- Warning message is issued when Hiperdispatch=YES systems are read into zPCR
Crippling performance problems can be seen if a flood of SRBs are scheduled from a higher priority address space to a lower priority address space:

- SRBs are given the dispatch priority of the target address space
- Multiple XM POSTs can be the source of the SRBs
- Existence of many SRB already dispatched in an address space may be due to CPU starvation

New Support:

- When there are many SRBs queued to be dispatched in an address space set the priority of new SRBs to the higher of:
  - The priority of the Scheduling address space
  - The priority of the target address space
**z/OS 1.11 New Group Capacity Reporting**

- **CAPPING WLM%** (percentage of time WLM capped the partition) is insufficient when the partition is member of a capacity group:
  - WLM% only tells to what extent a partition is **subject to capping** but not whether the partition was actually capped
  - WLM% is always 100 when the partition is capped with the phantom weight method although the partition does not use the capacity it is entitled to
  - WLM% is more a matter of how WLM caps the partition instead of how much it is being capped

- **RMF does not report how much capacity is available for the group**

<table>
<thead>
<tr>
<th>GROUP-CAPACITY LIMIT</th>
<th>PARTITION</th>
<th>SYSTEM</th>
<th>-- MSU --</th>
<th>WGT</th>
<th>-CAPPING-</th>
<th>- ENTITLEMENT -</th>
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</table>
RMF Group Capacity Enhancements

- The Postprocessor Group Capacity report displays the percentage of time where the partition was **actually capped**
  - Users of Capacity Groups can determine the available (unused) capacity for their group and whether the partition was actually capped:
    - SMF record 70 subtype 1 (CPU Activity) is extended
- The Postprocessor Partition Data report displays the available capacity for the group
- Greatly improved is the calculation of the remaining time until capping in Mon III CPC Capacity report

```
GROUP-CAPACITY REPORT

<table>
<thead>
<tr>
<th>NAME</th>
<th>LIMIT</th>
<th>PARTITION</th>
<th>SYSTEM</th>
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<th>-- WGT --</th>
<th>-CAPPING--</th>
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</table>

TOTAL      | 637   | 1000      |        |           |           |             |                |                 |
```

**Session: RMF Latest and Greatest**
New WLM Tools

- **WLMOPT**
  - Displays the current IEAOPT settings
  - Identifies the currently active OPT member, when it was installed, and the settings of all OPT parameters

- **WLMQUE**
  - ISPF based tool to display the application environments currently being used on your z/OS system
  - View the number of started and active server address spaces, and the service classes being used as work queues for the application environments
  - Tool can be used for any kind of application environment from WebSphere, DB2 or user specified types and applications

New RMF 1.11 Support

**RMF Monitor II** Library List and OPT Settings

Selection Menu
Enter selection number or command on selection line.
1 Link list  LNKLSTxx - Link Library list
2 LPA list  LPALSTxx - LPA Library List
3 APF list  IEAAPFx - Authorized Program List
4 OPT       IEAOPTxx - OPT Settings
Questions