Hypervisors, virtualization, and the cloud: Dive into the PowerVM hypervisor

Bhanu P Tholeti  
September 23, 2011

This article details the features, deployment processes, and VM management issues for the PowerVM™ hypervisor. PowerVM is a feature of the IBM® POWER5®, POWER6®, and POWER7® servers and support is provided for it on IBM i, AIX®, and Linux® operating systems. System virtualization is most commonly implemented with hypervisor technology; hypervisors are software or firmware components that are able to virtualize system resources. In this series, the author provides a round-up look at the features, deployment processes, and VM management issues for five hypervisors that help establish system virtualization within the cloud — PowerVM, VMware ESX Server, Xen, KVM, and z/VM.

About this series

This series starts with a background on hypervisor types and system virtualization, and then describes the features of five hypervisors, their deployment processes, and the management issues you might encounter.

- Introduction
- PowerVM
- VMware ESX Server
- Xen
- KVM
- z/VM

Use this series as a simple starting point for understanding the hypervisor's role in virtualization in the cloud or explore the individual articles to help you determine which hypervisor is best suited for your cloud needs.

What to know to start

Power is virtualization without limits. Businesses are turning to PowerVM virtualization to consolidate multiple workloads onto fewer systems, increasing server utilization, and reducing cost. Power VM provides a secure and scalable virtualization environment for AIX, IBM i, and Linux applications built upon the advanced RAS features and leading performance of the Power Systems Platform.
Operating system versions supported:

- AIX 5.3, AIX 6.1 and AIX 7
- IBM i 6.1 and IBM i 7.1
- Red Hat Enterprise Linux 5 and Red Hat Enterprise Linux 6 (when announced by Red Hat)
- SUSE Linux Enterprise Server 10 and SUSE Linux Enterprise Server 11

Hardware platforms supported:

- IBM Power Systems with POWER5, POWER6, and POWER7 processors

Figure 1 shows the architecture of PowerVM hypervisor:

**Figure 1. Architecture of PowerVM hypervisor**

![Architecture of PowerVM hypervisor](image)

**Features**

PowerVM Enterprise has two new industry-leading capabilities called *Active Memory Sharing* and *Live Partition Mobility*:

- Active Memory Sharing intelligently flows system memory from one partition to another as workload demands change.
- Live Partition Mobility allows for the movement of a running partition from one server to another with no application downtime, resulting in better system utilization, improved application availability, and energy savings. With Live Partition Mobility, planned application downtime due to regular server maintenance can be a thing of past.

Following are other features of PowerVM.

**Micro-partitioning support:** Micro-partitioning technology helps lower costs by allowing the system to be finely tuned to consolidate multiple independent workloads. Micro-partitions can be defined as small as 1/10th of a processor and be changed in increments as small as 1/100th of a processor. Up to 10 micro-partitions can be created per core.

**Integrated Virtualization Manager:** The Integrated Virtualization Manager (IVM) allows you to point, click, and consolidate workloads with an easy-to-use browser-based interface.
Virtual I/O Server: Let's you share I/O resources. The Virtual I/O Server is a special-purpose partition which provides virtual I/O resources to client partitions. The Virtual I/O Server owns the resources that are shared with clients. A physical adapter assigned to a partition can be shared by one or more other partitions. The Virtual I/O Server eliminates the need for dedicated network adapters, disk adapters, and disk drives.

PowerVM Lx86 support: You can run x86 Linux applications on POWER; this feature enables the dynamic execution of x86 Linux instructions by mapping them to instructions on a POWER-based system and caching the mapped instructions to optimize performance.

Shared dedicated capacity: Receive the benefits of dedicated resources without the waste. This feature allows the "donation" of spare CPU cycles for dedicated processor partitions to be used by the shared pool, thus increasing overall system performance. The dedicated partition maintains absolute priority for dedicated CPU cycles; sharing only occurs when the dedicated partition has not consumed all its resources. This feature is supported on POWER6 and POWER7 processor-based servers.

Multiple shared processor pools: With this feature, the system almost does the administration for you. You simply assign priorities to partitions and let the hypervisor allocate processing power as needed by your applications. This feature allows for automatic non-disruptive balancing of processing power between partitions assigned to shared pools, resulting in increased throughput and the potential to reduce processor-based software licensing costs.

N-port ID virtualization: NPIV provides direct access to Fibre Channel adapters from multiple client partitions, simplifying the management of Fibre Channel SAN environments. NPIV support is included with PowerVM Express, Standard, and Enterprise Edition and supports AIX V5.3, AIX V6.1, IBM i 6.1.1, and SUSE Linux Enterprise Server 11 partitions on all POWER6 and POWER7 processor-based servers, including blades.

Virtual tape: PowerVM has two virtualization methods for using tape devices on POWER6 and POWER7 processor-based servers, simplifying backup and restore operations. Both methods are supported with Power VM Express, Standard, or Enterprise Edition:

- NPIV enables PowerVM LPARs to access SAN tape libraries using shared physical HBA resources for AIX V5.3, AIX V6.1, and SUSE Linux Enterprise Server 11 partitions on POWER6 and POWER7 processor-based servers.
- Virtual tape support allows serial sharing of selected SAS tape devices for AIX V5.3, AIX V6.1, IBM i 6.1, and SUSE Linux Enterprise Server 11 partitions on POWER6 and POWER7 processor-based servers.

Live Partition Mobility: Move a running AIX or Linux partition from one physical Power Systems server to another without application downtime, helping clients to avoid application interruption for planned system maintenance, provisioning, and workload management. This feature is supported on POWER6 and POWER7 processor-based servers. It is also possible to move partitions from a POWER6 processor-based server to a POWER7 processor-based server to simplify upgrades to the newer platform.
PowerVM Live Partition Mobility is now supported in environments with two Hardware Management Consoles (HMCs) supporting larger and more flexible configurations. PowerVM partitions support both physical and virtual I/O enabling dynamic heterogeneous multiple path I/O. With this support, partitions can have paths to a storage device that includes both physical (such as dedicated FC adapters) and virtual (like with NPIV) adapters. Multiple path I/O is supported with Live Partition Mobility environments with AIX V5.3 and AIX V6.1 partitions on POWER6 and POWER7 processor-based servers.

**Active memory sharing:** Allowing for the more efficient utilization of system memory, the advanced memory sharing capability of PowerVM dynamically reallocates memory to running virtual partitions based on changing workload demands.

**Deployment:** Deploying your virtualization configuration includes the following tasks:

1. Installing the Virtual I/O Server.
2. Creating logical partitions and assigning virtual or physical resources to them.
3. Installing operating systems in the logical partitions.
4. Deploying Capacity on Demand.

The tools available to deploy virtualization configuration are as follows:

- **Hardware Management Console (HMC):** Import a system plan (created using SPT) to the HMC and the HMC can deploy that plan to the managed system. The HMC creates logical partitions based on the logical partition configuration specified in the system plan.

- **Virtual I/O Server:** The Virtual I/O Server is software that runs in its own logical partition and provides virtual I/O resources to client logical partitions on the managed system. The Virtual I/O Server lets one or more client logical partitions share physical adapters with attached disks or optical devices.

- **Integrated Virtualization Manager:** The Integrated Virtualization Manager is the user interface to the management partition (the Virtual I/O Server) on managed systems that are not managed by an HMC. You can use the Integrated Virtualization manager to create AIX and Linux client logical partitions on a single managed system. You can also configure virtual storage and virtual Ethernet on the managed system.

**Deploying virtualization with the Hardware Management Console**

You can create logical partitions, install operating systems, and deploy Capacity on Demand to a system that is managed by a Hardware Management Console (HMC).

To deploy virtualization configuration using the HMC, complete the following tasks:

- Optional: Enter the activation code for Virtualization Engine technologies.
- Optional: Create the Virtual I/O Server logical partition.
- Optional: Install the Virtual I/O Server.
- Create AIX and Linux logical partitions and assign resources to them.
- Install AIX and Linux in the logical partitions.
Deploying virtualization with the Integrated Virtualization Manager

You can create logical partitions and install operating systems on a system that is managed by the Integrated Virtualization Manager. To deploy virtualization configuration using the IVM, complete the following tasks:

- Enter the activation code for the Virtual I/O Server.
- Install the Virtual I/O Server.
- Prepare the Virtual I/O Server management partition.
- Create AIX and Linux logical partitions and assign resources to them.
- Install AIX and Linux in the logical partitions.

Managing your virtual machines

PowerVM manages virtual machines with the IVM: The IVM helps you:

- Simplify IT management by enabling computer resources to look and perform as one.
- Increase flexibility, allowing your organization to meet both anticipated and unanticipated spikes in server demand with shared capacity.

The IVM does not require the use of an HMC for managing LPARs on a single system. With IVM, clients can partition a single system by creating LPARs and provide for management of virtual storage and virtual Ethernet.

Choosing PowerVM

Consider the following pros and cons before deciding to use PowerVM as your virtualization tool.

On the pro side:

- PowerVM supports multiple operating environments on a single system.
- Enables up to 10 VMs per processor core.
- Processor, memory, and I/O resources can be dynamically moved between VMs.
- VMs can use dedicated or shared (capped or uncapped) processor resources.
- Processor resources can automatically move between VMs based on workload demands.
- Processor resources for a group of VMs can be capped, reducing software license costs.
- Storage resources for Power Systems servers and VIOS can be centralized in pools to optimize resource utilization.
- Simplifies VM creation and management for entry Power Systems servers and blades.
- Supports running many x86 Linux applications in a Linux on PowerVM.
- Live AIX and Linux VMs can be moved between servers, eliminating planned downtime.
- Intelligently flows memory from one VM to another for increased memory utilization.
- Simplifies the management and improves performance of Fibre Channel SAN environments.

On the con side:

- During high-demand periods, performance can suffer. PowerVM's Linux virtualization implementations have mechanics that allow for very granular resource management and control; during peak periods there is still the potential for performance degradation.
• With IBM PowerVM, you can virtualize 10 logical partitions (LPARs) to share one CPU or even one NIC; this practice can have a negative impact on performance (too much activity on too little hardware) and availability (consider the consequences of that one CPU failing). The flexibility and configurability of virtualization can lead to poorly designed systems that cause companies to abandon their entire virtualization strategy.

• Security: In the past, if a server was compromised, the vulnerability could be contained to that one server. With virtualization, every logical partition or virtual environment within the physical server has the potential to be compromised. While a systems administrator has the ability to make sure that the logical partitions within the physical box don't have access to one another, you should not overlook physical security as well.

• For example, while not required in many cases, most IBM System p shops use a dedicated Hardware Management Console (HMC) to perform their Linux logical partitioning and virtualization configuration. If the admin walks away from his desk and leaves the console open, an invader can gain access to every logical environment in the physical server.
Related topics

- Links for this series:
  - The PowerVM site.
  - Red Hat Enterprise Virtualization 3.0 Administration Guide.
  - VMware's Quick Start Guide version 5.17 | version 4.15.
  - VMware vSphere overview.
  - Getting Started with Xen Deployment online book.
  - Xen.org.
  - List of KVM documentation.
  - Red Hat Enterprise Virtualization 3.0 Administration Guide (for help with KVM).
  - IBM Director's Virtualization Manager can let you manage all your z/VM virtualized systems from the same console.
- In the developerWorks cloud developer resources, discover and share knowledge and experience of application and services developers building their projects for cloud deployment.

© Copyright IBM Corporation 2011
Trademarks
(www.ibm.com/developerworks/ibm/trademarks/)