PowerVM simplification enhancements

PowerVM infrastructure made simple

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Introduction

Managing the IBM® PowerVM® infrastructure involves configuring its different components, such as the POWER Hypervisor™ and the Virtual I/O Server(s). Historically, this has required the use of multiple management tools and interfaces, such as the Hardware Management Console (HMC) and the Virtual I/O Server command line interface.

The PowerVM simplification enhancements were designed to significantly simplify the management of the PowerVM infrastructure, improve the Power Systems™ management user experience, and reduce the learning ramp for users unfamiliar with the PowerVM technologies.

This paper provides an overview of the PowerVM simplification enhancements and illustrates how to use the new features available in the HMC to set up and manage the PowerVM infrastructure.

PowerVM infrastructure overview

IBM PowerVM is the virtualization solution that enables workload consolidation for AIX®, IBM i, and Linux environments on IBM Power Systems®. It is built on the advanced reliability, availability, serviceability (RAS) of POWER Systems and provides virtualization features enabled by the POWER Hypervisor and the Virtual I/O Server.

PowerVM combined with IBM POWER® processor features enables logical partitioning and other virtualization technologies such as Shared Processor Pools, Active Memory™ Sharing, Shared Storage Pools and Live Partition Mobility. For more information about these PowerVM technologies see Chapter 2 in the IBM Redbooks publication IBM PowerVM Virtualization Introduction and Configuration, SG24-7940.

The Virtual I/O Server (VIOS) is a software appliance that works in conjunction with the POWER Hypervisor to enable sharing of physical I/O resources among partitions. Two or more Virtual I/O Servers are often deployed to provide maximum RAS when provisioning virtual resources to partitions.

The Hardware Management Console (HMC) provides a centralized point for platform and virtualization infrastructure management of one or more Power Systems. The HMC interface helps you to configure and manage the PowerVM infrastructure, create and manage partitions or virtual machines, configure the Power Systems hardware, and manage service events, among other tasks.

Figure 1. PowerVM infrastructure
**PowerVM simplification enhancements overview**

The PowerVM simplification enhancements encompass architecture changes to the POWER hypervisor and Virtual I/O Server, new virtualization management features, and new Hardware Management Console (HMC) graphical and programmatic user interfaces to manage the PowerVM infrastructure. The enhancements can be grouped in three main areas:

1. **Simplified PowerVM infrastructure deployment using templates.**
   - The Deploy Template wizard guides users through simple set up and reduces time to value.
   - Flexible quick start templates can be easily tailored to the customer's environment.
   - Existing configurations can be captured in a template for consistent deployment across the data center.

2. **Simplified PowerVM management and virtual machine provisioning.**
   - The PowerVM management portal provides quick access to all virtualization settings.
   - Enhanced HMC capabilities significantly simplify PowerVM's virtual network and virtual storage management.
   - Integrated virtual I/O management provides simplified and quicker partition network and storage provisioning.

3. **Integrated performance and capacity monitoring tool.**
   - The new System Performance dashboard in the HMC provides quick visualization of system and virtual machine resources allocation and utilization.
   - Virtual I/O performance metrics allow easy monitoring of virtual environment status and health indicators.
   - Historic data for performance trend views are available at customizable sample rates for processor, memory, network, and storage resources.

These enhancements are available when managing POWER6®, POWER7®, and POWER8™ Systems using HMC V8.1 or later; except for the performance tool which is available with HMC V8.0 or later, VIOS V2.2.3 or later is recommended for best performance.

You can access all enhancements by logging in to the HMC Graphical User Interface (GUI) using the Enhanced or Enhanced+ log in option. The performance tool is also available with the Classic log in option. A comparison of the features available with each log in option can be found in the POWER 8 knowledge center².

All the enhancements and performance metrics are also available through the new HMC RESTful APIs. For more information see the HMC community in IBM Developerworks³.

**PowerVM infrastructure configuration steps**

Configuring and managing the PowerVM infrastructure on Power Systems can be accomplished performing the following tasks:

1. Capturing and editing templates to create custom PowerVM configurations that can be deployed on one or more systems.
2. Deploying a system template to initialize the PowerVM infrastructure.
3. Creating a partition from template to get ready to deploy workloads.
4. Managing PowerVM to modify the virtual network and virtual storage configuration as needed to meet workload demands.
5. Managing partitions to dynamically modify their virtual storage and network resources as needed.
6. Monitoring performance and capacity information to understand resource utilization and identify potential problems.

The next sections provide more details on how to perform these tasks using the Hardware Management Console interfaces (HMC) and illustrate some of the available HMC graphical user interfaces.

**PowerVM infrastructure deployment using templates**

The PowerVM infrastructure can be easily deployed using templates. Templates contain virtual configuration settings that can be applied to multiple target systems for consistent deployment of configurations across the data center. There are two types of templates: System and Partition templates.

- **System templates** contain system, hypervisor, Virtual I/O Server, and other virtualization infrastructure settings.
- **Partition templates** contain partition’s processor, memory, virtual network, and virtual storage settings.

**Template library**

A Template library in the HMC provides access to “quick start” templates that can be easily customized through the Edit template function to meet customers need.

The Template library provides access to templates management functions such as: View, Edit, Import, Export, Deploy, Copy, and Delete as illustrated in figure 2.

**Figure 2. Template library functions**

You can create a custom template in one of the following ways:

1. Copy a quick start template and Edit the new template to modify the settings as needed.
2. Capture template and optionally Edit the captured template to change configuration settings as needed.

You can create several templates customized to support specific workloads, meet virtual infrastructure requirements, or tailored to a specific system type.

You can deploy a system template on a new Power System to initialize its PowerVM infrastructure or on existing Power Systems to re-deploy a new PowerVM configuration. The deploy system template operation removes any existing configuration in the system (e.g. Virtual I/O Servers, partitions).

Once you have deployed a system template, your Power System is ready for workload deployment. You can Deploy a partition template to create the partitions needed for your workloads.

Capturing templates

You can use the Capture function to save the configuration settings of a system or partition in a template. You can choose to capture the physical I/O associated with the PowerVM configuration. This is helpful when you plan to deploy the template in systems with a similar I/O configuration (e.g. same I/O adapters and I/O adapter slot locations).

You can capture a system or partition template by selecting a system or partition and accessing the system’s or partition’s templates tasks, respectively.

Editing a system template

You can edit a system template to create custom PowerVM infrastructure settings for different purposes. For example, you can create a system template tailored for a large enterprise system or for smaller systems, for production workloads or development environments, among others. When editing a system template, keep in mind that the PowerVM infrastructure reflected in the template drives specific physical I/O requirements, e.g. number of physical network adapters that need to be available on the target system for the successful deployment of the template.

If the template contains captured physical I/O information, you can optionally use this information but you cannot edit it.

You can configure the following settings in a system template:

Virtual I/O servers: you can add or remove Virtual I/O Servers and modify the resource configuration (processor, memory, general properties) for each Virtual I/O Server.

Virtual networks: you can add or remove virtual networks. When adding a virtual network, you can specify whether the virtual network is internal or bridged. All virtual networks are created on the default virtual switch by default. You can optionally specify additional virtual switches when adding a virtual network. When adding a bridged network, you can specify virtual network bridge features such as failover or load sharing.

Virtual storage: you can optionally specify media repository settings for each Virtual I/O server and indicate if the Virtual I/O server will be part of a shared storage pool cluster.

Shared processor pools: you can add or remove shared processor pools and modify their settings. Multiple shared processor pools can be used to help track and cap processor usage for license management or resource charge back, among other things. The default shared processor pool cannot be removed or modified.

Shared memory pool: you can optionally configure a shared memory pool. A shared memory pool needs to be configured if you want to enable memory over commitment or shared memory mode on any partition.

Reserved storage device pool configuration: you can optionally configure a reserved storage pool. A reserved storage pool needs to be configured if you want to enable suspend/resume operations on any partition.

Hardware virtualized I/O: you can optionally specify adapter level settings for Host Ethernet Adapters (HEAs) and SR-IOV adapters if you plan to deploy the template on Power Systems configured with these adapters.

System settings: you can specify server power on policies and the logical memory block size, among other system settings.

Editing a partition template

You can edit a partition template to customize the resources allocated to a partition. For example, you can tailor a partition template for a specific workload or operating system environment.

You can configure the following settings in a partition template:

General partition properties: you can change the default values of any of the partition properties.

Processor and memory: you can customize all the basic and advanced processor and memory settings.

Virtual network: you can specify the number of virtual network connections. You can choose to specify the virtual network for each connection in the template or select it at deploy time, from the virtual networks available in the target Power System.

Virtual storage: you can specify whether virtual SCSI or virtual Fiber Channel storage will be configured to the partition at deploy time. You can also specify optical device settings and shared storage pool volume settings (number, size and type).

Hardware virtualized I/O: you can specify the number of logical Host Ethernet Adapters and logical SR-IOV ports and their settings.

Deploying System Templates

You can deploy a system template by selecting a system and accessing the system tasks. Alternatively, you can go to the template library and access the Deploy task for a system template.

The Deploy System Template wizard validates that the selected template can be deployed on the selected Power System and guides the user through three stages of deployment. Through each stage, the
user is prompted to enter target specific information that is not captured in the template, such as the physical I/O adapters for the virtual I/O server, as it is illustrated in Figure 3. The user can access the full template configuration details throughout the deploy stages by clicking on Template Details.

![Figure 3. Deploy system template wizard](image)

During the first stage, system configuration and adapter level settings are applied, a system initial program load or IPL might be initiated if needed for the configuration settings to take effect, and the Virtual I/O Servers are created and configured with the specified I/O adapters. In the second stage, the user enters information required to install the Virtual I/O server images and the VIOS and starts the installation process. The user has to monitor the VIOS install process for completion. Successful installation of the VIOS as well as connectivity to each of the Virtual I/O Servers is required to proceed to the next stage. Once the second stage has completed successfully, the user can advance the wizard to the third and last stage of the deployment process. During the last stage, the virtual network and virtual storage configuration is completed. For example, during the virtual network configuration, the user selects the backing devices for the virtual network bridges defined in the template. If a media repository or reserved storage pool is defined in the template, the user is prompted to select the physical volumes, as needed.

**Creating partition from templates**

You can create a partition from template by selecting a system and accessing the create partition task. Alternatively, you can go to the Template Library and access the Deploy task for a Partition Template.

The Create Partition Template wizard validates that the selected template can be deployed on the selected Power System and guides the user to customize unique partition settings such as partition name. The wizard also guides the user to provide the input required to complete the configuration of virtual network and virtual storage resources which are dependent on the PowerVM configuration of the target system. For example, the user selects the virtual networks the partition will connect to as illustrated in Figure 4. The user also selects the physical volumes, fiber channel ports, or shared storage pool, depending on the storage settings specified in the template.

![Figure 4. Create partition from template wizard](image)

The Create Partition wizard also provides an option to activate or power on the partition once the partition is created. You can then proceed to install the appropriate operating system (OS) image using the corresponding OS tools.

For more information about the templates functions see Chapter 4 in the IBM Redbooks™ publication IBM Power Systems Hardware Management Console: Version 8 Release 8.1.0 Enhancements, SG24-8232-00.

**PowerVM infrastructure management**

You can configure all the PowerVM infrastructure settings by selecting a system and accessing the Manage PowerVM task. Manage PowerVM provides a portal to access the following features as illustrated in Figure 5:

- **Virtual I/O Servers**: provides an overview of the resource allocation and status of all the Virtual I/O Servers configured in the system. It provides access to VIOS management tasks such as add and remove Virtual I/O Servers to/from your PowerVM configuration and manage VIOS resources, as well as VIOS operations such as activate, i.e. power on, and shutdown.

- **Virtual Networks**: provides an overview of PowerVM’s virtual network settings and access to management tasks, such as add or remove virtual networks, modify virtual network bridges, add, remove and modify link aggregation devices, among others.

- **Virtual Storage**: provides an overview of the virtual storage configuration for all the Virtual I/O Servers configured in the system and access to various configuration settings such as: 1) virtual storage configuration for each Virtual I/O server, 2) shared storage pool cluster configuration, and 3) virtual storage adapter configuration across all the Virtual I/O Servers.

- **Hardware virtualized I/O**: provides access to SR-IOV and HEA adapter configuration management, including physical port and logical port information for these adapters.
Others: Launching points for shared processor pool, reserved storage pool, and shared memory pool management tasks.

Virtual I/O Server management

You can view and modify all the Virtual I/O Server (VIOS) resources and configuration settings by selecting a VIOS in the VIOS overview and accessing the Manage task. The Manage task allows the user to change the processor, memory, physical I/O, and hardware virtualized I/O resources, e.g. logical Host Channel Ethernet Adapters or logical SR-IOV ports, configured to the VIOS, either dynamically, that is, while the VIOS is powered on, or when the VIOS is shutdown.

The Add Virtual I/O Server wizard guides the user to specify the resource configuration for the new Virtual I/O Server, install the VIOS image, and activate the Virtual I/O Server.

Virtual network management

The PowerVM network configuration has three main elements: virtual switches, virtual networks, and virtual network bridges.

Virtual Switch: a virtual switch is a Power Hypervisor implementation of a layered-2 IEEE 802.1Q switch. PowerVM is configured with a default virtual switch. Additional virtual switches can be added when a virtual network is created.

Virtual Network: a virtual network is a system resource associated with a virtual switch and optionally associated with a virtual network bridge. It is uniquely identified by its name or its VLAN ID and virtual switch. There are two types of virtual networks:

- Internal virtual networks connect partitions within a server and are not associated with a virtual network bridge.
- Bridged virtual networks are like internal virtual networks but are associated with a virtual network bridge to also allow connectivity between managed servers.

Virtual Network Bridge: a virtual network bridge is associated with a layer-2 bridge implementation in the Virtual I/O Server known as Shared Ethernet Adapter (SEA), that connects internal traffic to a physical network. A virtual network bridge uses one default load group or trunk adapter to connect internal traffic to external networks. It can be optionally configured with two or more load groups. Each load group has a Port VLAN ID (PVID), used for internal purposes, that can be optionally set by the user.

A virtual network bridge can be configured to provide high availability access to external networks. A virtual network bridge configured for high availability is associated with two Virtual I/O Servers and their respective SEAs. Such virtual network bridge can be enabled for either failover or load sharing. In failover mode, one Virtual I/O Server acts as the primary and the other as the backup when bridging network traffic. In load sharing mode, the virtual network bridge is configured with two or more load groups and both Virtual I/O servers can bridge network traffic on different load groups at the same time.

Figure 6 shows the Virtual Network configuration summary provided under Manage PowerVM: Virtual Networks.

Adding a Virtual Network

A Virtual Network can be created in two ways:

1. Deploying a System Template that contains Virtual Networks.
2. Using the Add Virtual Network wizard under Manage PowerVM: Virtual Networks.

Once a Virtual Network is created, the user can connect any partition to the virtual network through Manage Partition.

The Add Virtual Network wizard, illustrated in Figure 7, guides the user through the steps to 1) specify the virtual network name, VLAN ID and type (internal or bridged) and 2) select or create the virtual switch and the virtual network bridge, if applicable, associated with the virtual network.

When adding a virtual network, the user can create the virtual network on the default virtual switch, select from a list of available virtual switches, if applicable, or optionally create a new virtual switch. Creating virtual networks on separate virtual switch provides
an additional layer of security. For example, you can create a virtual network for your test environment using the default virtual switch and create a Demilitarized Zone (DMZ) virtual network on a second virtual switch. This configuration provides traffic isolation without relying entirely on VLAN separation.

**Figure 7. Add Virtual Network Wizard**

When the user creates a bridged virtual network, it can specify whether the VLAN ID will be used to apply IEEE 802.1Q tagging to the network traffic going out the virtual network bridge.

If IEEE 802.1Q tagging or “tagging” is not specified, the user is guided to create a new virtual network bridge. The VLAN ID of the virtual network is used as the Port VLAN ID of the default load group for the virtual network bridge.

If “tagging” is specified, the user is guided to select a virtual network bridge and either choose a load group (if multiple load groups are available) or create a new load group. Alternatively, the user can choose to create a new virtual network bridge. In this case, the user has to specify the Port VLAN ID of the default load group for the virtual network bridge.

When a new virtual network bridge is created, the user selects one or two Virtual I/O Servers, if high availability is desired, and chooses the physical Ethernet device (individual port or link aggregation device) for the bridge on each Virtual I/O Server.

If the virtual network bridge is configured for load sharing, two load groups are created by default on each of the Virtual I/O Servers. A Port VLAN ID is assigned to each load group and can be optionally changed by the user.

When adding a virtual network, you can optionally connect the Virtual I/O Servers in the system using the advanced settings in the Add Virtual Network wizard.

Figure 8 illustrates a PowerVM network configuration with three virtual networks: DMZ (Dev and Prod), two virtual switches (vSwitch0 and vSwitch1), and two virtual network bridges configured with failover (Bridge_100 and Bridge_200).

**Figure 8. PowerVM Network Configuration**

**Removing a Virtual Network**

You can remove a virtual network from the PowerVM configuration by selecting the virtual network and choosing the Remove task. If there are partitions connected to the virtual network, a warning is provided with the option to cancel the operation.

Removing a virtual network updates the PowerVM virtual switch and virtual network bridge configuration as needed. For example, if the virtual network is the last one configured on any of the user defined virtual switches, the virtual switch is removed. If the virtual network is the last one in one of the user-defined load groups, the load group is removed. If the virtual network is the last network associated with a virtual network bridge, the virtual network bridge is deleted. Note that an untagged virtual network cannot be deleted until all the tagged networks configured on the corresponding virtual network bridge are deleted.

**Link aggregation device management**

The Virtual Network overview provides access to interfaces to create, modify or remove IEEE 802.3ad Link Aggregation devices on any of the Virtual I/O Servers configured in the Power System.

Link aggregation devices aggregate Ethernet ports across Ethernet adapters configured to a Virtual I/O Server. A link aggregation device can be used in a virtual network bridge for increased bandwidth and availability.

**Virtual storage management**

The virtual storage overview provides access to three distinct virtual storage views illustrated in Figure 9:

**Virtual Storage Management**: provides a summary of the storage configuration for each of the Virtual I/O Servers. You can select a VIOS to launch the Virtual Storage Management task which provides access to the physical volumes, virtual fiber channel and optical device configuration, among others, for that VIOS.
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Shared Storage Pool Cluster: provides a summary of the Shared Storage Pools managed by the Hardware Management Console. Shared Storage Pools enable distributed access to a pool of SAN storage devices, accessible through a set of connected Virtual I/O Server nodes, which span across multiple Power Systems. Shared Storage Pools are used to provision storage to client partitions in the form of file-backed storage devices known as SSP volumes or logical units. Shared Storage Pools support thin provisioning for increased storage utilization. For more information about Shared Storage Pools see Chapter 4 in the IBM Redbooks publication IBM PowerVM Virtualization Introduction and Configuration, SG24-7940.

Adapters View: provides access to the virtual SCSI and virtual Fiber Channel host-client adapter configuration across all the Virtual I/O Servers, which includes information about the client storage device mapping for each client partition.

Adapters View

Figure 9. Manage PowerVM: Virtual Storage

Shared storage pool management

The Shared Storage Pool Cluster view, illustrated in Figure 10, shows the list of Shared Storage Pools (SSP) and provides quick access to selected tasks such as 1) add or remove VIOS nodes in this system to or from the SSP and 2) view SSP details. It also provides access to life cycle management tasks for Shared Storage Pools.

Figure 10. Virtual Storage: Shared Storage Pool Cluster

Manage All Clusters provides access to SSP management tasks. You can replace physical volumes in the SSP, replace the repository disk and remove SSP volumes that are not currently assigned to any partitions.

The Add SSP cluster wizard illustrated in Figure 11 guides the user through the process of adding VIOS nodes to the SSP cluster and selecting physical volumes for the Shared Storage Pool.

Figure 11. Add Shared Storage Pool Cluster Wizard

For more information about virtual storage management see Chapter 3 in the IBM Redbooks publication IBM Power Systems Hardware Management Console: Version 8 Release 8.1.0 Enhancements, SG24-8232-00.

Partition management

You can view and modify all partition resources by selecting a partition and accessing the Manage Partition task. You can dynamically change virtual network, virtual storage, and hardware virtualized I/O resources configured to the partition.

Virtual Networks: provides a list of virtual network connections configured to the partition. Manage Network Connections allows the user to connect the partition to any of the virtual networks defined in the PowerVM configuration or remove existing connections to virtual networks.

Figure 12. Manage Partition: Virtual Networks
The adapters view under virtual networks shows the virtual Ethernet adapters associated with each of the virtual network connections.

**Virtual Storage**: provides an overview of the virtual storage devices configured to the partition grouped by type. The Virtual SCSI view, illustrated in Figure 13, shows the physical volumes, shared storage pool volumes and logical volumes configured to the partition. The Virtual Fiber Channel view shows the list of virtual fiber channel devices configured to the partition and provides details about the physical fiber channel port and VIOS associated with each device.

![Figure 13. Manage Partition: Virtual Storage](image)

The connections information shows the Virtual I/O Servers that provide access to the storage device. You can easily add physical volumes and virtual fiber channel storage by selecting from the list of available storage devices, as illustrated in Figure 14. For storage devices that support redundant access through multiple Virtual I/O Servers, such as physical volumes and SSP volumes, you can optionally customize the connections information when adding the storage device or after the device has been configured.

![Figure 14. Manage Partition: Add Virtual SCSI Device](image)

If a Shared Storage Pool is available, you can add shared storage pool volumes to your partition by specifying the name, size, and type (thin or thick provisioned).

The adapters view provides information about the server-client virtual storage adapter pairs, which are configured as storage devices are provisioned to a partition. You can remove any storage device configured to the partition by selecting the device and choosing the Remove task. Removing a storage device updates the server-client virtual storage adapter configuration for the partition, accordingly.

**Hardware virtualized I/O**. You can configure logical host Ethernet adapters or SR-IOV logical ports to a partition, if the Power System is configured with host Ethernet adapters or SR-IOV adapters, respectively.

For more information about Manage Partition see Chapter 5 in the IBM Redbooks publication IBM Power Systems Hardware Management Console: Version 8 Release 8.1.0 Enhancements, SG24-8232-00.

**Performance and capacity monitoring**

You can access the performance dashboard for a system by selecting a system and choosing Performance. The performance dashboard provides quick visualization of system and partition processor, memory, and I/O resources allocation and utilization, as illustrated in Figure 15. It also provides a breakdown of the resources consumption by partitions, Virtual I/O Servers and the POWER Hypervisor.

![Figure 15. System Performance Dashboard](image)

The HMC gathers and keeps performance data based on customizable settings and displays basic trends for processor, memory, network, and storage resources. The network and storage utilization trend views provide aggregated and per partition views of
virtual network bridge and virtual fiber channel traffic and bandwidth usage, respectively.

**Figure 16. Network Utilization Trend View**

Performance data collection is disabled by default. You can enable performance data collection on all Power Systems or selected Power Systems through the Change Performance Monitoring Settings task under HMC Management.

For more information about the Performance and capacity monitoring capabilities in the Hardware Management Console see Chapter 6 in the IBM Redbooks publication IBM Power Systems Hardware Management Console: Version 8 Release 8.1.0 Enhancements, SG24-8232-00.

**Conclusion**

The PowerVM simplification enhancements available through the Hardware Management Console (HMC) significantly simplify virtualization management tasks on IBM Power Systems and support a repeatable workload deployment process. The enhancements can be grouped in three main areas:

- Simplified deployment of the PowerVM infrastructure using templates.
- Simplified PowerVM management and virtual machine provisionning.
- Integrated performance and capacity monitoring tool.

These features are available through the HMC Graphic User Interface (GUI) and RESTful (REST) Application Programming Interfaces (APIs).