



#27 zNibbler (zEnterprise Platform Performance Management) zTidBits Series

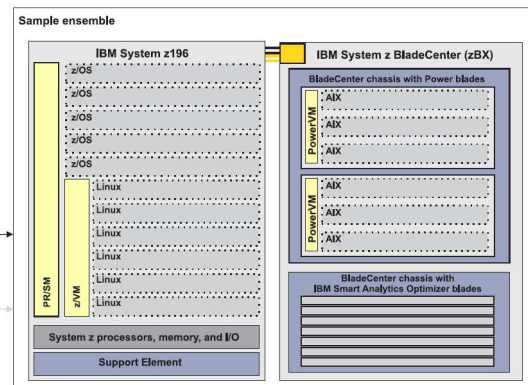
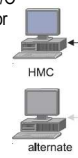
One of the strengths of the System z platform is the ability to run multiple workloads at the same time across multiple z/OS images, and to manage those workloads according to performance goals that you set. The IBM zEnterprise System (zEnterprise) extends this performance management capability to both traditional System z and BladeCenter hardware environments. For multitier applications that span System z hardware and BladeCenter hardware, this extended capability enables dynamic adjustments to CPU allocations to ensure that those applications are provided with sufficient resources.

To manage work on the z/OS operating system, you classify the work running on z/OS into service classes, and define goals for them that express the expectation of how the work should perform. The z/OS workload manager (WLM) uses these goal definitions to manage the work across all systems of a sysplex environment. Similarly, to manage hardware resources in the zEnterprise environment, you group these resources into workloads and define performance policies for them. The IBM zEnterprise Unified Resource Manager (zManager) uses these policy definitions to manage the resources for each workload in an ensemble.

The zManager's performance policies do not replace z/OS' WLM policy or the Service Definition. The performance monitoring and management done by the zManager performance management function is at a different scope than what is done with z/OS' WLM. The policies are separate. The zManager uses what are called Platform Workloads which is a grouping of the virtual servers (AIX partitions on power blades, z/VM virtual machines, PR/SM LPARs) which support a business application. The net is that there is not a need to change the z/OS WLM policy when implementing the zManager. The zManager collects some overall z/OS level performance metrics from z/OS WLM to include in the Platform Workload monitoring but the z/OS WLM policy remain in charge of managing z/OS resources. Basically, it provides recommendations to load balancers on how to distribute incoming work across multiple virtual servers/partitions. Many of z/OS' WLM terms and concepts apply to the Platform Workloads.

To set up a zEnterprise system, IT personnel determine the hardware and software resources that are required to provide sufficient capacity to support their company's business applications, and configure these resources in an ensemble. The zEnterprise environment supports many different ensemble configurations, one of which is shown below. An *ensemble* contains one or more IBM zEnterprise 196 (z196) and any optionally attached IBM zEnterprise BladeCenter Extension (zBX). Below displays sample hardware components:

- The primary Hardware Management Console (HMC) and its alternate. The HMC now includes tasks for ensemble management that are provided by the zManager, along with the traditional tasks for managing System z hardware and software. The primary HMC owns configuration and policy information that the zManager uses to monitor, manage, and adjust resources for this ensemble. The ensemble requires an alternate HMC for redundancy.
- One z196, with a structure that is similar to previous generations of the System z family of servers. The z196 contains System z processors, memory, and I/O connections. The attached Support Element (SE) provides the interface for managing the resources in this central processing complex. Each z196 and any zBX attached to it comprise one *node*.
- One zBX is attached to the z196. For illustrative purposes, the figure shows only two BladeCenter chassis in the zBX:
 - One chassis contains two POWER® blades.
 - The other chassis contains seven IBM Smart Analytics Optimizer for DB2® for z/OS® blades.



Sample zEnterprise Configuration

Note: This attached zBX is connected to the z196 through two private networks (not shown – see #68 zTidBits (zManager & Network Extensions) for more information on connectivity).

The zManager provides these specific performance management functions:

- Performance monitoring and reporting functions that offer system administrators and performance analysts with the data they need to understand whether performance goals are being met. If these goals are not being achieved, detailed performance data helps identify the source of performance problems.
- Virtual server CPU management provides the ability to manage CPU resources across virtual servers based on a goal-oriented performance policy. For the sample ensemble in the above figure, CPU resource allocations can be adjusted dynamically between the virtual servers on z/VM, and between those on “each” POWER blade.



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In the **zEnterprise environment**, a **workload** is a “collection of virtual servers” that performs a customer-defined collective purpose. With virtual resources defined and configured, workload administrators can use ensemble tasks in the HMC to create custom workloads and reassign virtual servers in the ensemble to those workloads.

The administration levels that accompany the zManager for performance management provides two suites for setting performance goals:

1. **Manage** – This provides a **default** workload policy and is always present
2. **Automate** – This provides for a **customized** workload policy

The basic **Manage** suite provides limited performance management functions. All virtual servers in the zEnterprise and IBM zEnterprise BladeCenter Extension (zBX) are *automatically* associated with the default workload and performance policy. This uses a medium *Velocity* and medium *Importance*. Through the Monitors Dashboard in the HMC, you can display CPU and I/O activity.

The **Automate** suite provides the high-value management functions that enable you to create your own custom workloads and performance policies. With the Automate suite, you are able to manage workloads by:

- Defining a workload and associating specific virtual servers with that custom workload.
- Creating performance policies for each custom workload.
- Monitoring and displaying performance data and other details for each workload.
- Monitoring platform resources used to support each workload.
- Viewing overall workload performance health from a platform perspective.
- Displaying whether goals defined in the workload performance policy are being achieved.
- Drilling down to identify which virtual servers are contributing to performance problems.

Also with the **Automate** suite, your custom workloads can benefit from dynamic adjustments to CPU resources to ensure that multitier applications are provided sufficient resources, and adhere to service level agreements.

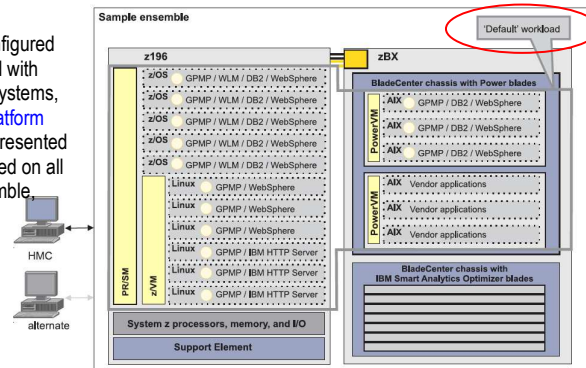
Performance management functions provided through either the Manage or Automate suite do *not* apply for the IBM Smart Analytics Optimizer for DB2 for z/OS.

When **guest platform management providers (GPMP)** are installed and started on virtual servers in the ensemble, the zManager can provide additional data in performance reports. A *guest platform management provider* is an ‘optional’ suite of applications that can be started on z/OS, or installed and started on Linux and AIX operating system images. Active guest platform management providers collect performance data that provides a view of resource usage and delays from operating systems and instrumented IBM middleware products.

When creating a virtual server, an administrator installs and activates the operating system and application images on the new virtual server. The administrator also can install and activate guest platform management providers on virtual servers that the workload administrator has selected for additional performance data collection.

A conceptual view of a configured ensemble that is populated with virtual servers, operating systems, and applications. **Guest platform management provider** (represented by white circles) are installed on all virtual servers in the ensemble, *except* for those on one POWER blade.

In this sample ensemble, all virtual servers are associated with the **default** workload.

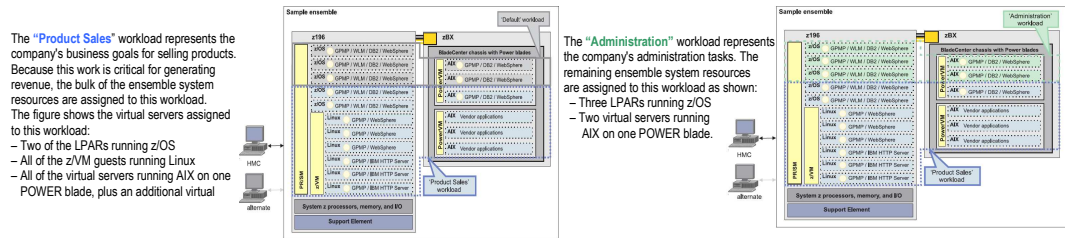


Note: The above illustration depicts the same sample ensemble used in the earlier figure, but the IBM Smart Analytics Optimizer for DB2 for z/OS blades are not showing GPMP because performance management functions do not apply to those blades.

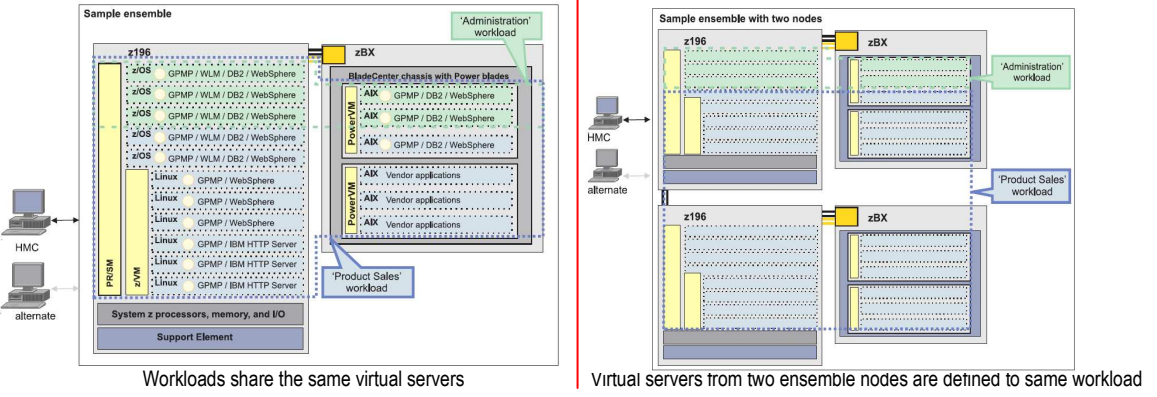
Now let's suppose that a company has a set of business goals for product sales, and it also has a business function for administration tasks such as managing employee payroll and benefits. To represent these business concerns in the zEnterprise environment, the company's workload administrator might define two workloads:



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Just as zEnterprise supports many different ensemble configurations, it also supports different workload “configurations.” The figures below illustrates another possibility in the previous configurations, virtual servers are *not assigned exclusively* to one workload. The virtual servers in the “Administration” workload also belong to the “Product Sales” workload. This type of configuration is a logical choice when both sets of applications (the set for “Product Sales” and the set for “Administration”) use the same DB2 database on z/OS.



- For workload configurations, the key points to remember are:
- A workload represents *business goals or functions*, and provides a method of grouping virtual servers to manage and monitor performance according to those goals or functions.
 - All virtual servers that are defined to a particular workload must run on a z196 or zBX *within the same ensemble*. As shown, virtual servers in different nodes can be part of the same workload but these nodes *must* belong to the same ensemble.

Once a custom workload is defined, an administrator can use ensemble tasks in the HMC to create performance policies that describe the workload performance objectives and importance, and to create service classes that set priority for and classify work within a policy.

While a workload provides the context for managing specific resources, performance policies and service classes specify actual values that govern performance management. Each workload can have one or more performance policies that describe the performance objectives and importance. As with z/OS' WLM, each performance policy has service classes that set the priority of and classify resources within the policy. The zManager uses the active performance policy and its service classes to manage how physical resources are applied to the virtual servers associated with the workload.

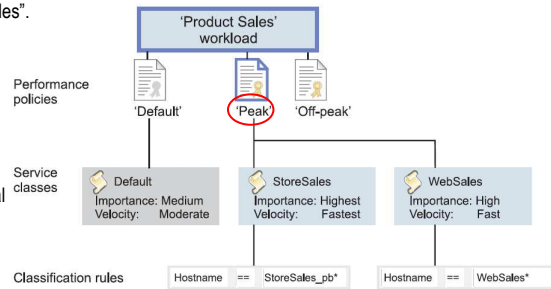
See the next illustration.

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- The "Peak" policy has two custom service classes, "StoreSales" and "WebSales". Each service class has an associated level of business importance and a performance goal based on velocity. A velocity goal is a relative measure of performance for a virtual server. In this example, the "StoreSales" service class has the highest level of importance, and the fastest velocity. The "WebSales" service class has slightly lower importance and velocity.
- Both the "StoreSales" and "WebSales" service classes have classification rules that identify which virtual servers should be managed to these goals:
 - The classification rule for the "StoreSales" service class identifies the virtual servers running on the POWER blade.
 - The classification rule for the "WebSales" service class identifies all virtual servers with a hostname that contains the string "WebSales".



Any virtual servers in the "Product Sales" workload that are not explicitly assigned to a service class through classification rules are managed to goals set in the 'Default' policy and its service class. The default service class has medium importance and moderate velocity. With performance policies and service classes defined, performance management administrators and operators can use HMC ensemble tasks to monitor performance, and to determine whether performance goals are being met.

Performance Monitoring and Reporting

Performance data is continuously collected, and available through a variety of reports that you view through the HMC. By setting a time interval, you can filter the data that is retrieved and displayed in a report. You can request data collected for previous intervals during the last 36 hours.

You can request the **following types of performance reports**. Additional report types are available if your workload includes virtual servers on which active guest platform management providers are running.

Sample Workload Report

This report provides high-level performance status and goal achievement information for all the workloads defined for the ensemble. This illustrates a sample workload report, as it might appear on the HMC.

Select	Workload	Worst Performing Service Class PI (Name)	Performance Policy
<input checked="" type="radio"/>	WORKLOAD01	0.69 (ServiceClass57)	PerfPolicy50
<input checked="" type="radio"/>	WORKLOAD02	0.55 (ServiceClass29)	PerfPolicy0
<input type="radio"/>	WORKLOAD03	0.24 (ServiceClass99)	PerfPolicy10
<input type="radio"/>	WORKLOAD04	0.69 (ServiceClass56)	PerfPolicy94
<input type="radio"/>	WORKLOAD05	1.00 (ServiceClass8)	PerfPolicy96
<input type="radio"/>	WORKLOAD06	0.46 (ServiceClass29)	PerfPolicy56
<input type="radio"/>	WORKLOAD07	0.18 (ServiceClass5)	PerfPolicy85
<input type="radio"/>	WORKLOAD08	0.35 (ServiceClass83)	PerfPolicy92

Total: 11 Filtered: 11 Selected: 1

Note: Performance Index (PI) and Service Class assignments

Note: Alerts  can be set to notify you when a specific performance issue arises for a service class or virtual server.

Sample Service Class Report

This report provides a list of all the service classes defined for the workload and for each service class, details that include the active performance policy, goal and importance definitions, and actual performance data. If this report indicates performance problems, you can drill down to individual virtual server reports for additional details. This figure illustrates a sample service class report, as it might appear on the HMC.

Select	Service Class	Performance Policy	Current Performance	PI	Goal	Business importance
<input checked="" type="radio"/>	SClass01xxWORKLOAD01	PP1	Slow	0.37	Velocity - Fast	Medium
<input type="radio"/>	SClass02xxWORKLOAD01	PP1	Moderate	1.00	Velocity - Moderate	High
<input type="radio"/>	SClass03xxWORKLOAD01	PP1	Moderate	0.47	Velocity - Fastest	Highest
<input type="radio"/>	SClass04xxWORKLOAD01	PP1	Fast	1.00	Velocity - Fast	Medium
<input type="radio"/>	SClass05xxWORKLOAD01	PP1	Fastest	2.12	Discretionary	
<input type="radio"/>	SClass06xxWORKLOAD01	PP1	Fastest	1.00	Velocity - Fastest	Highest

Total: 6 Filtered: 6 Selected: 1

Note: Discretionary with a PI = 2.12

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Sample Virtual Server Report

This report provides data for virtual servers associated with the workload or a service class. The data includes allocated resources, resource utilization data, and delay statistics. This figure illustrates a portion of a sample virtual server report, as it might appear on the HMC.

Server Memory (MB)
Physical CPU Usage %
Hypervisor CPU
Delay %
Idle Time %
Other Time %

Select	Virtual Server	Virtual Processors	Allocated Memory (MB)	Physical CPU Utilization (%)	Hypervisor CPU Delay (%)	Idle Time (%)	Other Time (%)
	VS222	10	4,096	75.0		95.4	91.9
	VS333	15	2,048	14.8		33.8	21.6
	VS224	8	8,192	19.0		13.5	15.9
	VS215	12	8,192	49.8		57.3	95.9
	VS306	4	1,024	17.4			

Sample Hypervisor Report

This report provides details about the virtual servers that are running in the same hypervisor instance, and how these virtual servers are competing for shared resources. This report includes any adjustments made for the virtual servers running in the hypervisor. This figure illustrates a portion of a sample workload report, as it might appear on the HMC.

Processor entitlement
in relation to
Virtual processor count

Virtual Server	Workload Management Status	Workload Management Reason	Virtual Processor Count	Consumed Processors (%)	Hypervisor Processing Unit Delay (%)	Allocated Memory (MB)
pla3223_AIX6.1F	Active	None	2	0.02	0.0	1,024
pla3224_AIX6.1F	Active	None	2	1.98	2.7	1,024
pla3228_AIX6.1F	Active	None	2	0.01	0.0	624

Sample Resource Adjustment Report

This report lists any successful and unsuccessful resource adjustments for a given workload, virtual server, or service class. The report identifies the donors and receivers of additional resources. This figure illustrates a portion of a sample resource adjustment report for virtual servers, as it might appear on the HMC.

Note: The Donor - Receiver loop activity.

Reason for adjustment and timeframe

Receiver Virtual Servers	Receiver Workload	Receiver Service Class	Receiver Processing Units After (Before)	Donor Virtual Servers
VS222	WORKLOAD02	SClass01xxWORKLOAD02	0.90 (0.70)	VS222
VS222	WORKLOAD02	SClass05xxWORKLOAD02	1.50 (0.90)	VS215
VS306	WORKLOAD09	SClass06xxWORKLOAD09	1.05 (0.80)	VS222
VS355	WORKLOAD07	SClass02xxWORKLOAD07	1.00 (0.70)	VS222
VS222	WORKLOAD02	SClass04xxWORKLOAD02	1.10 (0.95)	VS228

Receiver Virtual Servers	Receiver Workload	Receiver Service Class	Failure Reason	Time
VS222	WORKLOAD02	SClass03xxWORKLOAD02	Not enough capacity	Apr 9, 2010 9:10
VS222	WORKLOAD02	SClass04xxWORKLOAD02	No potential donors	Apr 9, 2010 9:12

Virtual server CPU management

Virtual server CPU management is another zEnterprise performance management function that is similar to the goal-based resource balancing that z/OS provides.

On z/OS, Intelligent Resource Director (IRD) manages CPU resources across logical partitions based on a goal-oriented policy. Because IRD uses facilities in z/OS WLM, Parallel Sysplex, and PR/SM, the scope of management encompasses the z/OS LPARs on a single mainframe that are part of a single sysplex where a group of LPARs are clustered together. This IRD feature has similar functionality to zEnterprise resource management.

zEnterprise performance management also uses goal-oriented policies to manage CPU resources, but the scope of management encompasses virtual servers within the ensemble, and resources can be adjusted only among virtual



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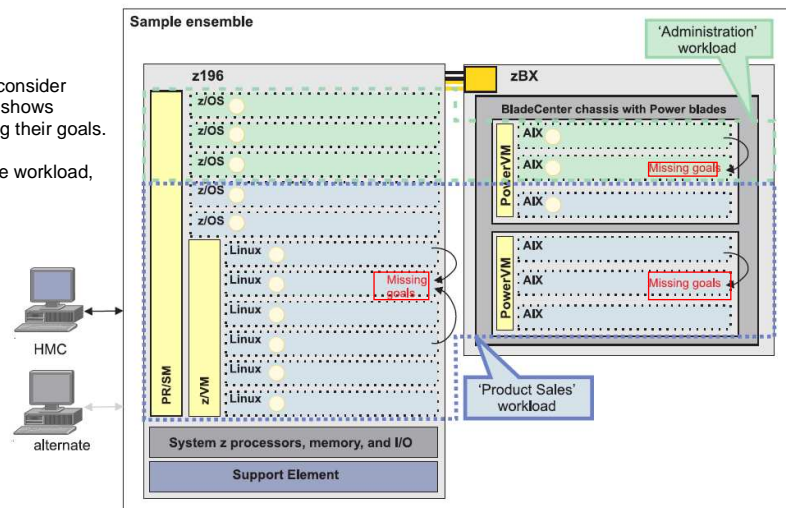
servers that run under the same hypervisor. With zEnterprise performance management, the ability to manage CPU resources is extended to other hypervisors: To z/VM and to AIX on POWER blades.

For z/VM guests - zEnterprise performance management can adjust the CPU allocation across guests with relative, not absolute, CPU shares. Because the z/VM Resource Manager (VMRM) also adjusts guest CPU shares, you need to decide whether VMRM or zEnterprise performance management will manage the CPU allocation for each guest in an ensemble.

For virtual servers on a POWER blade - For the virtual servers running AIX on a POWER blade, zEnterprise performance management raises processor entitlement to give an LPAR more CPU resources, and lowers the processor entitlement of other LPARs that need less resource.

For an illustration of CPU management, consider the sample ensemble in the figure which shows three virtual servers that are not achieving their goals.

Two of these servers are part of the same workload, but run under different hypervisors.



Note: Three virtual servers missing performance goals

Using the above illustration, when a specific virtual server within a workload is not achieving its goals, the zManager first determines whether the performance of that virtual server can be improved with additional resources. If performance can be improved by readjusting resource allocations, the zManager then projects the impact of adjusting resources from other virtual servers under the *same* hypervisor.

- In the z196, all of the z/VM virtual servers are potential candidates for donating resources to the one z/VM virtual server that is missing its goals.
- In the lower POWER blade, only two virtual servers are available to donate resources. Only virtual servers that run under the same hypervisor instance can donate resources to a virtual server.
- In the upper POWER blade, two virtual servers are available to donate resources, even though only one of them belongs to the same workload as the virtual server that is missing its goals. Regardless of their workload association, all virtual servers that run under the same hypervisor instance can donate resources to any other virtual server under that same hypervisor.

In all of these cases, the zManager adjusts resources only if the impact on the donor virtual servers is acceptable according to the donor's active performance policy. Although the virtual servers that donate or receive CPU resources do not have to belong to the same workload, they must run under the same hypervisor instance, and they must belong to the same ensemble. CPU resource adjustments do not cross ensemble boundaries.

You can request and view information about resource adjustments through the Resource Adjustments Report on the HMC. This report lists any successful and unsuccessful resource adjustments for a given workload, virtual server, or service class. The report identifies the donors and receivers of additional resources.

Although the zManager monitors the performance of LPARs that are running z/OS, and provides performance data reports for those virtual servers, it does *not* manage CPU resources for those servers.

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