Veritas Storage Foundation™ and High Availability Solutions 6.0.1 Virtualization Guide - AIX

September 2012

Symantec™

Veritas Storage Foundation and High Availability Solutions Virtualization Guide

Product version: 6.0.1

Document version: 6.0.1 Rev 2

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- Version and patch level
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- Router, gateway, and IP address information
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  - Troubleshooting that was performed before contacting Symantec
  - Recent software configuration changes and network changes

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Documentation

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https://sort.symantec.com/documents

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https://www-secure.symantec.com/connect/storage-management/forums/storage-and-clustering-documentation

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http://www.symantec.com/connect/storage-management

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Section 1

Overview of IBM virtualization

Chapter 1

Overview

This chapter includes the following topics:

Introduction to AIX logical partition (LPAR) virtualization technology

The Veritas Storage Foundation and High Availability (SFHA) solutions can be used in LPAR-based virtualization environments to provide advanced storage management, mission-critical clustering, and fail-over capabilities.

AIX logical partition virtual machine technology is released by IBM with AIX as a full virtualization solution. LPAR differs from other popular alternatives like Xen and VMware in terms of operation, performance and flexibility. LPAR comes as a kernel module, with a set of user space utilities to create and manage logical partitions (LPARs).

IBM LPAR virtualization technology includes the following:

IBM LPAR virtualization technology	Description
IBM LPARs with dedicated I/O	The baseline configuration is a traditional AIX deployment with dedicated HBAs and NICs. The deployment may include partitions with virtual CPUs or partitions that support DLPAR events.
IBM LPARs with Virtual I/O Servers	With Virtual I/O Servers LPARs can share physical resources. The VIOS provides virtual SCSI, virtual fibre channel, and virtual networking for sharing. Sharing of resources between LPARs enables more efficient utilization of physical resources and facilitates consolidation.
Workload Partitions (WPARs)	Workload Partitions enable administrators to virtualize the AIX operating system, by partitioning an AIX operating system instance into multiple environments. Each environment within the AIX operating system instance is called a workload partition (WPAR). One WPAR can host applications and isolate the applications from applications executing in other WPARs. WPAR is a pure software solution and has no dependencies on hardware features.
Live Partition Mobility	Live Partition Mobility enables greater control over the usage of resources in the data center by enabling the migration of a logical partition from one physical system to another. This feature enables the transfer of a configuration from source to destination without disrupting the hosted applications or the setup of the operating system and applications.
Live Application Mobility	Live Application Mobility enables the planned migration of workloads from one system to another without interrupting the application and can be used to perform a planned firmware installation on a server.
Active Memory Sharing	Active Memory Sharing is a virtualization technology that enables multiple partitions to share a pool of physical memory. AMS increases system memory utilization and reduces the amount of physical memory that the system requires. The Veritas Storage Foundation High Availability stack supports VIO clients that use memory from the Active Memory Sharing (AMS) pool. Symantec recommends that the ratio of the physical memory in the AMS pool should comply with the AIX guidelines.

IBM LPAR virtualization technology	Description
Active Memory Expansion	Active Memory Expansion relies on compression of in-memory data to increase the amount of data that can be placed into memory. This feature expands the effective memory capacity of a POWER7 system. The operating system manages the in-memory data compression, which is transparent to applications and users. Active Memory Expansion is configurable per logical partition (LPAR) . Active Memory Expansion can be selectively enabled for one or more LPARs on a system. When Active Memory Expansion is enabled for a LPAR, the operating system compresses a portion of the LPAR's memory and leave the remaining portion of memory uncompressed. The memory is effectively broken up into two pools – a compressed pool and an uncompressed pool. The operating system dynamically varies the amount of memory that is compressed, based on the workload and the configuration of the LPAR.

This guide illustrates some reference configurations for the use of Storage Foundation and High Availability (SFHA) Solutions 6.0.1 with IBM Power virtualization. These reference configurations can be customized to fit most implementations. An assumption is made that the reader understands the AIX operating system, including its architecture, as well as how to configure and manage LPARs using the management software already provided by AIX. There is also an expectation that the user is familiar with the basic Veritas Storage Foundation and High Availability Solutions software and is well versed with its administration and management utilities. Additional details regarding IBM AIX, LPARs and Veritas Storage Foundation and High Availability Solutions software are available in the Additional documentation section.

About Veritas Storage Foundation and High Availability products

The following sections describe the products and component software available in this Veritas Storage Foundation and High Availability Solutions release.

About Veritas Storage Foundation

Veritas Storage Foundation by Symantec includes Veritas File System (VxFS) and Veritas Volume Manager (VxVM.)

Veritas File System is a high performance journaling file system that provides easy management and quick-recovery for applications. Veritas File System delivers scalable performance, continuous availability, increased I/O throughput, and structural integrity.

Veritas Volume Manager removes the physical limitations of disk storage. You can configure, share, manage, and optimize storage I/O performance online without interrupting data availability. Veritas Volume Manager also provides easy-to-use, online storage management tools to reduce downtime.

VxFS and VxVM are included in all Veritas Storage Foundation products. If you have purchased a Veritas Storage Foundation product, VxFS and VxVM are installed and updated as part of that product. Do not install or update them as individual components.

Veritas Storage Foundation includes the dynamic multi-pathing functionality.

The Veritas Replicator option, which replicates data to remote locations over an IP network, can also be licensed with this product.

Before you install the product, read the *Veritas Storage Foundation Release Notes*.

To install the product, follow the instructions in the *Veritas Storage Foundation Installation Guide*.

About Veritas Storage Foundation High Availability

Storage Foundation High Availability includes Veritas Storage Foundation and Veritas Cluster Server. Veritas Cluster Server adds high availability functionality to Storage Foundation products.

Before you install the product, read the *Veritas Storage Foundation and High Availability Release Notes*.

To install the product, follow the instructions in the *Veritas Storage Foundation and High Availability Installation Guide*.

For HA installations, also read the *Veritas Cluster Server Release Notes*.

About Veritas Storage Foundation Basic

Veritas Storage Foundation Basic by Symantec (SF Basic) is a special product that is available for download from the Symantec Web site. SF Basic is not part of the Storage Foundation and High Availability Solutions product suite. Storage Foundation Basic supports all Storage Foundation Standard features, however, there are deployment and technical support limitations.

For complete information on ordering this product, licensing, and technical support, visit the following URL:

http://www.symantec.com/business/storage-foundation-basic

Limited deployment

Storage Foundation Basic has a limited set of configurations.

SF Basic deployment is limited to the following configurations:

- Maximum four VxVM volumes per physical server (excludes the system volumes that are required for starting the system from root disks)
- Maximum four VxFS file systems per physical server (excludes root file systems)
- Maximum server capacity of two CPU sockets

Technical support

Technical support is self-service only, available from the Symantec Support Web site. You can purchase additional support corresponding to the terms of the Storage Foundation Basic license. To access the self-service knowledge base, go to the following URL:

http://entsupport.symantec.com

About Veritas Storage Foundation Cluster File System High Availability

Veritas Storage Foundation Cluster File System High Availability by Symantec extends Veritas Storage Foundation to support shared data in a storage area network (SAN) environment. Using Storage Foundation Cluster File System High Availability, multiple servers can concurrently access shared storage and files transparently to applications.

Veritas Storage Foundation Cluster File System High Availability also provides increased automation and intelligent management of availability and performance.

Storage Foundation Cluster File System High Availability includes Veritas Cluster Server, which adds high availability functionality to the product.

Veritas Replicator Option can also be licensed with this product.

Before you install the product, read the *Veritas Storage Foundation Cluster File System High Availability Release Notes*.

To install the product, follow the instructions in the *Veritas Storage Foundation Cluster File System High Availability Installation Guide*.

For information on high availability environments, read the Veritas Cluster Server documentation.

About Veritas Storage Foundation for Oracle® RAC

Veritas Storage Foundation for Oracle® RAC by Symantec is an integrated suite of Veritas storage management and high-availability software. The software is engineered to improve performance, availability, and manageability of Real Application Cluster (RAC) environments. Certified by Oracle Corporation, Veritas Storage Foundation for Oracle RAC delivers a flexible solution that makes it easy to deploy and manage RAC.

The Veritas Replicator feature, which replicates data, can also be licensed with this product.

Before you start the installation, read the *Veritas Storage Foundation for Oracle RAC Release Notes*.

To install the product, follow the instructions in the *Veritas Storage Foundation for Oracle RAC Installation Guide*.

About Veritas Replicator Option

Veritas Replicator Option is an optional, separately-licensable feature.

Veritas Volume Replicator replicates data to remote locations over any standard IP network to provide continuous data availability.

This option is available with Storage Foundation for Oracle RAC, Storage Foundation Cluster File System, and Storage Foundation Standard and Enterprise products.

Before installing this option, read the Release Notes for the product.

To install the option, follow the instructions in the Installation Guide for the product.

About Veritas Cluster Server

Veritas Cluster Server (VCS) by Symantec is a clustering solution that provides the following benefits:

- Minimizes downtime.
- Facilitates the consolidation and the failover of servers.
- Effectively manages a wide range of applications in heterogeneous environments.

Before you install the product, read the *Veritas Cluster Server Release Notes*.

To install the product, follow the instructions in the *Veritas Cluster Server Installation Guide*.

About Veritas Cluster Server agents

Veritas agents provide high availability for specific resources and applications. Each agent manages resources of a particular type. Typically, agents start, stop, and monitor resources and report state changes.

Before you install VCS agents, review the configuration guide for the agent.

In addition to the agents that are provided in this release, other agents are available through an independent Symantec offering called the Veritas Cluster Server Agent Pack. The agent pack includes the currently shipping agents and is re-released quarterly to add the new agents that are now under development.

Contact your Symantec sales representative for the following details:

- Agents that are included in the agent pack
- Agents under development
- Agents available through Symantec Consulting Services

You can download the latest agents from the Symantec Operations Readiness Tools website:

sort.symantec.com/agents

Veritas Cluster Server (VCS) support for logical partitions (LPARs)

VCS can manage an LPAR as an application resource. The following terms apply in an LPAR environment where VCS is also used:

- Management LPAR (MLPAR): a regular LPAR with VCS installed that is specially configured to manage other LPARs within the same physical server.
- Managed LPAR: the regular LPARs that are managed as resources in VCS by a management LPAR.

About Veritas Dynamic Multi-Pathing

Veritas Dynamic Multi-Pathing (DMP) provides multi-pathing functionality for the operating system native devices configured on the system. The product creates DMP metadevices (also known as DMP nodes) to represent all the device paths to the same physical LUN.

In earlier releases, DMP was only available as a feature of Veritas Volume Manager (VxVM). DMP supported VxVM volumes on DMP metadevices, and Veritas File System (VxFS) file systems on those volumes.

Symantec now extends DMP metadevices to support OS native logical volume managers (LVM). You can create LVM volumes and volume groups on DMP metadevices.

Note: Veritas Dynamic Multi-Pathing is a standalone product. Support for dynamic multi-pathing is also included in Veritas Storage Foundation products.

Before you install this product, review the *Veritas Dynamic Multi-Pathing Release Notes*.

To install the product, follow the instructions in the *Veritas Dynamic Multi-Pathing Installation Guide*.

About Veritas Operations Manager

Veritas Operations Manager provides a centralized management console for Veritas Storage Foundation and High Availability products. You can use Veritas Operations Manager to monitor, visualize, and manage storage resources and generate reports.

Symantec recommends using Veritas Operations Manager (VOM) to manage Storage Foundation and Cluster Server environments.

You can download Veritas Operations Manager at no charge at http://go.symantec.com/vom.

Refer to the Veritas Operations Manager documentation for installation, upgrade, and configuration instructions.

The Veritas Enterprise Administrator (VEA) console is no longer packaged with Storage Foundation products. If you want to continue using VEA, a software version is available for download from http://go.symantec.com/vcsm_download. Veritas Storage Foundation Management Server is deprecated.

If you want to manage a single cluster using Cluster Manager (Java Console), a version is available for download from http://go.symantec.com/vcsm_download. You cannot manage the new features of this release using the Java Console. Veritas Cluster Server Management Console is deprecated.

About Symantec Product Authentication Service

Symantec Product Authentication Service is a common Symantec feature. This feature validates the identities that are based on existing network operating system domains (such as NIS and NT) or private domains. The authentication service protects communication channels among Symantec application clients and services through message integrity and confidentiality services.

About Symantec ApplicationHA

Symantec ApplicationHA provides monitoring capabilities for applications running inside virtual machines in the virtualization environment. Symantec ApplicationHA adds a layer of application awareness to the core high availability (HA) functionality offered by Veritas™ Cluster Server (VCS) in the physical host. Symantec ApplicationHA is based on VCS, and uses similar concepts such as agents, resources, and service groups. However, Symantec ApplicationHA has a lightweight server footprint that enables faster installation and configuration in virtualization environments.

Before you install the product, read the *Symantec ApplicationHA Release Notes*.

To install the product, follow the instructions in the *Symantec ApplicationHA Installation Guide*.

Supported configurations for Virtual I/O servers (VIOS) on AIX

Veritas Storage Foundation and High Availability Solutions (SFHA Solutions) products support various configurations in the VIOS-based virtual environment. Veritas Storage Foundation High Availability Solutions 6.0.1 is certified on AIX.

Storage Foundation and High Availability Solutions provide the following functionality for VIO:

- Storage visibility
- Storage management
- Replication support
- High availability
- Disaster recovery

The configurations profiled in the table below are the minimum required to achieve the storage and availability objectives listed. You can mix and match the use of SFHA Solutions products as needed to achieve the desired level of storage visibility, management, replication support, availability, and cluster failover for the Virtual I/O server (VIOS) and logical partitions (LPARS).

Table 1-1 Storage Foundation and High Availability Solutions features in a VIO environment

Objective	Recommended SFHA Solutions product configuration
Storage visibility for LPARs	Dynamic Multi-Pathing (DMP) in the LPAR
Storage visibility for the VIOS	DMP in the VIOS
Storage management features and replication support for LPARs	Storage Foundation (SF) in the LPARs
Advanced storage management features and replication support for VIOS	Storage Foundation Cluster File System High Availability (SFCFSHA) in the LPARs
End-to-end storage visibility in the VIOS and LPARs	DMP in the VIOS and LPARs
Storage management features and replication support in the LPARs and storage visibility in in the VIOS	DMP in the VIOS and SF in the LPARs
Application monitoring and availability for LPARs	Symantec ApplicationHA in the LPARs
Virtual machine monitoring and failover for managed LPARs	Veritas Cluster Server (VCS) in the management LPARs
Application failover for LPARs	VCS in the LPARs
Application availability and LPAR availability	Symantec Application HA in the LPARs and VCS in the management LPAR
Application failover across LPARs and physical hosts	VCS in a cluster across LPARs and AIX physical host machines

Each configuration has specific advantages and limitations.

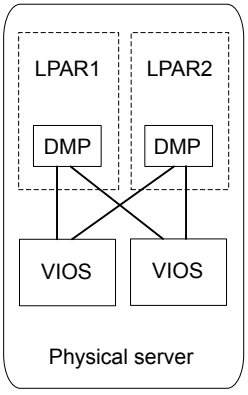
Veritas Dynamic Multi-Pathing in the logical partition (LPAR)

Veritas Dynamic Multi-Pathing (DMP) by Symantec can provide storage visibility in LPARs. DMP in the LPAR provides:

- Multi-pathing functionality for the operating system devices configured in the LPAR
- DMP metadevices (also known as DMP nodes) to represent all the device paths to the same physical LUN

- Support for enclosure-based naming
- Support for standard array types

Figure 1-1 Veritas Dynamic Multi-Pathing in the LPAR



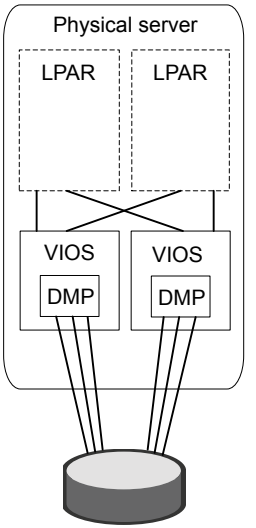
For more information on DMP features, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

Veritas Dynamic Multi-Pathing in the Virtual I/O server (VIOS)

Veritas Dynamic Multi-Pathing (DMP) by Symantec can provide storage visibility in the VIOS. Using DMP in the VIOS enables:

- Centralized multi-pathing functionality
- Enables active/passive array high performance failover
- Centralized storage path management
- Fast proactive failover
- Event notification

Figure 1-2 Veritas Dynamic Multi-Pathing in the VIOS



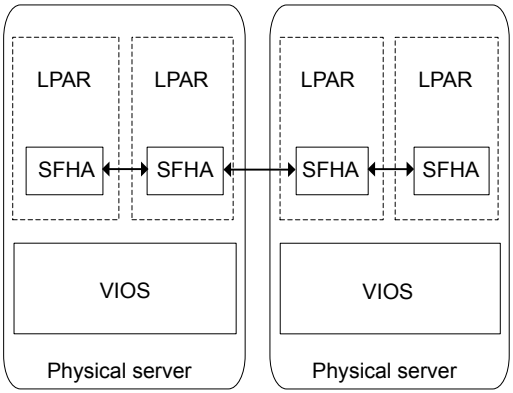
For more information on DMP features, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

Veritas Storage Foundation and High Availability in the logical partition (LPAR)

Veritas Storage Foundation (SF) by Symantec in the LPAR provides storage management functionality for the LPAR resources. Veritas Storage Foundation enables you to manage LPAR storage resources more easily by providing:

- Enhanced database performance
- Point-in-time copy features for data back-up, recovery, and processing
- Options for setting policies to optimize storage
- Methods for migrating data easily and reliably
- Replication support.

Figure 1-3 Veritas Storage Foundation and High Availability in the LPAR



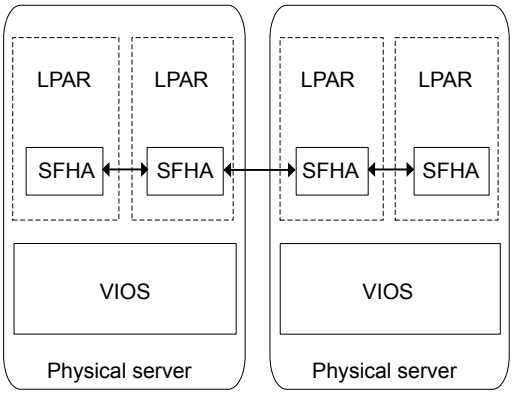
For more information on Veritas Storage Foundation features, see the *Veritas Storage™ Foundation Administrator's Guide*.

Veritas Storage Foundation Cluster File System High Availability in the logical partition (LPAR)

Veritas Storage Foundation Cluster File System High Availability (SFCFSHA) by Symantec provides advanced storage management functionality for the LPAR. SFCFSHA enables you to manage your LPAR storage resources more easily by providing:

- Enhanced database performance
- Point-in-time copy features for data back-up, recovery, and processing
- Options for setting policies to optimize storage
- Methods for migrating data easily and reliably
- Replication support
- High availability and disaster recovery for the LPARs

Figure 1-4 Veritas Storage Foundation Cluster File System High Availability in the LPAR



For more information on Storage Foundation features, see the *Veritas Storage Foundation™ Cluster File System High Availability Administrator's Guide*.

Veritas Dynamic Multi-Pathing in the Virtual I/O server (VIOS) and logical partition (LPAR)

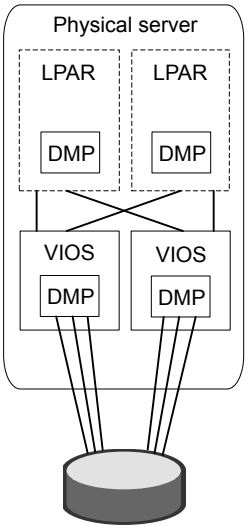
Veritas Dynamic Multi-Pathing (DMP) by Symantec can provide end-to-end storage visibility across both the VIOS and LPAR. Using DMP in the LPAR provides:

- Multi-pathing functionality for the operating system devices configured in the LPAR
- DMP metadevices (also known as DMP nodes) to represent all the device paths to the same physical LUN
- Support for enclosure-based naming
- Support for standard array types

Using DMP in the VIOS enables:

- Centralized multi-pathing functionality
- Enables active/passive array high performance failover
- Centralized storage path management
- Fast proactive failover
- Event notification

Figure 1-5 Veritas Dynamic Multi-Pathing in the LPAR and the VIOS



For more information on DMP features, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

Veritas Storage Foundation HA in the logical partition (LPAR) and Veritas Dynamic Multi-Pathing in the Virtual I/O server (VIOS)

Using Veritas Storage Foundation and High Availability (SFHA) by Symantec in the LPAR in combination with Dynamic Multi-Pathing (DMP) in the VIOS provides storage management functionality for LPAR resources and storage visibility in the VIOS. Using SFHA in the LPAR provides:

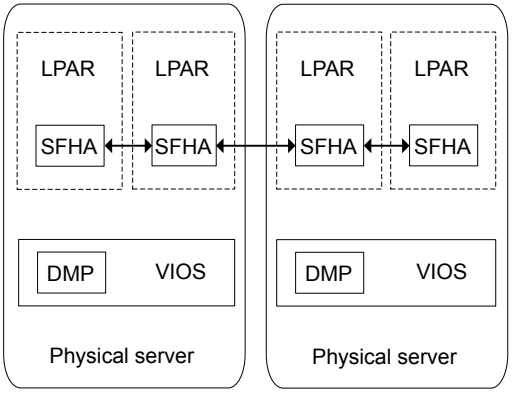
- Enhanced database performance
- Point-in-time copy features for data back-up, recovery, and processing
- Options for setting policies to optimize storage
- Methods for migrating data easily and reliably
- Replication support
- High availability and disaster recovery for the applications

Using DMP in the VIOS provides:

- Centralized multi-pathing functionality
- Active/passive array high performance failover

- Centralized storage path management
- Fast proactive failover
- Event notification

Figure 1-6 Veritas Storage Foundation HA in the LPAR and DMP in the VIOS



For more information on SFHA features, see the *Veritas Storage Foundation™ Cluster File System High Availability Administrator's Guide*.

For more information on DMP features, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

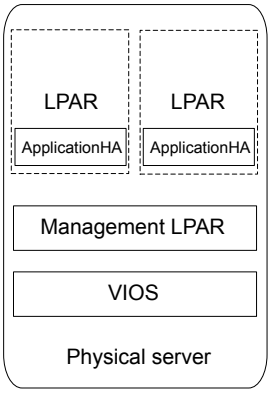
Symantec ApplicationHA in the logical partition (LPAR)

Symantec ApplicationHA enables configuration of LPAR resources for application failover. ApplicationHA provides the following for LPARs:

- Full visibility and control over applications with the ability to start, stop, and monitor applications running inside virtual machines
- High availability of the application as well as the virtual machine on which the application runs
- Graded application fault-management responses such as:
  - Application restart
  - ApplicationHA-initiated, internal or soft reboot of an LPAR
- VCS-initiated or hard reboot of virtual machine
- Standardized way to manage applications using a single interface that is integrated with the Veritas Operations Manager (VOM) dashboard

- Specialized Application Maintenance mode, in which ApplicationHA enables you to intentionally take an application out of its purview for maintenance or troubleshooting
- Easy configuration and setup
- Lighter footprint inside LPARs

Figure 1-7 Symantec ApplicationHA in the LPAR



For more information on Symantec ApplicationHA features, see the *Symantec™ ApplicationHA User's Guide*.

Veritas Cluster Server (VCS) in the management LPAR

Veritas Cluster Server (VCS) by Symantec provides virtual machine monitoring and failover for the management LPAR. VCS enables the following for managed LPARs:

- Connects multiple, independent systems into a management framework for increased availability
- Redundant Hardware Management Console (HMC) support.
- Multiple VIOS support
- Enables nodes to cooperate at the software level to form a cluster
- Enables other nodes to take predefined actions when a monitored application fails, for instance to take over and bring up applications elsewhere in the cluster.
- Virtual machine monitoring and failover for LPARs

Figure 1-8 VCS in the management LPAR

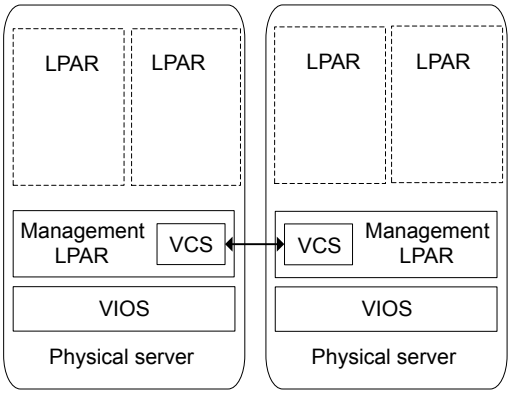
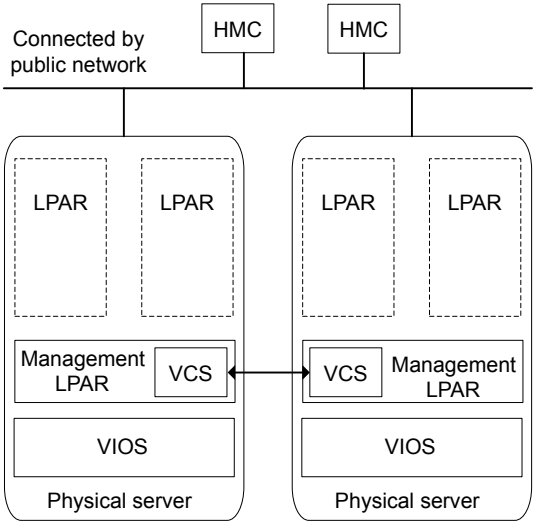
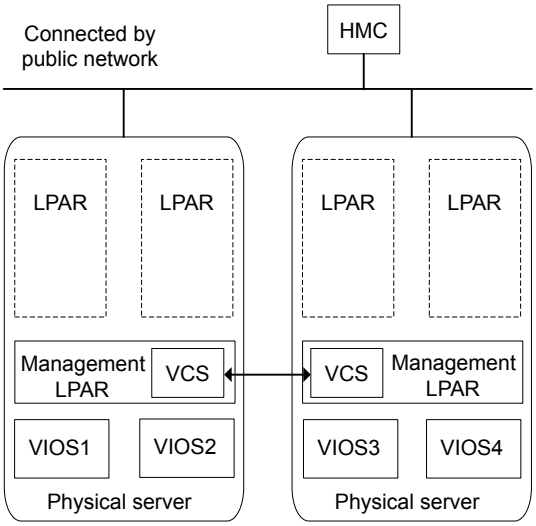


Figure 1-9 VCS in the management LPAR with redundant HMCs



The VCS LPAR agent now supports redundant HMC configurations. VCS can use any HMC which is up and running to manage and monitor the LPARs.

Figure 1-10 VCS in the management LPAR with multiple VIOS



Multiple VIOS support provides high availability to LPARs in case of VIO server(s) crash: LPAR agent now provides high availability against VIO server(s) crash for the managed LPARs. If all the VIO servers specified are down, managed LPARs are failed over to another host.

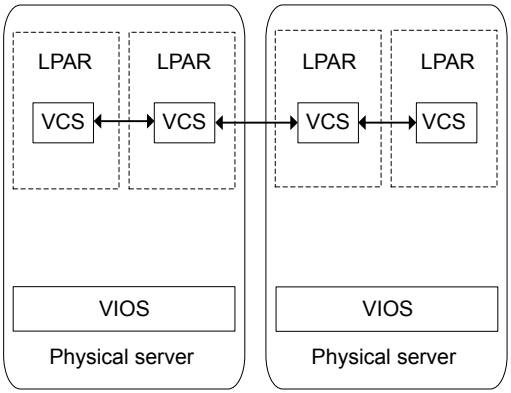
For more information on Veritas Cluster Server features, see the *Veritas Cluster Server Administrator's Guide*.

Veritas Cluster Server in the logical partition (LPAR)

Veritas Cluster Server (VCS) by Symantec enables configuration of LPAR resources for high availability. VCS provides the following functionality for LPARs:

- Connects multiple, independent systems into a management framework for increased availability
- Enables nodes to cooperate at the software level to form a cluster
- Enables other nodes to take predefined actions when a monitored application fails, for instance to take over and bring up applications elsewhere in the cluster

Figure 1-11 Veritas Cluster Server in the LPAR



For more information on Veritas Cluster Server features, see the *Veritas Cluster Server Administrator's Guide*.

Symantec ApplicationHA in the logical partition (LPAR) and Veritas Cluster Server in the management LPAR

Using Symantec Application HA in the LPAR in combination with Veritas Cluster Server (VCS) by Symantec in the management LPAR provides an end-to-end availability solution for LPARs and their resources.

ApplicationHA provides the following for LPARs:

- Full visibility and control over applications with the ability to start, stop, and monitor applications running inside virtual machines
- High availability of the application as well as the virtual machine on which the application runs
- Graded application fault-management responses such as:
  - Application restart
  - ApplicationHA-initiated, internal or soft reboot of an LPAR
- VCS-initiated or hard reboot of virtual machine or failover of the LPAR to another physical host.
- Standardized way to manage applications using a single interface that is integrated with the Veritas Operations Manager (VOM) dashboard
- Specialized Application Maintenance mode, in which ApplicationHA enables you to intentionally take an application out of its purview for maintenance or troubleshooting

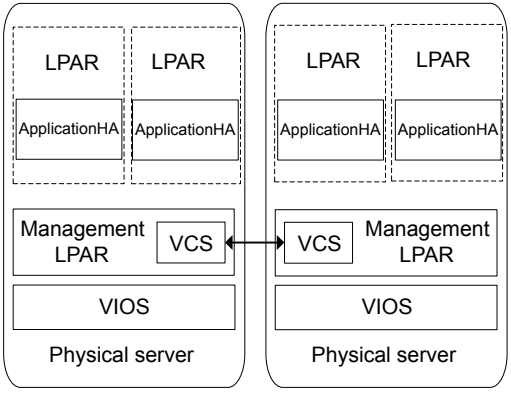
VCS provides the following for the management LPAR:

- Connects multiple, independent systems into a management framework for increased availability
- Redundant Hardware Management Console (HMC) support.
- Multiple VIOS support
- Enables nodes to cooperate at the software level to form a cluster
- Enables other nodes to take predefined actions when a monitored application fails, for instance to take over and bring up applications elsewhere in the cluster.
- Virtual machine monitoring and failover for LPARs

VCS in the management LPAR in combination with ApplicationHA running in the managed LPARs:

- Enables application availability
- Monitors the applications running inside the LPAR
- Restarts the application in case of application fault
- Can notify VCS running in the management LPAR to trigger a virtual machine failover

Figure 1-12 Symantec ApplicationHA in the LPAR and Veritas Cluster Server in the management LPAR



For more information on Symantec ApplicationHA features, see the *Symantec ApplicationHA User's Guide*.

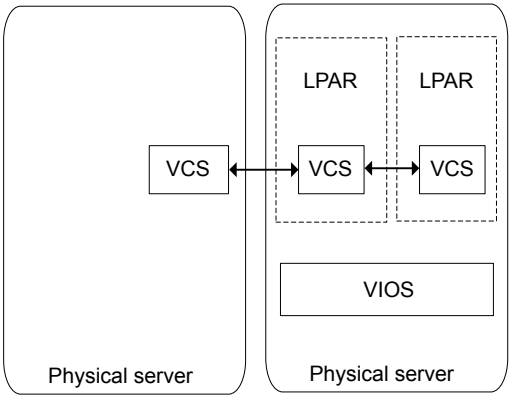
For more information on Veritas Cluster Server features, see the *Veritas Cluster Server Administrator's Guide*.

Veritas Cluster Server in a cluster across logical partitions (LPARs) and physical machines

Using Veritas Cluster Server (VCS) by Symantec in both guests and hosts enables an integrated solution for resource management across virtual machines (VMs) and physical hosts. You can create a physical to virtual cluster combining VCS in the LPAR together with VCS running in the managed LPAR on another physical host, enabling VCS to:

- Monitor applications running within the LPAR
- Fail the applications over to another physical host
- Failover an application running on a physical host to a LPAR

Figure 1-13 Veritas Cluster Server in a cluster across LPARs and physical machines



For more information on Storage Foundation features, see the *Veritas Cluster Server Administrator's Guide*.

Use cases that are addressed by Storage Foundation and High Availability Solutions in a PowerVM environment

Use cases where Storage Foundation and High Availability (SFHA) Solutions products can improve the VIOS environment:

Table 1-2 SFHA Solutions for Virtual I/O use cases

Virtualization use case	Symantec solution	Implementation details
Live Partition Mobility	SFHA or SCFSHA in the logical partition (LPAR)	How to migrate a logical partition from one physical system to another See "About Live Partition Mobility (LPM) " on page 113.
Physical to virtual migration	SFHA or SCFSHA in the LPAR	How to set migrate data from physical to virtual clients with NPIV See "About migration from Physical to VIO environment" on page 141.
Boot device management	DMP in the VIOS	How to use DMP on the rootvg to simplify system administration and system reliability See "Using DMP to provide multi-pathing for the root volume group (rootvg)" on page 143.

Section 2

Implementing a VIOS environment

Chapter 2

Getting started

This chapter includes the following topics:

About setting up logical partitions (LPARs) with Veritas Storage Foundation and High Availability Solutions products

Before setting up your virtual environment, verify that your planned configuration will meet the system requirements, licensing and other considerations for installation with Veritas Storage Foundation and High Availability (SFHA) Solutions products.

- Licensing: Veritas Storage Foundation or Veritas Storage Foundation Cluster File System in an LPAR may be licensed either by licensing the entire server (for an unlimited number of LPARs) or licensing the maximum number of processors cores assigned to that LPAR.
- IBM Power virtualization requirements: see IBM documentation.

- Symantec product requirements: see Table 2-2
- *Release Notes*: each Veritas product contains last minute news and important details for each product, including updates to system requirements and supported software. Review the Release Notes for the latest information before you start installing the product.
  The product documentation is available on the Web at the following location: https://sort.symantec.com/documents

Table 2-1 IBM Power Virtualization system requirements

Supported architecture	Power PC
Minimum system requirements	No specific requirements. See the Release Notes for your product.
Recommended system requirements	■ 6GB plus the required disk space recommended by the guest operating system per guest. For most operating systems more than 6GB of disk space is recommended ■ One processor core or hyper-thread for each virtualized CPU and one for the host ■ 2GB of RAM plus additional RAM for LPARs
IBM documentation for more information	

Table 2-2 Symantec product requirements

Hardware	Full virtualization-enabled CPU http://www.symantec.com/docs/TECH170013
Software	■ Veritas Dynamic Multi-pathing 6.0.1 Used for storage visibility on logical partitions (LPARs) and VIOS ■ Veritas Storage Foundation 6.0.1 Used for storage management on LPARs and VIOS ■ Veritas Storage Foundation HA 6.0.1 Storage Foundation and High Availability 6.0.1 Used for storage management and clustering on LPARs and VIOS ■ Veritas Cluster Server 6.0.1 Used for applications and managed LPARs monitoring and failover ■ Symantec ApplicationHA 6.0 Used for application monitoring and availability inside the managed LPARs

Table 2-2 Symantec product requirements *(continued)*

Supported OS version in LPAR	AIX 6.1, 7.1
Supported OS management LPAR	AIX 6.1, 7.1
Storage	■ Shared storage for holding the LPAR image. (virtual machine failover) ■ Shared storage for holding the application data. (application failover)
Networking	■ Configure the LPAR for communication over the public network ■ Setup virtual interfaces for private communication.
Documentation: see the product release notes to for the most current system requirements, limitations, and known issues:	■ *Veritas Dynamic Multi-Pathing Release Notes* ■ *Veritas Storage Foundation Release Notes* ■ *Veritas Storage Foundation HA Release Notes* ■ *Veritas Storage Foundation for Cluster Server HA Release Notes* ■ *Veritas Cluster Server HA Release Notes* ■ *Symantec ApplicationHA Release Notes* ■ Symantec Operations Readiness Tools: https://sort.symantec.com/documents ■ Storage Foundation DocCentral Site: http://sfdoccentral.symantec.com/

See "Additional documentation" on page 57.

Installing and configuring Storage Foundation and High Availability (SFHA) Solutions in the logical partition (LPAR)

To set up an LPAR environment with SFHA solutions after installing AIX:

- Install the Storage Foundation and High Availability (SFHA) Solutions product on the required LPARs.
- Configure the SFHA Solutions product on the required LPARs.
- For SFHA Solutions product installation information:
  - *Veritas Dynamic Multi-Pathing Installation Guide*
  - *Veritas Storage Foundation Installation Guide*

- *Veritas Storage Foundation High Availability Installation Guide*
- *Veritas Storage Foundation for Cluster Server High Availability Installation Guide*
- See "Additional documentation" on page 57.

The steps above apply for the following configurations:

Figure 2-1 Dynamic Multi-pathing in the LPAR

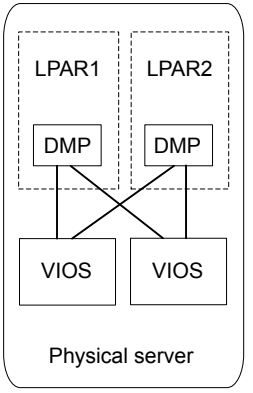


Figure 2-2 Storage Foundation in the LPAR

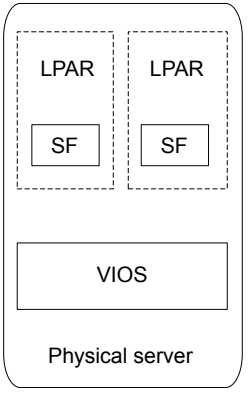


Figure 2-3 Storage Foundation High Availability in the LPAR

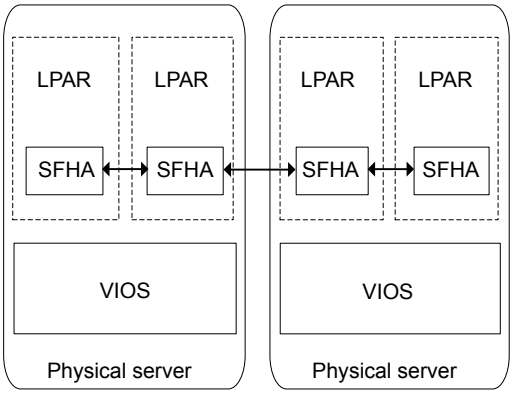
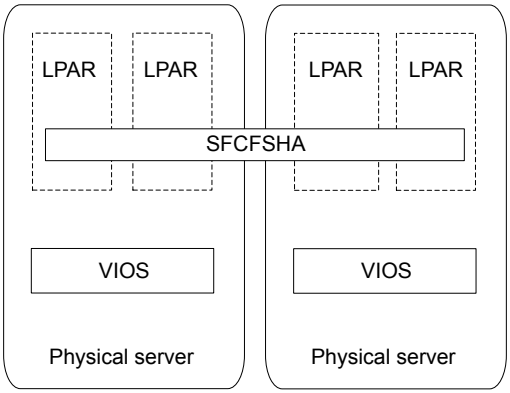


Figure 2-4 Storage Foundation for Cluster File System in the LPAR



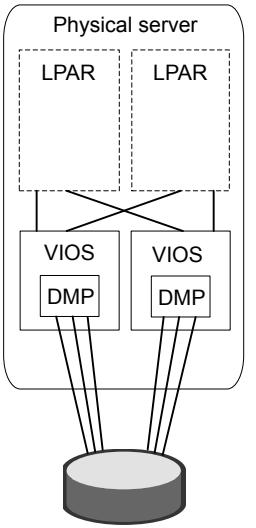
Installing and configuring storage solutions in the Virtual I/O server (VIOS)

To set up a VIOS with DMP after installing VIOS:

- Install Dynamic Multi-Pathing (DMP) on the required VIOS.
- Configure the DMP on the required VIOS.
- For DMP installation information:
  - *Veritas Dynamic Multi-Pathing Installation Guide*
  - See "Additional documentation" on page 57.

The steps above apply for the following configuration:

Figure 2-5 Dynamic Multi-pathing in the VIOS



Installing and configuring Veritas Cluster Server for logical partition and application availability

To set up a logical partition (LPAR) environment with Veritas Cluster Server (VCS):

- Install VCS.
- Configure VCS.
- No additional VCS configuration is required to make it work inside the LPAR with or without VIOS.
- For installation information:
  Veritas Cluster Server Installation Guide
  See "Additional documentation" on page 57.

The steps above apply for the following configurations:

- VCS in the LPAR
- VCS in the management LPAR

  Note: You must use VCS 6.0.1 or later in the management LPAR

- VCS in the management LPAR with redundant HMCs

- VCS in the management LPAR with multiple VIOS
- VCS in the management LPAR and ApplicationHA in the LPAR
- VCS in a cluster across LPARs

Figure 2-6 VCS in the LPAR

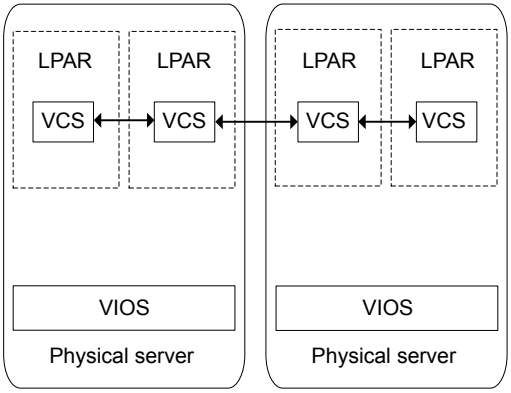


Figure 2-7 VCS in the management LPAR

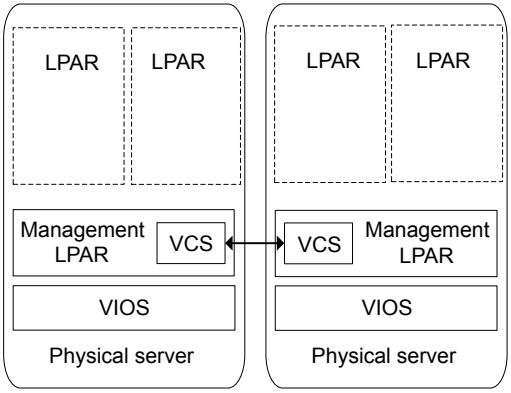


Figure 2-8 VCS in the management LPAR with redundant HMCs

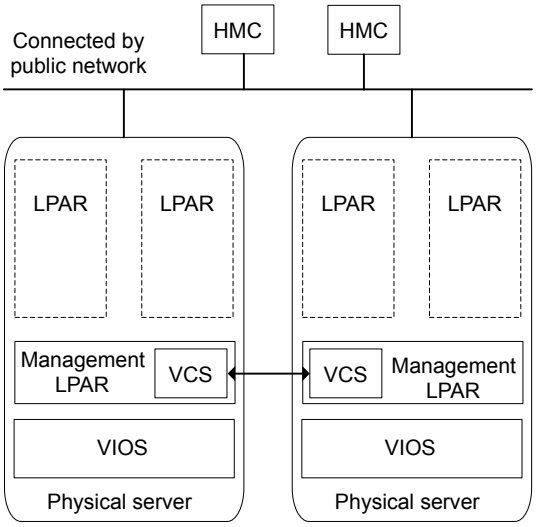


Figure 2-9 VCS in the management LPAR with multiple VIOS

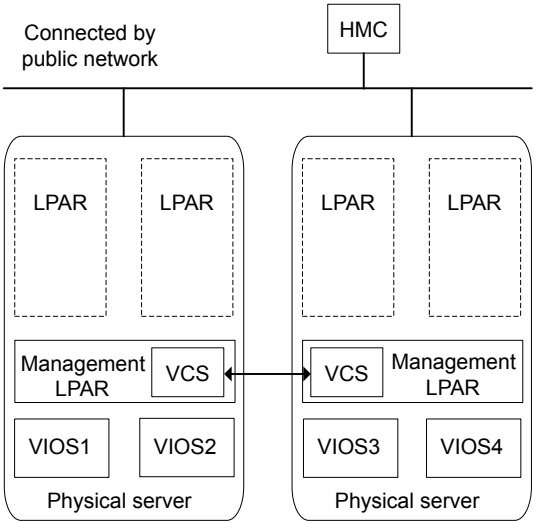


Figure 2-10 VCS in the management LPAR and ApplicationHA in the LPAR

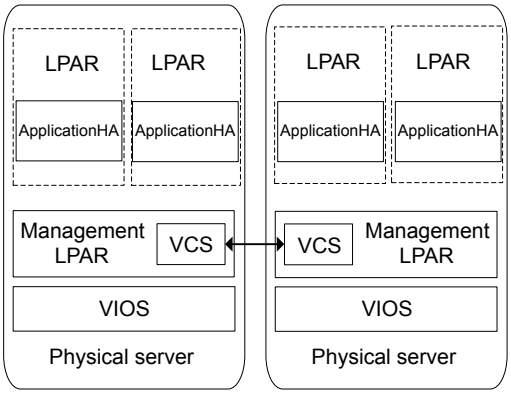
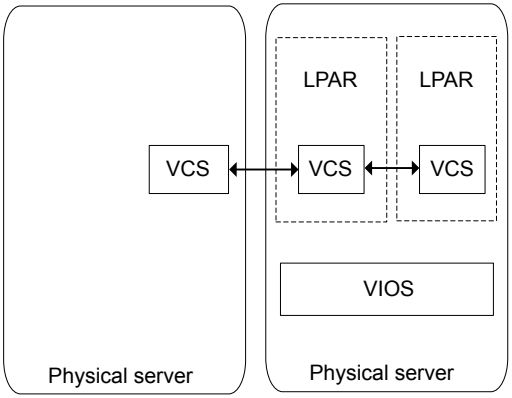


Figure 2-11 VCS in a cluster across LPARs



How Veritas Cluster Server (VCS) manages logical partitions (LPARs)

High-level overview of how VCS manages LPARs.

- Management LPARs form a cluster.
  For information about installing VCS, see the *Veritas Cluster Server Installation Guide*.
- CPU and memory resources are made available to create LPARs on all nodes in the cluster.
- VCS is installed on all the management LPARs to manage the LPARs.
- The operating system is installed on the LPAR on any one host.
- The LPAR is configured as an LPAR resource in VCS.

For detailed instructions on creating and configuring a PowerVM guest, see the IBM documentation.

To configure an LPAR for across physical servers, the following conditions apply:

- You must configure a VM guest on one node with the operating system installed on a shared storage accessible to all the VCS cluster nodes.
- Ensure that the image file resides on the shared storage so that the virtual machines can fail over across cluster nodes.
- You can configure the first LPAR using the standard installation procedure. See "Setting up management LPAR" on page 50.

Bundled agents are included with VCS for managing many applications. The LPAR agent is included and can be used to manage and provide high availability for LPARs. For information on LPAR agent attributes, resource dependency and agent function, refer to the *Veritas Cluster Server Bundled Agents Reference Guide*.

VCS requirements for managing LPARs as virtual machines

To use VCS to manage LPARs as virtual machines, the following requirements must be met.

Table 2-3 System requirements for the LPAR-supported configurations

VCS version	6.0 and later
Supported OS version in LPARs	AIX 6.1 TL 5 and above. AIX 7.1 and above.
Supported VIOS version	2.1.3.10-FP-23 and above
Supported HMC version	7.2.0.0 **Note:** All the physical servers that are part of a cluster should be managed by the same HMC.
Supported hardware	Power 5, 6, and 7

Setting up management LPAR

Following is a high-level overview of the steps required for setting up the management LPARs.

Setting up management LPAR

1. Install VCS on all nodes of the management LPARs cluster. For information about installing VCS, refer to the Veritas Cluster Server Installation Guide.
2. Make sure that the HMC is at the supported level.
3. Make sure that the VIOS are at the supported level.
4. Configure password-less SSH communication from the management LPAR to the HMC. This step is required for all nodes of the cluster even if a node has no LPAR resource.

   See " Configuring password-less SSH communication between VCS nodes and HMC" on page 51.
5. The managed LPARs are managed via HMC. Ensure that the network connection between the physical servers and the HMC has redundancy.
6. Set auto restart of management LPAR to "on".
7. Ensure that PhysicalServer system level attribute has the physical server name.

   Use the following command to retrieve the physical server name.

   ```
   # lssyscfg -r sys -F name
   ```
8. Set up the managed LPARs.

   See "Setting up managed LPARs" on page 52.
9. Configure the LPARs that need to be managed and monitored as VCS LPAR resources.

   See "Bundled agents for managing the LPAR" on page 54.

   See the *Veritas Cluster Server Bundled Agents Reference Guide*.
10. Set the Service Group level attribute SysDownPolicy = {"AutoDisableNoOffline"} for groups that have LPAR resources.

    See "Managing logical partition (LPAR) failure scenarios" on page 64.

    For more information on the Service Group level attribute SysDownPolicy, see the *Veritas Cluster Server User's Guide*.

Configuring password-less SSH communication between VCS nodes and HMC

To use remote command operations on the HMC, you must have SSH installed on the LPARs in the VCS cluster. You must configure the HMC to allow password-less

SSH access from these LPARs. Refer to the appropriate IBM AIX documentation for information.

To verify that you have password-less SSH

- From each LPAR in the cluster, execute the following command to test if the password-less access works:

```
> ssh -l hscroot hmc2.veritas.com
   Last login:Thur Jun 16 22:46:51 2011 from 10.182.9.34
hscroot@hmc2:~>
```

Setting up managed LPARs

The following procedure provides a high-level overview of how to set up LPARs that VCS manages.

For detailed instructions on creating and configuring a LPAR, refer to the IBM PowerVM Guide.

To set up managed LPARs

1. Ensure CPU and memory resources are available to create managed LPARs on all physical servers in the cluster, where the managed LPAR can start.
2. Install VCS on all the management LPARs, to manage the LPAR.

   For information about installing VCS, see the *Veritas Cluster Server Installation Guide*.
3. Create the LPAR profile on all the physical servers whose management LPAR is in the SystemList for the LPAR resource.

   See "Creating an LPAR profile " on page 52.
4. Set auto restart of the managed LPAR to "off" via HMC when VCS is managing the LPAR.
5. The boot disk should be shared and should be accessible from all the physical servers where the LPAR can fail over.
6. Verify if the LPAR can fail over to the other physical servers.
7. Configure the LPAR as a resource in VCS.

   See "Configuring VCS service groups to manage the LPAR" on page 55.

Creating an LPAR profile

The following steps describe how to create LPAR profile:

To create an LPAR profile

1 Identify the disk on which the AIX OS is to be installed for the LPAR. This disk should be on shared storage in order for LPAR to be capable of failover across physical servers. Change the following attributes of the disk on all VIOS of the physical servers that the LPAR will be configured to boot on.

```
vio1#chdev -a hcheck_cmd=inquiry -l hdisk7
vio1#chdev -a hcheck_interval=60 -l hdisk7 -P
vio1#chdev -a pv=yes -l hdisk7
vio1#chdev -a reserve_policy=no_reserve
```

2 Create the Virtual SCSI Host adapter on all VIOS on which the LPAR will be configured to boot on. Reboot the VIO, and then map the OS disk to this host adapter.

3 Log in to HMC and create the LPAR profile. The following example shows creating an LPAR profile.

```
hscadmin1@hmc2.veritas.com:~> lssyscfg -r sys -F name
 PServer1-SN100129A
 PServer2-SN100130A

hscadmin1@hmc2.veritas.com:~> lssyscfg -m PServer1-SN100129A -r lpar \
 -F name
Pserver1_VIO1

hscadmin1@hmc2.veritas.com:~> mksyscfg -m PServer1-SN100129A -r lpar \
-i name=lpar_test,lpar_env=aixlinux,profile_name=lpar_test,min_mem=512,\
desired_mem=512,max_mem=512,proc_mode=shared,sharing_mode=uncap,\
uncap_weight=128,min_proc_units=0.1,desired_proc_units=0.4,\
max_proc_units=2.0,min_procs=1,desired_procs=2,max_procs=4,\
lpar_io_pool_ids=none,max_virtual_slots=10,auto_start=1,\
boot_mode=norm,power_ctrl_lpar_ids=none,conn_monitoring=0,\
virtual_eth_adapters=2/1/1//0/1,virtual_scsi_adapters=3/client/1//10/1"

hscadmin1@hmc2.veritas.com:~> lssyscfg -m PServer1-SN100129A \
-r lpar -F name
 Pserver1_VIO1
 lpar_test
```

The virtual Ethernet adapter's VLAN ID should match that of VIO server in order for connectivity to outside network, the virtual scsi adapter's remote-lpar-ID/remote-lpar-name/remote-slot-number should match with that of VIO's partition ID, VIO's name and VIO's virtual SCSI Host adapter ID that has the OS disk mapped for this LPAR. Note: The VIO's virtual SCSI Host adapter that is assigned for this LPAR should have any partition and any slot option if this LPAR is capable and might be used for LPM in future (in addition to VCS failover capability).

4 Create the same profile on all physical servers where the LPAR can fail over.

5 Verify that the LPAR can boot on the physical servers where the profile has been created.

Bundled agents for managing the LPAR

The LPAR agent can be used to manage and provide high availability for LPARs.

The LPAR agent performs the following functions using HMC CLIs:

- Open: Blocks migration of the management LPAR. Get the information required by the LPAR agent.
- Monitor: Monitors the status of LPAR.
- Online: Starts the LPAR.
- Offline: Shuts down the LPAR.
- Clean: Stops the LPAR forcefully.
- Shutdown: Unblock migration of the management LPAR.

Configuring VCS service groups to manage the LPAR

You must configure a VCS service group to manage the LPAR.

To configure LPAR service groups

1. Create a failover service group for LPAR.
2. Set the PhysicalServer attribute of all the systems (which are management LPARs) using the name of the physical server (managed system name).
3. Set SysDownPolicy = { "AutoDisableNoOffline" } for this group.
4. Configure all the cluster nodes (management LPARs) in the SystemList attribute where the managed LPAR can fail over.
5. Configure LPAR resource for the managed LPAR.

The sample main.cf for a VCS failover cluster for managed LPARs:

```
include "types.cf"

cluster cluster01 (
        )

system aixnode55mp1 (
        PhysicalServer = aixnode55
        )

system aixnode56mp1 (
        PhysicalServer = aixnode56
        )



group LPAR_aixnode5556mp2 (
        SystemList = { aixnode55mp1 = 0, aixnode56mp1 = 1 }
```

```
SysDownPolicy = { AutoDisableNoOffline }
)

LPAR aixnode5556mp2 (
        LPARName = aixnode5556mp2
        MCUser = { hscroot, hscroot }
        MCName = { hmc6, hmc7 }
        VIOSName @aixnode55mp1 = { aixnode55vio1, aixnode55vio2 }
        VIOSName @aixnode56mp1 = { aixnode56vio1, aixnode56vio2 }
        RestartLimit = 1
        )
```

Installing and configuring ApplicationHA for application availability

To set up a logical partition (LPAR) environment with Symantec ApplicationHA:

- Install ApplicationHA.
- Configure ApplicationHA.
- For installation information:
  Symantec ApplicationHA Installation Guide
  See "Additional documentation" on page 57.

The steps above apply for the following LPAR configurations:

- ApplicationHA in the managed LPAR
- VCS in the management LPAR and ApplicationHA in the managed LPAR

Figure 2-12 ApplicationHA in the LPAR

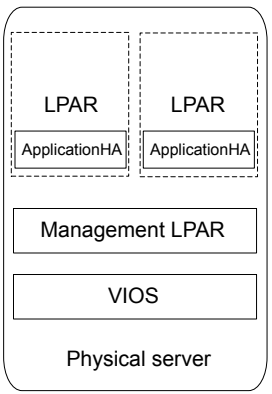
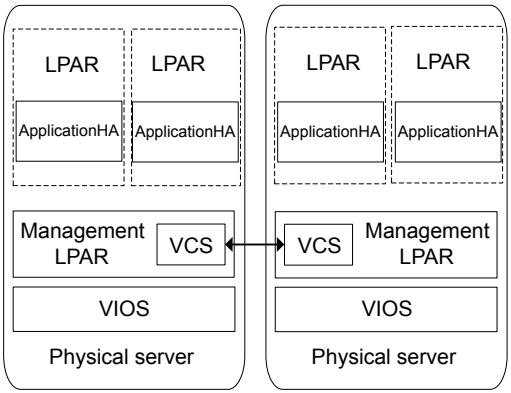


Figure 2-13 VCS in the management LPAR and ApplicationHA in the managed LPAR



Additional documentation

For IBM documentation:

See http://www-03.ibm.com/systems/power/software/virtualization

For Symantec product installation and configuration information:

- *Veritas Dynamic Multi-Pathing Installation Guide*
- *Veritas Storage Foundation Installation Guide*
- *Veritas Storage Foundation High Availability Installation Guide*
- *Veritas Storage Foundation for Cluster Server High Availability Installation Guide*
- *Veritas Cluster Server High Availability Installation Guide*
- *Veritas Cluster Server Bundled Agents Reference Guide*
- *Symantec ApplicationHA Installation Guide*

To locate Symantec product guides:

- Symantec Operations Readiness Tools:
  https://sort.symantec.com/documents
- Storage Foundation DocCentral Site:
  http://sfdoccentral.symantec.com/

Chapter 3

Veritas Cluster Server support for managing and monitoring logical partitions (LPARs)

This chapter includes the following topics:

VCS support for IBM PowerVM

IBM PowerVM is virtualization solution for AIX environments on IBM POWER technology. In the IBM PowerVM environment, multiple logical partitions (LPARs) can be carved in a physical server. The physical system is also called the managed system. The LPARs can be assigned physical or virtual resources. The Virtual I/O Server is a dedicated partition and is a software appliance with which you can associate physical resources and that allows you to share these resources among multiple client logical partitions. The Virtual I/O Server can use both virtualized storage and network adapters. The managed system, LPARs and the resources are managed using the Hardware Management Console (HMC) appliance sitting outside the physical frame.

You can use Veritas Cluster Server (VCS) by Symantec in a IBM PowerVM virtualization environment to provide mission-critical clustering and failover capabilities.

The following configurations are supported:

- LPAR to LPAR clustering and failover for application availability.
  VCS runs in the LPARs forming a cluster, and provides high availability of the applications running in the LPAR.
- LPAR to LPAR Clustering and Fail-over for LPAR (virtual machine) availability.
  VCS runs in one LPAR on each physical server, known as the management LPAR. The management LPAR behaves as a control point, and provides high-availability to the other LPARs running on the same physical server. The management LPAR views the LPARs that it manages as virtual machines but does not have visibility into the applications on the managed LPARs.
  You can create a cluster of the management LPARs on more than one physical server to provide failover of the managed LPARs on the different physical servers.
  See "VCS in the management LPAR" on page 60.
- VCS in the managed LPAR
  VCS can also run inside the individual managed LPARs to provide high-availability for applications running inside the LPAR.
  See "ApplicationHA in the managed LPAR" on page 61.

VCS in the management LPAR

VCS provides high availability for the AIX LPARs within a physical server. VCS is run in the control point which is an LPAR that is designated for management of other LPARs. The management LPARs on different physical servers form a VCS cluster.

VCS runs in one management LPAR on each physical server. The management LPAR provides high availability to the other LPARs on the same physical server, known as managed LPARs. Each managed LPAR is simply a resource that is managed and monitored by VCS running on the management LPAR, with the help of LPAR agent. This capability allows VCS to monitor the individual LPAR as an individual resource. VCS can restart the service group that has the LPAR resource on the same physical server or fail-over to another physical server.

The management LPAR views the LPARs that it manages as virtual machines but does not have visibility into the applications on the managed LPARs. The management LPAR cluster does not monitor resources inside the managed LPARs.

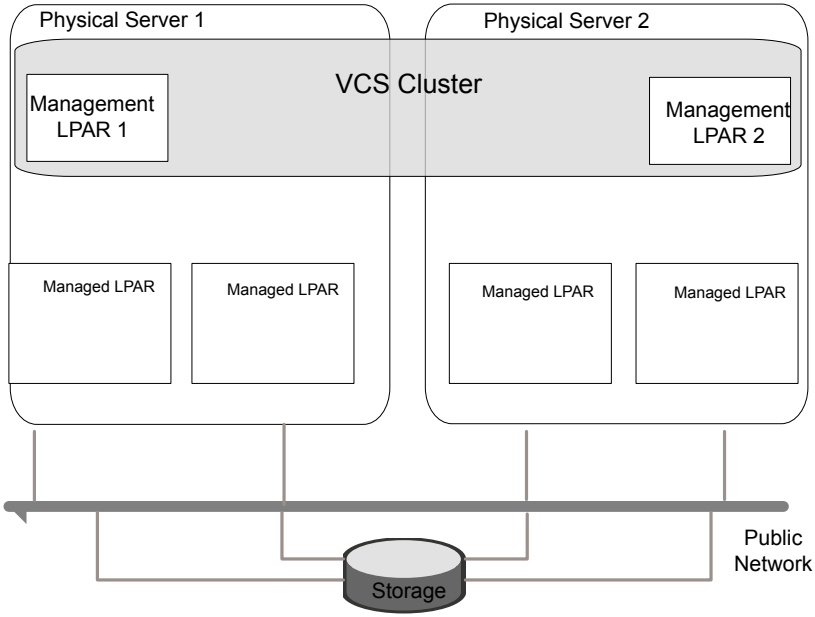
A VCS cluster is formed among the management LPARs in this configuration. The VCS cluster provides failover for the managed LPARs between the management LPARs.

- Each physical server where you want VCS to manage LPARs should have one management server.

- VCS supports only one management LPAR per physical server.
- Each managed LPAR resource can have only one VCS system on one physical server in the system list.
- For a VCS configuration example:
  See "Configuring VCS service groups to manage the LPAR" on page 55.

Figure 3-1 provides an example of VCS in the management LPAR.

Figure 3-1 VCS in the management LPAR



This configuration also provides high availability for applications running on the management LPAR. The VCS cluster manages and controls the applications and services that run inside the management LPARs. Any faulted application or service is failed over to other management LPARs in the cluster.

Note: The managed LPARs cannot be in a cluster configuration.

ApplicationHA in the managed LPAR

ApplicationHA can run within each managed LPAR to provide application monitoring and fault handling of applications running within the LPAR. ApplicationHA manages and controls the applications and services that run inside

the LPARs. This configuration provides restart of the application within the LPAR, but not failover between managed LPARs or physical servers.

In this configuration, the LPARs do not form a cluster. ApplicationHA runs as single-node ApplicationHA.

Figure 3-2 provides an example of ApplicationHA in the managed LPAR.

Figure 3-2 ApplicationHA in the managed LPAR

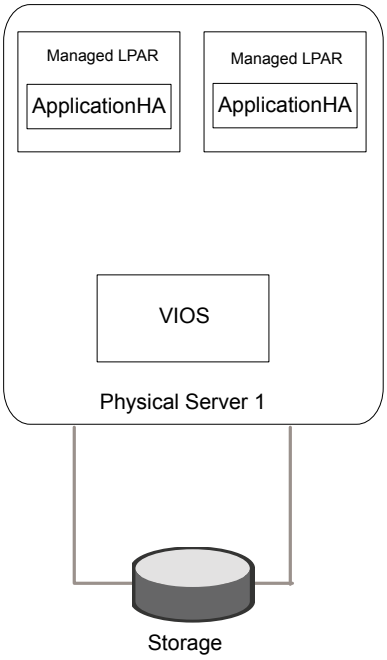
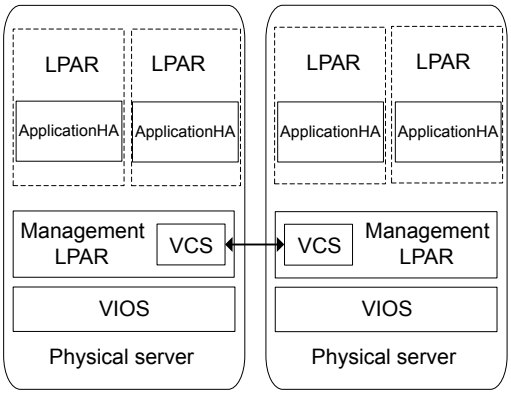


Figure 3-3 provides an example of ApplicationHA in the managed LPAR and VCS in the management LPAR. ApplicationHA running in each managed LPAR provides high availability to applications running within the managed LPAR. VCS running in the management LPARs provide high availability to managed LPARs. The ApplicationHA instances work independently.

Figure 3-3 ApplicationHA in the managed LPARs and VCS in the management LPARs



Limitations and unsupported LPAR features

The following limitations apply to VCS support for LPARs:

- Live partition mobility of management LPARs is not supported.
  If LPARs are managed by VCS running in the management LPAR, then the live partition mobility of the management LPAR is blocked by VCS.
  If you need to migrate the management LPAR, follow the recommended steps.
  See " Live partition mobility of management LPARs" on page 63.
- If the LPAR agent crashes, the migration of the management LPAR will remain blocked even if it is not managing any LPARs. To unblock, you can perform the following:

  ```
  # /usr/sbin/drmgr -u vcs_blockmigrate.sh
  ```

Live partition mobility of management LPARs

Live partition mobility is not supported if VCS is running in the management LPAR on a physical system.

If LPARs are managed by VCS running in the management LPAR, then the live partition mobility of the management LPAR is blocked by VCS. If you need to migrate the management LPAR, use the following procedure.

To migrate the management LPAR

1. Migrate or fail over the managed LPARs to another physical server before migrating the management LPAR.
2. Stop the LPAR agent.

3 Migrate the management LPAR.

4 When management LPAR is back on the source physical server (which matches with the value of PhysicalServer in the VCS system), start the LPAR agent.

See the *Veritas Cluster Server Bundled Agents Reference Guide* for more information on the LPAR agent.

Live partition mobility of managed LPARs

When LPAR is managed by VCS, set the virtual SCSI adapter with any partition and any slot on the VIO. Map the virtual SCSI adapter to the correct SCSI adapter on the managed LPAR. This step needs to be part of the initial configuration on all physical hosts. Otherwise, reboot the VIO so that the configuration takes effect before you perform the migration.

To migrate the managed LPAR

1 From the source managed system, back up the LPAR profile. After migration completes, the LPAR and its profiles are automatically deleted from the source.

For VCS to manage the LPAR, the profile is required on the managed physical system of the management VCS that is part of the system list of the LPAR resource.

2 On the destination system, rename the LPAR profile that was created during initial configuration of LPAR as a resource on all systems. LPM validation fails if it finds the profile with same LPAR name on the destination managed physical system

3 Migrate the managed LPAR.

4 Perform one of the following:

- If migration succeeds, the profile on source is removed. Restore and rename the LPAR profile from the backup that was taken in step 1. Remove the renamed LPAR profile on the destination.
- If migration fails, remove the backup profile on the source. On the destination, rename the renamed LPAR profile to original LPAR profile.

Managing logical partition (LPAR) failure scenarios

VCS handles the LPAR failures in the following cases.

Table 3-1 Failure scenarios and their resolutions

Failure scenario	Resolution
Physical server is down	When the physical server is down, the management LPAR as well as managed LPARs will be down. In this case, the managed LPARs which are running will be failed over to another system by VCS using the sysoffline trigger with the help of HMC. Ensure that HMC access is setup on all nodes of the cluster even if the node is not managing any LPAR.
Management LPAR is down but physical server is up	When the management LPAR is down, the physical server may not be down. The managed LPARs might be running. In this case, it is not desirable to automatically failover the managed LPARs. To ensure that the managed LPAR is not automatically failed over, the group that has LPAR resource should have SysDownPolicy = { "AutoDisableNoOffline" }. With this the groups will remain autodisabled on system fault. You can online the LPAR on any other system by setting autoenable for the group, after ensuring that the LPAR is down on the faulted system.
VIO servers are down	When all the VIO servers which are providing virtual resources to the managed LPARs are down, then the managed LPARs are failed over to another host. Ensure that VIOSName attribute of the LPAR resources is populated with list of all VIO servers which are servicing that LPAR. If VIOSName is not populated, managed LPARs will not be failed over in case of VIO server(s) crash. If any one of the VIO servers specified in VIOSName attribute is running, LPAR agent won't failover the managed LPARs.
HMC is down	If the environment has redundant HMC, then even if one of the HMC goes down, LPAR agent can still manage the LPARs without any issues. For this, ensure that MCName and MCUser attributes are populated with both HMC details.

Chapter 4

Veritas Cluster Server Solutions for IBM LPARs with Virtual Ethernet

This chapter includes the following topics:

About IBM Virtual Ethernet

Virtual Ethernet enables communication between inter-partitions on the same server, without requiring each partition to have a physical network adapter. You can define in-memory connections between partitions that are handled at the system level (for example, interaction between POWER Hypervisor and the operating systems). These connections exhibit characteristics similar to physical high-bandwidth Ethernet connections and support the industry standard protocols (such as IPv4, IPv6, ICMP, or ARP). Virtual Ethernet also enables multiple partitions to share physical adapters for access to external networks using Shared Ethernet Adapter (SEA).

Shared Ethernet Adapter (SEA)

A Shared Ethernet Adapter is a layer-2 network bridge to securely transport network traffic between virtual Ethernet networks and physical network adapters. The SEA also enables several client partitions to share one physical adapter. The SEA is hosted in the Virtual I/O Server.

To bridge network traffic between the internal virtual network and external networks, configure the Virtual I/O Server with at least one physical Ethernet adapter. Multiple virtual Ethernet adapters can share one SEA. Each virtual Ethernet adapter can support multiple VLANs.

The SEA has the following characteristics:

- Virtual Ethernet MAC addresses of virtual Ethernet adapters are visible to outside systems (using the `arp -a` command).
- Supports unicast, broadcast, and multicast. Protocols such as Address Resolution Protocol (ARP), Dynamic Host Configuration Protocol (DHCP), Boot Protocol (BOOTP), and Neighbor Discovery Protocol (NDP) can work across an SEA.

VCS configuration in the Virtual Ethernet environment

To use VCS in the Virtual Ethernet environment, configure VCS according to the following sections:

- Configure the LLT private links.
  See "LLT Private links configuration " on page 68.
- Configure the VCS Agents.
  See "VCS Agents" on page 71.

LLT Private links configuration

LLT heartbeats

LLT uses standard Ethernet networks to provide communication for its heartbeats. These networks can be provided through physical ports or virtual Ethernet interfaces. These interfaces do not require IP addresses to be configured since LLT heartbeats are based on layer 2 protocols. The best practice includes two independent paths for heartbeats to eliminate any single point of failure. This scenario includes redundant VIO servers with each providing a virtual Ethernet to each client LPAR participating in the VCS cluster.

LLT Private Links connections

The diagrams illustrate LLT Heartbeat connections in an IBM VIO environment with Virtual Ethernet, Shared Ethernet Adapters, and LPARs. The three node cluster consists of two VIO Client Partitions in System A and one LPAR in System B. POWER6 based systems that are controlled by the same Hardware Management Console (HMC).

Figure 4-1 shows an example of an environment with a single Virtual I/O Server

Figure 4-1 A VCS environment with a single Virtual I/O Server

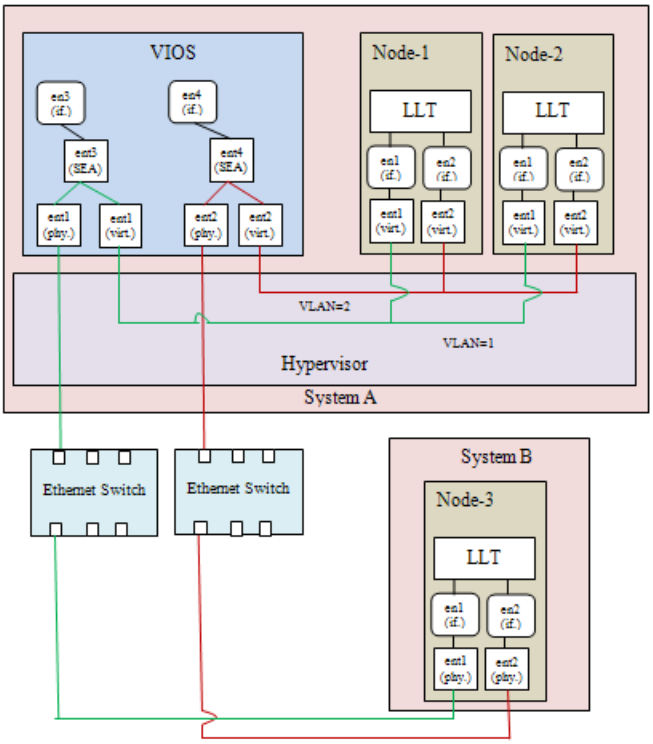
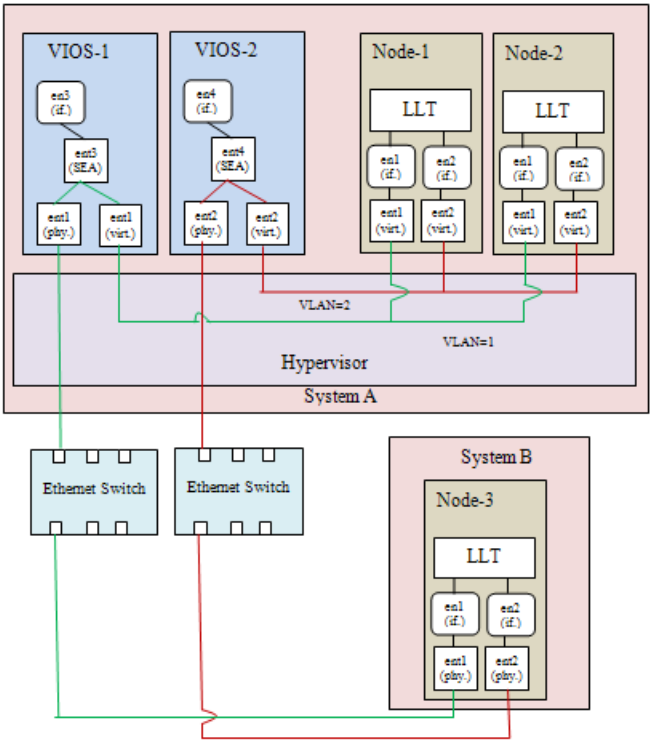


Figure 4-2 shows an example of an environment with two Virtual I/O Servers

Figure 4-2 A VCS environment with two Virtual I/O Servers



MTU settings

Virtual Ethernet allows fairly large MTU for communication between LPARs. Communication through the Shared Ethernet is limited to much smaller MTU supported by the physical media. Therefore, choose the MTU for the Virtual Ethernet such that packets can be sent outside using the Shared Ethernet without any packet drop. You must make sure that LLT configuration file has MTU=1500 set for each of the virtual Ethernet interface you use for the private links.

The VCS installer detects the virtual Ethernet interfaces and sets the correct MTU in the LLT configuration file. If you are installing with manual steps, you must configure the MTU before you start the LLT.

Sample output of the /etc/llttab file restricting the MTU size to 1500:

```
# more /etc/llttab
set-node vcs_node_2
set-cluster 1234
```

```
link en1 /dev/dlpi/en:1 - ether - 1500
link en2 /dev/dlpi/en:2 - ether - 1500
```

After you configure the LLT, use the below command on all the nodes of your cluster to be sure that the overall MTU size is less than 1500.

```
# lltstat -c | grep mtu
mtu: 1460
```

VCS Agents

All VCS network-related agents support Virtual Ethernet environment. You can configure any of the bundled networking agents to monitor the network inside an LPAR.

Virtual Ethernet and Cluster Management Software

Virtual Ethernet environment offers various advantages and flexibility, but you should be aware of the challenges. The various independent clusters consisting of VIO client partitions in the same physical computer can be configured with the heartbeat routed through the same physical Ethernet adapters to additional nodes outside the physical computer. Ensure that each cluster has a unique cluster ID. Unique cluster IDs eliminate conflict and allow the Virtual Ethernet environment to greatly reduce the required number of physical Ethernet adapters. According to IBM, there are issues to be aware that are not the fault of the applicable Cluster Management Software or the configuration. Rather, the issues arise as a direct consequence of I/O virtualization.

To reiterate, although some of these may be viewed as configuration restrictions, many are direct consequences of I/O Virtualization.

The issues and recommendation are as follows:

- If two or more Clustered nodes use a VIO server or servers in the same frame, the Cluster Management Software cannot detect and react to single physical interface failures. This behavior does not limit the availability of the entire cluster because VIOS itself routes traffic around the failure. The behavior of the VIOS is analogous to AIX the EtherChannel. Notification of individual Adapter failures must use other methods (not based on the VIO server) .
- All Virtual Ethernet interfaces that are defined to the Cluster Management Software should be treated as “single-Adapter networks” according to IBM. To correctly monitor and detect failure of the network interface, you must create a file that includes a list of clients to ping. Due to the nature of Virtual

Ethernet, other mechanisms to detect the failure of network interfaces are not effective.

- If the VIO server has only a single physical interface on a network, then the Cluster Management Software can detect a failure of that interface. However, that failure isolates the node from the network.

Check the IBM documentation for detailed information on the Virtual Ethernet and various configuration scenarios using virtual I/O Server. For information about the above issues, see the following link:

http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/FLASH10390

Chapter 5

Storage Foundation and High Availability Virtualization Solutions for IBM LPARs with virtual SCSI Devices

This chapter includes the following topics:

About IBM LPARs with virtual SCSI devices

This discussion of vSCSI devices applies only to SAN-based LUNs presented through VIO. Internal devices, volumes, and files presented by VIO as vSCSI devices are not recommended for use with Storage Foundation.

Virtual SCSI uses a client/server model. A Virtual I/O server partition owns the physical I/O devices, and exports the devices as virtual SCSI (vSCSI) resources to the client partitions. The Virtual I/O client is a logical partition that has a virtual client adapter node defined in its device tree. The VIO client uses the vSCSI resources provided by the Virtual I/O Server partition to access the storage devices.

If redundant SAN connections exist to the VIO server, the VIO server provides multi-pathing to the array. Client partitions can also perform multi-pathing between VIO servers in an active/standby configuration. This configuration provides extended protection from VIO configuration and maintenance. Redundant VIO servers are recommended for production workloads.

What is a virtual SCSI (vSCSI) disk?

A virtual SCSI (vSCSI) disk is a resource which can be a SCSI disk, or a volume or file in a VIO Server (VIOS) that is exported to a virtual IO client (VIOC). IBM vSCSI LUNs implement a sub-set of the SCSI protocol. The two main limitations are:

- Persistent reservations (SCSI3 – PGR) are not implemented.
  The lack of SCSI reservations means that I/O Fencing is not supported. Storage Foundation Cluster File System High Availability (SFCFS HA) and Storage Foundation for Oracle RAC (SFRAC) do not support vSCSI disks, because SFCFS HA and SFRAC require I/O fencing.
- Device inquiry limitations.
  Veritas Storage Foundation (SF) cannot directly fetch the inquiry data, as is done from a physical SCSI disk. However, if the vSCSI disk in VIOC is backed by a dmpnode in VIOS, then all the inquiry data that can be fetched from a physical disk can be fetched.
  Cross-platform data sharing (CDS) functionality is supported.

Using Storage Foundation in the VIO client with virtual SCSI devices

Storage Foundation provides support for virtual SCSI (vSCSI) devices on the VIO client. You can create and manage Veritas Volume Manager (VxVM) volumes on vSCSI devices, as for any other devices. Storage Foundation provides Dynamic Multi-Pathing (DMP) for vSCSI devices, by default. Storage Foundation can also co-exist with MPIO for multi-pathing. If you choose to use MPIO to multipath the vSCSI devices, DMP works in pass-through mode.

Use the `vxddladm` utility and the `vxdmpadm` utility to administer DMP for vSCSI devices. The `vxddladm` utility controls enabling and disabling DMP on vSCSI devices, adding and removing supported arrays, and listing supported arrays. The `vxdmpadm` utility controls the I/O policy and the path policy for vSCSI devices.

Using Storage Foundation with virtual SCSI devices

Versions of SF that support vSCSI disks are:

Prior to Storage Foundation 5.1, Portable Data Containers (disk type CDS) were not supported. With extensions included in Storage Foundation 5.1, CDS type devices are now supported.

Storage Foundation can be used in the following ways:

- use DMP in the VIO server to provide multi-pathing to the array. DMP presents a dmpnode as a vSCSI device to the VIO client.
- use Storage Foundation in the VIO client to provide volume management on the vSCSI devices, and multi-pathing through the VIO servers with DMP.
- use SF in the VIO client to provide volume management on the vSCSI devices, and use MPIO to provide multi-pathing.

Setting up DMP for vSCSI devices in the Virtual I/O Client

In this release of Storage Foundation, Veritas Dynamic Multi-Pathing (DMP) is enabled on VIO clients by default. After you install or upgrade Storage Foundation in the Virtual IO client, any vSCSI devices are under DMP control and MPIO is disabled.

If you have already installed or upgraded Storage Foundation in the Virtual I/O client, use the following procedure to enable DMP support for vSCSI devices. This procedure is only required if you have previously disabled DMP support for vSCSI devices.

To enable vSCSI support within DMP and disable MPIO

1 Enable vSCSI support.

```
# vxddladm enablevscsi
```

2 You are prompted to reboot the system, if required.

DMP takes control of the devices, for any array that has DMP support to use the array for vSCSI devices. You can add or remove DMP support for vSCSI for arrays.

See "Adding and removing DMP support for vSCSI devices for an array" on page 77.

About disabling DMP multi-pathing for vSCSI devices in the Virtual IO Client

DMP can co-exist with MPIO multi-pathing in the Virtual I/O client. If you prefer to use MPIO for multi-pathing, you can override the default behavior, which enables Dynamic Multi-Pathing (DMP) in the Virtual I/O client.

There are two ways to do this:

- Before you install or upgrade Storage Foundation in the Virtual I/O client
  See "Preparing to install or upgrade Storage Foundation with DMP disabled for vSCSI devices in the Virtual I/O client" on page 76.
- After Storage Foundation is installed in the Virtual I/O client
  See "Disabling DMP multi-pathing for vSCSI devices in the Virtual IO Client, after installation" on page 76.

Preparing to install or upgrade Storage Foundation with DMP disabled for vSCSI devices in the Virtual I/O client

Before you install or upgrade Storage Foundation, you can set an environment variable to disable DMP use for the vSCSI devices. Storage Foundation is installed with DMP in pass-through mode. MPIO is enabled for multi-pathing.

Note: When you upgrade an existing VxVM installation that has DMP enabled, then DMP remains enabled regardless of whether or not the environment variable __VXVM_DMP_VSCSI_ENABLE is set to no.

To disable DMP before installing or upgrading SF in the Virtual I/O Client

1 Before you install or upgrade VxVM, set the environment variable __VXVM_DMP_VSCSI_ENABLE to no.

```
# export __VXVM_DMP_VSCSI_ENABLE=no
```

Note: The environment variable name __VXVM_DMP_VSCSI_ENABLE begins with two underscore (_) characters.

---

2 Install Storage Foundation, as described in the *Storage Foundation High Availability Installation Guide*

Disabling DMP multi-pathing for vSCSI devices in the Virtual IO Client, after installation

After VxVM is installed, use the `vxddladm` command to switch vSCSI devices between MPIO control and DMP control.

To return control to MPIO, disable vSCSI support with DMP. After DMP support has been disabled, MPIO takes control of the devices. MPIO implements multi-pathing features such as failover and load balancing; DMP acts in pass-through mode.

To disable vSCSI support within DMP and enable MPIO

1 Disable vSCSI support.

```
# vxddladm disablevscsi
```

2 You are prompted to reboot the system, if required.

Adding and removing DMP support for vSCSI devices for an array

Veritas Dynamic Multi-Pathing (DMP) controls the devices for any array that has DMP support to use the array for vSCSI devices.

To add or remove DMP support for an array for use with vSCSI devices

1 To determine if DMP support is enabled for an array, list all of the arrays that DMP supports for use with vSCSI devices:

```
# vxddladm listvscsi
```

2 If the support is not enabled, add support for using an array as a vSCSI device within DMP:

```
# vxddladm addvscsi array_vid
```

3 If the support is enabled, you can remove the support so that the array is not used for vSCSI devices within DMP:

```
# vxddladm rmvscsi array_vid
```

4 You are prompted to reboot the system, if required.

How DMP handles I/O for vSCSI devices

On the VIO client, DMP uses the Active/Standby array mode for the vSCSI devices. Each path to the vSCSI device is through a VIO server. One VIO server is Active and the other VIO servers are Standby. An Active/Standby array permits I/O through a single Active path, and keeps the other paths on standby. During failover, I/O is scheduled on one of the standby paths. After failback, I/Os are scheduled back onto the original Active path. The Active/Standby mode is a variation of an active/active array; only one path is active at a time.

The DMP I/O policy for vSCSI enclosures is always Single-Active. It is not possible to change the DMP I/O policy for the vSCSI enclosure, because only one VIO server can be Active.

The following command shows the vSCSI enclosure:

```
# vxdmpadm listenclosure all
ENCLR_NAME   ENCLR_TYPE  ENCLR_SNO   STATUS     ARRAY_TYPE  LUN_COUNT
=============================================================================
ibm_vscsi0   IBM_VSCSI   VSCSI       CONNECTED  VSCSI   9
```

The following command shows the I/O policy for the vSCSI enclosure:

```
# vxdmpadm getattr enclosure ibm_vscsi0 iopolicy
ENCLR_NAME     DEFAULT        CURRENT
============================================
ibm_vscsi0     Single-Active  Single-Active
```

For vSCSI devices, DMP balances the load between the VIO servers, instead of balancing the I/O on paths. By default, the `iopolicy` attribute of the vSCSI array is set to `lunbalance`. When `lunbalance` is set, the vSCSI LUNs are distributed so that the I/O load is shared across the VIO servers. For example, if you have 10 LUNs and 2 VIO servers, 5 of them are configured so that VIO Server 1 is Active and VIO Server 2 is Standby. The other 5 are configured so that the VIO Server 2 is Active and VIO Server 1 is Standby. To turn off load sharing across VIO servers, set the `iopolicy` attribute to `nolunbalance`.

DMP dynamically balances the I/O load across LUNs. When you add or remove disks or paths in the VIO client, the load is rebalanced. Temporary failures like enabling or disabling paths or controllers do not cause the I/O load across LUNs to be rebalanced.

Setting the vSCSI I/O policy

By default, DMP balances the I/O load across VIO servers. This behavior sets the I/O policy attribute to `lunbalance`.

To display the current I/O policy attribute for the vSCSI array

- Display the current I/O policy for a vSCSI array:

```
# vxdmpadm getattr vscsi iopolicy
VSCSI     DEFAULT      CURRENT
============================================
IOPolicy  lunbalance   lunbalance
```

To turn off the LUN balancing, set the I/O policy attribute for the vSCSI array to `nolunbalance`.

To set the I/O policy attribute for the vSCSI array

- Set the I/O policy for a vSCSI array:

```
# vxdmpadm setattr vscsi iopolicy={lunbalance|nolunbalance}
```

Note: The DMP I/O policy for each vSCSI device is always Single-Active. You cannot change the DMP I/O policy for the vSCSI enclosure. Only one VIO server can be Active for each vSCSI device.

Using Veritas Cluster Server with virtual SCSI devices

Veritas Cluster Server (VCS) supports disk groups and volume groups created on virtual SCSI devices. The VCS DiskGroup agent supports disk groups. The VCS LVMVG agent supports volume groups.

Due to lack of SCSI3 persistent reservations, I/O Fencing is not supported with virtual SCSI devices.

Chapter 6

Veritas Dynamic Multi-Pathing for the Virtual I/O Server

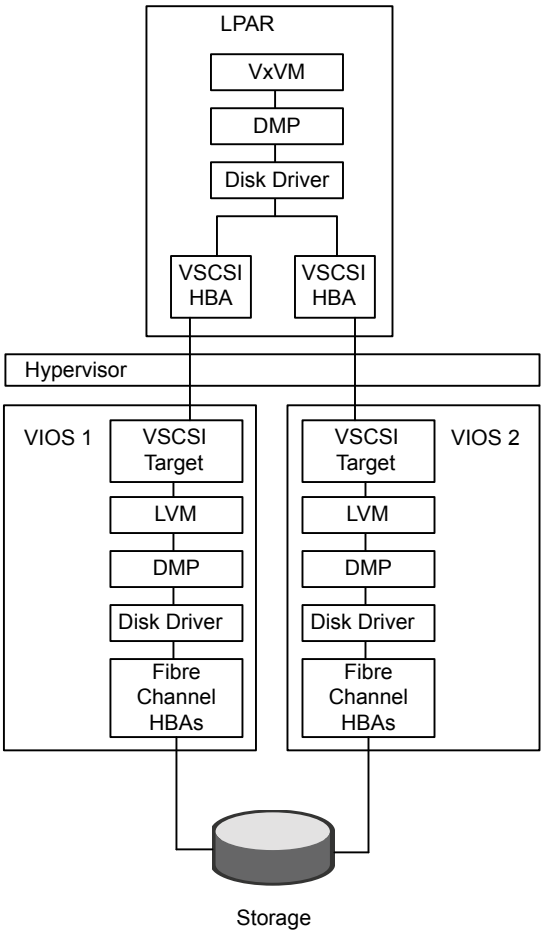
This chapter includes the following topics:

Virtual I/O server overview

Virtual I/O (VIO) server is a virtualization technology by IBM. A Virtual I/O server is a logical partition (LPAR) that runs a trimmed-down version of the AIX operating system. Virtual I/O servers have APV support, which allows sharing of physical I/O resources between virtual I/O clients.

Figure 6-1 illustrates DMP enablement in the Virtual I/O Server.

Figure 6-1 Veritas Dynamic Multi-Pathing in the Virtual I/O Server



For support information concerning running Dynamic Multi-Pathing (DMP) in Virtual I/O Server (VIOS), see the *Veritas Dynamic Multi-Pathing Release Notes*.

See the PowerVM wiki for more in-depth information about VIO server and virtualization:

http://www.ibm.com/developerworks/wikis/display/virtualization/VIO

For more information, see the *PowerVM Virtualization on IBM System p redbook*:

http://www.redbooks.ibm.com/redpieces/abstracts/sg247940.html

Virtual I/O Server (VIOS) requirements

To run DMP in VIOS, the minimum VIOS level that is required is 2.1.3.10-FP-23 or later.

DMP administration and management on Virtual I/O Server

DMP is fully functional in the Virtual I/O server. DMP administration and management commands (`vxdmpadm`, `vxddladm`, `vxdisk`) must be invoked from the non-restricted root shell.

```
$ oem_setup_env
```

Some example commands:

```
dmpvios1$ vxdmpadm getsubpaths dmpnodename=ibm_ds8x000_0337

NAME    STATE[A] PATH-TYPE[M] CTLR-NAME ENCLR-TYPE ENCLR-NAME  ATTRS
================================================================================
hdisk21 ENABLED(A)  -         fscsi0   IBM_DS8x00  ibm_ds8x000  -
hdisk61 ENABLED(A)  -         fscsi0   IBM_DS8x00  ibm_ds8x000  -
hdisk80 ENABLED(A)  -         fscsi1   IBM_DS8x00  ibm_ds8x000  -
hdisk99 ENABLED(A)  -         fscsi1   IBM_DS8x00  ibm_ds8x000  -

dmpvios1$ vxdmpadm listenclosure all

ENCLR_NAME  ENCLR_TYPE ENCLR_SNO STATUS    ARRAY_TYPE LUN_COUNT
============================================================
disk        Disk       DISKS     CONNECTED Disk       1
ibm_ds8x000 IBM_DS8x00 75MA641   CONNECTED A/A        6
```

For complete information about managing Dynamic Multi-Pathing, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

Veritas Volume Manager (VxVM) administration and management

Veritas Volume Manager (VxVM) functionality is disabled in Virtual I/O Server. VxVM commands that manage volumes or disk groups are disabled in the VIO server.

In the VIOS, VxVM does not detect disk format information, so the disk status for VxVM disks is shown as unknown. For example:

```
dmpvios1$ vxdisk list
DEVICE           TYPE     DISK    GROUP   STATUS
disk_0           auto     -       -       unknown
ibm_ds8x000_02c1 auto     -       -       unknown
ibm_ds8x000_0288 auto     -       -       unknown
ibm_ds8x000_029a auto     -       -       unknown
ibm_ds8x000_0292 auto     -       -       unknown
ibm_ds8x000_0293 auto     -       -       unknown
ibm_ds8x000_0337 auto     -       -       unknown
```

In the VIOS, VxVM displays an error if you run a command that is disabled, as follows:

```
dmpvios1$ vxdisk -f init ibm_ds8x000_0288
VxVM vxdisk ERROR V-5-1-5433 Device ibm_ds8x000_0288: init failed:
Operation not allowed. VxVM is disabled.

dmpvios1$ vxdg import datadg
VxVM vxdg ERROR V-5-1-10978 Disk group datadg: import failed:
Operation not allowed. VxVM is disabled.
```

Configuring DMP on Virtual I/O Server

In this release, you can install DMP in the virtual I/O server (VIOS). This enables the VIO server to export dmpnodes to the VIO clients. The VIO clients access the dmpnodes in the same way as any other vSCSI devices. DMP handles the I/O to the disks backed by the dmpnodes.

Installing Veritas Dynamic Multi-Pathing (DMP) on Virtual I/O Server

Veritas Dynamic Multi-Pathing (DMP) can operate in the Virtual I/O server. Install DMP on the Virtual I/O server.

To install DMP on the Virtual I/O Server

1. Log into the VIO server partition.
2. Use the `oem_setup_env` command to access the non-restricted root shell.

3 Install Veritas Dynamic Multi-Pathing on the Virtual I/O Server.

See the *Veritas Dynamic Multi-Pathing Installation Guide*.

4 Installing DMP on the VIO server enables the dmp_native_support tunable. Do not set the dmp_native_support tunable to off.

```
dmpvios1$ vxdmpadm gettune dmp_native_support
Tunable                Current Value  Default Value
-----------------  --------------- -------------------
dmp_native_support        on              off
```

Migrating from other multi-pathing solutions to DMP on Virtual I/O Server

DMP supports migrating from AIX MPIO and EMC PowerPath multi-pathing solutions to DMP on Virtual I/O Server.

To migrate from other multi-pathing solutions to DMP on Virtual I/O Server

1 Before migrating, back up the Virtual I/O Servers to use for reverting the system in case of issues.

2 Shut down all VIO client partitions that are serviced by the VIOS.

3 Log into the VIO server partition. Use the following command to access the non-restricted root shell. All subsequent commands in this procedure must be invoked from the non-restricted shell.

```
$ oem_setup_env
```

4 For each Fibre Channel (FC) adapter on the system, verify that the following attributes have the recommended settings:

fc_err_recov	fast_fail
dyntrk	yes

If required, use the `chdev` command to change the attributes.

The following example shows how to change the attributes:

```
dmpvios1$ chdev -a fc_err_recov=fast_fail -a dyntrk=yes -l \
 fscsi0 -P
fscsi0 changed
```

The following example shows the new attribute values:

```
dmpvios1$ lsattr -El  fscsi0


attach       switch   How this adapter is CONNECTED  False
dyntrk       yes      Dynamic Tracking of FC Devices True
fc_err_recov fast_fail FC Fabric Event Error RECOVERY
Policy True
scsi_id      0xd0c00  Adapter SCSI ID                False
sw_fc_class  3        FC Class for Fabric            True
```

5 Use commands like `lsdev` and `lsmap` to view the configuration.

6 Unconfigure all VTD devices from all virtual adapters on the system:

```
dmpvios1$ rmdev -p vhost0
```

Repeat this step for all other virtual adapters.

7 Migrate from the third-party device driver to DMP.

Note that you do not need to do turn on the dmp_native_support again, because it is turned on for VIOS by default. You can use the `vxdmpadm gettune dmp_native_support` command to verify that the tunable parameter is turned on.

For the migration procedure, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

8 Reboot the VIO Server partition.

9 Use the following command to verify that all Virtual SCSI mappings of TPD multi-pathing solution have been correctly migrated to DMP:

```
dmpvios1$ /usr/ios/cli/ioscli lsmap -all
```

10 Repeat step 1 through step 9 for all of the other VIO server partitions of the managed system.

11 After all of the VIO Server partitions are successfully migrated to DMP, start all of the VIO client partitions.

Example: migration from MPIO to DMP on Virtual I/O Server for a dual-VIOS configuration

This section shows an example of a migration from MPIO to DMP on the Virtual I/O Server, in a configuration with two VIO Servers.

Example configuration:

```
Managed System:  dmpviosp6
VIO server1: dmpvios1
VIO server2: dmpvios2
VIO clients: dmpvioc1
SAN LUNs: IBM DS8K array
Current multi-pathing solution on VIO server: IBM MPIO

ODM definition fileset required to disable MPIO support
for IBM DS8K array LUNs:
devices.fcp.disk.ibm.rte
```

To migrate dmpviosp6 from MPIO to DMP

1 Before migrating, back up the Virtual I/O Server to use for reverting the system in case of issues.

See the IBM website for information about backing up Virtual I/O Server.

2 Shut down all of the VIO clients that are serviced by the VIO Server.

```
dmpvioc1$ halt
```

3 Log into the VIO server partition.Use the following command to access the non-restricted root shell. All subsequent commands in this procedure must be invoked from the non-restricted shell.

```
$ oem_setup_env
```

4 Verify that the FC adapters have the recommended settings. If not, change the settings as required.

For example, the following output shows the settings:

```
dmpvios1$ lsattr -El fscsi0
attach       switch  How this adapter is CONNECTED    False
dyntrk       yes     Dynamic Tracking of FC Devices   True
fc_err_recov fast_fail FC Fabric Event Error RECOVERY
Policy True
scsi_id      0xd0c00 Adapter SCSI ID                  False
sw_fc_class  3       FC Class for Fabric              True
```

5 The following command shows `lsmap` output before migrating MPIO VTD devices to DMP:

```
dmpvios1$ /usr/ios/cli/iosctl lsmap -all
SVSA            Physloc                      Client Partition ID
--------------- ---------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11     0x00000004

VTD                vtscsi0
Status             Available 8100000000000000
Backing device     hdisk21
LUN                0x
Physloc            U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L4
003403700000000

VTD                vtscsi1
Status             Available
LUN                0x8200000000000000
Backing device     hdisk20
Physloc            U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L4
00240C100000000

VTD                vtscsi2
Status             Available
LUN                0x8300000000000000
Backing device     hdisk18
Physloc            U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L4
002409A00000000
```

The VIO Server has MPIO providing multi-pathing to these hdisks. The following commands show the configuration:

```
dmpvios1$ lsdev -Cc disk | egrep "hdisk21|hdisk20|hdisk18"

hdisk18 Available 02-08-02 MPIO Other FC SCSI Disk Drive
hdisk20 Available 02-08-02 MPIO Other FC SCSI Disk Drive
hdisk21 Available 02-08-02 MPIO Other FC SCSI Disk Drive
```

6 Unconfigure all VTD devices from all virtual adapters on the system:

```
dmpvios1 $ rmdev -p vhost0
vtscsi0 Defined
vtscsi1 Defined
vtscsi2 Defined
```

Repeat this step for all other virtual adapters.

7 Migrate the devices from MPIO to DMP.

Unmount the file system and varyoff volume groups residing on the MPIO devices.

Display the volume groups (vgs) in the configuration:

```
dmpvios1$ lsvg
rootvg
brunovg

dmpvios1 lsvg -p brunovg

brunovg:
PV_NAME PV STATE TOTAL PPs FREE PPs FREE DISTRIBUTION
hdisk19 active   511       501      103..92..102..102..102
hdisk22 active   511       501      103..92..102..102..102
```

Use the `varyoffvg` command on all affected vgs:

```
dmpvios1$ varyoffvg brunovg
```

Install the IBMDS8K ODM definition fileset to remove IBM MPIO support for IBM DS8K array LUNs.

```
dmpvios1$ installp -aXd . devices.fcp.disk.ibm.rte


+-----------------------------------------------------+
             Pre-installation Verification...
+-----------------------------------------------------+
Verifying selections...done
Verifying requisites...done
Results...
Installation Summary
--------------------
Name                      Level   Part  Event  Result
-------------------------------------------------------
devices.fcp.disk.ibm.rte  1.0.0.2 USR   APPLY  SUCCESS
devices.fcp.disk.ibm.rte  1.0.0.2 ROOT  APPLY  SUCCESS
```

8 Reboot VIO server1

```
dmpvios1$ reboot
```

9 After the VIO server1 reboots, verify that all of the existing volume groups on the VIO server1 and MPIO VTDs on the VIO server1 are successfully migrated to DMP.

```
dmpvios1 lsvg -p brunovg

brunovg:
PV_NAME          PV STATE TOTAL PPs FREE PPs FREE DISTRIBUTION
ibm_ds8000_0292 active   511       501    103..92..102..102..102
ibm_ds8000_0293 active   511       501    103..92..102..102..102
```

Verify the vSCSI mappings of IBM DS8K LUNs on the migrated volume groups:

```
dmpvios1 lsmap -all

SVSA            Physloc                       Client Partition ID
--------------- ----------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11      0x00000000
VTD                   vtscsi0
Status                Available
LUN                   0x8100000000000000
Backing device        ibm_ds8000_0337
Physloc

VTD                   vtscsi1
Status                Available
LUN                   0x8200000000000000
Backing device        ibm_ds8000_02c1
Physloc

VTD                   vtscsi2
Status                Available
LUN                   0x8300000000000000
Backing device        ibm_ds8000_029a
Physloc
```

10 Repeat step 1 through step 9 for VIO server2.

11 Start all of the VIO clients using HMC.

Example: migration from PowerPath to DMP on Virtual I/O Server for a dual-VIOS configuration

This section shows an example of a migration from PowerPath to DMP on the Virtual I/O Server, in a configuration with two VIO Servers.

Example configuration:

```
Managed System:  dmpviosp6
VIO server1: dmpvios1
VIO server2: dmpvios2
VIO clients: dmpvioc1
SAN LUNs: EMC Clariion array
Current multi-pathing solution on VIO server: EMC PowerPath
```

To migrate dmpviosp6 from PowerPath to DMP

1. Before migrating, back up the Virtual I/O Server to use for reverting the system in case of issues.

   See the IBM website for information about backing up Virtual I/O Server.

2. Shut down all of the VIO clients that are serviced by the VIO Server.

   ```
   dmpvioc1$ halt
   ```

3. Log into the VIO server partition.Use the following command to access the non-restricted root shell. All subsequent commands in this procedure must be invoked from the non-restricted shell.

   ```
   $ oem_setup_env
   ```

4. Verify that the FC adapters have the recommended settings. If not, change the settings as required.

   For example, the following output shows the settings:

   ```
   dmpvios1$ lsattr -El fscsi0
   attach       switch    How this adapter is CONNECTED  False
   dyntrk       yes       Dynamic Tracking of FC Devices True
   fc_err_recov fast_fail FC Fabric Event Error RECOVERY Policy
    True
   scsi_id      0xd0c00   Adapter SCSI ID                False
   sw_fc_class  3         FC Class for Fabric            True
   ```

5 The following command shows `lsmap` output before migrating PowerPath VTD devices to DMP:

```
dmpvios1$ /usr/ios/cli/iosctl lsmap -all

SVSA            Physloc                      Client Partition ID
--------------- ---------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11     0x00000004

VTD              P0
Status           Available
LUN              0x8100000000000000
Backing device   hdiskpower0
Physloc          U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L4
0034037
00000000

VTD              P1
Status           Available
LUN              0x8200000000000000
Backing device   hdiskpower1
Physloc          U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L40
0240C10
0000000

VTD              P2
Status           Available
LUN              0x8300000000000000
Backing device   hdiskpower2
Physloc          U789D.001.DQD04AF-P1-C5-T1-W500507630813861A-L40
02409A00000000
```

6 Unconfigure all VTD devices from all virtual adapters on the system:

```
dmpvios1 $ rmdev -p vhost0
P0 Defined
P1 Defined
P2 Defined
```

Repeat this step for all other virtual adapters.

7 Migrate the devices from PowerPath to DMP.

Unmount the file system and varyoff volume groups residing on the PowerPath devices.

Display the volume groups (vgs) in the configuration:

```
dmpvios1$ lsvg
rootvg
brunovg

dmpvios1 lsvg -p brunovg

brunovg:
PV_NAME     PV STATE TOTAL PPs FREE PPs FREE DISTRIBUTION
hdiskpower3 active   511       501    103..92..102..102..102
```

Use the varyoffvg command on all affected vgs:

```
dmpvios1$ varyoffvg brunovg
```

Unmanage the EMC Clariion array from PowerPath control

```
# powermt unmanage class=clariion
hdiskpower0 deleted
hdiskpower1 deleted
hdiskpower2 deleted
hdiskpower3 deleted
```

8 Reboot VIO server1

```
dmpvios1$ reboot
```

9 After the VIO server1 reboots, verify that all of the existing volume groups on the VIO server1 and MPIO VTDs on the VIO server1 are successfully migrated to DMP.

```
dmpvios1 lsvg -p brunovg

brunovg:
PV_NAME      PV STATE TOTAL PPs FREE PPs FREE DISTRIBUTION
emc_clari0_138 active  511      501    103..92..102..102..102
```

Verify the mappings of the LUNs on the migrated volume groups:

```
dmpvios1 lsmap -all

SVSA           Physloc                     Client Partition ID
-------------- --------------------------- ------------------
vhost0         U9117.MMA.0686502-V2-C11   0x00000000
VTD              P0
Status           Available
LUN              0x8100000000000000
Backing device   emc_clari0_130
Physloc

VTD              P1
Status           Available
LUN              0x8200000000000000
Backing device   emc_clari0_136
Physloc

VTD              P2
Status           Available
LUN              0x8300000000000000
Backing device   emc_clari0_137
Physloc
```

10 Repeat step 1 to step 9 for VIO server2.

11 Start all of the VIO clients.

Configuring DMP pseudo devices as virtual SCSI devices

DMP in the VIO server supports the following methods to export a device to the VIO client:

- DMP node method
  See “Exporting DMP devices as virtual SCSI disks ” on page 97.
- Logical partition-based method
  See “Exporting a Logical Volume as a virtual SCSI disk” on page 100.
- File-based method
  See “Exporting a file as a virtual SCSI disk” on page 102.

Exporting DMP devices as virtual SCSI disks

DMP supports disks backed by DMP as virtual SCSI disks. Export the DMP device as a vSCSI disk to the VIO client.

To export a DMP device as a vSCSI disk

1. Log into the VIO server partition.
2. Use the following command to access the non-restricted root shell. All subsequent commands in this procedure must be invoked from the non-restricted shell.

   ```
   $ oem_setup_env
   ```

3. The following command displays the DMP devices on the VIO server:

   ```
   dmpvios1$ lsdev -t dmpdisk

   ibm_ds8000_0287 Available  Veritas DMP Device
   ibm_ds8000_0288 Available  Veritas DMP Device
   ibm_ds8000_0292 Available  Veritas DMP Device
   ibm_ds8000_0293 Available  Veritas DMP Device
   ibm_ds8000_029a Available  Veritas DMP Device
   ibm_ds8000_02c1 Available  Veritas DMP Device
   ibm_ds8000_0337 Available  Veritas DMP Device
   ```

4. Assign the DMP device as a backing device. Exit from the non-restricted shell to run this command from the VIOS default shell.

   ```
   dmpvios1$ exit

   $ mkvdev -vdev ibm_ds8000_0288 -vadapter vhost0
   vtscsi3 Available
   ```

5 Use the following command to display the configuration.

```
$ lsmap -all

SVSA            Physloc                     Client Partition ID
--------------- --------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11    0x00000000
VTD               vtscsi0
Status            Available
LUN               0x8100000000000000
Backing device    ibm_ds8000_0337
Physloc

VTD               vtscsi1
Status            Available
LUN               0x8200000000000000
Backing device    ibm_ds8000_02c1
Physloc

VTD               vtscsi2
Status            Available
LUN               0x8300000000000000
Backing device    ibm_ds8000_029a
Physloc V

TD                vtscsi3
Status            Available
LUN               0x8400000000000000
Backing device    ibm_ds8000_0288
Physloc
```

6 For a dual-VIOS configuration, export the DMP device corresponding to the same SAN LUN on the second VIO Server in the configuration. To export the DMP device on the second VIO server, identify the DMP device corresponding to the SAN LUN as on the VIO Server1.

- If the array supports the AVID attribute, the DMP device name is the same as the DMP device name on the VIO Server1.
- Otherwise, use the UDID value of the DMP device on the VIO Server1 to correlate the DMP device name with same UDID on the VIO Server2.
  On VIO Server1:

  ```
  $ oem_setup_env
  ```

```
dmpvios1$ lsattr -El ibm_ds8000_0288

attribute value            description        user_settable
dmpname   ibm_ds8x000_0288 DMP Device name    True
pvid      none             Physical volume identifier True
unique_id IBM%5F2107%5F75MA641%5F6005076308FFC61A000000000
0000288
Unique device identifier   True
```

On VIO Server2:

```
$ oem_setup_env

dmpvios2$ odmget -q "attribute = unique_id and
value = 'IBM%5F2107%5F75MA641%5F6005076308FFC61A000000000
0000288'" CuAt

CuAt:

   name = "ibm_ds8000_0288"
   attribute = "unique_id"
   value = "IBM%5F2107%5F75MA641%5F6005076308FFC61A00
   00000000000288"
   type = "R"
   generic = "DU"
   rep = "s"
   nls_index = 4
```

7 Use the DMP device name identified in step 6 to assign the DMP device as a backing device. Exit from the non-restricted shell to run this command from the VIOS default shell.

```
dmpvios1$ exit

$ mkvdev -vdev ibm_ds8000_0288 -vadapter vhost0
vtscsi3 Available
```

8 Use the following command to display the configuration.

```
$ lsmap -all

SVSA            Physloc                     Client Partition ID
--------------- --------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11  0x00000000
VTD               vtscsi0
Status            Available
LUN               0x8100000000000000
Backing device    ibm_ds8000_0337
Physloc

VTD               vtscsi1
Status            Available
LUN               0x8200000000000000
Backing device    ibm_ds8000_02c1
Physloc

VTD               vtscsi2
Status            Available
LUN               0x8300000000000000
Backing device    ibm_ds8000_029a
Physloc V

TD                vtscsi3
Status            Available
LUN               0x8400000000000000
Backing device    ibm_ds8000_0288
Physloc
```

Exporting a Logical Volume as a virtual SCSI disk

DMP supports vSCSI disks backed by a Logical Volume. Export the Logical Volume as a vSCSI disk to the VIO client.

To export a Logical Volume as a vSCSI disk

1 Create the volume group.

```
$ mkvg -vg brunovg ibm_ds8000_0292 ibm_ds8000_0293
brunovg
```

The following command displays the new volume group:

```
$ lsvg -pv brunovg
brunovg:
PV_NAME          PV STATE TOTAL PPs FREE PPs FREE DISTRIBUTION
ibm_ds8000_0292 active   494       494      99..99..98..99..99
ibm_ds8000_0293 active   494       494      99..99..98..99..99
```

2 Make a logical volume in the volume group.

```
$ mklv -lv brunovg_lv1 brunovg 1G
brunovg_lv1
```

The following command displays the new logical volume:

```
$ lsvg -lv brunovg
brunovg:
LV NAME       TYPE   LPs   PPs   PVs  LV STATE      MOUNT POINT
brunovg_lv1   jfs    256   256   1    closed/syncd  N/A
```

3 Assign the logical volume as a backing device.

```
$ mkvdev -vdev brunovg_lv1 -vadapter  vhost0
vtscsi4 Available
```

4 Use the following command to display the configuration.

```
$ lsmap -all

SVSA            Physloc                     Client Partition ID
--------------- --------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11    0x00000000
VTD                   vtscsi0
Status                Available
LUN                   0x8100000000000000
Backing device        ibm_ds8000_0337
Physloc

VTD                   vtscsi1
Status                Available
LUN                   0x8200000000000000
Backing device        ibm_ds8000_02c1
Physloc

VTD                   vtscsi2
Status                Available
LUN                   0x8300000000000000
Backing device        ibm_ds8000_029a
Physloc

VTD                   vtscsi3
Status                Available
LUN                   0x8400000000000000
Backing device        ibm_ds8000_0288
Physloc

VTD                   vtscsi4
Status                Available
LUN                   0x8500000000000000
Backing device        brunovg_lv1
Physloc
```

Exporting a file as a virtual SCSI disk

DMP supports vSCSI disks backed by a file. Export the file as a vSCSI disk to the VIO client.

To export a file as a vSCSI disk

1 Create the storage pool.

```
$ mksp brunospool ibm_ds8000_0296
brunospool
0516-1254 mkvg: Changing the PVID in the ODM.
```

2 Create a file system on the pool.

```
$ mksp -fb bruno_fb -sp brunospool -size 500M
bruno_fb
File system created successfully.
507684 kilobytes total disk space.
New File System size is 1024000
```

3 Mount the file system.

```
$ mount


node       mounted   mounted over   vfs    date     options
---------- ----------------------   ----- --------------------
/dev/hd4       /        jfs2      Jul 02 14:47 rw,log=/dev/hd8
/dev/hd2      /usr      jfs2      Jul 02 14:47 rw,log=/dev/hd8
/dev/hd9var   /var      jfs2      Jul 02 14:47 rw,log=/dev/hd8
/dev/hd3      /tmp      jfs2      Jul 02 14:47 rw,log=/dev/hd8
/dev/hd1      /home     jfs2      Jul 02 14:48 rw,log=/dev/hd8
/dev/hd11admin /admin   jfs2      Jul 02 14:48 rw,log=/dev/hd8
/proc         /proc     procfs    Jul 02 14:48 rw
/dev/hd10opt  /opt      jfs2      Jul 02 14:48 rw,log=/dev/hd8
/dev/livedump /var/adm/ras/livedump jfs2 Jul 02 14:48 rw,log=
/dev/hd8
/dev/bruno_fb /var/vio/storagepools/bruno_fb jfs2 Jul 02 15:38
rw,log=INLINE
```

4 Create a file in the storage pool.

```
$ mkbdsp -bd bruno_fbdev -sp bruno_fb 200M
Creating file "bruno_fbdev" in storage pool "bruno_fb".
bruno_fbdev
```

5 Assign the file as a backing device.

```
$ mkbdsp -sp bruno_fb -bd bruno_fbdev -vadapter vhost0
Assigning file "bruno_fbdev" as a backing device.
vtscsi5 Available
bruno_fbdev
```

6 Use the following command to display the configuration.

```
$ lsmap -all

SVSA            Physloc                      Client Partition ID
--------------- ---------------------------- ------------------
vhost0          U9117.MMA.0686502-V2-C11     0x00000000
...
...
VTD                vtscsi5
Status             Available
LUN                0x8600000000000000
Backing device     /var/vio/storagepools/bruno_fb/bruno_fbdev
Physloc
```

Extended attributes in VIO client for a virtual SCSI disk

Using DMP in the Virtual I/O server enables the DMP in the VIO Client to receive the extended attributes for the LUN. This enables the client LPAR to view back-end LUN attributes such as thin, SSD, and RAID levels associated with the vSCSI devices.

For more information about extended attributes and the prerequisites for supporting them, see the following tech note:

http://seer.entsupport.symantec.com/docs/337516.htm

Configuration prerequisites for providing extended attributes on VIO client for virtual SCSI disk

DMP in VIO client will provide extended attributes information of backend SAN LUN. The following conditions are prerequisites for using extended attributes on the VIO client:

- VIO client has vSCSI disks backed by SAN LUNs.
- In the VIO Server partition, DMP is controlling those SAN LUNs.
- On VIO client, DMP is controlling the vSCSI disks.

Displaying extended attributes of virtual SCSI disks

When a VIO client accesses a virtual SCSI disk that is backed by a DMP device on the Virtual I/O Server, the VIO client can access the extended attributes associated with the virtual SCSI disk.

The following commands can access and display extended attributes information associated with the vSCSI disk backed by DMP device on Virtual I/O Server.

- `vxdisk -e list`
- `vxdmpadm list dmpnodename=<daname>`
- `vxdmpadm -v getdmpnode dmpnodename=<daname>`
- `vxdisk -p list <daname>`

For example, use the following command on the VIO client dmpvioc1:

```
# vxdisk -e list
```

```
DEVICE           TYPE          DISK   GROUP  STATUS       OS_NATIVE_NAME  ATTR
ibm_ds8x000_114f auto:LVM      -      -      LVM          hdisk83         std
3pardata0_3968   auto:aixdisk  -      -      online thin  hdisk84         tp
```

```
# vxdmpadm list dmpnode dmpnodename=3pardata0_3968
```

```
dmpdev          = 3pardata0_3968
state           = enabled
enclosure       = 3pardata0
cab-sno         = 744
asl             = libvxvscsi.so
vid             = AIX
pid             = VDASD
array-name      = 3PARDATA
array-type      = VSCSI
iopolicy        = Single-Active
avid            = 3968
lun-sno         = 3PARdata%5FVV%5F02E8%5F2AC00F8002E8
udid            = AIX%5FVDASD%5F%5F3PARdata%255FVV%255F02E8%255F2AC00F8002E8
dev-attr        = tp
###path         = name state type transport ctlr hwpath aportID aportWWN attr
path            = hdisk84 enabled(a) - SCSI vscsi1 vscsi1 3 - -
```

Virtual IO client adapter settings for Dynamic Multi-Pathing in dual-VIOS configurations

Symantec recommends the following Virtual I/O client (VIO client) adapter settings when using Dynamiic Multi-Pathing (DMP) in dual-VIOS configurations:

- Set the vscsi_err_recov attribute to fast_fail.
  The virtual SCSI (vSCSI) adapter driver uses the vscsi_err_recov attribute, which is similar to the attribute fc_error_recov for physical fibre channel (FC) adapters. When this parameter is set to fast_fail, the VIO client adapter sends a FAST_FAIL datagram to the VIO server so that the I/O fails immediately, rather than being delayed.
- Enable the vscsi_path_to attribute.
  This attribute allows the virtual client adapter driver to determine the health of the VIO Server and improve path failover processing. The value of this attribute defines the number of seconds that the vSCSI client adapter waits for commands sent to the vSCSI server adapter to be serviced. If that time is exceeded, the vSCSI client adapter fails the outstanding requests. If DMP is present, another path to the disk will be tried to service the requests.
  A value of 0 (default) disables this functionality.

To set the VIO client adapter settings

1. Set the vscsi_err_recov attribute to fast_fail, and the vscsi_path_to attribute to a non-zero number. For example:

```
# chdev -a vscsi_err_recov=fast_fail -a vscsi_path_to=30 -l vscsi0
```

2. Verify the settings.

```
# lsattr -El vscsi0
vscsi_err_recov        fast_fail
vscsi_path_to          30
```

3. Repeat step 1 and step 2 for each vSCSI client adapter.

Chapter 7

Storage Foundation and High Availability Virtualization Solutions for IBM LPARs with N_Port ID Virtualization

This chapter includes the following topics:

About IBM LPARs with N_Port ID Virtualization (NPIV)

N_Port ID Virtualization or NPIV is a Fibre Channel industry standard technology that allows multiple N_Port IDs to share a single physical N_Port. NPIV provides the capability to take a single physical Fibre Channel HBA port and divide it such that it appears, to both the host and to the SAN, as though there are multiple World Wide Port Names (WWPNs).

NPIV provides direct access to the Fibre Channel adapters from multiple virtual machine (client partitions), simplifying zoning and storage allocation. Resources can be zoned directly to the virtual client, which has its own World Wide Port Name (WWPN).

The use of NPIV with IBM VIO provides the capability to use a single Fibre Channel port and overlay multiple WWPNs so that it appears to the SAN as both the VIO server and client partitions. NPIV enables the AIX VIO server to provision entire dedicated logical ports to client LPARs rather than individual LUNs. Client partitions with this type of logical port operates as though the partition has its own dedicated FC protocol adapter. To utilize the NPIV functionality, a new type of virtual Fibre Channel (VFC) adapter is defined on both the VIO and Client. A server VFC adapter can only be created on a VIO server partition; a client VFC adapter can only be created on client partitions. WWPNs are allocated to client VFC adapters when they are defined in the profile, based upon an assignment pool generated from the backing physical adapter.

There is always corresponding one-to-one mapping relationship between VFC adapters on client logical partitions and VFC on the VIOS. That is, each VFC that is assigned to a client logical partition must connect to only one VFC adapter on VIOS, and each VFC on VIOS must connect to only one VFC on the client logical partition.

Characteristics of a LUN through NPIV

- To the operating system, multi-pathing drivers and system tools, a LUN presented through NPIV has all the characteristics of a LUN presented through a dedicated HBA. Device inquiry and probing works as with physical HBAs. When a VFC interface is created, two World Wide Port Names (WWPNs) are assigned. This information is available in the HMC as part of the virtual HBA properties.
- All SCSI device inquiry operations work, allowing for array identification functions, visibility of LUN Device Identifiers, and discovery of such attributes as thin and thin re-claim capability. SCSI-3 persistent reservation functionality is also supported, enabling the use of SCSI-3 I/O Fencing if the underlying storage supports.
- When Zoning/LUN mapping operations occur, care should be made to ensure that storage is assigned to both WWPNs. During normal operation, only one of the WWPN identifiers is in use, but during a Live Partition migration event, the WWPN identifier not previously used will be configured on the appropriate backing HBA on the target system, log into the SAN, and then become the active WWPN. The previously used WWPN will become inactive until the next Live Partition Mobility operation.

Table 7-1 Requirements for NPIV

Requirement	Description
NPIV support	Included with PowerVM Express, Standard, and Enterprise Edition and supports AIX 6.1 and AIX 7.1.
VIO requirements	NPIV requires a minimum of Power6 systems, VIOS 2.1, and 8GB HBA adapters. NPIV also requires NPIV aware switches. The end storage devices need not be NPIV aware.
Hardware requirements	NPIV requires extended functionality on the HBA. Currently IBM sells this as an 8GB HBA, part number XXXXX. The SAN Switch ports must also support NPIV as well, Brocade and Cisco make products that provide this functionality.
Information for NPIV and how to configure an IBM VIO environment	See IBM documentation.

Storage Foundation and High Availability Solutions in a N_Port ID Virtualization (NPIV) environment

Storage Foundation supports NPIV in IBM Virtual I/O Server (VIOS) environments:

- The VIOS is configured with NPIV capable FC adapters that are connected to a SAN switch that is NPIV capable.
- The LUNs mapped to the VIO client behave like an LPAR having a dedicated FC adapter.
- The devices in the VIO client appear as regular SCSI disks. Storage Foundation can access these LUNS, and treat these devices as if they came from a regular SAN storage array LUN. Unlike in the classic VIO environment without NPIV, Storage Foundation treats these devices as if they came from a regular SAN storage array LUN.
- With NPIV, the VIO client environment is transparent to Storage Foundation. All of the Storage Foundation commands would have the same output as in a regular physical AIX server.
- Storage Foundation identifies the vSCSI LUNs through the array properties of the LUNs. Otherwise, the devices in the VIO client appear as regular SCSI disks.

- You can import the disk group, which provides access to volumes and file systems.
- Symantec has qualified NPIV support with Storage Foundation, starting with 5.0MP3 RP1.
- Symantec has also qualified migration of storage used by Storage Foundation from the AIX physical server environment to the IBM VIO environment.
  See "Migrating from Physical to VIO environment" on page 142.

Table 7-2 Storage Foundation and High Availability (SFHA) Solutions NPIV support

Storage Foundation	Storage Foundation 6.0.1 supports all functionality available with dedicated HBAs when using LUNs presented through NPIV. All IBM supported NPIV enabled HBAs are supported by Storage Foundation.
Storage Foundation Cluster File System High Availability (SFCFS HA)	SFCFS HA is supported with NPIV.
Veritas Cluster Server (VCS)	VCS supports NPIV. With NPIV, the VIOS client environment is transparent to VCS and the LUNs are treated as regular SAN storage array LUNs. Since SCSI3 persistent reserve is available, I/O fencing is also supported.
Installation, patching, and configuration requirements	No patches are needed at the time of release .No other configuration is required. Using 6.0.1 products with the latest patches when they become available is strongly recommended. For current information on patches, see: https://vos.symantec.com/checklist/install/

Installation, patching, and configuration requirements

Symantec strongly recommends that you use Storage Foundation 6.0.1 with the latest patches. No other configuration is required. Refer to the following website for the latest patches for Storage Foundation 6.0.1 on AIX:

https://sort.symantec.com/checklist/install/

Section 3

Use cases for IBM virtualization

Chapter 8

Storage Foundation and High Availability support for Live Partition Mobility

This chapter includes the following topics:

About Live Partition Mobility (LPM)

The Live Partition Mobility enables you to migrate an entire logical partition from one physical system to another. Live Partition Mobility transfers the configuration from source to destination without disrupting the hosted applications or the setup of the operating system and applications. The Live Partition Mobility feature from IBM gives you a greater control over the usage of resources in the data center.

Live Partition Mobility enables a level of reconfiguration that in the past was not possible due to complexity or because of service level agreements that do not allow an application to be stopped for an architectural change. The migration process can be performed in the following ways:

- Inactive migration
  The logical partition is powered off and moved to the destination system.

- Active migration
  The migration of the partition is performed while service is provided, without disrupting user activities. During an active migration, the applications continue to handle their normal workload. Disk data transactions, running network connections, user contexts, and the complete environment are migrated without any loss and migration can be activated any time on any production partition.

Storage Foundation and High Availability (SFHA) Solutions support

All SFHA Solutions products support Live Partition Mobility (LPM) including fencing configured with NPIV disks.

Some limitations for LPM apply when VCS is configured to manage high availability of LPARs.

See "Limitations and unsupported LPAR features" on page 63.

See the IBM documentation for the detailed information on the LPM requirements and LPM process.

The main requirements for the migration of a logical partition are:

System requirements	■ Two POWER6 , POWER7, or later systems controlled by the same Hardware Management Console (HMC). ■ The destination system must have enough CPU and memory resources to host the mobile partition.
Network requirements	■ The migrating partition must use the virtual LAN (VLAN) for all LLT links and public network access. The VLAN must be bridged to a physical network using a shared Ethernet adapter in the Virtual I/O Server partition. If there is more than one VLAN, each VLAN must be bridged. ■ The Virtual I/O Servers on both systems must have a shared Ethernet adapter configured to bridge to the same Ethernet network used by the mobile partition. ■ Your LAN must be configured such that migrating partitions can continue to communicate with the other nodes after a migration is completed.

Storage requirements	■ The operating system, applications, and data of the mobile partition must reside on virtual storage on an external storage subsystem since the mobile partition's disk data must be available after the migration to the destination system is completed. An external, shared access storage subsystem is required. ■ The mobile partition's virtual disks must be mapped to LUNs; they cannot be part of a storage pool or logical volume on the Virtual I/O Server. The LUNs must be zoned and masked to the Virtual I/O Servers on both systems.

About VCS support for Live Partition Mobility

You can use Live Partition Mobility to perform a stateful migration of an LPAR in a VCS environment. During this period, you may see notifications if the migrating node is unable to heartbeat with its peers within LLT's default peer inactive timeout. To avoid false failovers, determine how long the migrating node is unresponsive in your environment. If that time is less than the default LLT peer inactive timeout of 16 seconds, VCS operates normally. If not, increase the peer inactive timeout to an appropriate value on all the nodes in the cluster before beginning the migration. Reset the value back to the default after the migration is complete.

Some limitations for LPM apply when VCS is configured to manage high availability of LPARs.

See "Limitations and unsupported LPAR features" on page 63.

For more information, refer to the *Veritas Cluster Server Administrator's Guide*.

Overview of partition migration process

The partition migration, either inactive or active, is divided into the following stages:

- Preparing the infrastructure to support Live Partition Mobility.
- Checking the configuration and readiness of the source and destination systems.
- Transferring the partition state from the source to destination. The same command is used to launch inactive and active migrations. The HMC determines the appropriate type of migration to use based on the state of the mobile partition.

- Completing the migration by freeing unused resources on the source system and the HMC.

Performance considerations

Active partition migration involves moving the state of a partition from one system to another while the partition is still running. The mover service partitions working with the hypervisor use partition virtual memory functions to track changes to partition memory state on the source system while it is transferring memory state to the destination system.

During the migration phase, there is an initial transfer of the mobile partition's physical memory from the source to the destination. Since the mobile partition is still active, a portion of the partition's resident memory will almost certainly have changed during this pass. The hypervisor keeps track of these changed pages for retransmission to the destination system in a dirty page list. It makes additional passes through the changed pages until the mover service partition detects that a sufficient number of pages are clean or the timeout is reached. The speed and load of the network that is used to transfer state between the source and destination systems influence the time that is required for both the transfer of the partition state and the performance of any remote paging operations. The amount of changed resident memory after the first pass is controlled more by write activity of the hosted applications than by the total partition memory size. Nevertheless, it is reasonable to assume that partitions with a large memory requirement will have higher numbers of changed resident pages than smaller ones.

To ensure that active partition migrations are truly non-disruptive, even for large partitions, the POWER Hypervisor resumes the partition on the destination system before all the dirty pages have been migrated over to the destination. If the mobile partition tries to access a dirty page that has not yet been migrated from the source system, the hypervisor on the destination sends a demand paging request to the hypervisor on the source to fetch the required page.

Providing a high-performance network between the source and destination mover partitions and reducing the partition's memory update activity before migration will improve the latency of the state transfer phase of migration. We suggest using a dedicated network for state transfer, with a bandwidth of at least 1 Gbps.

Chapter 9

Storage Foundation and High Availability support for IBM Workload Partitions

This chapter includes the following topics:

About IBM Workload Partitions

IBM Workload Partitions (WPARs) are implemented starting with AIX 6.1. Workload Partitions allow administrators to virtualize the AIX operating system, by partitioning an AIX operating system instance into multiple environments. Each environment within the AIX operating system instance is called a workload partition (WPAR). One WPAR can host applications and isolate the applications from applications executing in other WPARs. WPAR is a pure software solution and has no dependencies on hardware features.

The WPAR solution allows for fewer operating system images on your IBM System p partitioned server. Prior to WPARs, you had to create a new Logical Partition

(LPAR) for each new "isolated" environment. Starting with AIX 6.1, you can instead use multiple WPARs within one LPAR, in many circumstances.

In an LPAR environment, each LPAR requires its own operating system image and a certain number of physical resources. While you can virtualize many of these resources, some physical resources must be allocated to the system for each LPAR. Furthermore, you need to install patches and technology upgrades to each LPAR. Each LPAR requires its own archiving strategy and DR strategy. It also takes some time to create an LPAR; you also need to do this outside of AIX, through a Hardware Management Console (HMC) or the Integrated Virtualization Manager (IVM).

In contrast, WPARs are much simpler to manage and can be created from the AIX command line or through SMIT. WPARs allow you to avoid the biggest disadvantage of LPARs: maintaining multiple images, and therefore possibly over-committing expensive hardware resources, such as CPU and RAM. While logical partitioning helps you consolidate and virtualize hardware within a single box, operating system virtualization through WPAR technology goes one step further and allows for an even more granular approach of resource management.

The WPAR solution shares operating system images and is clearly the most efficient use of CPU, RAM, and I/O resources. Rather than a replacement for LPARs, WPARs are a complement to them and allow one to further virtualize application workloads through operating system virtualization. WPARs allow for new applications to be deployed much more quickly.

WPARs have no real dependency on hardware and can even be used on POWER4 systems that do not support IBM's PowerVM (formerly known as APV). For AIX administrators, the huge advantage of WPARs is the flexibility of creating new environments without having to create and manage new AIX partitions.

On the other hand, it's important to understand the limitations of WPARs. For example, each LPAR is a single point of failure for all WPARs that are created within the LPAR. In the event of an LPAR problem (or a scheduled system outage), all underlying WPARs are also affected.

The following sections describe the types of WPARs:

- System workload partition: the system WPAR is much closer to a complete version of AIX. The system WPAR has its own dedicated, completely writable file-systems along with its own inetd and cron. You can define remote access to the System workload partition.
- Application workload partition: application WPARs are lightweight versions of virtualized OS environments. They are extremely limited and can only run application processes, not system daemons such as inetd or cron. You cannot even define remote access to this environment. These are only temporarily objects; they actually disintegrate when the final process of the application

partition ends, and as such, are more geared to execute processes than entire applications.

When to use WPARs

You can use WPARs when you need an isolated environment, especially if you do not want to create new LPARs because of the limitation of the available resources. Here are a few recommended scenarios:

- Application/workload isolation
- Quickly testing an application
- Availability: If you are in an environment where it is very difficult to bring a system down, it's important to note that when performing maintenance on an LPAR that every WPAR defined will be affected. At the same time, if there is a system panic and AIX crashes, every WPAR has now been brought down.

WPARs share the global resources with other WPARs in the same LPAR, which limits the usefulness of WPARs in some situations.

We recommend not using WPARs in the following situations:

- Security: WPAR processes can be seen by the global environment from the central LPAR. If you are running a highly secure type of system, this may be a problem for you from a security standpoint. Further, the root administrator of your LPAR will now have access to your workload partition, possibly compromising the security that the application may require.
- Performance: Each WPAR within the LPAR uses the same system resources of the LPAR. You need to be more careful when architecting your system and also when stress testing the system.
- Physical devices: Physical devices are not supported within a WPAR. More details on WPAR administration can be found in the IBM red book on WPARs at
  http://www.redbooks.ibm.com/abstracts/sg247431.html

Storage Foundation support for WPARs

This section describes Veritas File System (VxFS) support for workload partitions (WPARs). Currently, there are no VxVM operations available within a system WPAR, so any VxFS file system that is needed for data use must be created in the global environment, then set up so the WPAR can access it. The VxFS (local mount only) is supported inside the workload partition (WPAR) environment. Cluster

mount is not yet supported inside a WPAR. WPAR can have both root and non-root partitions as VxFS file system.

In Storage Foundation, there is limited support for WPARs, as follows:

- All the Storage Foundation packages must be installed and configured in the global partition of AIX.
- Storage Foundation can only be administered from the global partition.

There are two ways to use a local mount VxFS file system inside WPAR environment.

- Using a VxFS file system within a single system WPAR
- Using VxFS as a shared file system

Using a VxFS file system within a single system WPAR

The following procedure describes how to set up a WPAR with VxFS for non-root partition.

To set up WPAR with VxFS for non-root partition

1. Create a vxfs filesystem in the global environment:

```
# /opt/VRTS/bin/mkfs -V vxfs /dev/vx/rdsk/testvg/vol1
```

2. Create a WPAR. For example, use the following command.

```
# mkwpar -n wpar1
```

   For other options while creating WPARs, refer to the IBM Redbook for WPAR.

3. List the WPAR.

```
# lswpar
Name             State Type Hostname         Directory
-------------------------------------------------------------------
wpar1 D     S    wpar1 /wpars/wpar1
```

4. The above output shows that WPAR does not have the devices. To get the vxfs file system in WPAR, create the file system in the global environment. Then mount it to the WPAR directories which are located at `/wpar/wparname/`

```
# mkdir /wpars/wpar1/vxfs_dir
# mount -V vxfs /dev/vx/dsk/testdg/vol1 \
/wpars/wpar1/vxfs_dir
```

5 Start the WPAR:

```
# startwpar -Dv wpar1 2>/startwpar_tl2
```

6 Log in to the WPAR.

```
# clogin hostname
```

For example, to log in to the WPAR wpar1:

```
# clogin wpar1
```

7 The following output shows the VxFS mount point in the WPAR.

```
# mount
```

```
node   mounted mounted over vfs    date         options
------ ------- ------------ ----   ------------ -------------
       Global  /            jfs2   Jun 23 03:15 rw,log=INLINE
       Global  /home        jfs2   Jun 23 03:15 rw,log=INLINE
       Global  /opt         namefs Jun 23 03:15 ro
       Global  /proc        namefs Jun 23 03:15 rw
       Global  /tmp         jfs2   Jun 23 03:15 rw,log=INLINE
       Global  /usr         namefs Jun 23 03:15 ro
       Global  /var         jfs2   Jun 23 03:15 rw,log=INLINE
       Global  /vxfs_dir    vxfs   Jun 23 03:14 rw,delaylog,
                        suid,ioerror=mwdisable,qio,largefiles
```

8 To stop the WPAR, use the following command:

```
# stopwpar -Dv wpar1 2>/wpar1_tl2
```

WPAR with root (/) partition as VxFS

The / (root) partition of any WPAR can be created as vxfs. Previously, it was mandatory to have the root partition as JFS2. Other mount points appear as previously but root partition can be VxFS.

To set up WPAR with root (/) partition as VxFS

1 Create the / (root) partition of the WPAR as VxFS.

```
# mkwpar -n fsqawpar -M directory=/ dev=/dev/vx/rdsk/rootdg/vol2 vfs=vxfs
```

2 Start the WPAR.

```
# startwpar -v fsqawpar 2>/fsqawpar_tl2
```

3 Login to the WPAR.

```
# clogin fsqawpar
```

4 Other mount points appear as previously while root can be VxFS.

```
# mount
node   mounted  mounted over vfs    date         options
------ -------- ------------ ------ ------------ -------------
       Global   /            vxfs   Jun 23 03:30 rw, delaylog,
                          suid,ioerror=mwdisable,qio,largefiles
       Global  /home         jfs2   Jun 23 03:30 rw,log=INLINE
       Global  /opt          namefs Jun 23 03:30 ro
       Global  /proc         namefs Jun 23 03:30 rw
       Global  /tmp          jfs2   Jun 23 03:30 rw,log=INLINE
       Global  /usr          namefs Jun 23 03:30 ro
       Global  /var          jfs2   Jun 23 03:30 rw,log=INLINE
```

Using VxFS as a shared file system

VxFS is also supported as “namefs” in the WPAR, so a VxFS file system can also be shared between the global environment and WPARs.

To use VxFS as a shared file system

1 Mount vxfs on some directory in the global environment.

```
# mount -V vxfs /dev/vx/dsk/testdg/vol1 /mnt
```

2 Mount that directory in /wpar/ wpar1/vxfs_dir.

```
# mount /mnt /wpars/wpar1/vxfs_dir/
```

3 Start the WPAR.

```
# startwpar -Dv wpar1 2>/wpar1_tl2
```

4 Login to the WPAR.

```
# clogin wpar1
```

5 After login to wpar1, /vxfs_dir will appear as namefs.

```
# mount
node   mounted mounted over vfs   date         options
-----  -------------------- ----- ------------ -------------
       Global /             jfs2   Jun 23 03:30 rw,log=INLINE
       Global /home         jfs2   Jun 23 03:30 rw,log=INLINE
       Global /opt          namefs Jun 23 03:30 ro
       Global /proc         namefs Jun 23 03:30 rw
       Global /tmp          jfs2   Jun 23 03:30 rw,log=INLINE
       Global /usr          namefs Jun 23 03:30 ro
       Global /var          jfs2   Jun 23 03:30 rw,log=INLINE
       Global /vxfs_dir     namefs Jun 23 03:29 rw
```

WPAR mobility

Live application mobility allows for planned migrations of workload from one system to another without interrupting the application. This technology can be used to perform a planned firmware installation on the server. Most workloads do not need to be aware of the WPAR relocation.

WPAR mobility, also referred to as relocation, applies to both types of WPARs: application and system. The relocation of a WPAR consists of moving its executable code from one LPAR to another one while keeping the application data on the same storage devices. It is therefore mandatory that these storage devices are accessible from both the source and target LPARs hosting the WPAR. The hosting global environment hides the physical and logical device implementations from the hosted WPARs. The WPAR only works with data storage at the file system level. All files that need to be written by the application must be hosted on an NFS file system.

All other files, including the AIX operating system files, can be stored in file systems local to the hosting global environment. The NFS server must provide access to both the global environment and the WPAR in order for the WPAR to work at all. In a mobility scenario, access must be provided to the WPAR and all global environments to which the WPAR might be moved.

About VCS support for WPARs

VCS provides application management and high availability to applications that run in WPARs. VCS supports only system WPARs, application WPARs are not supported.

Overview of how VCS works with WPARs

You can use VCS to perform the following:

- Start, stop, monitor, and failover a WPAR.
- Start, stop, monitor, and failover an application that runs in a WPAR.

Installing and configuring WPARs in VCS environments

Install and configure the WPAR. Create the service group with the standard application resource types (application, storage, networking) that need to be run inside the WPAR, and the WPAR resource. VCS represents the WPAR and its state using the WPAR resource. You then configure the service group's ContainerInfo attribute.

Configuring the ContainerInfo attribute

The service group attribute ContainerInfo specifies information about the WPAR. When you have configured and enabled the ContainerInfo attribute, you have enabled the WPAR-aware resources in the service group to work in the WPAR environment. VCS defines the WPAR information at the level of the service group so that you do not have to define it for each resource. You can specify a per-system value for the ContainerInfo attribute.

Running VCS, its resources, and your applications

VCS and the necessary agents run in the global environment. For applications that run in a WPAR, the agents can run some of their functions (entry points) inside the WPAR. If any resource faults, VCS fails over the service group with the WPAR to another node.

The ContainerInfo attribute

The ContainerInfo attribute has the Name key, Type key, and Enabled key. The Name key defines the name of the WPAR. The Type key lets you select the type of container that you plan to use (WPAR). The Enabled key enables the WPAR-aware resources within the service group. To configure the ContainerInfo attribute, use the `hawparsetup.pl` command.

You can specify a per-system value for the ContainerInfo attribute. For more information, refer to the *Veritas Cluster Server Administrator's Guide*.

The ContainerOpts attribute

The ContainerOpts attribute has the RunInContainer key and PassCInfo key. If the resource type has the RunInContainer and PassCInfo keys defined in ContainerOpts, the resource type is WPAR-aware. WPAR-aware indicates that VCS can monitor and control a resource of that type inside a WPAR.

The ContainerOpts attribute determines the following:

- The RunInContainer key determines whether the entry points of a WPAR-aware resource type can run in the WPAR.
- The PassCInfo key determines whether the container information is passed to the entry points of the resource type. The container information is defined in the service group's ContainerInfo attribute. An example use of the PassCInfo key is to pass the agent the name of the WPAR.
  For more information, refer to the *Veritas Cluster Server Administrator's Guide*.

Note: Symantec recommends that you do not modify the value of the ContainerOpts attribute, with the exception of the Mount agent.

WPAR-aware resource types

The following are the ContainerOpts attribute default values for resource types. WPAR-aware resources have predefined default values for the ContainerOpts attribute.

Table 9-1 ContainerOpts attribute default values for resource types

Resource Type	RunInContainer	PassCInfo
Application	1	0
DB2	1	0
IP	0	1
IPMultiNICB	0	1
Netlsnr	1	0
Mount	0	0
Oracle	1	0

Table 9-1 ContainerOpts attribute default values for resource types *(continued)*

Resource Type	RunInContainer	PassCInfo
Process	1	0
WPAR	0	1

About the Mount agent

You may need to modify the ContainerOpts values for the Mount resource in certain situations. Refer to the *Veritas Cluster Server Bundled Agents Reference Guide* for more information.

About the WPAR agent

The WPAR agent monitors WPARs, brings WPARs online, and takes them offline.

For more information about the agent, see the *Veritas Cluster Server Bundled Agents Reference Guide*.

This agent is IMF-aware and uses asynchronous monitoring framework (AMF) kernel driver for IMF notification. For more information about the Intelligent Monitoring Framework (IMF) and intelligent resource monitoring, refer to the *Veritas Cluster Server Administrator's Guide*.

The agent requires a user account with group administrative privileges to enable communication between the global environment and the WPAR. To create a user account, use the `hawparsetup.pl` command to configure the service group.

See "Configuring the service group for the application" on page 131.

In secure clusters, the agent renews the authentication certificate before the certificate expires.

About configuring VCS in WPARs

Configuring VCS in WPARs involves the following tasks:

- Review the prerequisites.
  See "Prerequisites for configuring VCS in WPARs" on page 127.
- Decide on the location of the WPAR root, which is either on local storage or NFS. The WPAR root is the topmost directory in a section of the file system hierarchy in which the WPAR is configured.
  See "Deciding on the WPAR root location" on page 128.
- Install the application in the WPAR.

See "Installing the application" on page 131.

- Create the application service group and configure its resources.
  See "Configuring the service group for the application" on page 131.

Prerequisites for configuring VCS in WPARs

- In a WPAR configuration, all nodes that host applications must run the same version of the operating system.
- The WPAR root must be installed on JFS, JFS2, NFS, or VxFS.
- Mounts must meet one of the following two conditions:
  - Use a namefs file system. All mounts that the application uses must be part of the WPAR configuration and must be configured in the service group. For example, you can create a WPAR, w_ora, and define the file system containing the application's data to have the mount point as /oradata. When you create the WPAR, you can define a path in the global environment, for example /export/home/oradata, which maps to the mount directory in the WPAR. The MountPoint attribute of the Mount resource for the application is set to /export/home/oradata.
  - Use a direct mount file system. All file system mount points that the application uses that run in a WPAR must be set relative to the WPAR's root. For example, if the Oracle application uses /oradata, and you create the WPAR with the WPAR path as /w_ora, then the mount must be /w_ora/oradata. The MountPoint attribute of the Mount resource must be set to this path.

  For more information about how to configure Mount resource inside WPAR, see the *Veritas Cluster Server Bundled Agents Reference Guide*.

About using custom agents in WPARs

- If you use custom agents to monitor applications running in WPARs, make sure the agents use script-based entry points. VCS does not support running C++ entry points inside a WPAR.
- If the custom agent monitors an application that runs in a WPAR, add the resource type to the APP_TYPES environment variable. If the custom agent monitors an application running in the global environment, add the resource type to the SYS_TYPES environment variable.

Note: This step is required only for `hawparsetup`.

- If you want the custom agent to monitor an application in the WPAR, for the custom agent type, set the following values for the ContainerOpts attribute: RunInContainer = 1 and the PassCInfo = 0.
- If you do not want the custom agent to monitor an application in the WPAR, for the custom agent type, set the following values for the ContainerOpts attribute: RunInContainer = 0 and the PassCInfo= 0.

Deciding on the WPAR root location

Each WPAR has its own section of the file system hierarchy in the WPAR root directory. Processes that run in the WPAR can access files only within the WPAR root.

You can set the WPAR root in the following two ways:

- WPAR root on local storage.
  In this configuration, you must create a WPAR on each node in the cluster.
- WPAR root on NFS.
  In this configuration, create a WPAR on the NFS storage. You need to duplicate the WPAR configuration across all the nodes in the cluster.
  When you set the WPAR root on NFS, install the WPAR from one node only. The WPAR root can fail over to the other nodes in the cluster. The system software, including the patches, must be identical on each node during the existence of the WPAR.

Creating a WPAR root on local disk

Use the following procedure to create a WPAR root on the local disk on each node in the cluster.

To create a WPAR root on local disks on each node in the cluster

1. Create the actual WPAR root directory.
2. Use the `mkwpar` command to create the WPAR.

   ```
   mkwpar -n wpar -h host -N ip_info -d wroot -o /tmp/wpar.log
   ```

   Use the following information to replace the appropriate variables:

wpar	The name of the WPAR.
host	The hostname for the WPAR being created.
ip_info	The information to set the virtual IP address of the system to be the IP address of the WPAR. This value also defines the device name for the NIC associated with the IP address. If you do not specify the value of the interface or netmask, the global partition's values are used. Use the following format to replace ip_info: `interface=interface netmask=netmask address=IPaddress` Example: `interface='en0' address='172.16.0.0' netmask='255.255.255.0'`
wroot	The location of the WPAR root directory. For example: /wpar1.

3. Repeat the command in step 2 to create the WPAR on each system in the service group's SystemList.
4. Start the WPAR.
5. On one of the systems in the SystemList, mount the shared file system containing the application data.

Creating WPAR root on shared storage using NFS

Use the following procedure to create a WPAR root on shared storage using NFS.

To create WPAR root on shared storage using NFS

1. Create a file system on NFS storage for the WPAR root. The file system that is to contain the WPAR root may be in the same file system as the file system containing the shared data.
2. Type the following `mkwpar` command to create the WPAR:

   ```
   mkwpar -n wpar -h host -N ip_info -r -M r_fs -M v_fs -M h_fs -M
   t_fs -d wroot
   ```

   Use the following information to replace the appropriate variables:

Attribute	Description
wpar	The name of the WPAR.
host	The hostname of the WPAR being created.
ip_info	The information to set the virtual IP address of the system to be the IP address of the WPAR. This value also defines the device name for the NIC associated with the IP address. Use the following format to replace ip_info: `interface=interface netmask=netmask address=IPaddress` For example: `interface='en0' address='172.16.0.0' netmask='255.255.255.0'` If you do not specify the value of the interface or netmask, the global partition's values are used.
r_fs	The information to specify the NFS volume to use for the root private file system for the WPAR. For example: `directory=/ vfs=nfs host=host123 dev=/root01`
v_fs	The information to specify the NFS volume to use for the /var private file system for the WPAR. For example: `directory=/var vfs=nfs host=host123 dev=/var01`
h_fs	The information to specify the NFS volume to use for the /home private file system for the WPAR. For example: `directory=/home vfs=nfs host=host123 dev=/home01`
t_fs	The information to specify the NFS volume to use for the /tmp private file system for the WPAR. For example: `directory=/tmp vfs=nfs host=host123 dev=/tmp01`
wroot	The location of the WPAR root directory, for example, /wpar1.

3 Use the `lswpar` command to display information about the WPAR's properties and their values.

4 On the system where you created the WPAR, run the command:

```
mkwpar -w -o config_file_name -e wparname_just_created
```

5 On all the other systems copy the configuration file, run the command:

```
mkwpar -p -f config_file_name -n wparname_just_created
```

6 List the WPAR.

7 Start the WPAR.

8 On one system, mount the shared file system containing the application data.

9 Make sure the WPAR created from the first system is in the D state on all other systems in the service group's System List.

Installing the application

Install the application in the WPAR. Perform the following:

- If you have created WPARs on each node in the cluster, install the application identically on all nodes. If you are installing an application that supports a Veritas High Availability agent, see the installation and configuration guide for the agent.
- Install the agent. Agent packages are installed in the global environment and the currently existing WPARs. The operating system installs the agents in future WPARs when they are created.
- In the WPAR, configure all mount points used by the application.
  - If you use namefs mounts, verify the global directories are properly mounted inside the WPAR.
  - If you use a direct mount, verify the mount points used by the application have been mounted relative to the WPAR's root. For example, if a WPAR w_ora needs to use /oracle, mount the drive at /wpars/w_ora/oracle.

Configuring the service group for the application

The following diagrams illustrates different examples of resource dependencies. In one case the WPAR root is set up on local storage. In the other, WPAR root is set up on shared storage.

Figure 9-1 WPAR root on local disks (with direct mount file system)

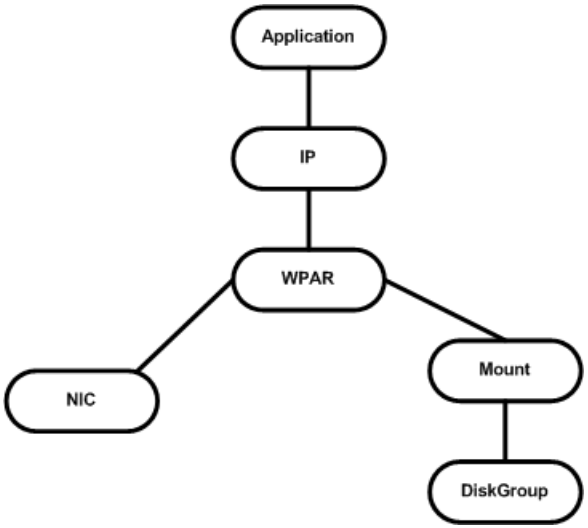


Figure 9-2 WPAR root on local disks (file system mounted from inside WPAR)

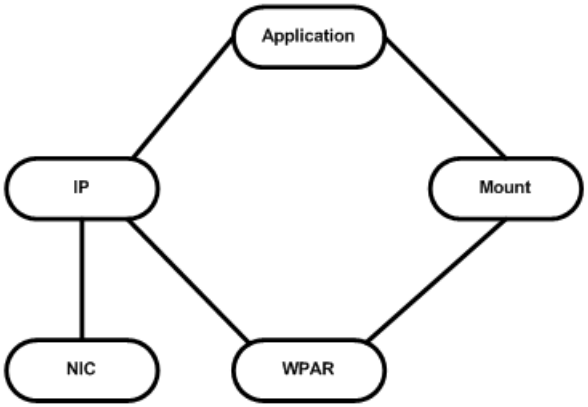
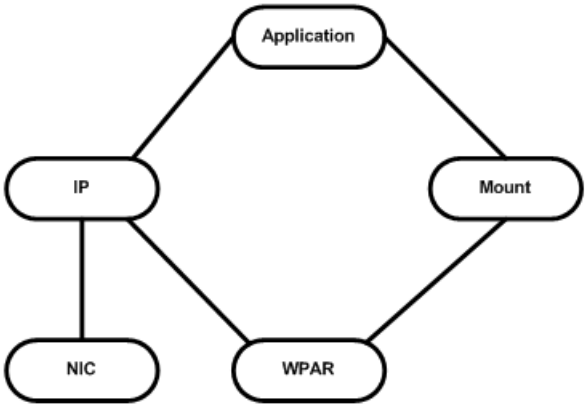


Figure 9-3 WPAR root on shared storage (with namefs file system)



Modifying the service group configuration

Perform the following procedure to modify a service group's configuration.

To add a service group or modify the service group configuration

1 Run the `hawparsetup.pl` command to set up the WPAR configuration.

```
# /opt/VRTSvcs/bin/hawparsetup.pl servicegroup_name WPARres_name WPAR_name
```

servicegroup_name	Name of the application service group.
WPARres_name	Name of the resource configured to monitor the WPAR.
WPAR_name	Name of the WPAR.
password	Password to be assigned to VCS or Security (Symantec Product Authentication Service) user created by the command.
systems	List of systems on which the service group will be configured. Use this option only when creating the service group.

The command adds a resource of type WPAR to the application service group. It also creates a user account with group administrative privileges to enable WPAR to global communication.

If the application service group does not exist, the command creates a service group.

2 Modify the resource dependencies to reflect your WPAR configuration. See the resource dependency diagrams for more information.

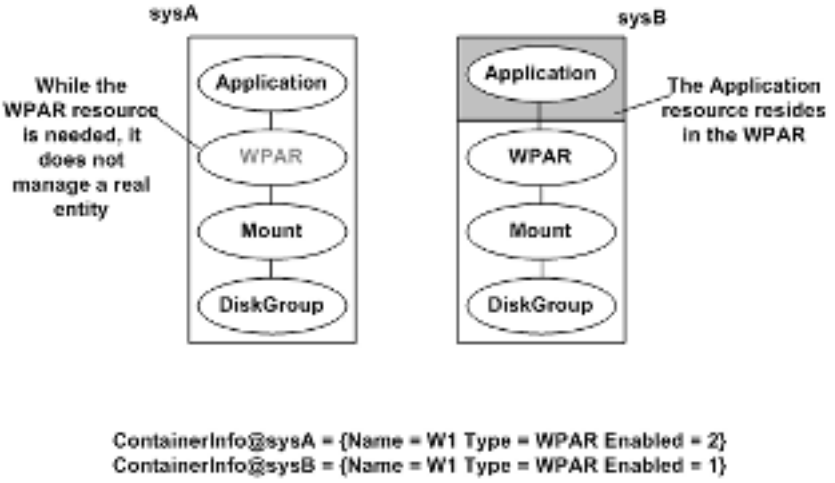
3 Save the service group configuration and bring the service group online.

About configuring failovers

An application can be failed over from an LPAR to a WPAR running on a different LPAR. You can configure VCS to fail over from a physical system to a virtual system and vice versa. A physical to virtual failover gives an N + N architecture in an N + 1 environment. For example, several physical servers with applications can fail over to containers on another physical server. On AIX, a container is a WPAR.

In this configuration, you have two LPARs. One node runs AIX 7.1 (sysA) and another node that runs AIX 6.1 (sysB). The node that runs AIX 6.1 has WPARs configured.

Figure 9-4 An application service group that can fail over onto a WPAR



In the `main.cf` configuration file, define the container name, type of container, and whether it is enabled or not. The following is an example of the ContainerInfo lines in the `main.cf` file:

```
ContainerInfo@sysA = {Name = W1, Type = WPAR, Enabled = 2}

ContainerInfo@sysB = {Name = W1, Type = WPAR, Enabled = 1}
```

On sysA, you set the value of Enabled to 2 to ignore WPARs so that the application runs on the physical system. When an application running on sysA fails over to sysB, the application runs inside the WPAR after the failover because Enabled is set to 1 on sysB. The application can likewise fail over to sysA from sysB.

IMF must be disabled on the node where Enabled is set to 2 (sysA in this example). To disable IMF, set the mode to 0.

Verifying the WPAR configuration

Run the `hawparverify.pl` command to verify the WPAR configuration. The command verifies the following requirements:

- The systems hosting the service group have the required operating system to run WPARs.
- The service group does not have more than one resource of type WPAR.
- The dependencies of the WPAR resource are correct.

To verify the WPAR configuration

1. If you use custom agents make sure the resource type is added to the APP_TYPES or SYS_TYPES environment variable.

   See "About using custom agents in WPARs" on page 127.

2. Run the `hawparverify.pl` command to verify the WPAR configuration.

   # `/opt/VRTSvcs/bin/hawparverify` *`servicegroup_name`*

Maintenance tasks

Perform the following maintenance tasks when you use WPARs:

- Whenever you make a change that affects the WPAR configuration, you must run the `hawparsetup` command to reconfigure the WPARs in VCS.
  See "Configuring the service group for the application" on page 131.
- Make sure that the WPAR configuration files are consistent on all the nodes at all times.
- When you add a patch or upgrade the operating system on one node, make sure to upgrade the software on all nodes.
- Make sure that the application configuration is identical on all nodes. If you update the application configuration on one node, apply the same updates to all nodes.

Troubleshooting information

Symptom	Recommended Action
VCS HA commands do not work.	Verify that the VCS filesets are installed. Run the `hawparsetup` command to set up the WPAR configuration. Run the `hawparverify` command to verify the configuration. Run the `halogin` command from the WPAR. For more information, refer to the *Veritas Cluster Server Administrator's Guide*. Verify your VCS credentials. Make sure the password is not changed. Verify the VxSS certificate is not expired.

Symptom	Recommended Action
Resource does not come online in the WPAR.	Verify VCS and the agent filesets are installed correctly. Verify the application is installed in the WPAR. Verify the configuration definition of the agent. Make sure to define the Name and Type keys in the ContainerInfo attribute.

Configuring AIX WPARs for disaster recovery using VCS

AIX workload partitions (WPARs) can be configured for disaster recovery by replicating the base directory using replication methods like Hitachi TrueCopy, EMC SRDF, Veritas Volume Replicator, and so on. The network configuration for the WPAR in the primary site may not be effective in the secondary site if the two sites are in different IP subnets. Hence, you need to make these additional configuration changes to the WPAR resource.

To configure the WPAR for disaster recovery, you need to configure VCS on both the sites in the logical partitions (LPARs) with the GCO option.

Refer to the *Veritas Cluster Server Administrator's Guide* for more information about global clusters.

To set up the WPAR for disaster recovery

1. On the primary site, create the WPAR and configure its network parameters.
2. On the primary site, start the WPAR and configure the DNS settings.
3. On the primary site, shut down the WPAR.
4. Use replication-specific commands to fail over the replication to the secondary site from the primary site.
5. Repeat step 1 on the secondary site.
6. Perform step 7, step 8, step 9, and step 10 on both the primary cluster and secondary clusters.
7. Create a VCS service group with a VCS WPAR resource for the WPAR.

   Refer to the *Veritas Cluster Server Bundled Agents Reference Guide* for more information about the WPAR resource.

   Configure the DROpts association attribute on the WPAR resource with the following keys and site-specific values for each: DNSServers, DNSSearchPath, and DNSDomain.

8 Add the appropriate Mount resources and DiskGroup resources for the file system and disk group on which the WPAR's base directory resides.

Add a resource dependency from the WPAR resource to the Mount resource and another dependency from the Mount resource to the Diskgroup resource.

9 Add the appropriate VCS replication resource in the service group.

Examples of hardware replication agents are SRDF for EMC SRDF, HTC for Hitachi TrueCopy, MirrorView for EMC MirrorView, etc.

Refer the appropriate VCS replication agent guide for configuring the replication resource.

For VVR-based replication, add the appropriate RVGPrimary resource to the service group.

Refer to the following manuals for more information:

- For information about configuring VVR-related resources, see the *Veritas Storage Foundation and High Availability Solutions Replication Administrator's Guide*.
- For information about the VVR-related agents, see the *Veritas Cluster Server Bundled Agents Reference Guide*.

10 Add a dependency from the DiskGroup resource to the replication resource.

Figure 9-5 Sample resource dependency diagram for hardware replication based WPARs

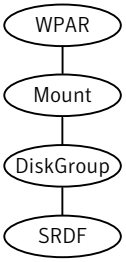
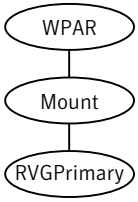


Figure 9-6 Sample resource dependency diagram for VVR replication-based WPARs



When the replication resource is online in a site, the replication agent makes sure of the following:

- The underlying replicated devices are in primary mode and hence the underlying storage and eventually the WPAR's base directory is always in read-write mode.
- The remote devices are in secondary mode.

When the WPAR resource goes online the resource modifies the appropriate files inside the WPAR to apply the disaster recovery-related parameters to the WPAR.

Chapter 10

Data migration from Physical to Virtual Clients with NPIV

This chapter includes the following topics:

About migration from Physical to VIO environment

Symantec has qualified migration of storage that is used by Storage Foundation from the physical environment to IBM VIO environment.

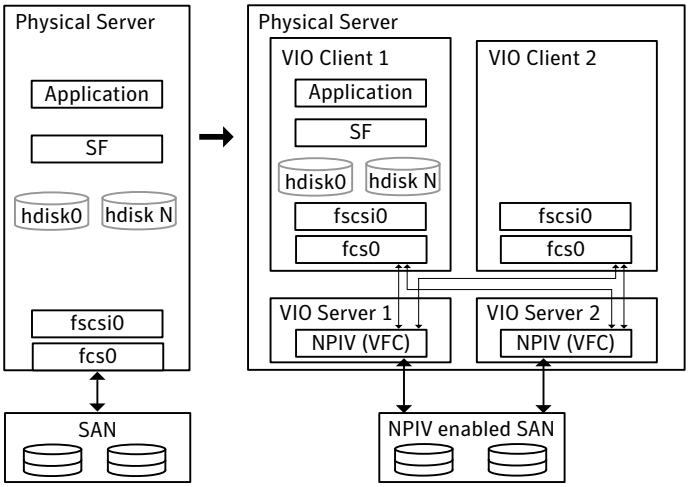
Storage Foundation provides the PDC (Portable Data Container) feature, which enables migrating storage from other platforms (Solaris, HP-UX, or Linux) to AIX VIO environment. You can also use PDC feature to migrate the storage consumed by a AIX physical server to a AIX VIO environment. NPIV helps you migrate the applications along with storage from a AIX physical environment to AIX VIO environment and vice-versa.

When storage is consumed by SF, Veritas Volume Manager (VxVM) initializes the storage LUNs as CDS (Cross-platform Data Sharing) type disks by default. A CDS disk group can be imported in a VIO client which has access to LUN's that are mapped through VFC Adapter on the client.

As part of the migration qualification, an application's storage is migrated from physical server to VIO environment (VIO client 1) which has NPIV capable FC adapter connected to it. This allows the application to access the storage in VIO

client 1. With NPIV capable FC adapter at VIOS, the devices presented to the VIO client would appear as regular AIX hdisk devices. Figure 10-1 shows this migration.

Figure 10-1 SF migration from a physical environment to AIX VIO environment



Migration is an offline task.

Migrating from Physical to VIO environment

Migration of storage from a physical environment to the VIO environment is an offline task. The migration procedure involves stopping the application, unmounting the file systems and deporting the disk group on the physical server. Prior to being deported, you can take a space optimized snapshot, to facilitate fail-back.

Verify that the devices are visible on VIO client and the VFC adapter mapping between VIOS and VIO client is set up correctly. Refer to the IBM documentation for details. After all the required devices are accessible in VIO client 1, import the disk group in the client, mount the file system, and then start the application on the VIO client 1.

Refer to *IBM* documentation on how to configure the VFC adapter mappings between the VIO partition and the Client Partition.

Storage Foundation requirements for migration

Both the source and the target must have the same version of Storage Foundation. The version must be at least 5.0 MP3 RP1.

Chapter 11

Boot device management

This chapter includes the following topics:

Using DMP to provide multi-pathing for the root volume group (rootvg)

In many cases, the use of MPIO for the rootvg creates a situation with dual multi-pathing tools. To simplify system administration and system reliability, use DMP to provide multi-pathing for the rootvg.

DMP is supported for the rootvg on vSCSI, NPIV, and physical HBAs. DMP is also supported for alternate root disks and root disks with multiple volumes.

To use DMP on the rootvg, DMP requires a vendor-specific ODM predefined fileset. Symantec includes the predefined filesets for vSCSI devices in the Veritas product distribution. For other devices, obtain and install the ODM predefined fileset from the storage vendor. For example, for the IBM DS array, install the `devices.fcp.disk.ibm.rte` fileset.

http://www-1.ibm.com/support/docview.wss?rs=540&context=ST52G7&dc=D400&q1=host+script&uid=ssg1S4000199&loc=en_US&cs=utf-8&lang=en

Rootability is achieved by using the `vxdmpadm` command, which uses the OS Native stack support feature internally.

To get help about rootability

- Run the following command:

```
# vxdmpadm help native

Manage DMP support for AIX boot volume group(rootvg)
Usage:
  vxdmpadm native { enable | disable } vgname=rootvg
  vxdmpadm native list [ vgname=rootvg ]
  vxdmpadm native { release | acquire } [ vgname=rootvg ]
where,
  enable   Enable DMP support for AIX boot volume group(rootvg)
  disable  Disable DMP support for AIX boot volume group(rootvg)
  list     List boot paths on which DMP support is enabled
  release  Giveback pvid to OS device paths corresponding to rootvg
  acquire  Takeover pvid from OS device paths corresponding to rootvg
```

To enable rootability

1. Run the following command:

```
# vxdmpadm native enable vgname=rootvg
```

2. Reboot the system to enable DMP support for LVM bootablity.

To disable rootability

1. Run the following command:

```
# vxdmpadm native disable vgname=rootvg
```

2. Reboot the system to disable DMP support for LVM bootability.

To monitor rootability

- Run the following command:

```
# vxdmpadm native list
PATH          DMPNODENAME
==========================
hdisk64       ams_wms0_302
hdisk63       ams_wms0_302
```

For more information about using DMP with rootvg, see the *Veritas Dynamic Multi-Pathing Administrator's Guide*.

Boot device on NPIV presented devices

Dynamic Multi-Pathing (DMP) supports the NPIV presented devices for the rootvg, within the requirements outlined in the vendor support matrix.

Hardware and software requirements

- Any Power 6 or Power 7 based computer
- SAN Switch & FC Adapters should be NPIV capable.
- At least one 8 GB PCI Express Dual Port FC Adapter in VIOS.
- VIOC Minimum OS-level:
  - AIX 6.1 TL5 or later
  - AIX 7.1 or later
- VIO Server Version 2.1 with Fix Pack 20.1 or later
- HMC 7.3.4

Boot Device Management

All the LUNs presented through NPIV for a client LPAR have the characteristics of a dedicated HBA. Therefore the procedure for using DMP on rootvg devices from NPIV presented devices is similar to using DMP on rootvg devices from physical HBA. Use of DMP on rootvg is supported through `vxdmproot native` command.

NPIV for Data volumes

The behavior of Data volumes presented through NPIV is similar to that of physical HBA. No special handling is required for these volumes. All SCSI device inquiry operations work and SCSI-3 persistent reservation functionality is also supported, enabling the use of SCSI-3 I/O Fencing if the underlying storage supports.

Glossary

Active Memory™ Sharing - Statement of Direction	Provides the ability to pool memory across micro-partitions which can be dynamically allocated based on partition's workload demands to improves memory utilization.
Dynamic Logical Partition (DLPAR)	A virtual server with the ability to add or remove full processors, network, or storage adapters while the server remains online.
Hardware Management Console (HMC)	Dedicated hardware/software to configure and administer a partition capable POWER server.
Integrated Virtualization Manager	Management console which runs in the VIO for partition management of entry level systems.
Live Partition Mobility	Provides the ability to migrate running AIX and Linux partitions across physical servers.
Lx86	Supports x86 Linux applications running on POWER.
Logical Partition (LPAR)	A virtual server running its own operating system instance with dedicated processors and I/O adapters.
Micro-partition	A virtual server with shared processor pools with support for up to10 micro-partitions per processor core. Depending upon the Power server, you can run up to 254 independent micro-partitions within a single physical Power server. Processor resources can be assigned at a granularity of 1/100th of a core. Also known as shared processor partition.
Multiple Shared Processor Pools	Shared and capped processor resources for a group of micro-partitions.
N_Port ID Virtualization (NPIV)	Virtual HBAs which enable multiple LPARs/micro-partitions to access SAN devices thru shared HBAs providing direct Fibre Channel connections from client partitions to storage. Fibre Channel Host Bus Adapters (HBAs) are owned by VIO Server partition.
POWER Hypervisor	The POWER Hypervisor is responsible for dispatching the logical partition workload across the shared physical processors. The POWER Hypervisor also enforces partition security, and provides inter-partition communication that enables the Virtual I/O Server's virtual SCSI and virtual Ethernet function.

Shared Ethernet Adapter The Shared Ethernet Adapter (SEA) enables network traffic outside the physical server by routing it through a software-based layer 2 switch running in the VIO Server.

Virtual I/O Server (VIO) A dedicated LPAR which supports the I/O needs of client partitions (AIX and Linux) without the need to dedicate separate I/O slots for network connections and storage devices for each client partition.

Virtual Ethernet In-memory network connections between partitions by POWER Hypervisor that reduce or eliminate the need for separate physical Ethernet Adapters in each LPAR.

Virtual SCSI Virtual disks (vDisks) provided by the VIO server to reduce the need for dedicated physical disk resources for client partitions. HBAs are contained in the VIO server. vDisks can be full LUNs or logical volumes. Dynamic LPARs or micro-partitions can also use dedicated HBAs.

Application WPAR An application Workload Partition (WPAR) is a light weight partition in which individual applications run. An application WPAR can only run application processes, not system daemons such as `inetd` or `cron`. An application WPAR is a temporary object which is removed when app is completed.

System WPAR A system Workload Partition (WPAR) has a private copy of many of the AIX OS parameters. If desired, it can have its own dedicated, completely writable file systems. Most OS daemons can run, and each system WPAR has its own user privilege space. By default, a system WPAR has no access to physical devices.

WPAR Manager The WPAR Manager allows an administrator to create, clone, and remove WPAR definitions, or start and stop WPARs. It enables Live Application Mobility which allows relocation of WPARs from one server to another without restarting the application. The WPAR Manager includes a policy engine to automate relocation of WPARs between systems based on system load and other metrics.