Notes:
Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.
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Agenda

- IBM zEnterprise System
- zEnterprise Unified Resource Manager (zManager)
- Managing the Ensemble
  - Hypervisors and Servers
- Platform Management Requirements
- Service Policies
  - Integrating with z/OS WLM
- Monitoring and Reporting
The world’s fastest and most scalable system: IBM zEnterprise 196 (z196)

- Ideal for large scale data and transaction serving and mission critical applications
- Most efficient platform for Large-scale Linux® consolidation
- Leveraging a large portfolio of z/OS and Linux on System z applications
- Capable of massive scale up, over 50 Billion Instructions per Second (BIPS)

Unified management for a smarter system: zEnterprise Unified Resource Manager

- Unifies management of resources, extending IBM System z qualities of service end-to-end across workloads
- Provides platform, hardware and workload management

Scale out to a trillion instructions per second: IBM zEnterprise BladeCenter Extension (zBX)

- Selected IBM POWER7 blades and IBM System x Blades1 for tens of thousands of AIX and Linux applications
- High performance optimizers and appliances to accelerate time to insight and reduce cost
- Dedicated high performance private network
zEnterprise Unified Resource Manager

- Runs on HMC and Support Element
- Comprised of six management areas
  - Operational Controls (Operations)
  - Virtual Server Lifecycle Management (Virtual Servers)
  - Hypervisor Management (Hypervisors)
  - Energy Management (Energy)
  - Network Management (Network)
  - Workload Awareness and platform performance management (Performance)
- Two different suites
  - Manage Suite
  - Automate Suite - Optional
IBM Washington Systems Center

zManager – Hardware Management

**Hypervisor Management**
- Integrated deployment and configuration of hypervisors
- Hypervisors (except z/VM®) shipped and serviced as firmware.
- Management of ISO images.
- Creation of virtual networks.

**Operational Controls**
- Auto-discovery and configuration support for new resources.
- Cross platform hardware problem detection, reporting and call home.
- Physical hardware configuration, backup and restore.
- Delivery of system activity using new user.

**Network Management**
- Management of virtual networks including access control

**Energy Management**
- Monitoring and trend reporting of CPU energy efficiency.
- Ability to query maximum potential power.

**Key**
- Manage suite
- Automate suite
zManager – Platform Management

**Hypervisor Management**
- Manage and control communication between virtual server operating systems and the hypervisor.

**Energy Management**
- Static power savings

**Workload Awareness and Platform Performance Management**
- Wizard-driven management of resources in accordance with specified business service level objectives
- HMC provides a single consolidated and consistent view of resources
- Monitor resource use within the context of a business workload
- Define workloads and associated performance policies

**Virtual Server Lifecycle Management**
- Single view of virtualization across platforms.
- Ability to deploy multiple, cross-platform virtual servers within minutes
- Management of virtual networks including access control

**Key**
- Manage suite
- Automate suite
zManager Manage and Automate Suites

- Manage Suite is the default Suite with zManager

- The optional Automate Suite provides the necessary tools for platform performance monitoring
  - Allows definition of custom workloads by name
  - Differentiate between multiple workloads in an Ensemble by creating named workload definitions

- Performance Management
  - Management of CPU resource across virtual servers hosted in the same hypervisor instance to achieve workload performance policy objectives
  - Performance service-level policy definition and performance monitoring and resource optimization
  - Allow virtual CPU capacity to be adjusted across a hypervisor
Managing the Ensemble

- All zManager tasks are performed on either the HMC or Support Element
- One HMC manages the ensemble
  - Multiple HMCs can provide traditional management
  - Only the PRIMARY HMC can perform ensemble related management
- If web access is enabled on the primary HMC, any workstation can access the HMC with compatible web browser
Hypervisors and Servers

- Hypervisors are the virtualization layer that simulate underlying hardware
  - Allows instances, or logical entries, of a virtual server to run as if it had access to a full set of hardware

- zManager supports the following Hypervisors
  - PR/SM
  - z/VM
  - PowerVM

- Virtual Servers
  - Container for an operating system
    - z/OS is not a virtual server, it is the OS inside the virtual server
    - z/VM guest machines are the virtual servers, with Linux and z/OS the OSes inside those containers
Platform Management Requirements

- The following slides review the pieces of the puzzle needed to manage the resource in a zEnterprise ensemble
- ARM, GPMP, Workloads, and Performance Policies are reviewed
ARM – Application Response Measurement

- Allows measurement of end-to-end response time
  - Correlator assigned to classify work. Correlator is passed to secondary applications and other managed servers that process the application
  - Similar to Performance Blocks in z/OS Workload Manager

zManager uses information to determine

- The amount of time that each application or server used to process the transaction
- The name of the application or server that processed the transaction
- The end-to-end transaction flow as it moves from one application or server to the next

Movement of work request from one application OR server to another is considered a 'HOP'

- Data viewed from the HOPS Report

All applications and servers that will process a work request must be ARM enabled for end-to-end management and reporting
Basic ARM calls

- `arm_register_application`
- `arm_register_transaction`
- `arm_start_application`
- for (each transaction)
  - `arm_start_transaction`
  - `arm_bind_thread`
  - `arm_blocked`
    - Call downstream sub-transaction
  - `arm_unblocked`
  - `arm_unbind_thread`
  - `arm_stop_transaction`
- `arm_stop_application`
- `arm_destroy_application`
Workflow Example with ARM

Standards Based Application Instrumentation

- Application Environment Statistics
  - Topology
  - Work Request Correlators
  - State Information
  - Work Request Processing

- The Open Group ARM Standard V4.0
  - Process registration, deregistration
  - Work request classification, start, and stop
ARM Instrumented Middleware

- **Web Server support:**
  - WebSphere provided plugin
    - IHS/Apache
    - IIS
    - Domino
    - iPlanet

- **WebSphere Application Server**
  - WAS 6.0, WAS 7.0

- **DB2 Universal Database**
  - Including z/OS DB2
GPMP

- GPMP - Guest Platform Management Provider
  - Lightweight component of PPM that provides monitoring data
  - Link between operating system and zManager

- GPMP collects performance data for work running on a virtual server and passes it to zManager

- With ARM instrumented middleware support, GPMP provides metrics that allows detailed transaction topology as transaction hops through heterogeneous platforms in zEnterprise
  - ARM-instrumented middleware applications required
  - Middleware calls ARM APIs while servicing work requests
<table>
<thead>
<tr>
<th>GPMP</th>
</tr>
</thead>
</table>

- With z/OS V1R12, WLM can be set up to automatically start GPMP on all LPARs in an ensemble
  - If all z/OS Images are at z/OS V1R11 or earlier, GPMP must be started manually

- With ARM instrumented middleware support, GPMP provides metrics that allows detailed transaction topology as transaction hops through heterogeneous platforms in zEnterprise
Enable GPMP on z/OS

z/OS Service Support

- Guest Platform Management Provider ships with z/OS
- Supported on z/OS R12, R11, R10
- Following APARs are required to enable GPMP support
- With z/OS R12, WLM can be set up to start GPMP
  - R11 or earlier, GPMP must be started manually

<table>
<thead>
<tr>
<th>APAR(FMID)</th>
<th>APAR (FMID)</th>
<th>APAR (FMID)</th>
<th>Comment</th>
</tr>
</thead>
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<tr>
<td>OA30928 (HBB7770)</td>
<td>OA30928 (HBB7760)</td>
<td>OA30928 (HBB7750)</td>
<td>z/OS WLM</td>
</tr>
<tr>
<td>OA31690 (HBB7770)</td>
<td>OA31690 (HBB7760)</td>
<td>OA31690 (HBB7750)</td>
<td>z/OS GPMP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OA33259 (HBB7750)</td>
<td>z/OS USS</td>
</tr>
<tr>
<td>OA32099 (HVT61C0)</td>
<td>OA32099 (HVT61B0)</td>
<td>OA32099 (HVT1A0)</td>
<td>Comm Server SNA</td>
</tr>
<tr>
<td>PM08334 (HIP61C0)</td>
<td>PM08334 (HIP61B0)</td>
<td>PM08334 (HIP61A0)</td>
<td>Comm Server IP</td>
</tr>
</tbody>
</table>
z/OS WLM Settings

Service definition was extracted. (IWMAM036)
z/OS WLM Settings

Guest Platform Management Provider (GPMP) Settings

Command ===> 

Activate guest platform management provider: 2
  1. NO
  2. YES

Names of systems to be excluded:
Benefits of GPMP

- Guest Platform Management Provider (GPMP) is a lightweight component of PPM that provides additional monitoring data.

- Allows virtual server to be classified with additional attributes such as:
  - HostName
  - SystemName
  - OS Level etc.

- With instrumented middleware support, GPMP provides metrics that allows detailed transaction topology as transaction hops through heterogeneous platforms in zEnterprise.
zManager Platform Workload

- In z/OS, workload is a collection of work to be managed, tracked, and reported as a unit. Can be one managed in one or multiple service classes.
- For zEnterprise, workload is a collection of logical constructs, i.e. virtual servers that perform a customer defined collective purpose.
- A workload represents business goals or functions:
  - Represents a way to group virtual servers to be managed.
- All virtual servers to be managed by zManager must run in the same ensemble:
  - Can be in different blades or nodes.
- Workload will have one or more Performance Policies:
  - Each Performance Policy will have one or more Service Classes.
- Requires Automate Suite.

![Diagram of Ensemble with Workloads and Policies]
Performance Policy

- A workload can have one or more performance policies to describe its business importance and objectives
  - Every new workload has at least the 'Default' performance policy
  - Additional policies may be defined as needed
- Define one or more virtual servers to a workload
- Each performance policy has service classes that set the priority of and classify the virtual servers
  - zManager uses the active performance policy and its service classes to determine how physical resources are applied to the virtual servers
Workload and Service Class
Importance and Goals

- Both Workloads and Service Classes will have importance levels
  - Workload Importance will determine importance of service classes in this workload relative to service classes in other workloads
  - Service Class Importance determines importance between other service classes in same workload

- Five Importance levels are possible
  - Highest, High, Medium, Low, Lowest

- Five Velocity Goals are possible
  - Fastest, Fast, Moderate, Slow, Slowest

- If applications are ARM enabled, name of zManager service class can be used to classify work to WLM in z/OS
  - Uses EWLM classification rules
    - Goals must be a response time goal (average or percentile)
    - Single period service classes only
  - If no EWLM classification rules apply, or ARM has not been enabled, work coming into z/OS will use standard classification rules (DDF, JES, etc.)
Defining Workload

- From HMC use New Workload Wizard
  - Simple step-by-step process that will walk through every step needed to set up the basics of a new workload, performance policy, and service class.

![New Workload - ATSENS1](image-url)
z/OS WLM Classification Example

- Done either through WLM ISPF application, or through z/OSMF
- From WLM Classification rules, edit EWLM rules
z/OS Classification Rules Cont.

- ESC is the only Qualifier Type
- Qualifier name is name of ensemble performance policy Service Class
  - Sub-rules needed for PPM Service Classes longer than eight characters

<table>
<thead>
<tr>
<th>Subsystem-Type</th>
<th>Xref</th>
<th>Notes</th>
<th>Options</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Modify Rules for the Subsystem Type Scroll ==> CSR

Subsystem Type . : EWLM Fold qualifier names? N (Y or N)
Description . . . EWLM Rules for PPM

Action codes: A=After C=Copy M=Move I=Insert rule
              B=Before D=Delete row R=Repeat IS=Insert Sub-rule

<table>
<thead>
<tr>
<th>Action</th>
<th>Type</th>
<th>Name</th>
<th>Start</th>
<th>Service</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
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<td>ESC</td>
<td>SrvClsFo</td>
<td>1</td>
<td></td>
<td>PPMDFLT</td>
</tr>
<tr>
<td></td>
<td>ESC</td>
<td>rFastest</td>
<td>9</td>
<td></td>
<td>PPMDFLT</td>
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<tr>
<td></td>
<td>ESC</td>
<td>Highest</td>
<td>17</td>
<td>PPMGHST</td>
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<td>PPMDFLT</td>
</tr>
<tr>
<td></td>
<td>ESC</td>
<td>rFastest</td>
<td>9</td>
<td></td>
<td>PPMDFLT</td>
</tr>
<tr>
<td></td>
<td>ESC</td>
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<td>PPMHIGH</td>
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<td>ESC</td>
<td>ZMGRT1SC</td>
<td>1</td>
<td>PPMGRT1</td>
<td></td>
</tr>
</tbody>
</table>
Performance Measurement

- zManager will assign a PI for every service class
  - PI = 1.0 – Service Class Achieving Goal
  - PI > 1.0 – Service Class Missing Goal
  - PI < 1.0 – Service Class Overachieving Goal

- All zManager service classes are velocity based
  - Need to determine what velocity is getting desired response times for ensemble workloads
Platform Management - CPU

- zManager will distribute CPU resources where necessary based on the achievement of the goals in the active service policy

- CPU Management must be enabled
  - Default for z/VM and POWER hypervisors is disabled
  - When creating a virtual server, CPU management is enabled by default, but hypervisor must have it enabled as well

- POWER virtual servers need to be defined Shared processing mode
  - Set initial, minimum, and maximum processing units and processors
Monitoring Performance

- Currently 8 reports viewable from HMC to monitor performance of workloads and virtual servers
  - Workloads Report
  - Service Classes Report
  - Virtual Servers Report
  - Hypervisor Report
  - Resource Adjustment Report
  - Virtual Server Topology Report
  - View Statistics Report
  - HOPS Report
- Currently 36 hours of history is available
Reports Continued

- Reports can be filtered to show only specific workloads or servers as requested
- Historical data can be kept and reviewed as needed from HMC
- Alerts can also be set up if certain criteria are hit
  - Emails sent to those on specific notification list for each alert
- Report data can be downloaded to local workstation
  - Uses CSV format
  - Can only download data currently represented on screen
Report Examples
The Workload Details

<table>
<thead>
<tr>
<th>Name</th>
<th>Hypervisor</th>
<th>Type</th>
<th>Performance Policy</th>
<th>Performance Policy Status</th>
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</thead>
<tbody>
<tr>
<td>rja IHS1</td>
<td>B.2.07</td>
<td>POWER</td>
<td>rja_wkld1</td>
<td>Activated</td>
</tr>
<tr>
<td>rja WAS1</td>
<td>B.2.08</td>
<td>POWER</td>
<td>rja_wkld1</td>
<td>Activated</td>
</tr>
<tr>
<td>T05P11</td>
<td>TSY5</td>
<td>PR/SM</td>
<td>rja_wkld1</td>
<td>Activated</td>
</tr>
</tbody>
</table>
# The Workload Details

![Workload Details - rja_wkld](image)

**Performance Policies**

<table>
<thead>
<tr>
<th>Select Policy</th>
<th>Status</th>
<th>Business Importance</th>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rja_wkld1</td>
<td>Active</td>
<td>Highest</td>
<td>1</td>
<td>Workload Policy</td>
</tr>
<tr>
<td>Default</td>
<td></td>
<td>Medium</td>
<td>1</td>
<td>The default workload performance policy</td>
</tr>
</tbody>
</table>

**Details for rja_wkld1**

- **Activation status:** Active
- **Last activation requested date:** Dec 12, 2010 4:38:35 PM EST
- **Last activation completed date:** Dec 12, 2010 4:38:35 PM EST
- **Created date:** Dec 12, 2010 4:38:35 PM EST
- **Last modified date:** Dec 12, 2010 4:38:35 PM EST

**Service Class**

<table>
<thead>
<tr>
<th>Class</th>
<th>Performance Goal</th>
<th>Business Importance</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>rja_wkld1_sc</td>
<td>Velocity - Fastest</td>
<td>Highest</td>
<td>Service Class for wkld1</td>
</tr>
<tr>
<td>Default</td>
<td>Velocity - Moderate</td>
<td>Medium</td>
<td>The default workload performance policy service class.</td>
</tr>
</tbody>
</table>
The rja_wkld Workload Details

**Workload Details - rja_wkld**

- **Select Action**
  - New Based On
  - Details
  - Activate
  - Print View
  - View Revisions
  - Export Policy

**Performance Policies**

- **Status**: Active
- **Business Importance**: Highest
- **Revision**: 1
- **Description**: Workload Policy

- **Selected**: 1

- **Active**
  - **Date**: Dec 12, 2010 4:38:35 PM EST
  - **Last Activated by**: HWATSRA

- **Created date**
  - **Date**: Dec 12, 2010 4:38:35 PM EST
  - **Created by**: HWATSRA

- **Last modified date**
  - **Date**: Dec 12, 2010 4:38:35 PM EST
  - **Last modified by**: HWATSRA

**Service Class**

- **Class**: rja_wkld1_sc
- **Goal**: Velocity - Fastest
- **Business Importance**: Highest
- **Description**: Service Class for wkld1

- **Default**
  - **Goal**: Velocity - Moderate
  - **Business Importance**: Medium
  - **Description**: The default workload performance policy service class.
The Workload CPU Utilization Report

CPU Utilization Distribution for Workload nja_wkld

Number of Servers

0.0-10.0 10.0-20.0 20.0-30.0 30.0-40.0 40.0-50.0 50.0-60.0 60.0-70.0 70.0-80.0 80.0-90.0 90.0-100.0

© 2011 IBM Corporation
The Virtual Servers Report
The Virtual Servers Report

<table>
<thead>
<tr>
<th>Server</th>
<th>Virtual Processors</th>
<th>Allocated Memory (MB)</th>
<th>Physical CPU Utilization (%)</th>
<th>Hypervisor CPU Delay (%)</th>
<th>Idle Time (%)</th>
<th>Other Time (%)</th>
<th>Service Class (PID)</th>
<th>OS Processes Total CPU Using Samples (%)</th>
<th>OS Processes Total CPU Delay Samples (%)</th>
<th>OS Processes Total I/O Delay Samples (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>rja_IHS1</td>
<td>2</td>
<td>6,144</td>
<td>1.2</td>
<td>0.0</td>
<td></td>
<td></td>
<td>rja_kiit1_stc (1.00)</td>
<td>6.6</td>
<td>2.3</td>
<td></td>
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<tr>
<td>rja_WAS1</td>
<td>2</td>
<td>6,144</td>
<td>1.3</td>
<td>0.0</td>
<td></td>
<td></td>
<td>rja_kiit1_MS (1.00)</td>
<td>5.5</td>
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<td>TOS11</td>
<td>2</td>
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<td>Default (0.00)</td>
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</tr>
</tbody>
</table>

CPU Utilization for Virtual Server rja_WAS1
Service Class Adjustment Report

![Service Class Resource Adjustments Report - SrvClSForFastest★Highest](image)

**Report Interval:** Starting 3/16/11 5:12:30 PM for 15 minutes (3/16/11 5:27:30 PM)  Modify

**Successful Adjustments:**

<table>
<thead>
<tr>
<th>Receiver Virtual Servers</th>
<th>Receiver Workload</th>
<th>Receiver Service Class</th>
<th>Receiver Processing Units After (Before)</th>
<th>Donor Virtual Servers</th>
<th>Donor Workload</th>
<th>Donor Processing Units After (Before)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>rjava01</td>
<td>rjava_wild</td>
<td>SrvClSForFastest★</td>
<td>0.42 (4.00)</td>
<td>rjava02</td>
<td>Default</td>
<td>4.98 (5.00)</td>
<td>Mar 16, 2011 5:13:12 PM EDT</td>
</tr>
<tr>
<td>rjava01</td>
<td>rjava_wild</td>
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<td>rjava_wild</td>
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<td>0.80 (4.00)</td>
<td>rjava02</td>
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<td>4.50 (4.00)</td>
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<td>Default</td>
<td>4.34 (4.00)</td>
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<td>SrvClSForFastest★</td>
<td>1.19 (4.00)</td>
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<td>Default</td>
<td>4.21 (4.00)</td>
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</tr>
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<td>rjava01</td>
<td>rjava_wild</td>
<td>SrvClSForFastest★</td>
<td>1.35 (4.00)</td>
<td>rjava02</td>
<td>Default</td>
<td>4.05 (4.00)</td>
<td>Mar 16, 2011 5:22:43 PM EDT</td>
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<td>1.43 (4.00)</td>
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<td>Default</td>
<td>3.97 (4.00)</td>
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</table>

**Failed Adjustments:**

<table>
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<tr>
<th>Receiver Virtual Servers</th>
<th>Receiver Workload</th>
<th>Receiver Service Class</th>
<th>Failure Reason</th>
<th>Time</th>
</tr>
</thead>
</table>

**Page 1 of 1**

Total: 0  Filtered: 0  Displayed: 0

**GMT/UTC: Thu 16:00**  
London: Thu 16:00  
Washington, DC: Thu 12:00  
Los Angeles: Thu 09:00  
Done
Workload Topology

Diagram showing a network topology with nodes labeled rja_IHS1, rja_WAS1, and TOSP11, with arrows indicating the direction of data flow and numbers representing the amount of data transferred.
**PPM HOPS Report**

**Details for rja_wkdd1_sc:**
- **Workload:** rja_wkdd1
- **Performance goal:** Velocity-Fastest
- **Performance policy:** rja_wkdd1
- **Business Importance:** Highest
- **Performance:** Fastest

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<thead>
<tr>
<th>Name</th>
<th>Hop Number</th>
<th>Group Name</th>
<th>Successful Transactions</th>
<th>Failed Transactions</th>
<th>Stopped Transactions</th>
<th>Inflight Transactions</th>
<th>Queue Time (s)</th>
<th>Execution Time (s)</th>
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Summary – PPM Components

- **HMC**
  - HMC is management server and console
  - Provides ensemble wide aggregation of performance data
  - UI for defining workloads, performance policy and reporting data
  - Pushes management directives to all the nodes of ensemble

- **Support Element (SE)**
  - Provides node (or CPC) level aggregation of performance data
  - Pushes management directives to all the hypervisors in the node.
Summary – PPM Components

- **Hypervisors**
  - Monitors goal defined in performance policy and performs dynamic resource mgmt to achieve performance goal where applicable
  - Collects virtual server statistics from hypervisor and guest platform management providers. Pushes aggregated metrics to SE

- **Virtual Servers**
  - Optional Guest Platform Management Provider software needs to be deployed in Virtual Server
  - Collects monitoring data from Operating system and ARM instrumented applications and pushes to hypervisors.
Platform Performance Management Structure

- Ensemble Performance Management (GUI/Console, Reporting, Workload & Policy Management)

- HMC
  - EPM

- SE
  - NPM

- Node Performance Mgmt (Policy Management, Data Collection and Aggregation)

- Hypervisor
  - HPM
    - Guest Platform Mgmt Provider (OS Monitoring)
    - Virtual Server
      - GPMP
    - Virtual Server
      - GPMP
    - Virtual Server
      - GPMP
    - Hypervisor Performance Mgmt (Monitoring, Resource Optimization)
Summary

- The Platform Performance Manager portion of zEnterprise Unified Resource Manager is a powerful set of tools and functions that allow users to manage the zEnterprise.

- Resources are directed to virtual servers based on the goals and importance levels of the workloads running.
  - ARM enablement and GPMP allow for end-to-end monitoring of application performance.

- z/OS Enablement allows for tight linkage between zManager goals and z/OS WLM Goals.

- Built in reports give unified, cross-server view.