


# Implementing IBM Power Virtualization Center in Your Data Center

## IBM Redbooks Solution Guide

This IBM® Redbooks® Solution Guide describes IBM Power Virtualization Center (PowerVC), the next generation of enterprise virtualization management for IBM Power Systems™. PowerVC is designed to simplify the management of virtual resources in IBM Power Systems environments.

PowerVC has a powerful yet simple and intuitive GUI and a deep integration with IBM Power Virtualization Management (PowerVM®) virtualization technologies. PowerVC enables virtualization without limits for the IBM Power Systems family of servers running IBM AIX®, IBM i, or IBM PowerLinux™. This Solution Guide is intended for experienced users of PowerVM and other virtualization solutions. The following figure indicates some of the significant features that are offered with PowerVC.



### Bring these benefits to your organization with IBM PowerVC:

- ✓ An open and extensible PowerVM management system that enables you to run in parallel with your existing infrastructure, preserving your investment
- ✓ Manage real-time optimization and virtual machine (VM) resilience to increase productivity
- ✓ Meet critical business needs in your organization
- ✓ Reduce operations costs and maintenance costs

Figure 1. Meet your virtual environment needs with IBM PowerVC

### Did you know?

More than 70% of IT budgets is spent on operations and maintenance costs. With PowerVC, you can manage your virtual environment with little concern about your existing virtualization configurations while realizing reduced operations and maintenance costs, and unleashing innovation within IT departments. Both editions of PowerVC (PowerVC Express Edition and the PowerVC Standard Edition) can provide a virtualized environment that is adaptable to the changing needs of your organization.

## Business value

PowerVC joins the PowerVM set of enterprise virtualization technologies to provide a virtualization management solution that is deeply integrated with IBM Power Systems. PowerVC is based on open standards and is a building block of IBM Infrastructure as a Service (IaaS) offerings based on IBM Power Systems.

### Two editions of PowerVC

PowerVC is available in two editions:

- *PowerVC Express Edition:* For managing small deployments using the IBM Integrated Virtualization Manager (IVM), a browser-based tool from which you can point, click, and consolidate multiple workloads onto one IBM Power Systems system
- *PowerVC Standard Edition:* For managing larger deployments using the IBM Hardware Management Console (HMC)

### Environment and features

PowerVC can manage Linux on Power and AIX running on IBM POWER® hardware, including IBM Flex System™ POWER compute nodes. Here are the features and benefits of the PowerVC Express and Standard Editions:

- Virtual Image capture, deployment, and management
- Policy-based virtual machine (VM) placement to improve usage
- Targeted VM placement for deployment to reduce complexity
- Managing real-time optimization and VM resilience to increase productivity
- VM Mobility with placement policies to reduce the burden on IT staff
- A management system that manages existing PowerVM deployments
- An open and extensible PowerVM management system that is adaptable and runs in parallel with existing infrastructure, preserving your investment

### HMC benefits

HMC is a critical component for managing your IBM Power Systems hardware infrastructure. Similarly, PowerVC can become a critical component as well, bringing the following benefits to your PowerVM virtualization infrastructure:

- A management solution for all PowerVM virtualization users
- Increased resource usage
- Improved workload management for performance and availability
- Reduced operations and maintenance costs
- Effective and efficient management of the advanced features that are offered by IBM Power Systems premium hardware

Steps for configuring your storage area network (SAN) and network on PowerVC are explained in *IBM PowerVC Introduction and Configuration*, SG248199. (For a link to this book, see the "Related information" section in this Solution Guide.) After the storage controllers and switches are accessible, PowerVC Standard Edition does the following tasks:

- Collects inventory on Fibre Channel (FC) fabric.
- Collects inventory on storage devices (pools and volumes).
- Monitors for health.
- Detects misconfigurations.
- Manages zoning.

- Manages logical unit numbers (LUNs) on storage devices.
- Manages masking of LUNs on storage devices.
- Manages snapshots on storage devices.
- Manages LUN copy operations on storage devices.

**Note:** PowerVC Express Edition manages storage controllers, but does not manage SAN switches.

## Solution overview

This Solution Guide offers product information about both editions of PowerVC. Consider which edition might serve the critical business needs in your environment. This section begins with an overview of each edition and the components that make each product unique.

### PowerVC Express Edition

PowerVC Express Edition is intended for organizations that are entering the virtualization arena, in which the VM hosts are IBM POWER7® or IBM POWER7+™ based IBM Power Systems Express servers that are managed by IVM.

- IBM Storwize® V3700
- IBM Storwize V7000
- IBM SAN Volume Controller
- IVM local storage

### PowerVC Standard Edition

PowerVC Standard Edition is intended for enterprise class virtualization environments where VM hosts are IBM POWER6®, POWER7, and POWER7+ based IBM Power Systems servers that are managed by HMC.

Dual Virtual I/O Servers per host are supported for accessing storage and network. VMs can also use N\_Port ID Virtualization (NPIV) attached storage. Here is the supported hardware:

- IBM Storwize V3700
- IBM Storwize V7000
- IBM SAN Volume Controller

### Powered by OpenStack

PowerVC is powered by open source OpenStack from the OpenStack Foundation. OpenStack is software that controls large pools of server, storage, and networking resources throughout a data center. PowerVC and OpenStack work in concert to lead your data center toward higher efficiencies.

For more information about the OpenStack modular architecture, see *IBM PowerVC Introduction and Configuration*, SG24-8199 and the website at <http://www.openstack.org>.

## **IBM Platform Enterprise Grid Orchestrator (EGO) and OpenStack**

PowerVC uses IBM Platform Enterprise Grid Orchestrator (EGO) to extend the OpenStack set of technologies in to IBM Power Systems environments. EGO incorporates enhanced security, intelligent placement of VMs, and other advanced policy-based features that are required for enterprise-level clouds. EGO is a proven technology that is used in grid and scaled-out environments by more than 2000 IBM clients. Its open, extensible architecture supports reservations, energy-aware, over-subscription, and user-defined policies.

### **Simple to manage**

PowerVC is designed to simplify the management of virtual resources in your Power Systems environment. The PowerVC no-menus interface guides you through three simple configuration steps to register physical hosts, storage providers, and network resources to start capturing and intelligently deploying your virtual machines, among the other tasks that are shown in the following list:

- Create virtual machines and then resize and attach volumes to them.
- Import existing virtual machines and volumes so they can be managed by IBM PowerVC.
- Monitor the usage of the resources that are in your environment.
- Migrate virtual machines while they are running (hot migration).
- Deploy images quickly to create virtual machines that meet the demands of your ever-changing business needs.

### **Solution architecture**

Why is there another virtualization management offering? IBM designed PowerVC to give IBM Power Systems customers virtualization management in which nearly all pre-existing virtualization configurations can act as the starting point.

PowerVC sits between the HMC and the IBM SmartCloud® Infrastructure as a Service (IaaS) offerings. In this way, it provides a systems management product that our enterprise customers require to perform the following tasks:

- Effectively manage the advanced features that are offered by our premium hardware
- Drive up resource usage and manage workloads for performance and availability

The following figure shows a graphic representation of the technology behind PowerVC.

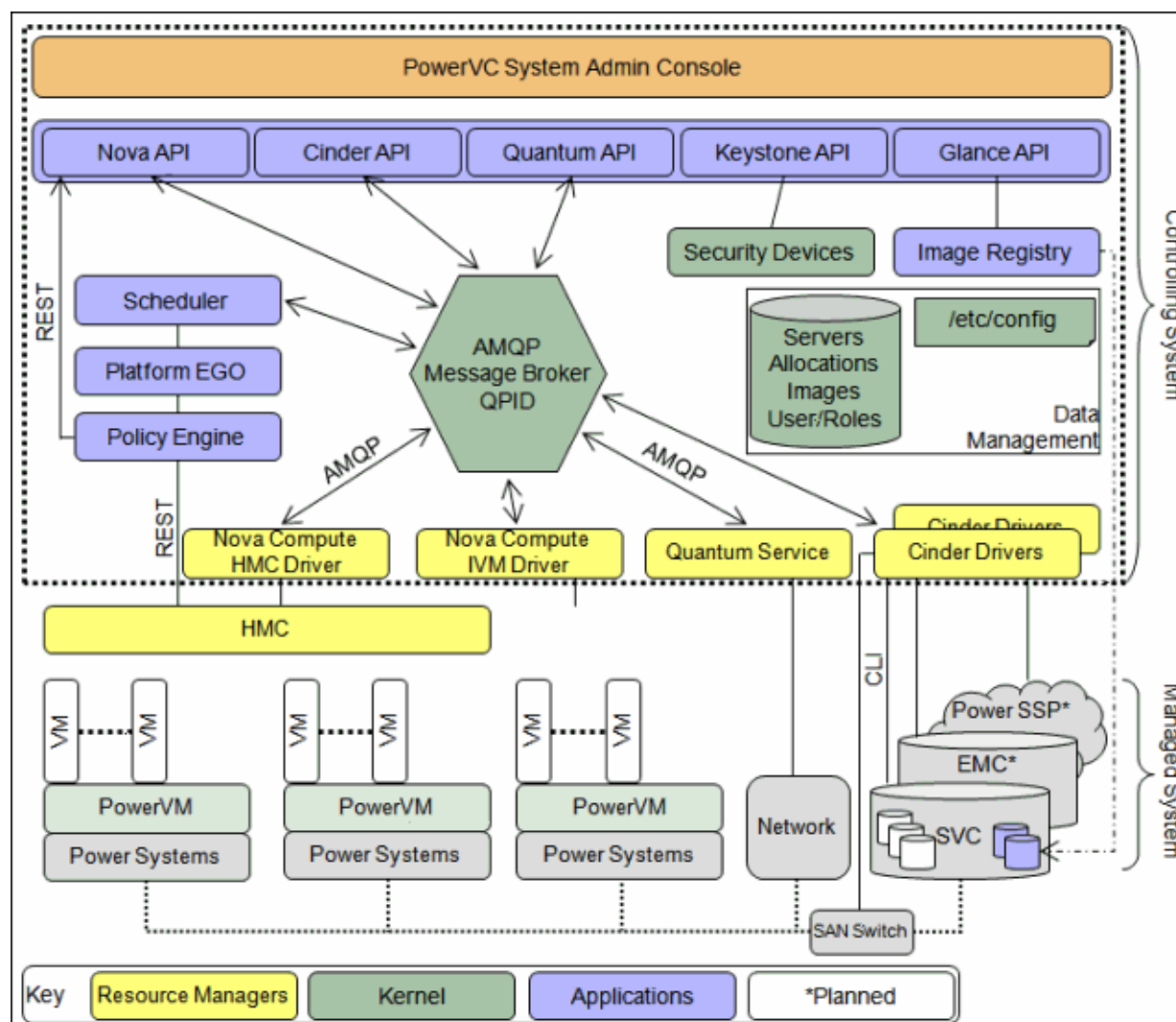


Figure 1. PowerVC technology overview

For more information, see *IBM PowerVC Introduction and Configuration*, SG24-8199.

### Storage access in PowerVC Express Edition

PowerVC Express Edition uses virtual Internet small computer system interface (vSCSI) for access to storage.

Here is a description of the flow of storage management from physical storage LUNs to VMs in the PowerVC Express Edition:

- LUNs are provisioned on a supported storage controller.
- LUNs are masked to IVM FC ports and are discovered as hard disk logical devices in the IVM.
- LUNs are mapped from IVM to VMs over the vSCSI virtual adapter pair.

This process is performed automatically by PowerVC Express Edition. No zoning is involved because individual VMs do not access physical LUNs directly over the SAN.

The following figure shows how VMs in the PowerVC Express Edition access storage.

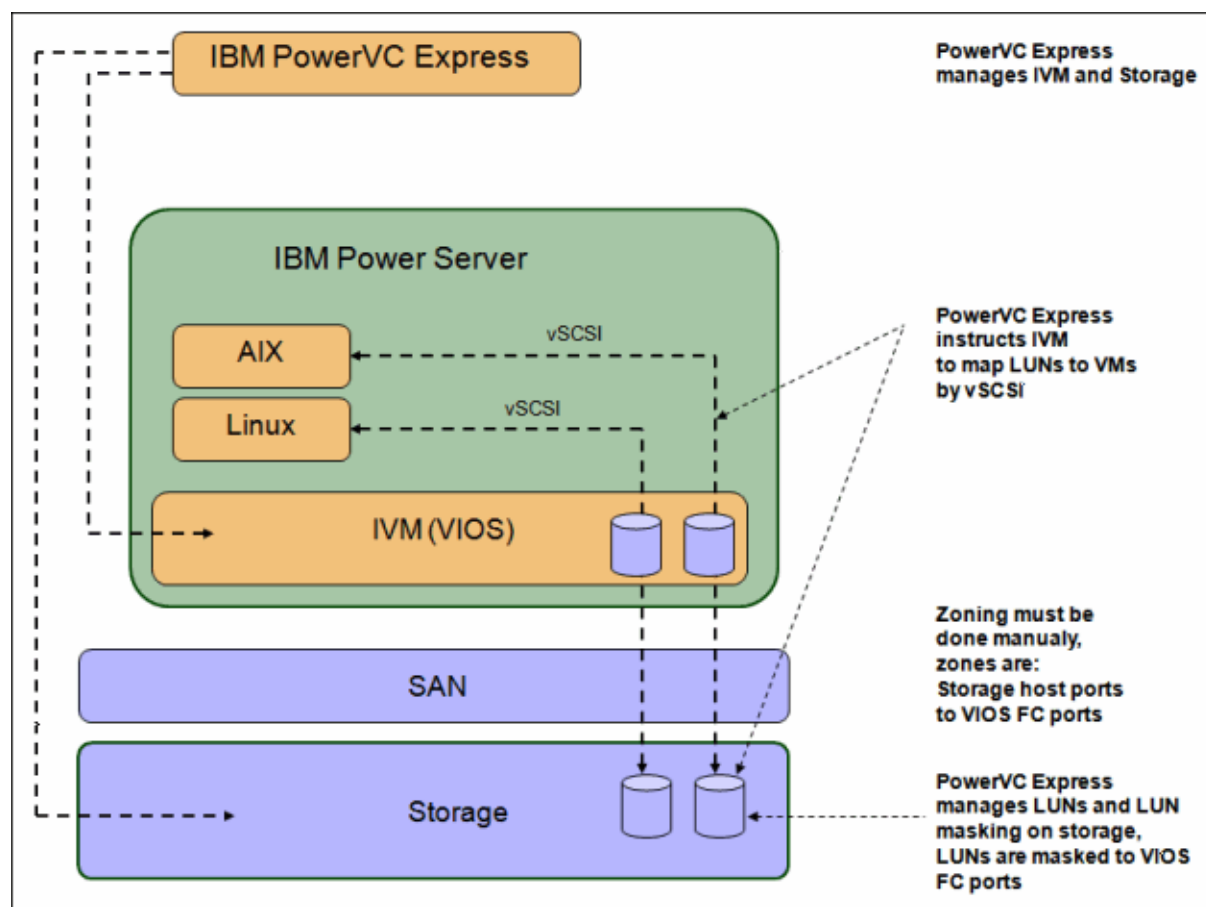


Figure 2. PowerVC Express Edition storage access flow

### Storage access in PowerVC Standard Edition

Here is a description of the flow of storage management from physical storage LUNs to VMs in the PowerVC Standard Edition:

- Access to SAN from VMs is configured on Virtual I/O Servers using FC adapter pair and NPIV.
- LUNs are provisioned on a supported storage controller.
- LUNs are masked to VM virtual FC ports.
- SAN zoning is adjusted so that VMs have access from their virtual FC ports to the storage controller host ports. Changes in zoning are done automatically by PowerVC Standard Edition because individual VMs access physical LUNs directly over SAN.
- LUNs are discovered as logical devices in the VMs

These steps are performed automatically by PowerVC Standard Edition.

The following figure shows how VMs in PowerVC Standard Edition access storage.

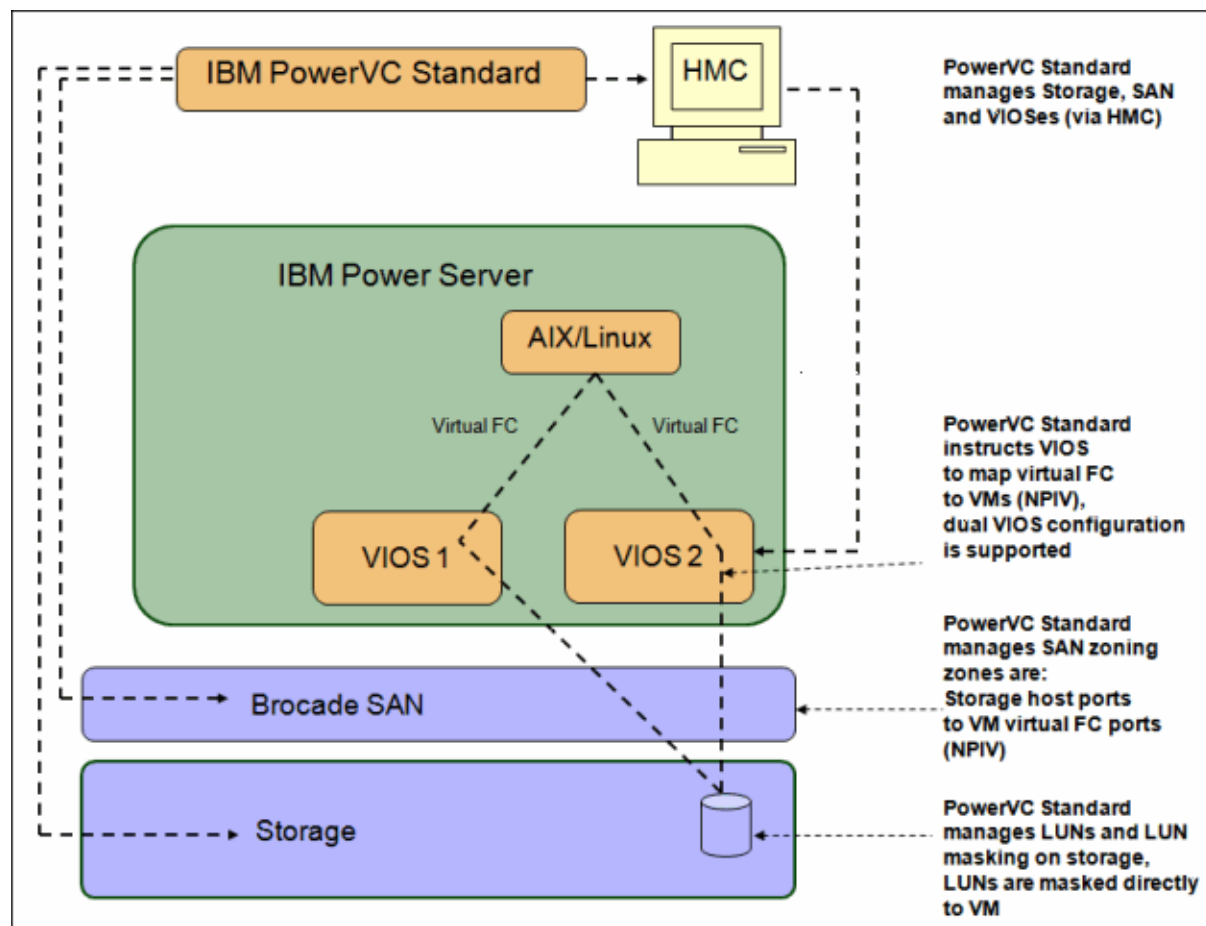


Figure 3. PowerVC Standard Edition storage access flow

## Usage scenarios

This section describes two scenarios: one for PowerVC Express Edition, and one for PowerVC Standard Edition. For each scenario, there is a description of the hardware and software requirements.

During installation and configuration in an IBM lab environment, some roadblocks were faced and addressed. We share these roadblocks with you in *IBM PowerVC Introduction and Configuration*, SG24-8199, which also lists the components that were used during the installation and setup of PowerVC Express Edition.

### PowerVC Express Edition

PowerVC Express Edition is intended for environments that are entering the virtualization arena, and where the VM hosts are POWER7 or POWER7+ based IBM Power Systems Express servers that are managed by IVM.

The information in this section provides a consolidated view of the hardware and software requirements for your PowerVC Express Edition environment.

## Management and managed hosts

The following tables describe the hardware, software, and minimum requirements for PowerVC Express Edition.

Table 1. Hardware and OS support for PowerVC Express Edition host

Host type	Supported hardware	Supported OSs
PowerVC management host	IBM Power processor-based models: <ul style="list-style-type: none"> <li>• IBM PowerLinux 7R1 and PowerLinux 7R2 servers</li> <li>• POWER7 and POWER7+ servers</li> <li>• IBM System x® servers that meet the following minimum requirements: Processors - Intel or AMD x64 processors with 2 or more logical cores and a speed of 2 GHz, 10 GB memory, and a 40 GB hard disk</li> </ul>	Red Hat Enterprise Linux (RHEL) Version 6.4 or later for IBM Power or x86_64
Managed hosts	<ul style="list-style-type: none"> <li>• PowerLinux 7R1 and PowerLinux 7R2 servers</li> <li>• POWER7 and POWER7+ servers</li> </ul> <p><b>Note:</b> Managed hosts must be IBM PowerLinux, POWER6, POWER7, or POWER7+ models and not a combination of these systems.</p>	<ul style="list-style-type: none"> <li>• Red Hat Enterprise Linux 5.9 and 6.4 or later</li> <li>• SUSE Linux Enterprise Server (SLES) Version 11 SP3 or later</li> <li>• AIX V6.1 TL9 or later and AIX V7.1 TL3 or later</li> </ul>

Table 2. Minimum resource requirements for PowerVC Express Edition VMs

System resource	Amount
Processors	<ul style="list-style-type: none"> <li>• Minimum: An uncapped shared processor VM with 1.0 processor unit of entitled processing capacity and 2 virtual processors.</li> <li>• Suggest one of the following: An uncapped shared processor VM with a minimum of 2.0 processor units of entitled processing capacity and 2 virtual processors.</li> <li>• A VM with 2 dedicated processors.</li> </ul>
Memory	10 GB
Hard disk	<ul style="list-style-type: none"> <li>• 40 GB for SAN storage</li> <li>• 60 GB for local storage</li> </ul>

**Tip:** You must temporarily store International Organization for Standardization (ISO) images before you import them into PowerVC. If you plan to store them temporarily on your PowerVC VM, then you might need to create the VM with more than the minimum 40 or 60 GB of hard disk drive space. Choose the size based on the number and size of the ISO images that you plan to import.

In addition, all hosts must have FC cards that are suitable for connecting to the SAN switches.

## Virtualization platform

The following table includes the virtualization platform version requirement for the PowerVC Express Edition.

Table 3. Supported virtualization platforms for PowerVC Express Edition

Platform	Requirement
Virtual I/O Server	Version 2.2.2.1 or later



## Network resources

The following table describes the network infrastructure that is supported by PowerVC Express Edition.

Table 4. Supported network resources for PowerVC Express Edition

Item	Requirement
Network switches that are supported by PowerVC	Any entry level IBM or Cisco switch that supports VLAN tagging

## Storage providers

The following table shows the hardware that is supported by PowerVC Express Edition.

Table 5. Supported hardware for PowerVC Express Edition

Item	Requirement
Storage systems that can be managed by PowerVC.	Version 6.4 or later of IBM Storwize V3500 (China only), V3700, and V7000, and SAN Volume Controller
SAN switches that are supported by PowerVC	IBM System Networking SAN24B-5

**Note:** PowerVC Express Edition does not manage network switches, but supports network configurations that use virtual LAN (VLAN)-capable switches. PowerVC Standard Edition does support the management of SAN switches.

## PowerVC Standard Edition

PowerVC Standard Edition is designed for enterprise class virtualization environments where VMs are hosted on IBM Power Systems servers that are managed by the HMC.

PowerVC Standard Edition integrates with any IBM system that includes a POWER6, POWER7, or POWER7+ processor on a Power System or IBM PureFlex™ System Foundation (built to order) that is managed through HMC.

## Management and managed hosts

The following tables describe the hardware, software, and minimum requirements for PowerVC Standard Edition.

Table 6. Hardware and OS support for PowerVC Standard Edition host

Host type	Supported hardware	Supported operating systems
PowerVC management host	IBM Power processor-based models: <ul style="list-style-type: none"> <li>POWER7 and POWER7+ processor-based blades</li> <li>Flex System on IBM Power Architecture® compute nodes</li> </ul> IBM System x servers that meet the following minimum requirements: <ul style="list-style-type: none"> <li>Intel or AMD x64 processors with 2 or more logical cores and a speed of 2 GHz, 10 GB memory, and 40 GB hard disk</li> </ul>	Red Hat Enterprise Linux (RHEL) Version 6.4 or later for IBM Power or x86_64
Managed hosts	<ul style="list-style-type: none"> <li>POWER6, IBM POWER6+™, POWER7, and POWER7+ processor-based servers</li> <li>POWER6 and POWER7 processor-based blades.</li> <li>Flex System Power Architecture compute nodes</li> </ul>	<ul style="list-style-type: none"> <li>Red Hat Enterprise Linux 5.9 and 6.4 or later</li> <li>SUSE Linux Enterprise Server (SLES) Version 11 SP3 or later</li> <li>AIX V6.1 TL9 or later and Version 7.1 TL3 or later</li> </ul>

**Tip:** As a preferred practice, the PowerVC management host should have at least 200 maximum virtual adapters that are configured on each virtual input server.

Table 7. Minimum resource requirements for PowerVC Standard Edition VMs

System resource	IBM Power Systems	IBM System x
Processors	<ul style="list-style-type: none"> <li>Minimum: An uncapped shared processor VM with 1.0 processor unit of entitled processing capacity and 2 virtual processors</li> </ul> As a preferred practice, use one of the following options: <ul style="list-style-type: none"> <li>An uncapped shared processor VM with a minimum of 2.0 processor units of entitled processing capacity and 2 virtual processors</li> <li>A VM with 2 dedicated processors</li> </ul>	Intel or AMD x64 with two or more logical cores each and a speed of 2 GHz
Memory	10 GB	10 GB
Hard disk	40 GB	40 GB

## Hardware Management Console (HMC)

The following table shows the HMC version and release requirements to support PowerVC Standard Edition.

Table 8. HMC requirements for PowerVC Standard Edition

Item	Requirement
Software level	Version 7.7.8 or later

## Virtualization platform

The following table lists the Virtual I/O version requirement for PowerVC Standard Edition.

Table 9. Supported virtualization platforms for PowerVC Standard Edition

Platform	Requirement
Virtual I/O Server	Version 2.2.3 or later

## Network resources

The following table describes the network infrastructure that is supported by PowerVC Standard Edition.

Table 10. Supported network resources for PowerVC Standard Edition

Item	Requirement
Network switches	PowerVC does not manage network switches, but supports network configurations that use VLAN-capable switches.
Virtual networks	Supports shared Ethernet adapters for VM networking.

## Storage providers

The following table shows the hardware that is supported by PowerVC Standard Edition.

Table 11. Supported storage hardware for PowerVC Standard Edition

Item	Requirement
Storage systems	Version 6.4 or later of IBM Storwize V3500 (China only), V3700, V7000, and SAN Volume Controller.
SAN switches	Can manage the IBM System Networking SAN24B-5 and SAN48B-5 switches.
Attachments	NPIV-capable FC is required for storage controllers. Internet small computer system interface (iSCSI) is not supported.

## Security

The following table lists the security features that are supported by PowerVC Standard Edition.

Table 12. Supported security software for PowerVC Standard Edition

Item	Requirement
Lightweight Directory Access Protocol (LDAP) server (optional)	All versions of OpenLDAP

## Integration

The following table shows the available set of platform and virtualization management solutions for IBM Power Systems when they are used as the foundation for IBM SmartCloud solutions that integrate PowerVM.

Table 13. IBM Power Systems VM solutions

Offering	Solution	Functions
SmartCloud	Cloud management	<ul style="list-style-type: none"><li>• User self-service provisioning</li><li>• Service catalog with virtual systems and applications</li><li>• Subscriber and account management (multi-tenancy)</li><li>• Delivered as IBM SmartCloud Entry, IBM SmartCloud Provisioning, and IBM SmartCloud Orchestrator solutions</li></ul>
PowerVC	IBM Power Systems virtualization management	<ul style="list-style-type: none"><li>• Leadership solution for PowerVM</li><li>• Intelligent virtual image management and deployment</li><li>• Resource pooling and dynamic virtual management placement</li><li>• Ongoing optimization and VM resilience</li></ul>
HMC	IBM Power platform management	<ul style="list-style-type: none"><li>• PowerVM configuration and virtualization setup</li><li>• Hardware and firmware configuration and controls</li><li>• Service, support, and update management</li></ul>

For more integration specifics, see the "Usage scenarios" section in this Solution Guide, where the following integration components for the two scenarios are listed:

- PowerVC Express Edition:
  - Management and managed hosts
  - Virtualization platform
  - Network resources
  - Storage providers
- PowerVC Standard Edition
  - Management and managed hosts
  - HMC
  - Virtualization platform
  - Network resources
  - Storage providers
  - Security

## Supported platforms

The following are key prerequisites for PowerVC:

- PowerVM Standard Edition (5765-PVS): Basic function
- PowerVM Enterprise Edition (5765-PVE): Full function

## Ordering information

Orders may be placed by using the e-config application online, which is available at <http://www.ibm.com/services/econfig>. For new orders, select the type, model, and features from the following tables. The following tables list the feature numbers for ordering the PowerVC editions.

Table 14. 5765-VCX - PowerVC Express Edition V1.2

Description	Feature number
Per processor - Power 750 and below, with PureFlex Power nodes and 1 year Software Maintenance Agreement	0002

Table 15. 5765-VCS - PowerVC Standard Edition V1.2

Description	Feature number
Per processor - Power 750 (and below) with PureFlex Power nodes and 1 year Software Maintenance Agreement	0003
Per processor - Power 770 with 1 year Software Maintenance Agreement	0002
Upgrade Power 750 (and below) to Power 770	0006
Per processor - Power 780 or Power 795 with 1 year Software Maintenance Agreement	0001
Upgrade Power 750 (and below) to Power 780 or Power 795	0005
Upgrade Power 770 to Power 780 or Power 795	0004
Upgrade from 5765-VCX	0009

For more ordering information, see the "Related information" section of this Solution Guide. *5765-VCS - PowerVC Standard Edition V1.2* (sales manual) contains an IBM Offering Information page that might be of interest.

## Related information

For more information about the products, technologies, and processes that are described in this Solution Guide, see the following resources:

- IBM PowerVC - Virtualization Center  
<http://www.ibm.com/systems/power/software/virtualization-management/>
- *5765-VCS - IBM PowerVC Standard Edition V1.2* (sales manual)  
[http://www.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep\\_sm/s/872/ENUS5765-VCS/index.html&lang=en&request\\_locale=en](http://www.ibm.com/common/ssi/ShowDoc.wss?docURL=/common/ssi/rep_sm/s/872/ENUS5765-VCS/index.html&lang=en&request_locale=en)
- *IBM PowerVC Introduction and Configuration*, SG24-8199  
<http://www.redbooks.ibm.com/abstracts/sg248199.html?Open>
- *IBM PowerVM 2013 Enterprise Enhancements*, SG24-8198  
<http://www.redbooks.ibm.com/abstracts/sg248198.html?Open>
- *IBM PowerVM Virtualization Introduction and Configuration*, SG24-7940  
<http://www.redbooks.ibm.com/abstracts/sg247940.html?Open>
- *IBM PowerVM Virtualization Managing and Monitoring*, SG24-7590  
<http://www.redbooks.ibm.com/abstracts/sg247590.html?Open>
- *Explore New Solutions with IBM PowerVM Enhancements*, TIPS1135  
<http://www.redbooks.ibm.com/abstracts/tips1135.html?Open>
- *IBM PowerVM for Growing Businesses: Reduce Total Cost of Computing, and More, in a Virtual Environment*, TIPS1099  
<https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/tips1099.html?Open>
- *IBM PowerVM for Growing Businesses: Managing and Monitoring a Virtual Environment*, TIPS1091  
<https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/tips1091.html?Open>
- IBM Power Systems (product page)  
<http://www-03.ibm.com/systems/power/>

# Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service. IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.*

**The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:** INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you. This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products. This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

## COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

**© Copyright International Business Machines Corporation 2014. All rights reserved.**

Note to U.S. Government Users Restricted Rights -- Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

This document was created or updated on January 15, 2014.

Send us your comments in one of the following ways:

- Use the online **Contact us** review form found at:  
[ibm.com/redbooks](http://ibm.com/redbooks)
- Send your comments in an e-mail to:  
[redbook@us.ibm.com](mailto:redbook@us.ibm.com)
- Mail your comments to:  
IBM Corporation, International Technical Support Organization  
Dept. HYTD Mail Station P099  
2455 South Road  
Poughkeepsie, NY 12601-5400 U.S.A.

This document is available online at <http://www.ibm.com/redbooks/abstracts/tips1136.html> .

## Trademarks

IBM, the IBM logo, and [ibm.com](http://ibm.com) are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the web at <http://www.ibm.com/legal/copytrade.shtml>.

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX®  
IBM®  
IBM Flex System™  
IBM SmartCloud®  
POWER®  
Power Architecture®  
Power Systems™  
POWER6®  
POWER6+™  
POWER7®  
POWER7+™  
PowerLinux™  
PowerVM®  
PureFlex™  
Redbooks®  
Redbooks (logo)®  
Storwize®  
System x®

The following terms are trademarks of other companies:

Intel, Intel logo, Intel Inside logo, and Intel Centrino logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.