IBM Integrated Virtualization Manager

Lowering the cost of entry into PowerVM Virtualization

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Executive Overview

In today's dynamic marketplace, small and medium businesses are continually striving to adapt and respond to rapidly shifting IT requirements coupled with tight budget constraints. Simplifying the IT infrastructure is very important to business executives and IT professionals alike.

To help address these issues, IBM created the Integrated Virtualization Manager (IVM). The IVM is an easy-to-use, browser-based tool which literally allows clients to point, click and consolidate multiple workloads onto one IBM Power System.

The IVM, coupled with the advanced capabilities of Power Systems, offers small and medium business the opportunity to:

- Simplify IT management by enabling computer resources to look and perform as one
- Increase business flexibility, allowing your organization to meet both anticipated and unanticipated spikes in server demand with shared capacity
- Save time and money, helping clients get the most out of their IT investment

In addition to the benefits mentioned above, IVM offers a lower cost of entry into virtualization on IBM POWER processor-based servers, since it does not require the use of a separate hardware appliance like the Hardware Management Console (HMC) or Systems Director Management Console(SDMC) for managing logical partitions (LPARs) on a single system. With IVM, clients can partition a single system by creating LPARs and provide for management of devices such as storage and virtual Ethernet. Best of all, IVM is included at no additional charge with the purchase of PowerVM on IBM Power Systems and is packaged in the Virtual I/O Server (VIOS) software.

IVM offers a rich set of PowerVM virtualization function; however it is a subset of the function offered via the management consoles. Be sure to look at the Appendix I for a detailed comparison of the different PowerVM management options.

Integrated Virtualization Manager

Introduction

IVM provides an interface to many of the PowerVM virtualization features that otherwise require an additional appliance like the HMC or SDMC. The implementation of an additional appliance can be cost prohibitive for a smaller to mid-sized business, or a larger business with a distributed environment (i.e. a bank with many branch locations), looking to consolidate their workloads onto a POWER processor-based server. Because the management console supports the full range of POWER functionality, the interface can be complex, requiring an in-depth knowledge of IBM's implementation of partitioning and virtualization. IVM provides a tightly integrated and easy to use management environment at no additional charge with the purchase of PowerVM.

Features and Benefits

The Integrated Virtualization Manager provides an intuitive, browser-based system management interface that is used to manage a single Power System Express or BladeCenter server. See appendix II for a complete list of IVM supported hardware. Clients can create logical partitions, manage virtual storage and virtual Ethernet, and view service information related to the server.

IVM may be used to complete the following tasks:

- Create and manage logical partitions
- Configure the virtual Ethernet networks
- Manage storage in the Virtual I/O Server
- Depending on the PowerVM version, IVM supports advanced PowerVM features such as Live Partition Mobility, Active Memory Sharing, NPIV Fibre-channel, and Dynamic Logical Partitioning (DLPAR),
- Create and manage user accounts
- Create and manage serviceable events through Service Focal Point
- Download and install updates to device microcode and to Virtual I/O Server software
- Back up and restore logical partition configuration information
- View application logs and the device inventory

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Integrated Virtualization Manager vs the Management Console

The Integrated Virtualization Manager is not a replacement for the management console in all environments. Rather, it is a targeted offering for clients requiring a simplified user interface to manage virtualization on self-contained smaller servers. Throughout this paper we will discuss the differences between the management console and IVM. The major difference to keep in mind is that a management console is the ideal choice for a high availability environment since it allows for a fully redundant configuration.

Because the IVM and the management console both provide management capabilities, they may not be used in conjunction with one another to manage the same server.
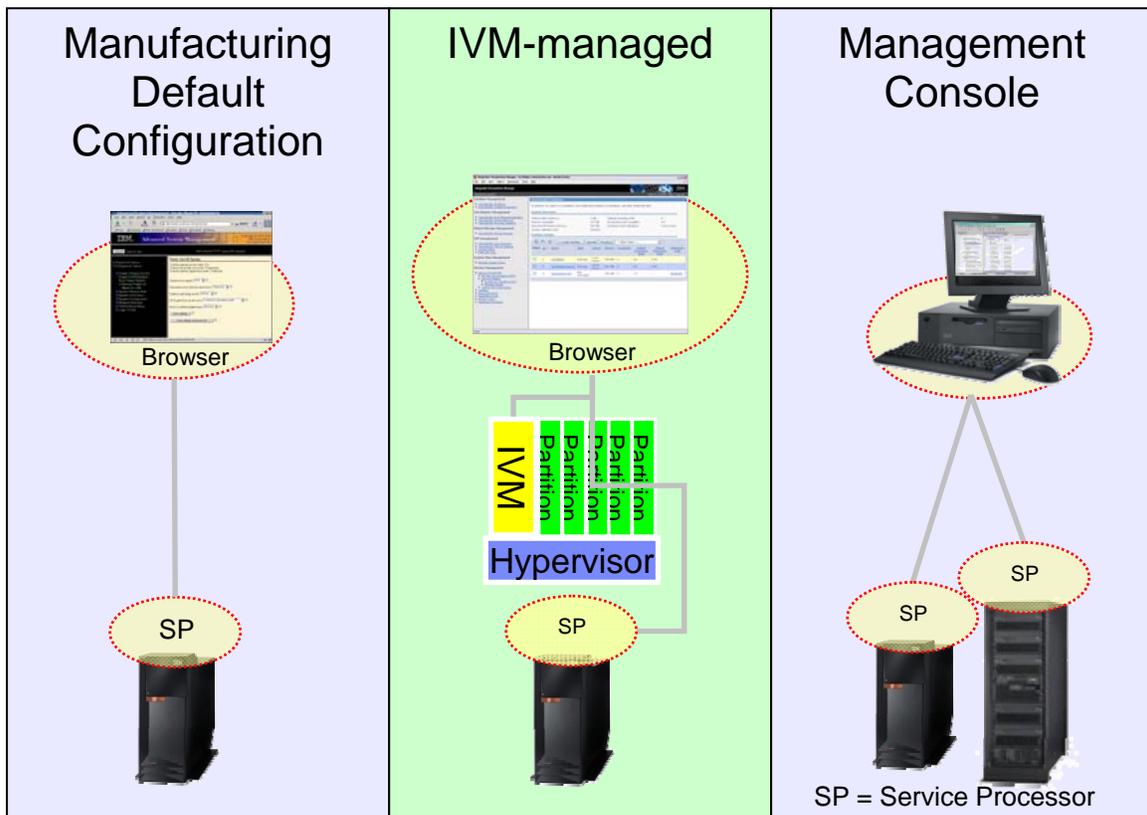
Fig 1: PowerVM management offerings

Target Market

The Integrated Virtualization Manager is an ideal solution for:
- Smaller to mid-sized businesses looking to consolidate existing workloads onto one or two supported servers
- Businesses with a geographically distributed IT infrastructure which would otherwise require a management console for each location
- Businesses wishing to employ virtualization on a BladeCenter server. Note: With the introduction of the SDMC, Power Blades can now be managed by a management console.

Because the IVM contains a subset of features and functionality provided by the management console (highlighted at the end of this section), clients should consider the type of workload they intend to run on their server. For example, the management console is the preferred solution for those whose primary concern is high availability. Environments for which high availability is a primary concern are advised to employ a fully redundant configuration, including two or more Virtual I/O Server partitions. Since only one VIOS instance is supported on a system managed by IVM, it is not recommended for high availability environments where PowerHA is not an option.

PowerVM Virtualization - the Basis for IVM

The Integrated Virtualization Manager is integrated into the Virtual I/O Server (VIOS), which is part of PowerVM Virtualization. IVM is not separately orderable and can only be purchased as part of PowerVM. IVM is included with the Virtual IO Server (VIOS) which is a single-function virtual machine that runs in a LPAR and facilitates the sharing of physical I/O resources for client partitions within the server. VIOS provides virtual SCSI, virtual optical, and Shared Ethernet Adapter support to the client partitions, which enables a client partition to fully virtualize its real IO resources.

The PowerVM features available with IVM include:
- Micro-Partitioning™ support for a single processor to be shared by up to 10 logical partitions.
- Virtual I/O Server (VIOS)
    - Virtual SCSI (VSCSI): Enables the sharing of physical storage adapters (SCSI and Fibre Channel) and storage devices (disk and optical) between logical partitions.
    - Virtual networking: A Shared Ethernet Adapter provides connectivity between internal and external Virtual LANs (VLANs); Virtual Ethernet provides high-speed connections between partitions.
    - Integrated Virtualization Manager
- Live Partition Mobility (available with PowerVM Enterprise Edition) support for migrating an active partition between two physical IVM managed systems with no application downtime
- N-Port ID Virtualization for Fibre-Channel
- Active Memory Sharing
- Dynamic Logical Partitioning – add/remove memory, CPU, and I/O resources on the fly without having to restart your partitions.

Utilize Server Resources - Virtualize and Consolidate

Many servers today serve one distinct application environment, such as a Web server or database. Each application environment is implemented on its own physical hardware, which includes the server, router, and storage. This process requires dedicated hardware for each application, which may result in low hardware utilization. There is an understandable desire to consolidate these redundant resources and get the maximum utilization possible.

The Integrated Virtualization Manager makes consolidation easy.
- With full Micro-Partitioning support, it provides default settings that are designed to automatically optimize processor usage by taking full advantage of the POWER system by employing shared pool processing..
- Virtual Ethernet support allows logical partitions that don't consistently use the full network bandwidth to share a physical adapter. For those workloads which require additional bandwidth, it also allows for aggregation of two or more physical adapters into one virtual adapter.
- Virtual SCSI and optical support allows for finer-grained storage assignment, which allows assignment of physical disks, partial disks, or external LUNs to hosted logical partitions. It is no longer necessary to assign an entire physical SCSI adapter or host bus adapter (HBA) to a logical partition. This capability is particularly useful on smaller systems that are limited to one or two physical SCSI adapters or host bus adapters.
- N-Port ID Virtualization enables partitions to share a physical Fibre-Channel adapter.

PowerVM Virtualization in Depth

Design

The POWER processor-based server lines offer two types of virtualization management modes, depending on the client's environment and requirements.

1. **Management console-managed**: In this mode, a separate Management Console is used to manage one or more servers. All management tasks can be done directly from the management console, including partitioning the system. All system events and state information is forwarded to the management console. When a management console connects to a system, it will transition automatically to a management console managed system.
2. **IVM-managed**:   When the Virtual I/O Server is installed as the operating system on a system in Manufacturing Default Configuration mode, the system will automatically transition to be IVM-managed. The VIOS partition owns all of the physical I/O resources; however, it will only own a portion of the memory and processing resources. Client partitions can be created using the IVM interface. Processing and memory resources are assigned directly by the Hypervisor to these client partitions; however, I/O is typically virtualized through the VIOS.

Creating and managing partitions requires an interface through which to communicate with the PowerVM Hypervisor. The management console accomplishes this via the Service Processor which routes the messages up to the PowerVM Hypervisor. Because the IVM is running directly on the system, a new virtual device called the Virtual Management Channel (VMC) was created to enable communication between the IVM and the Hypervisor. This device is available to servers that are in IVM-managed mode, and is assigned only to the VIOS partition.

Because the IVM is running within a partition, there are certain management functions that the user must still use Advanced Systems Management Interface (ASMI) to perform, such as powering on and powering down the system.
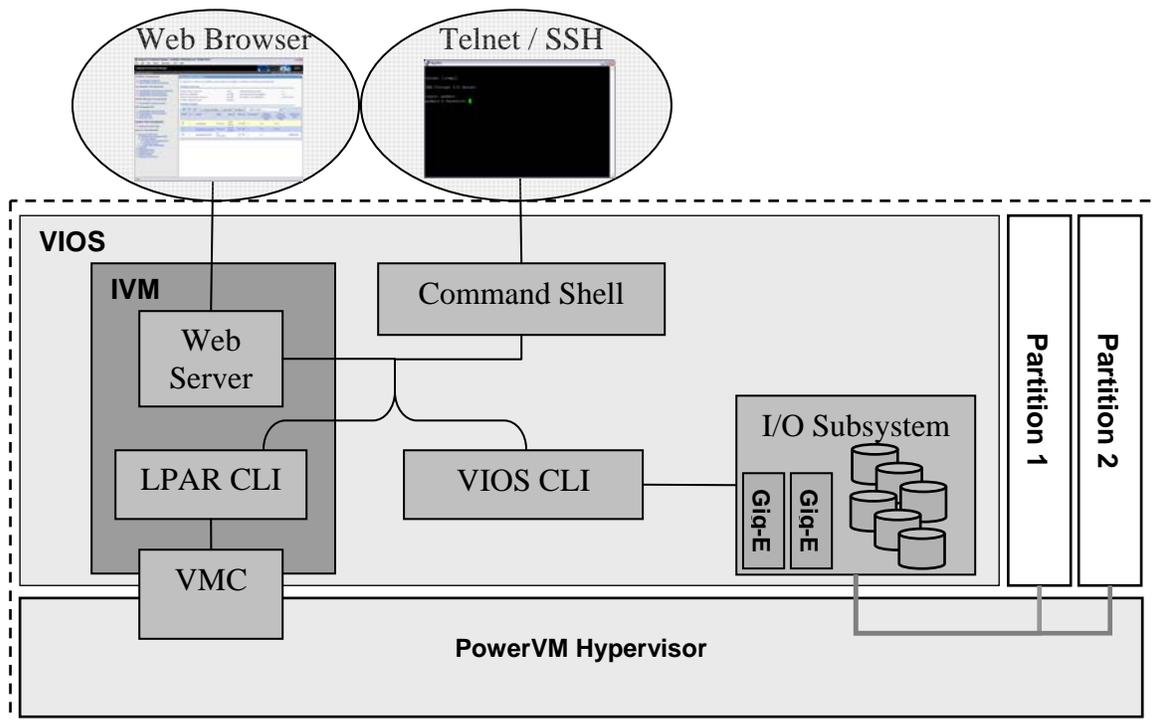

Fig 2: IVM high-level design

Resource Utilization

Because the Integrated Virtualization Manager is running inside of a partition, it consumes processing and memory resources. To minimize this impact, the IVM was architected to minimize resource consumption in the following ways:

- The IVM interface is stateless. When not being actively used by the user for configuration, it is mostly dormant. With the exception of a daemon that collects processor utilization statistics (and can be disabled by the user), no polling or data collection is performed except when explicitly retrieved by the user.
- The command line interface, while sharing a similar syntax to the management console's command line, was rewritten by IBM in C++ to help ensure optimal performance specifically for the IVM.
- The Web server, which is running in the VIOS partition, has been optimized for a small memory footprint.

User Interfaces

The IVM provides both a browser-based graphical interface and a command line interface.

- The graphical interface provides an intuitive, easy to use method to configure and manage the system. Because it is browser-based, the only client requirement is a computer with a Web browser which has network access to the VIOS partition. This Web interface is built on top of the command line interface and provides access to all commonly used partitioning, virtual I/O, and service commands.
- The command line interface has a similar syntax to the management console command line interface. It requires an interactive console, telnet or ssh session be established with the VIOS partition. There are three types of commands available:
  - **Partition Management**: These provide all partitioning function such as creating and modifying partitions. These items are part of the IVM specific command set, and are only available when the system is in IVM-managed mode.
  - **Virtual I/O**: These features provide the virtual I/O provisioning functions such as creating and assigning virtual disks and shared Ethernet adapters. Most of these commands exist on the VIOS outside of the IVM environment (i.e. when the system is being managed by a management console).
  - **Service and maintenance:** These provide the service functions, such as user management, serviceable event management, and firmware/microcode management. With the exception of serviceable event management, these commands also exist on the VIOS outside of the IVM environment.

Access to the console of managed partitions is provided through the VIOS command line using the *mkvt* and *rmvt* commands.

Usability

POWER processor-based servers offer unparalleled virtualization capabilities, which until now only advanced system administrators have been able to optimally configure and leverage. The IVM was designed with ease of use as a primary objective. With the usability improvements in the IVM, POWER virtualization is now accessible to a much broader audience. And, IVM enables leading-edge virtualization capability on the BladeCenter and Express Power Servers.
The browser-based interface was designed by IBM and influenced by user-centered design experience and feedback. Some examples of these usability improvements are listed below.

A simple view of processing

Understanding all of the configuration settings for Micro-Partitioning technology can be quite a daunting task. There are four different settings required to successfully set up Micro-Partitioning technology: Processing Units, Virtual Processors, Capped/Uncapped, and Uncapped Weight. If one of these settings is wrong, the partition will likely still function, but the performance and utilization of the system will probably not be optimal.

The IVM simplified these settings down to one simple assignment - the number of processors. Reasonable defaults are chosen for all other values depending on the number of processors selected. These settings provide good defaults to all but the most advanced users. Those users who need more control can still tweak all the settings by later viewing and modifying the detailed partition properties.
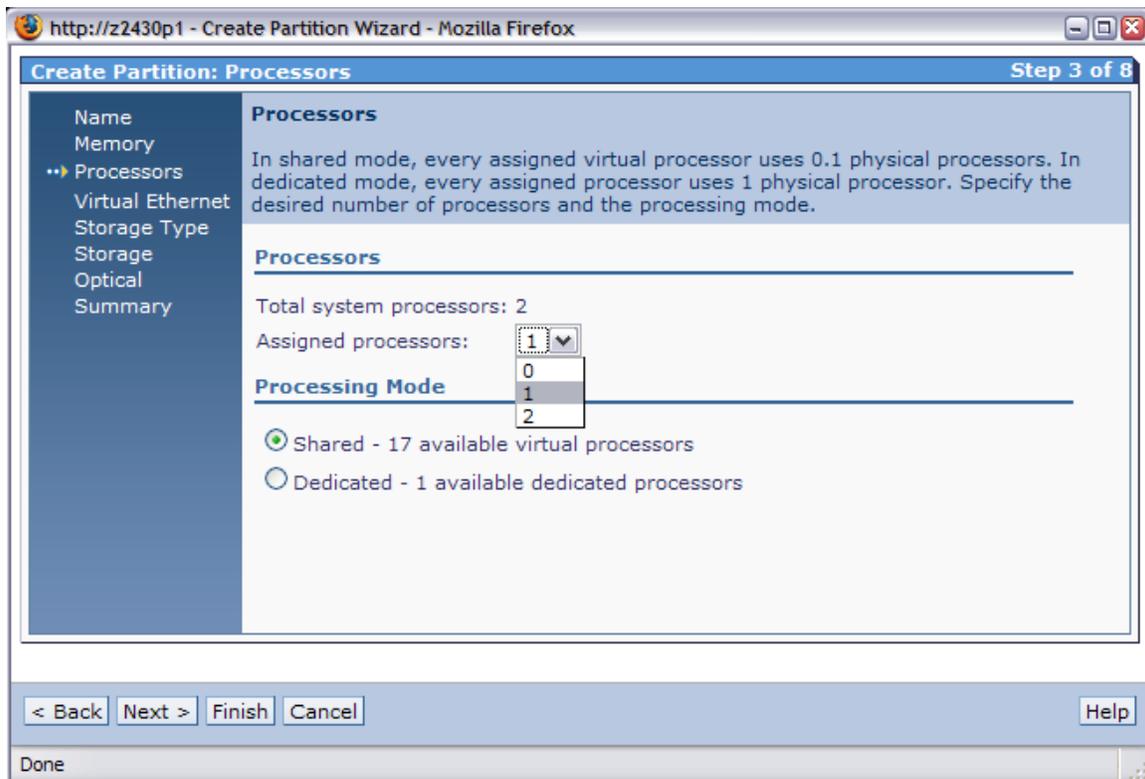

Fig 3: Selecting the number of processors while creating a new partition in IVM

Tight virtual I/O integration

While the partition configuration can be thought of as separate from the virtual Ethernet and virtual storage assigned to a partition from an architectural perspective, this view makes little sense from a client's perspective. With that in mind, the virtual I/O configuration is tightly coupled with the partition configuration. A prime example of this is the creation and assignment of a virtual disk.

To create and assign a virtual disk in a management console-managed environment, a user must:(This is a HMC specific example)
1. Dynamically add a virtual SCSI Server adapter on the VIOS partition using the HMC and add the virtual SCSI Server adapter to the current partition profile for the VIOS.
2. Create a virtual SCSI Client adapter on the client partition using the HMC, making sure that the client points to the server adapter.
3. Create the virtual disk (logical volume) using the VIOS command line. The volume group and disk size must be included as command line parameters.
4. Map the virtual disk to the virtual SCSI Server adapter using the VIOS command line. This feature requires the user to manually determine the virtual SCSI Server adapter name on the VIOS.

To do the same thing in the IVM environment, a user must:
1. Select the size for the virtual disk.
2. Select the partition to which to assign the virtual disk. If they are creating the disk in the Create Partition wizard, then this step isn't needed.
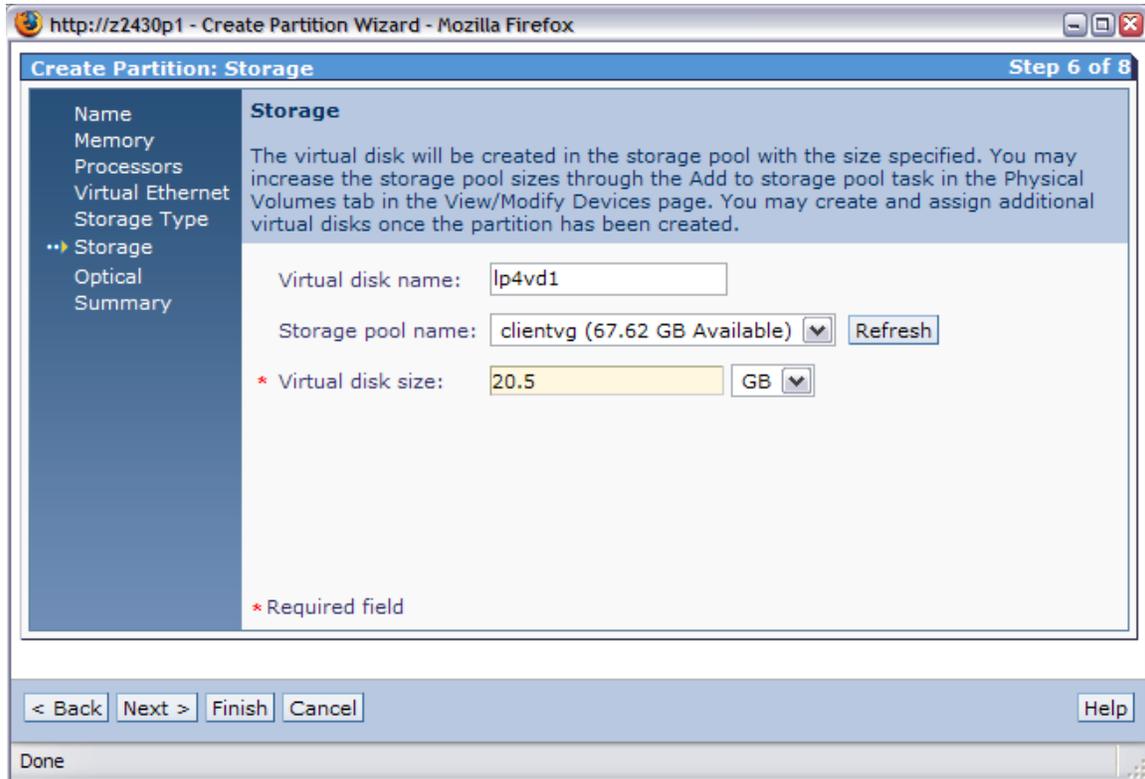
Fig 4: Creating a virtual disk while creating a partition in the IVM

Many of the simplifications that IVM introduced have now been brought into the Systems Director Management Console (SDMC).

Serviceability

The IVM provides a subset of the service function that is available on a management console. It acts as a repository and provides a management interface for Serviceable Events, and for system and service processor dumps. It also provides backup/restore capabilities for both the partition configuration and the Virtual I/O Server itself, as well as device microcode and system firmware updates.

Customers requiring the full set of service functions available on Power Systems (for example concurrent system firmware updates), should choose the management console.

Features Specific to the Management Console

Customers should carefully review their unique environment requirements when deciding whether to deploy the Integrated Virtualization Manager or the management console. Highlighted below are some specific items which can help users to make this decision.

- **Advanced Service Function:** The Management Console supports advanced service function such as concurrent maintenance. IVM supports concurrent maintenance for adapters owned by the VIOS.
- **High Availability:** In an environment where high availability is required, IBM recommends that the client employ a fully redundant environment. One method of doing this is to create two or more VIOS partitions on the system. Since IVM only supports a single instance of VIOS, IVM is not recommended for highly available environments.

Deployment Examples

The Integrated Virtualization Manager is designed for users who would like to deploy logical partitions without a separate management console. Below are a few usage scenarios which could be deployed using the IVM.

Consolidating Web Application Servers

A client has a number of Web application servers which are currently underutilized and would like to consolidate them onto a single system. Using IVM, the user is able to quickly deploy a POWER server with four micro-partitions with uncapped processors: three Web application servers and a new test server. Using the default LPAR configuration settings from the IVM:

- Each deployed LPAR is on a single virtual LAN which is bridged to the external Ethernet switch using the Shared Ethernet Adapter support in the VIOS. This support allows each LPAR to operate as though plugged directly into the external Ethernet switch.
- Each partition loads from a virtual disk which is backed by the default storage pool in the VIOS. These disks can be extended as capacity needs change.
- Each partition is given shared processor allocations, which maximize the ability of the POWER Hypervisor to perform fine-grained allocation of processor resources to each LPAR.
- Each partition is given a user-defined amount of memory.
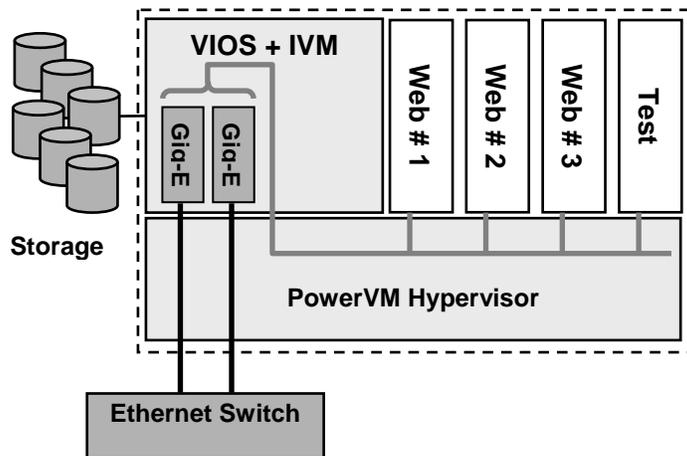
Fig 5: Web application server consolidation

Deploying Test and Development Systems

The Integrated Virtualization Manager is also a great solution for development and test environments. It is often difficult to procure dedicated hardware for development and test environments, which often have low to average utilization rates. Since the IVM introduces simplified deployment of cost-effective micro-partitions, it is easy to deploy independent test and development partitions in minutes using the same virtualization for processing, memory, network, and storage (see figure below). Since the resources are virtualized, creating a new partition on an existing partitioned server is simply a matter of helping to ensure that remaining capacity is available for the new workload.
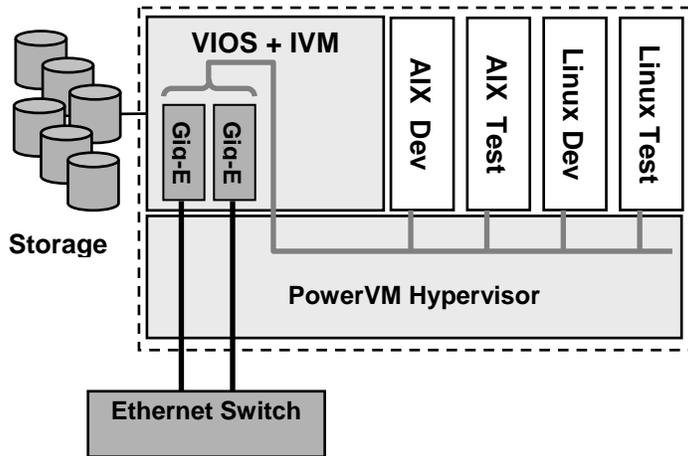
Fig 6: Test and deployment system consolidation

Appendix I: IVM and Management Console Comparison at a Glance

	Integrated Virtualization Manager (IVM)	Management Console
Physical footprint	Integrated into the server	A desktop or rack-mounted appliance
Installation	Installed with the VIOS (optical or network). Preinstall option available on some systems.	Appliance is preinstalled. Reinstall via optical media or network is supported.
Managed operating systems supported	AIX Linux IBM i	AIX, Linux and IBM i
Virtual console support	AIXand Linux virtual console support	AIX, Linux and IBM i virtual console support
User security	Password authentication with support for either full or ready only authorities	Password authentication with granular control of task based authorities and object based authorities
Network security	-Firewall support via command line -Web server SSL support	-Integrated firewall -SSL support for clients and for communications with managed systems
Servers supported	BladeCenter PS7xx Blades Power 710 Express Power 720 Express Power 730 Express Power 740 Express Power 750 Express	All Power6 & Power7 Servers
Multiple system support	One IVM per server	One management console can manage multiple servers
Redundancy	One IVM per server	Multiple management consoles can manage the same system for redundancy
Maximum number of partitions supported	Firmware maximum	Firmware maximum
Uncapped partition support	Yes	Yes
Partition Mobility	Yes - between 2 IVM managed systems	Yes - between 2 systems managed by a management console
Host Ethernet Adapter (Integrated Virtual Ethernet)	Yes	Yes
Multiple Shared Processor Pool	No - default pool only	Yes
Other POWER7 Functions (share while active, partition priority, etc)	Yes	Yes
Dynamic Resource Movement (dynamic LPAR)	Yes - full support	Yes - full support
I/O Support for AIX and Linux	Virtual and Direct	Virtual and Direct
I/O Support for IBM i	Virtual only	Virtual and Direct

Maximum # of virtual LANs	4096	4096
Fix/Update process for Manager	VIOS fixes and updates	Management Console e-fixes and release updates
Adapter microcode updates	Inventory scout	Inventory scout
Firmware updates	VIOS firmware update tools (not concurrent)	Service Focal Point with concurrent firmware updates
I/O Concurrent Maintenance	VIOS support for slot and device level concurrent maintenance via the diag hot plug support	Guided support in the "Repair and Verify" function on the management console.
Scripting and Automation	VIOS command line interface (CLI) and HMC compatible CLI	Management console command line interface
Capacity on Demand	Entry of PowerVM codes only	Full Support
User Interface	Web browser (no local graphical display)	Web browser (local or remote)
Workload Management (WLM) Groups Supported	One	254
LPAR Configuration Data Backup and Restore	Yes	Yes
Support for multiple profiles per partition	No	Yes
Serviceable event management	Service Focal Point Light - Consolidated management of firmware and management partition detected errors	Service Focal Point support for consolidated management of operating system and firmware detected errors
Hypervisor and service processor dump support	Dump collection with support to do manual dump downloads	Dump collection and call home support
Remote support	No remote support connectivity	Full remote support for the management console and connectivity for firmware remote support

Appendix II: System Requirements

Supported Systems:

BladeCenter PS700, PS701, PS702, PS703, PS703-L, PS704
Power 710 Express
Power 720 Express
Power 730 Express
Power 740 Express
Power 750 Express

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