

VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

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International Technical Support Organization

VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

October 2015

Note: Before using this information and the product it supports, read the information in "Notices" on page ix.

First Edition (October 2015)

This edition applies to the VersaStack software levels that are described in Chapter 3, "Software revisions and configuration guidelines" on page 11.

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Preface

Dynamic organizations want to accelerate growth while reducing costs. To do so, they must speed the deployment of business applications and adapt quickly to any changes in priorities. Organizations today require an IT infrastructure to be easy, efficient, and versatile.

The VersaStack solution by Cisco and IBM® can help you accelerate the deployment of your data centers. It reduces costs by more efficiently managing information and resources while maintaining your ability to adapt to business change.

The VersaStack solution combines the innovation of Cisco UCS Integrated Infrastructure with the efficiency of the IBM Storwize® storage system. The Cisco UCS Integrated Infrastructure includes the Cisco Unified Computing System (Cisco UCS), Cisco Nexus and Cisco MDS switches, and Cisco UCS Director. The IBM Storwize V7000 enhances virtual environments with its Data Virtualization, IBM Real-time Compression[™], and IBM Easy Tier® features. These features deliver extraordinary levels of performance and efficiency.

The VersaStack solution is Cisco Application Centric Infrastructure (ACI) ready. Your IT team can build, deploy, secure, and maintain applications through a more agile framework. Cisco Intercloud Fabric capabilities help enable the creation of open and highly secure solutions for the hybrid cloud. These solutions accelerate your IT transformation while delivering dramatic improvements in operational efficiency and simplicity.

Cisco and IBM are global leaders in the IT industry. The VersaStack solution gives you the opportunity to take advantage of integrated infrastructure solutions that are targeted at enterprise applications, analytics, and cloud solutions.

The VersaStack solution is backed by Cisco Validated Designs (CVD) to provide faster delivery of applications, greater IT efficiency, and less risk.

This IBM Redbooks® publication is aimed at experienced storage administrators that are tasked with deploying a VersaStack solution with Microsoft Sequel (SQL), IBM Spectrum[™] Protect, and IBM Spectrum Control[™].

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Sally Neate, Paul Merrison, Matt Smith, Eric Stouffer, Ian Shave, Warren Hawkins, Rob Wallis **IBM**

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Introduction

Cisco and IBM have a long history of working together to deliver technology that benefits their mutual clients. Expanding on this success, IBM and Cisco have announced VersaStack, an innovative validated design that brings together IBM Storwize and the Cisco Unified Computing System (UCS) integrated infrastructure, allowing Business Partners and customers to create solutions that transform their businesses and reduce risk.

This collaboration incorporates IBM Storwize storage into the "single pane of glass" management environment that is provided by Cisco UCS Director, with future capabilities to deliver Application Centric Infrastructure (ACI) and Intercloud Fabric from Cisco and use within the IBM Cloud Builder Professional Services offering from IBM Global Services.

VersaStack will be backed by a series of Cisco Validated Design (CVD) and IBM Redbooks publications that are developed together by Cisco and IBM, which provides faster delivery of applications, greater reliability, and confidence for customers and Business Partners.

1.1 Easy, efficient, and versatile

In today's environment, quick deployment and execution of business applications plus the versatility to adapt as business priorities change are essential for dynamic organizations that want to accelerate business growth while reducing costs. Organizations today require an IT infrastructure that is easy, efficient, and versatile. The VersaStack solution by Cisco and IBM helps accelerate data center infrastructure deployment, efficiently manage information and resources, and adapt to business change.

VersaStack includes the IBM Storwize V7000 storage system, which includes technologies that both complement and enhance virtual environments with built-in functions, such as IBM Data Virtualization, Real-time Compression, and Easy Tie, which deliver extraordinary levels of performance and efficiency.

Alternatively (and outside the intended scope of this book) for clients who require the combined capabilities to support block and file data, the IBM Storwize V7000 Unified storage product is also offered in VersaStack. This validated design also includes the performance and innovation of the Cisco UCS integrated infrastructure, which includes the Cisco Unified Computing System (Cisco UCS), Cisco Nexus and Cisco MDS 9000 Family switches, and Cisco UCS Director, with the performance and efficiency of the IBM Storwize storage system.

VersaStack is backed by Cisco Validated Designs (CVDs) for faster delivery of applications and increased IT efficiency with less risk. VersaStack is supported by a broad range of services from IBM Business Partners and IBM Global Services.

VersaStack is also ready for Cisco ACI, enhancing business agility by allowing IT to build, deploy, secure, and maintain applications through a more agile framework. This capability, which is combined with Cisco Intercloud Fabric, can enable the creation of open and secure hybrid cloud-ready solutions that accelerate IT agility while delivering dramatic improvements in deployment, operation efficiency, and simplicity.

1.2 Evolving data center requirements

The data center industry is always evolving, and current trends make evolution more critical than ever. The data center has moved far beyond a simple repository for digital records, and way beyond just a vehicle for backup and restore.

Increasingly, its compute, storage, and networking facilities are being used to power complex analytical operations that are becoming essential for competitive advantage and business agility.

This trend is exemplified by the growth in demand for big data applications, and the Internet of Things. These applications involve data sets so large and complex that they cannot easily be processed by using traditional computing tools.

Two other trends are making it easier to provision data center resources:

- Cloud computing, in which computing and storage assets are managed and allocated from a shared pool rather than from application-based silos, is rapidly becoming the standard for data center resource deployment.
- The advent of virtualization and software-defined networking (SDN), in which management is abstracted from lower-level functions, promises to make it easier than ever to allocate resources.

These trends are related because the scalability of big data and the simplicity that is implied by SDN help organizations manage the increased compute requirements of big data, and underpinning these trends are changes in hardware. Vendors are adapting specific data center components to address cloud, SDN, and big data requirements. IBM, for example, has evolved its Storwize family of virtualized storage technologies specifically for software-defined environments.

Cisco, meanwhile, developed Cisco Application Infrastructure (ACI) to accelerate the configuration of an infrastructure to match the needs of applications, and Cisco Intercloud Fabric technology to make it easier to move workloads between different cloud models.

Another significant development is the emergence of integrated infrastructure solutions for the data center. Previously, data center teams purchased computing, storage, and network building blocks separately, and assembled, configured, and tested the various technologies with the hope everything would work together. With integrated infrastructure, servers, networking resources, storage systems, and management systems are combined into a predesigned, tested, and supported solution. This approach massively simplifies asset purchasing, deployment, and management.

1.3 Holistic approach

This approach is not about just bolting hardware and software together. Both IBM and Cisco are fully aware of the requirements of the enterprise today. Therefore, it made perfect sense to streamline and consolidate the traditional infrastructure into a full-stack solution that is a new way to management efficiency and enhanced productivity. IT professionals the world over trust IBM and Cisco products as best in industry, and this partnership takes this quality to a new level.

The VersaStack solution by Cisco and IBM is optimized for those IT professionals.

1.4 Hardware options

All the screen captures and work in this document refer to the Storwize V7000 Gen2 storage system, with a combination of SAS and SSD drives. VersaStack can also be used with Storwize V5000 and IBM FlashSystem[™] V9000 storage systems (system validation upcoming).

The IBM FlashSystem V9000 storage system offers full integration and is a comprehensive all-flash enterprise storage solution. The IBM FlashSystem V9000 storage system delivers the full capabilities of IBM FlashCore[™] technology plus the rich set of storage virtualization features. It is optimized for flash storage with an upcoming release supporting a simple two-tier easy tier solution. The IBM FlashSystem V9000 storage system is ideal for migrating external storage into a new configuration and future flexibility.

The IBM FlashSystem V9000 storage system uses a fully featured and scalable all-flash architecture that performs at up to 2.5 M IOPS with IBM MicroLatency®, is scalable to 19.2 GBps, and delivers up to 2.28 PB effective capacity. Leveraging its Flash-optimized design, the IBM FlashSystem V9000 storage system can provide response times of 200 microseconds. It delivers better acquisition costs than high-performance spinning disks for the same effective capacity while achieving five times the performance, making it ideal for environments demanding extreme performance.

For more information about the IBM FlashSystem V9000 storage system, see the following resources:

- http://www.ibm.com/systems/uk/storage/flash/v9000/
- ► IBM FlashSystem V9000 Product Guide, TIPS1281

For customers who want to go outside the IBM FlashSystem V9000 solution, the IBM FlashSystem 900 storage system can go behind stand-alone SAN Volume Controller 2145-DH8 nodes, which offers greater flexibility.

The IBM FlashSystem 900 storage system can be added to a storage array and provide high performance and low latency to connected hosts, while taking advantage of the IBM storage management services. Leveraging IBM Spectrum Control, you can use advanced analytics to tier automatically I/O-intensive payloads to the IBM FlashSystem storage system.

The IBM FlashCore technology, which is used in the IBM FlashSystem 900 storage system, employs several new and patented mechanisms to achieve greater capacity and throughput so that you can accelerate your mid-range storage solution by taking advantage of the extreme performance and low latency of the IBM FlashSystem storage system.

This option is also available with the existing Storwize V7000 storage system and can be as simple as adding the IBM FlashSystem 900 storage system to an existing pool.

For more information about the IBM FlashSystem 900, see the following resources:

- http://www.ibm.com/systems/storage/flash/
- ► FlashSystem 900 Product Guide, TIPS1261
- Implementing IBM FlashSystem 900, SG24-8271

Table 1-1 shows a comparison of the SAN Volume Controller and Storwize nodes.

Feature	Storwize V5000 node	Storwize V7000 node	SAN Volume Controller 2145-DH8 node
Standard Host Interface	6 Gb SAS, 1 Gb iSCSI, 8 Gb FC, or 10 Gb iSCSI/FCoE	1 Gb iSCSI	1 Gb iSCSI
Optional Host Interfaces	None	2 (8 Gb/16 Gb FC or 10 Gb iSCSI/FCoE).	3 (8 Gb/16 Gb FC or 10 Gb iSCSI/FCoE).
RAM (per node)	8 GB	32 or 64 GB	32 or 64 GB
Expansion Enclosures (per control enclosure)	Up to 19	Up to 20	Up to 2 (with 12 Gb SAS HIC).
Licensed Function Enforcement	Honor	Honor	Honor
IBM FlashCopy®	License (per enclosure)	License (per enclosure)	License (per TiB)
Remote Copy	License (per enclosure)	License (per enclosure)	License (per TiB)
EasyTier	License (per enclosure)	License (per enclosure)	License (per TiB)
System Clustering	Yes - 2 control enclosures	Yes - 4 control enclosures	Yes - 4 control enclosures

Table 1-1 A quick comparison of Storwize V5000, Storwize V7000, and 2145-DH8 nodes

Feature	Storwize V5000 node	Storwize V7000 node	SAN Volume Controller 2145-DH8 node
General External Virtualization	License (per enclosure)	License (per enclosure)	License (per TiB)
Data Migration from external storage	Yes	Yes	Yes
Compression	No	License (per enclosure)	License (per TiB)
Compression Hardware	No	Yes, optional extra	Yes, optional extra
NAS	No	Yes, Storwize V7000 Unified	No

1.5 Related information

This section provides links to other material that is related to VersaStack that might be of interest to you.

VersaStack Solution - Cisco

http://www.cisco.com/c/en/us/solutions/data-center-virtualization/versastack-so lution-cisco-ibm/index.html

VersaStack Solution by Cisco and IBM

http://www.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=SP&htmlfid=T SS03159USEN&appname=TAB_2_1_Appname

VersaStack Designs (links to PDF download page)

http://www.cisco.com/c/en/us/solutions/enterprise/data-center-designs-cloud-com
puting/versastack-designs.html

Video: New VersaStack Solution by Cisco and IBM

https://www.youtube.com/watch?v=HHtgEABDYts

- Video: High-Level Business Value of VersaStack from IBM and CISCO https://www.youtube.com/watch?v=E0W4ggyN99o
- ► Video: IBM and Cisco VersaStack Introduction

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https://www.youtube.com/watch?v=mkg1fkpAKII
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- Video: IBM and Cisco VersaStack Turbo Compression https://www.youtube.com/watch?v=PR_Uir1mxXE
- Video: IBM and Cisco VersaStack Data Virtualization https://www.youtube.com/watch?v=N-rNcokXzf0
- Video: IBM and Cisco VersaStack Flash Optimization and IBM Easy Tier https://www.youtube.com/watch?v=J7Rr13fEv0U
- Video: IBM and Cisco VersaStack Flash Optimization and IBM Easy Tier https://www.youtube.com/watch?v=J7Rr13fEv0U

- Video: IBM and Cisco VersaStack Compression https://www.youtube.com/watch?v=xDbk4ddXzL0
- Video: Talking VersaStack with Your Customers https://www.youtube.com/watch?v=UHANwo51ie0
- Video: Client value of VersaStack https://www.youtube.com/watch?v=dvDG6UHMEuQ
- Video: Growth Opportunities with VersaStack Solution https://www.youtube.com/watch?v=h32TsA2smLk
- Video: Take 5 VersaStack by Cisco and IBM https://www.youtube.com/watch?v=18mKR0sKQ3o

2



Architecture

This chapter describes the features of the architecture that is implemented in this book.

2.1 VersaStack design

The SQL on VersaStack design combines a Microsoft SQL cluster running on VersaStack with IBM Spectrum Control and IBM Spectrum Protect, as shown in Figure 2-1.

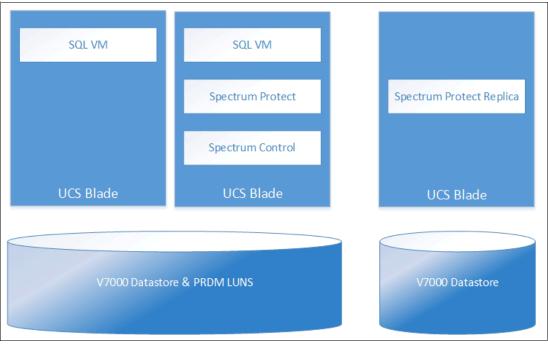


Figure 2-1 SQL on VersaStack with Spectrum Protect and Spectrum Control

It leverages the flexibility of the Cisco Fabric Interconnect to operate in FC Switching Mode. This deployment model eliminates the need for a separate Fibre Channel switch to help reduce deployment costs. Cisco UCS Manager SAN Connectivity Policies are used to help automate SAN zoning for the administrator.

The VersaStack architecture is highly modular. There is sufficient architectural flexibility and design options to scale as required with investment protection. The platform can be scaled up (adding resources to existing VersaStack units) or out (adding more VersaStack units).

Specifically, VersaStack is a defined set of hardware and software that serves as an integrated foundation for both virtualized and non-virtualized solutions.

VMware vSphere that is built on VersaStack includes IBM Storwize V7000 storage systems, Cisco networking, the Cisco Unified Computing System (Cisco UCS), Cisco Fibre Channel switches, and VMware vSphere software in a single package. The design is flexible enough that the networking, computing, and storage can fit in one data center rack or be deployed according to a customer's data center design. Port density enables the networking components to accommodate multiple configurations.

One benefit of the VersaStack architecture is the ability to meet any customer's capacity or performance needs in a cost-effective manner. A storage system capable of serving multiple protocols across a single interface allows for customer choice and investment protection because it is a wire-once architecture. This architecture references relevant criteria pertaining to resiliency, cost benefit, and ease of deployment of all components, including IBM Storwize V7000 storage.

The architecture for this solution, which is shown in Figure 2-2, uses two sets of hardware resources:

- Common Infrastructure services on redundant and self-contained hardware
- ► VersaStack PoD with the Microsoft SQL Cluster, Spectrum Control, and Spectrum Protect

The common infrastructure services include Active Directory, DNS, DHCP, vCenter, Nexus 1000v virtual supervisor module (VSM), and any other shared service. These components are considered core infrastructure because they provide necessary data center-wide services where the VersaStack PoD is. Because these services are integral to the deployment and operation of the platform, there is a need to adhere to preferred practices in their design and implementation. These practices include such features as high availability, appropriate RAID setup, and performance and scalability considerations because such services might need to be extended to multiple PoDs. At a customer's site, depending on whether this is a new data center, there might not be a need to build this infrastructure piece.

Figure 2-2 illustrates Microsoft SQL built on VersaStack components and the network connections for a configuration with an IBM Storwize V7000 storage system. This Fabric Interconnect direct-attached design allows connection to the IBM Storwize V7000 storage controllers without the use of separate Fibre Channel switches.

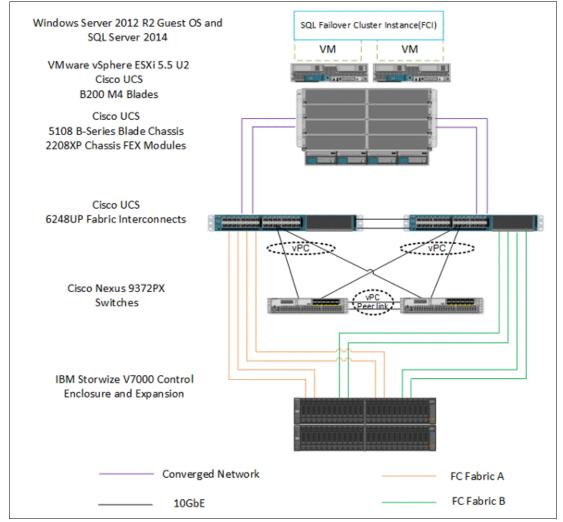


Figure 2-2 SQL on VersaStack architecture

VersaStack uses the Cisco Nexus 9396, and Cisco UCS B-Series with the Cisco UCS virtual interface card (VIC) and the IBM Storwize V7000 storage controllers, which are connected in a highly available design by using Cisco Virtual Port Channels (vPCs). This infrastructure is deployed to provide FC-booted hosts with block-level access to shared storage data stores.

The reference hardware configuration includes the following items:

- Two Cisco Nexus 9396 or 9372 switches.
- Two Cisco UCS 6248UP Fabric Interconnects.
- Support for 32 Cisco UCS C-Series servers without any additional networking components.
- Support for eight Cisco UCS B-Series servers without any additional blade server chassis.
- Support for 160 Cisco UCS C-Series and B-Series servers through additional fabric extenders and blade server chassis.
- One IBM Storwize V7000 system, which is composed of a V7000 control enclosure and V7000 expansion enclosure. There is support for up to 504 small form-factor (SFF) disks of any capacity.
- Support for up to a total of four V7000 control enclosures, up to 80 Storwize V7000 expansion enclosures, and up to 1056 SFF or large form-factor (LFF) disks of any capacity.

For server virtualization, the deployment includes VMware vSphere. Although this is the base design, each of the components can be scaled easily to support specific business requirements. For example, more (or different) servers or even blade chassis can be deployed to increase compute capacity, additional disk shelves can be deployed to improve I/O capability and throughput, and special hardware or software features can be added to introduce new features.

This book guides you through the low-level steps for deploying the base architecture. These procedures cover everything from physical cabling to network, compute and storage device configurations, Microsoft SQL Cluster deployment, and IBM Spectrum Control and Protect overviews.

For more information about the design of VersaStack, see the design guide, found at:

http://www.cisco.com/c/dam/en/us/td/docs/unified_computing/ucs/UCS_CVDs/Versastack
_design.pdf

Software revisions and configuration guidelines

This chapter describes the software revisions and versions that are used in an example VersaStack solution, and the configuration that is used.

3.1 Software revisions

Table 3-1 describes the software revisions that are used for validating various components of the Cisco Nexus 9000 based VersaStack architecture at the time of writing.

For current supported versions, see the following IBM and Cisco support matrix links:

► IBM System Storage® Interoperability Center:

http://www.ibm.com/systems/support/storage/ssic/interoperability.wss

- Spectrum Control Interoperability Matrix: http://www.ibm.com/support/docview.wss?uid=swg21386446
- Spectrum Protect Interoperability Matrix:

http://www.ibm.com/support/docview.wss?uid=swg21243309

FlashCopy Manager Interoperability Matrix:

http://www.ibm.com/support/docview.wss?uid=swg21829854

► Cisco UCS Interoperability Matrix:

http://www.cisco.com/web/techdoc/ucs/interoperability/matrix/matrix.html

After the software versions are validated, it is necessary to validate the Cisco Drivers:

- To validate your ENIC version, run ethtool -i vmnic0 by using the command-line interface (CLI) of the ESX host.
- ► To validate your FNIC version, run vmkload_mod -s fnic through the CLI of the ESX host.

Layer	Device	Version/Release	Details
Compute	Cisco UCS fabric interconnect 6248	2.2(3c)	Embedded management
	Cisco UCS 5108 Blade Server Chassis	N/A	Software runs on FI
	Cisco UCS B 200 M4	2.2(3c)	Software bundle release
	Cisco ENIC	2.1.2.59	Ethernet driver for Cisco VIC
	Cisco FNIC	1.6.0.12	FCoE driver for Cisco VIC
Network	Cisco Nexus 9000 c9372PX	6.1(2)I3(3a)	Operating system version
Storage	IBM Storwize V7000 storage system	7.5.0.0	Software version

Layer	Device	Version/Release	Details
Software	Cisco UCS hosts	VMware vSphere ESXi 5.5u2	Operating system version
	Microsoft SQL Server	Microsoft SQL Server 2008 R2	Built-in server for vCenter
	VMware vCenter	5.5u2	Software version
	Windows Server	Windows Server 2012 R2	Operating system version
	Microsoft SQL Server	Microsoft SQL Server 2014	Operating system version
	IBM Spectrum Control (IBM SmartCloud® Virtual Storage Center)	5.2.6	Software version
	IBM Spectrum Protect for Virtual Environments	7.1.2	Software version
	IBM Spectrum Protect	7.1.1.300	Software version
	IBM Spectrum Protect for Databases	7.1.2	Software version
	IBM Tivoli Monitoring for Spectrum Protect	7.1	Software version
	IBM Spectrum Protect (Tivoli Storage FlashCopy Manager)	4.1.2	Software version

3.2 Configuration guidelines

This document provides details about configuring a fully redundant, highly available VersaStack unit with an IBM Storwize V7000 storage system. Therefore, references are made at each step to the component being configured as either 01 or 02. For example, node01 and node02 are used to identify the two IBM storage controllers that are provisioned with this document, and Cisco Nexus A and Cisco Nexus B identify the pair of Cisco Nexus switches that are configured.

The Cisco UCS fabric Interconnects are similarly configured. Additionally, this document details the steps for provisioning multiple Cisco UCS hosts, and these are identified sequentially, that is, vm-host-infra-01, vm-host-infra-02, and so on.

Finally, to indicate that you should include information pertinent to your environment in a given step, <text> appears as part of the command structure.

For example, here are the network port vlan createcommand parameters:

network port vlan create ?

[-node] <nodename></nodename>	Node	
{ [-vlan-name] { <netport> <ifgrp>}</ifgrp></netport>	VLAN Name	
<pre>-port {<netport> <ifgrp>}</ifgrp></netport></pre>	Associated Network Port	
<pre>[-vlan-id] <integer> } Network Switch VLAN Identifier</integer></pre>		
Example 3-1 shows an example of the command.		
Example 3-1 network port		
network port vlan -node <node01> -vlan-name i0a-<vlan id=""></vlan></node01>		

This document is intended to enable you to configure fully the VersaStack PoD in the environment. Various steps require you to insert customer-specific naming conventions, IP addresses, and VLAN schemes, and to record appropriate MAC addresses.

Table 3-2 describes the VLANs that are necessary for deployment, as outlined in this guide.

VLAN name	VLAN ID that is used in validating this document	Purpose
DevMgmt	1	All infrastructure management in this VLAN
vMotion	30	VMware vMotion traffic
WinClus	40	Windows Cluster heartbeat traffic
WinCSV	50	Windows cluster shared volume traffic
Backup	60	Backup traffic for storage

Table 3-2 Necessary VLANs

Table 3-3 lists the virtual machines (VMs) that are necessary for deployment, as outlined in this book.

Table 3-3 VMware virtual machines created

Virtual machine description	Customer host name
Active Directory (contains DHCP and DNS)	
vCenter Server	

Table 3-4 on page 15 lists the configuration variables that are used throughout this document. This table can be completed based on the specific site variables and used in implementing the document configuration steps. These variables also are referenced at various places within this book.

Table 3-4 Config	uration variables
------------------	-------------------

Variable	Description	Customer value
< <var_node01_mgmt_ip>></var_node01_mgmt_ip>	Out-of-band management IP for cluster node 01	
< <var_node01_mgmt_mask>></var_node01_mgmt_mask>	Out-of-band management network netmask	
< <var_node01_mgmt_gateway>></var_node01_mgmt_gateway>	Out-of-band management network default gateway	
< <var_node02_mgmt_ip>></var_node02_mgmt_ip>	Out-of-band management IP for cluster node 02	
< <var_node02_mgmt_mask>></var_node02_mgmt_mask>	Out-of-band management network netmask	
< <var_node02_mgmt_gateway>></var_node02_mgmt_gateway>	Out-of-band management network default gateway	
< <var_cluster_mgmt_ip>></var_cluster_mgmt_ip>	Out-of-band management IP for cluster	
< <var_cluster_mgmt_mask>></var_cluster_mgmt_mask>	Out-of-band management network netmask	
< <var_cluster_mgmt_gateway> ></var_cluster_mgmt_gateway>	Out-of-band management network default gateway	
< <var_password>></var_password>	Global default administrative password	
< <var_dns_domain_name>></var_dns_domain_name>	DNS domain name	
< <var_nameserver_ip>></var_nameserver_ip>	DNS server IP	
< <var_timezone>></var_timezone>	VersaStack time zone (for example, America/New_York)	
< <var_global_ntp_server_ip> ></var_global_ntp_server_ip>	NTP server IP address	
< <var_email_contact>></var_email_contact>	Administrator email address	
< <var_admin_phone>></var_admin_phone>	Local contact number for support	
< <var_mailhost_ip>></var_mailhost_ip>	Mail server host IP	
< <var_country_code>></var_country_code>	Two-letter country code	
< <var_state>></var_state>	State or province name	
< <var_city>></var_city>	City name	
< <var_org>></var_org>	Organization or company name	
< <var_unit>></var_unit>	Organizational unit name	
< <var_street_address>></var_street_address>	Street address for support information	
< <var_contact_name>></var_contact_name>	Name of contact for support	

Variable	Description	Customer value
< <var_admin>></var_admin>	Secondary Admin account for storage login	
< <var_nexus_a_hostname>></var_nexus_a_hostname>	Cisco Nexus A host name	
< <var_nexus_a_mgmt0_ip>></var_nexus_a_mgmt0_ip>	Out-of-band Cisco Nexus A management IP address	
< <var_nexus_a_mgmt0_netmask>></var_nexus_a_mgmt0_netmask>	Out-of-band management network netmask	
< <var_nexus_a_mgmt0_gw>></var_nexus_a_mgmt0_gw>	Out-of-band management network default gateway	
< <var_nexus_b_hostname>></var_nexus_b_hostname>	Cisco Nexus B host name	
< <var_nexus_b_mgmt0_ip>></var_nexus_b_mgmt0_ip>	Out-of-band Cisco Nexus B management IP address	
< <var_nexus_b_mgmt0_netmask>></var_nexus_b_mgmt0_netmask>	Out-of-band management network netmask	
< <var_nexus_b_mgmt0_gw>></var_nexus_b_mgmt0_gw>	Out-of-band management network default gateway	
< <var_devmgmt_vlan_id>></var_devmgmt_vlan_id>	In-band management network VLAN ID	
< <var_vmotion_vlan_id>></var_vmotion_vlan_id>	VMware vMotionVLAN ID	
< <var_winclus_vlan_id>></var_winclus_vlan_id>	Windows Cluster heartbeat traffic	
< <var_wincsv_vlan_id>></var_wincsv_vlan_id>	Windows cluster shared volume traffic	
< <var_backup_vlan_id>></var_backup_vlan_id>	Backup traffic for storage	
< <var_ucs_clustername>></var_ucs_clustername>	Cisco UCS Manager cluster host name	
< <var_ucsa_mgmt_ip>></var_ucsa_mgmt_ip>	Cisco UCS fabric interconnect (FI) out-of-band management IP address	
< <var_ucsa_mgmt_mask>></var_ucsa_mgmt_mask>	Out-of-band management network netmask	
< <var_ucsa_mgmt_gateway>></var_ucsa_mgmt_gateway>	Out-of-band management network default gateway	
< <var_ucs_cluster_ip>></var_ucs_cluster_ip>	Cisco UCS Manager cluster IP address	
< <var_ucsb_mgmt_ip>></var_ucsb_mgmt_ip>	Cisco UCS FI B out-of-band management IP address	
< <var_vsan_a_id>></var_vsan_a_id>	VSAN ID for Fabric A (101 is used.)	
< <var_vsan_b_id>></var_vsan_b_id>	VSAN ID for Fabric B (102 is used.)	

Variable	Description	Customer value
< <var_fabric_a_fcoe_vlan_id>></var_fabric_a_fcoe_vlan_id>	Fabric ID for Fabric A (101 is used.)	
< <var_fabric_b_fcoe_vlan_id>></var_fabric_b_fcoe_vlan_id>	Fabric ID for Fabric B (102 is used.)	
< <var_in-band_mgmtblock_net>></var_in-band_mgmtblock_net>	Block of IP addresses for KVM access for UCS	
< <var_vmhost_infra_01_ip>></var_vmhost_infra_01_ip>	VMware ESXi host 01 in-band management IP	
< <var_vmhost_infra_01_2nd_i p>></var_vmhost_infra_01_2nd_i 	VMware ESXi host 01 secondary in-band management IP	
< <var_vmotion_vlan_id_ip_ho st-01>></var_vmotion_vlan_id_ip_ho 	vMotion VLAN IP address for ESXi host 01	
< <var_vmotion_vlan_id_mask_ host-01>></var_vmotion_vlan_id_mask_ 	vMotion VLAN netmask for ESXi host 01	
The last four variables should be repeated for all ESXi hosts.		

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4

Planning an SQL Server failover cluster implementation

This chapter describes some of the considerations and assumptions that are followed during the design of the SQL Server Failover Cluster installation.

4.1 Design considerations

The goal is to come up with a simple and efficient SQL Server database design that is suited for a VersaStack solution. The major design considerations of the recommended architecture are described in the following subsections. These assumptions are influenced by several factors, including the status of the technology and the specific business requirements driving each specific solution.

The upcoming sections detail the design considerations from different layers of the architectural stack.

4.1.1 Database workload

The entire architecture is designed to suit an Online Transaction Processing (OLTP) workload that is characterized by small number of random I/Os. Log I/O is the most critical component because it directly affects the transaction latency. Memory mitigates the I/O pressure on the storage subsystem. However, beyond a certain threshold, increasing memory might not yield any noticeable benefit. There are certain OLTP workloads that have a reporting or End Of Day consolidation (EOD) job in the mix. For this kind of reporting and EOD job, I/O capacity must be carefully evaluated to ensure that such workloads are not affecting regular production OLTP transactions. Many of the reporting and batch jobs use temporary database space. To provide optimal performance for this kind of workloads, you can employ solid-state drives (SSDs) or flash memory to store temporary database (tempdb) files.

4.1.2 Server virtualization

The database deployment is built on server virtualization by using VMware ESXi. This design provides an efficient and flexible back end for hosting SQL Server transactional workloads. Each of the virtual machines hosting the SQL Server database instances should be configured with the optimal computational and storage resources to suit the workload. Typical OLTP workloads are not CPU-intensive. For a virtualized database platform, you can start with four vCPUs and scale when the aggregate utilization of those vCPUS crosses the threshold that is set by the internal IT practices.

4.1.3 Database availability

The configuration is designed to have the database instance level availability by using Microsoft SQL Server Clustering technology. The VMWare hypervisor back end provides a rich medium to have virtual machine high availability and optimal performance by using the VMware HA and DRS features. However, in this configuration for SQL, VMs are use the Microsoft Failover Cluster capabilities to provide the high availability. On the SQL VMs, anti-affinity rules are set to prevent VMs migrating under the HA/DRS feature. This ensures that VMs are not on the same ESXi, and that VMs are not migrated to different ESXi host.

4.1.4 Quality of service and network segregation

The network traffic within the proposed architecture is segregated to ensure maximum bandwidth availability. Each of the network interfaces that are defined is designed to follow a certain quality of service (QoS) policy, which is assumed to give intended performance and functions.

With the SQL Server 2014 release, Cluster Shred Volumes (CSV) are supported for hosting the database files, which allows storage traffic to be routed through the cluster interconnect between the primary and standby nodes if the primary loses connectivity to the storage. For this purpose, jumbo frames are enabled on the interface, which t can carry CSV traffic.

4.1.5 Network availability

All the networking elements in the architecture are designed to have a high amount of redundancy. All the network paths are configured to ensure aggregated bandwidth for the traffic and resiliency against individual failures.

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5

Physical infrastructure

This chapter describes the physical infrastructure that is implemented and used in this book.

5.1 VersaStack cabling

The information in this section is provided as a reference for cabling the equipment in a VersaStack environment. To simplify cabling requirements, the tables include both local and remote device and port locations.

The tables in this section contain details for the prescribed and supported configuration of the IBM Storwize V7000 storage system running Version 7.4.0.

This document assumes that out-of-band management ports are plugged into an existing management infrastructure at the deployment site. These interfaces are used in various configuration steps.

Be sure to follow the cabling directions in this section. Failure to do so results in changes to the deployment procedures that follow because specific port locations are mentioned.

It is possible to order IBM Storwize V7000 storage systems in a different configuration from what is presented in the tables in this section. Before starting, be sure that the configuration matches the descriptions in the tables and diagrams in this section.

Figure 5-1 and Figure 5-2 on page 25 show cabling diagrams for a VersaStack configuration that uses the Cisco Nexus 9000 and IBM Storwize V7000 storage system. For SAS cabling information, the V7000 control enclosure and expansion enclosure should be connected according to the cabling guide found at the following website:

http://www.ibm.com/support/knowledgecenter/ST3FR7_7.4.0/com.ibm.storwize.v7000.740 .doc/v3500_qisascables_b4jtyu.html?cp=ST3FR7%2F1-3-0-1-3

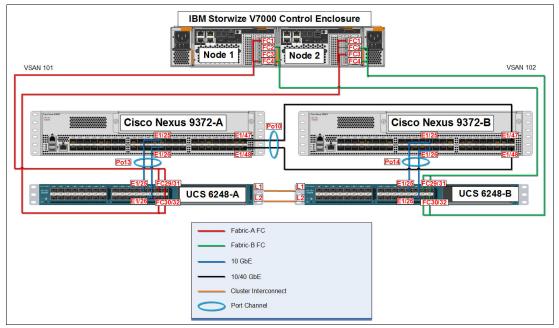


Figure 5-1 VersaStack block-only cable diagram

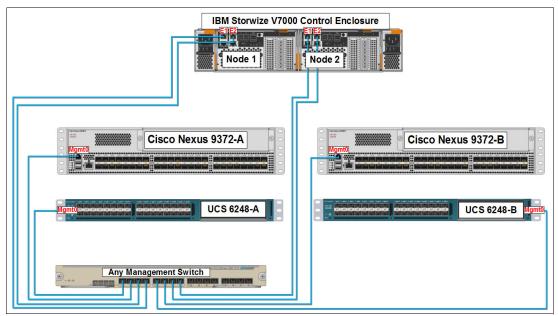


Figure 5-2 VersaStack management cable diagram

Table 5-1 shows the Cisco Nexus 9000-A cabling information.

Local device	Local port	Connection	Remote device	Remote port
Cisco Nexus 9000-A	Eth1/25	10 GbE	Cisco UCS fabric interconnect-A	Eth1/25
	Eth1/26	10 GbE	Cisco UCS fabric interconnect-B	Eth1/26
	Eth1/47	10 GbE	Cisco Nexus 9000-B	Eth1/47
	Eth1/48	10 GbE	Cisco Nexus 9000-B	Eth1/48
	Eth1/1	GbE	GbE management switch	Any

Table 5-1 Cisco Nexus 9000-A cabling information

Table 5-2 shows the Cisco Nexus 9000-B cabling information.

Table 5-2 Cisco Nexus 9000-B cabling information

Local device	Local port	Connection	Remote device	Remote port
Cisco Nexus 9000-A	Eth1/25	10 GbE	Cisco UCS fabric interconnect-A	Eth1/25
	Eth1/26	10 GbE	Cisco UCS fabric interconnect-B	Eth1/26
	Eth1/47	10 GbE	Cisco Nexus 9000-A	Eth1/47

Local device	Local port	Connection	Remote device	Remote port
	Eth1/48	10 GbE	Cisco Nexus 9000-A	Eth1/48
	Eth1/1	GbE	GbE management switch	Any

Table 5-3 shows the IBM Storwize V7000 Controller Node-1 cabling information.

Local device Local port Connection **Remote device** Remote port **IBM Storwize** E1/E2 GbE GbE Eth1/25 V7000 Controller management Node-1 switch FC1 Cisco UCS fabric FC1/29 8 Gbps interconnect-A FC2 Cisco UCS fabric FC1/29 8 Gbps interconnect-B FC3 Cisco UCS fabric FC1/31 8 Gbps interconnect-B FC4 Cisco UCS fabric 8 Gbps FC1/31 interconnect-A

Table 5-3 IBM Storwize V7000 Node-1 cabling information

Table 5-4 shows the IBM Storwize V7000 Controller Node-2 cabling information.

Local device	Local port	Connection	Remote device	Remote port
IBM Storwize V7000 Controller Node-2	E1/E2	GbE	GbE management switch	Eth1/25
	FC1	8 Gbps	Cisco UCS fabric interconnect-A	FC1/30
	FC2	8 Gbps	Cisco UCS fabric interconnect-B	FC1/30
	FC3	8 Gbps	Cisco UCS fabric interconnect-B	FC1/32
	FC4	8 Gbps	Cisco UCS fabric interconnect-A	FC1/32

Table 5-4 IBM Storwize V7000 Node-2 cabling information

Table 5-5 shows the Cisco UCS Fabric Interconnect-A cabling information.

Local device	Local port	Connection	Remote device	Remote port
Cisco UCS fabric interconnect-A	Mgmt0	GbE	GbE management switch	Any
	Eth1/25	10 GbE	Cisco Nexus 9000-A	Eth1/25
	Eth1/26	10 GbE	Cisco Nexus 9000-B	Eth1/26
	Eth1/1	10 GbE	Cisco UCS Chassis FEX-A	IOM 1/1
	Eth1/2	10 GbE	Cisco UCS Chassis FEX-A	IOM 1/2
	FC1/29	8 Gbps	V7000 Controller Node-1	FC1
	FC1/31	8 Gbps	V7000 Controller Node-1	FC4
	FC1/29	8 Gbps	V7000 Controller Node-2	FC2
	FC1/31	8 Gbps	V7000 Controller Node-2	FC3
	L1	GbE	Cisco UCS fabric interconnect-B	L1
	L2	GbE	Cisco UCS fabric interconnect-B	L2

Table 5-5 Cisco UCS Fabric Interconnect-A cabling information

Table 5-6 shows the Cisco UCS Fabric Interconnect-A cabling information.

Table 5-6 Cisco UCS Fabric Interconnect-A cabling information

Local device	Local port	Connection	Remote device	Remote port
Cisco UCS fabric interconnect-B	Mgmt0	GbE	GbE management switch	Any
	Eth1/25	10 GbE	Cisco Nexus 9000-B	Eth1/25
	Eth1/26	10 GbE	Cisco Nexus 9000-A	Eth1/26
	Eth1/1	10 GbE	Cisco UCS Chassis FEX-B	IOM 1/1
	Eth1/2	10 GbE	Cisco UCS Chassis FEX-B	IOM 1/2
	FC1/30	8 Gbps	V7000 Controller Node-1	FC1

Local device	Local port	Connection	Remote device	Remote port
	FC1/32	8 Gbps	V7000 Controller Node-1	FC4
	FC1/30	8 Gbps	V7000 Controller Node-2	FC2
	FC1/32	8 Gbps	V7000 Controller Node-2	FC3
	L1	GbE	Cisco UCS fabric interconnect-A	L1
	L2	GbE	Cisco UCS fabric interconnect-A	L2

5.2 Storage compatibility and interoperability

The IBM System Storage Interoperation Center (SSIC) provides information about supported external hardware and software for the specific IBM Storwize V7000 version.

Make sure that the hardware and software components are supported by the IBM Storwize V7000 version that you plan to install by going to the SSIC website and clicking **IBM System Storage Midrange Disk**, and then clicking **Storwize V7000** or **Storwize V7000 Unified Host Attachment or Storage Controller Attachment**.

Software and hardware limitations for the specific IBM Storwize V7000 version can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=ssg1S1004923

Detailed information about supported hardware, device driver, firmware, and software levels can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=ssg1S1004941

5.3 VersaStack System Build Process

Figure 5-3 illustrates the VersaStack system build workflow.

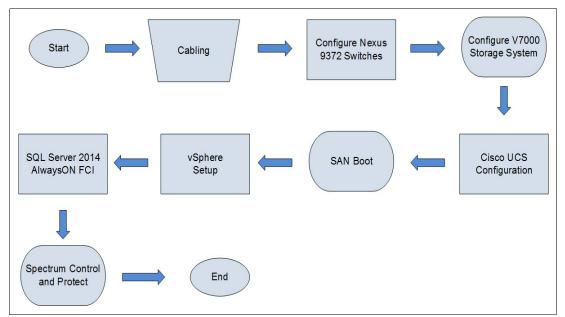


Figure 5-3 VersaStack system build workflow

30 VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

6

VersaStack Cisco Nexus 9000 Series Switches configuration

This chapter provides detailed instructions for configuring Cisco Nexus 9000 Series Switches in a VersaStack environment. After the procedures are complete, the configuration provides higher throughput and redundant Layer 2 network connectivity for the Cisco UCS environment to the upstream switches. Cisco Nexus 9000 Series Switches are Application Centric Infrastructure (Cisco ACI) ready, which provides a foundation for automating application deployments and delivering simplicity, agility, and flexibility. These deployment procedures are customized to include the environment variables

6.1 Cisco Nexus 9000 Series Switches network initial configuration setup

This section provides details for the initial setup of two Cisco Nexus 9000 Series Switches.

6.1.1 Configuring Cisco Nexus A

To set up the initial configuration for the first Cisco Nexus 9000 Series Switch (named Cisco Nexus A in this example), complete the procedure that is shown in Example 6-1.

Note: On initial boot and connection to the serial or console port of the switch, the NX-OS setup should automatically start and attempt to enter Power on Auto Provisioning.

Example 6-1 Configuration of Cisco Nexus A

```
Abort Auto Provisioning and continue with normal setup ?(yes/no)[n]: y
---- System Admin Account Setup ----
Do you want to enforce secure password standard (yes/no) [y]:
Enter the password for "admin":
Confirm the password for "admin":
---- Basic System Configuration Dialog VDC: 1 ----
This setup utility will guide you through the basic configuration of the system.
Setup configures only enough connectivity for management of the system.
Please register Cisco Nexus9000 Family devices promptly with your supplier.
Failure to register may affect response times for initial service calls. Nexus9000
devices must be registered to receive entitled support services.
Press Enter at anytime to skip a dialog. Use ctrl-c at anytime to skip the
remaining dialogs.
Would you like to enter the basic configuration dialog (yes/no): y
Create another login account (yes/no) [n]: n
Configure read-only SNMP community string (yes/no) [n]:
Configure read-write SNMP community string (yes/no) [n]:
Configure read-write SNMP community string (yes/no) [n]:
Enter the switch name : <<var_nexus_A_hostname>>
Continue with Out-of-band (mgmtO) management configuration? (yes/no) [y]:
Mgmt0 IPv4 address : <<var nexus A mgmt0 ip>>
Mgmt0 IPv4 netmask : <<var nexus A mgmt0 netmask>>
Configure the default gateway? (yes/no) [y]:
IPv4 address of the default gateway : <<var_nexus_A_mgmt0_gw>>
Configure advanced IP options? (yes/no) [n]:
Enable the telnet service? (yes/no) [n]:
Enable the ssh service? (yes/no) [y]:
Type of ssh key you would like to generate (dsa/rsa) [rsa]:
Number of rsa key bits <1024-2048> [1024]: 2048
Configure the ntp server? (yes/no) [n]: y
NTP server IPv4 address : <<var_global_ntp_server ip>>
Configure default interface layer (L3/L2) [L2]:
Configure default switchport interface state (shut/noshut) [noshut]:
Configure CoPP system profile (strict/moderate/lenient/dense/skip) [strict]:
The following configuration will be applied:
password strength-check
switchname <<var_nexus_A_hostname>>
vrf context management
```

```
ip route 0.0.0.0/0 <<var_nexus_A_mgmt0_gw>>
exit
no feature telnet
ssh kev rsa 2048 force
feature ssh
ntp server <<var global ntp server ip>>
system default switchport
no system default switchport
copp profile strict
interface mgmt0
ip address <<var nexus A mgmt0 ip>> <<var nexus A mgmt0 netmask>>
no shutdown
Would you like to edit the configuration? (yes/no) [n]:
Use this configuration and save it? (yes/no) [y]:
Copy complete.
```

6.1.2 Configuring Cisco Nexus B

To set up the initial configuration for the second Cisco Nexus 9000 Series Switch (named Cisco Nexus B in this example), complete the procedure that is shown in Example 6-2.

Note: On initial boot and connection to the serial or console port of the switch, the NX-OS setup should automatically start and attempt to enter Power on Auto Provisioning.

Example 6-2 Configuration of Cisco Nexus B

```
Abort Auto Provisioning and continue with normal setup ?(yes/no)[n]: y
---- System Admin Account Setup ----
Do you want to enforce secure password standard (yes/no) [y]:
Enter the password for "admin":
Confirm the password for "admin":
---- Basic System Configuration Dialog VDC: 1 ----
This setup utility will guide you through the basic configuration of the system.
Setup configures only enough connectivity for management of the system.
Please register Cisco Nexus9000 Family devices promptly with your supplier.
Failure to register may affect response times for initial service calls. Nexus9000
devices must be registered to receive entitled support services.
Press Enter at anytime to skip a dialog. Use ctrl-c at anytime to skip the
remaining dialogs.
Would you like to enter the basic configuration dialog (yes/no): y
Create another login account (yes/no) [n]: n
Configure read-only SNMP community string (yes/no) [n]:
Configure read-write SNMP community string (yes/no) [n]:
Enter the switch name : <<var nexus B hostname>>
Continue with Out-of-band (mgmtO) management configuration? (yes/no) [y]:
Mgmt0 IPv4 address : <<var nexus B mgmt0 ip>>
Mgmt0 IPv4 netmask : <<var nexus B mgmt0 netmask>>
Configure the default gateway? (yes/no) [y]:
IPv4 address of the default gateway : <<var nexus B mgmt0 gw>>
Configure advanced IP options? (yes/no) [n]:
Enable the telnet service? (yes/no) [n]:
Enable the ssh service? (yes/no) [y]:
Type of ssh key you would like to generate (dsa/rsa) [rsa]:
```

```
Number of rsa key bits <1024-2048> [1024]: 2048
Configure the ntp server? (yes/no) [n]: y
NTP server IPv4 address : <<var global ntp server ip>>
Configure default interface layer (L3/L2) [L2]:
Configure default switchport interface state (shut/noshut) [noshut]:
Configure CoPP system profile (strict/moderate/lenient/dense/skip) [strict]:
The following configuration will be applied:
password strength-check
switchname <<var nexus A hostname>>
vrf context management
ip route 0.0.0.0/0 <<var nexus B mgmt0 gw>>
exit
no feature telnet
ssh key rsa 2048 force
feature ssh
ntp server <<var global ntp server ip>>
system default switchport
no system default switchport
copp profile strict
interface mgmt0
ip address <<var_nexus_B_mgmt0_ip>> <<var_nexus_B_mgmt0_netmask>>
no shutdown
Would you like to edit the configuration? (yes/no) [n]:
Use this configuration and save it? (yes/no) [y]:
Copy complete.
```

6.1.3 Enabling the Cisco Nexus 9000 Series Switch features and settings

On *both* the Cisco Nexus A and Cisco Nexus B, to enable the IP switching feature and set the default spanning tree behaviors, complete the following steps (this example shows only Cisco Nexus A; do the same exact procedure for Cisco Nexus B):

1. On *each* Cisco Nexus 9000 Series Switch, enter configuration mode by running the following command:

N9K-A# config terminal

2. To enable the necessary features, run the following commands:

N9K-A(config)# feature udld N9K-A(config)# feature lacp N9K-A(config)# feature vpc

3. Configure the spanning tree and save the running configuration to start:

```
N9K-A(config)# spanning-tree port type network default
N9K-A(config)# spanning-tree port type edge bpduguard default
N9K-A(config)# spanning-tree port type edge bpdufilter default
N9K-A(config)# copy run start
```

6.1.4 Creating VLANs for VersaStack traffic

This section describes how to create the VLANs for VersaStack traffic.

Cisco Nexus A and Cisco Nexus B

To create the necessary virtual local area networks (VLANs), run the following commands on *both* switches when in configuration mode:

N9K-A(config)# vlan 30 N9K-A(config)# name vMotion N9K-A(config)# vlan 40 N9K-A(config)# name WinClus N9K-A(config)# vlan 50 N9K-A(config)# name WinCSV N9K-A(config)# vlan 60 N9K-A(config)# name Backup

6.1.5 Configuring the Virtual Port Channel Domain

This section describes how to create the Virtual Port Channel Domain.

Cisco Nexus A

To configure virtual port channels (vPCs) for Cisco Nexus A, complete the following steps:

1. From the global configuration mode, create a vPC domain by running the following command:

N9K-A(config-vpc-domain)# vpc domain 101

2. Make Nexus 9000 A the primary vPC peer by defining a low priority value by running the following command:

N9K-A(config-vpc-domain)# role priority 10

3. Use the management interfaces on the supervisors of the Nexus 9000 A to establish a keepalive link by running the following command:

```
N9K-A(config-vpc-domain)# peer-keepalive destination 192.168.10.32 source 192.168.10.31
```

4. Enable the features for this vPC domain by running the following commands:

```
N9K-A(config-vpc-domain)# peer-switch
N9K-A(config-vpc-domain)# delay restore 150
N9K-A(config-vpc-domain)# peer-gateway
N9K-A(config-vpc-domain)# ip arp synchronize
N9K-A(config-vpc-domain)# auto-recovery
```

Cisco Nexus B

To configure vPCs for Cisco Nexus B, complete the following steps:

1. From the global configuration mode, create a vPC domain by running the following command:

N9K-B(config-vpc-domain)# vpc domain 101

Make Nexus 9000 B the primary vPC peer by defining a low priority value by running the following command:

```
N9K-B(config-vpc-domain)# role priority 20
```

3. Use the management interfaces on the supervisors of Nexus 9000 B to establish a keepalive link by running the following command:

N9K-B(config-vpc-domain)# peer-keepalive destination 192.168.10.31 source 192.168.10.32

4. Enable the features for this vPC domain by running the following commands:

```
N9K-B(config-vpc-domain)# peer-switch
N9K-B(config-vpc-domain)# delay restore 150
N9K-B(config-vpc-domain)# peer-gateway
N9K-B(config-vpc-domain)# ip arp synchronize
N9K-B(config-vpc-domain)# auto-recovery
```

6.1.6 Configuring network interfaces for the vPC peer links

This section describes how to configure the network interfaces for the vPC peer links.

Cisco Nexus A

To configure the network interfaces for the vPC peer links for Cisco Nexus A, complete the following steps:

 Define a port description for the interfaces connecting to vPC Peer N9K-B by running the following commands:

```
N9K-A(config)# interface eth1/47
N9K-A(config-if)# description vPC Peer N9K-B:1/47
N9K-A(config-if)# interface eth1/48
N9K-A(config-if)# description vPC Peer N9K-B:1/48
```

Apply a port channel to both vPC peer links and start the interfaces by running the following commands:

```
N9K-A(config-if)# interface eth1/47,eth1/48
N9K-A(config-if-range)# channel-group 10 mode active
N9K-A(config-if-range)# no shutdown
```

Define a description for the port channel connecting to N9K-B by running the following commands:

```
N9K-A(config-if-range)# interface Po10
N9K-A(config-if)# description vPC peer-link
```

4. Make the port channel a switchport and configure a trunk to allow all VLANs by running the following commands:

```
N9K-A(config-if)# switchport
N9K-A(config-if)# switchport mode trunk
N9K-A(config-if)# switchport trunk allowed vlan all
```

5. Make this port channel the vPC peer link and bring it up by running the following commands:

```
N9K-A(config-if)# vpc peer-link
N9K-A(config-if)# no shutdown
```

Cisco Nexus B

To configure the network interfaces for the vPC peer links for Cisco Nexus B, complete the following steps:

 Define a port description for the interfaces connecting to vPC Peer N9K-A by running the following commands:

```
N9K-B(config-vpc-domain)# interface eth1/47
N9K-B(config-if)# description vPC Peer N9K-A:1/47
N9K-B(config-if)# interface eth1/48
N9K-B(config-if)# description vPC Peer N9K-A:1/48
```

2. Apply a port channel to both vPC peer links and start the interfaces by running the following commands:

```
N9K-B(config-if)# interface eth1/47,eth1/48
N9K-B(config-if-range)# channel-group 10 mode active
N9K-B(config-if-range)# no shutdown
```

3. Define a description for the port channel connecting to N9K-A by running the following commands:

```
N9K-B(config-if-range)# interface Po10
N9K-B(config-if)# description vPC peer-link
```

 Make the port channel a switchport and configure a trunk to allow all VLANs by running the following commands:

```
N9K-B(config-if)# switchport
N9K-B(config-if)# switchport mode trunk
N9K-B(config-if)# switchport trunk allowed vlan all
```

5. Make this port channel the vPC peer link and bring it up by running the following commands:

```
N9K-B(config-if)# vpc peer-link
N9K-B(config-if)# no shutdown
```

6. Verify the status of vPC by running sh vpc brief:

```
N9K-B(config-if)# sh vpc brief
Legend:
(*) - local vpc is down, forwarding via vPC peer-link
```

```
vPC domain id : 10
Peer status : peer adjacency formed ok
vPC keep-alive status : peer is alive
Configuration consistency status: success
Per-vlan consistency status : success
Type-2 consistency status : Consistency Check Not Performed
vPC role
                          : secondary
Number of vPCs configured : 0
                          : Enabled
Peer Gateway
Dual-active excluded VLANs
                          : -
Graceful Consistency Check : Enabled
Auto-recovery status : Enabled (timeout = 240 seconds)
vPC Peer-link status
_____
id Port Status Active vlans
-- ---- -----
    Po10 up
             30,40,50,60
1
```

6.1.7 Configuring network interfaces to the Cisco UCS Fabric Interconnect

This section describes how to configure the network interfaces to the Cisco UCS fabric interconnect.

Cisco Nexus A

To configure the network interfaces to the Cisco UCS fabric interconnect for Cisco Nexus A, complete the following steps:

 Define a description for the port channel connecting to FI-A by running the following commands:

```
N9K-A(config-if)# interface Po13
N9K-A(config-if)# description to FI-A
```

2. Make the port channel a switchport and configure a trunk to allow all VLAN traffic by running the following commands:

```
N9K-A(config-if)# switchport
N9K-A(config-if)# switchport mode trunk
N9K-A(config-if)# switchport trunk allowed vlan all
```

Make the port channel and associated interfaces into spanning tree edge ports by running the following command:

N9K-A(config-if)# spanning-tree port type edge trunk

4. Set the MTU to be 9216 to support jumbo frames by running the following command:

```
N9K-A(config-if)# mtu 9216
```

5. Make a vPC port channel and bring it up by running the following commands:

N9K-A(config-if)# vpc 13 N9K-A(config-if)# no shutdown

6. Define a port description for the interface connecting to FI-A by running the following commands:

```
N9K-A(config-if)# interface eth1/25
N9K-A(config-if)# description FI-A:1/25
```

7. Start the interface by running the following commands:

```
N9K-A(config-if)# channel-group 13 mode active
N9K-A(config-if)# no shutdown
```

 Define a description for the port channel connecting to FI-B by running the following commands:

```
N9K-A(config-if)# interface Po14
N9K-A(config-if)# description to FI-B
```

9. Make the port channel a switchport and configure a trunk to allow all VLAN traffic by running the following commands:

```
N9K-A(config-if)# switchport
N9K-A(config-if)# switchport mode trunk
N9K-A(config-if)# switchport trunk allowed vlan all
```

10. Make the port channel and associated interfaces into spanning tree edge ports by running the following command:

N9K-A(config-if) # spanning-tree port type edge trunk

- 11.Set the MTU to be 9216 to support jumbo frames by running the following command: N9K-A(config-if)# mtu 9216
- 12. Make a vPC port channel and bring it up by running the following commands:

N9K-A(config-if)# vpc 14 N9K-A(config-if)# no shutdown 13. Define a port description for the interface connecting to FI-B by running the following commands:

```
N9K-A(config-if)# interface eth1/26
N9K-A(config-if)# description FI-B:1/26
```

14. Start the interface by running the following commands:

Cisco Nexus B

1. Define a description for the port channel connecting to FI-B by running the following commands:

```
N9K-B(config-if)# interface Po14
N9K-B(config-if)# description to FI-B
```

2. Make the port channel a switchport and configure a trunk to allow all VLAN traffic by running the following commands:

```
N9K-B(config-if)# switchport
N9K-B(config-if)# switchport mode trunk
N9K-B(config-if)# switchport trunk allowed vlan all
```

Make the port channel and associated interfaces into spanning tree edge ports by running the following command:

N9K-B(config-if) # spanning-tree port type edge trunk

- Set the MTU to be 9216 to support jumbo frames by running the following command: N9K-B(config-if)# mtu 9216
- 5. Make a vPC port channel and bring it up by running the following commands:

```
N9K-B(config-if)# vpc 14
N9K-B(config-if)# no shutdown
```

Define a port description for the interface connecting to FI-B by running the following commands:

```
N9K-B(config-if)# interface eth1/25
N9K-B(config-if)# description FI-B:1/25
```

7. Start the interface by running the following commands:

```
N9K-B(config-if)# channel-group 14 mode active
N9K-B(config-if)# no shutdown
```

8. Define a description for the port channel connecting to FI-A by running the following commands:

```
N9K-B(config-if)# interface Po13
N9K-B(config-if)# description to FI-A
```

9. Make the port channel a switchport and configure a trunk to allow all VLAN traffic by running the following commands:

```
N9K-B(config-if)# switchport
N9K-B(config-if)# switchport mode trunk
N9K-B(config-if)# switchport trunk allowed vlan all
```

10. Make the port channel and associated interfaces into spanning tree edge ports by running the following command:

N9K-B(config-if)# spanning-tree port type edge trunk

- 11.Set the MTU to be 9216 to support jumbo frames by running the following command: N9K-B(config-if)# mtu 9216
- 12.Make a vPC port channel and bring it up by running the following commands:

N9K-B(config-if)# vpc 13 N9K-B(config-if)# no shutdown

13. Define a port description for the interface connecting to FI-A by running the following commands:

```
N9K-B(config-if)# interface eth1/26
N9K-B(config-if)# description FI-A:1/26
```

14. Start the interface by running the following commands:

6.1.8 Linking in to an existing network infrastructure

Depending on the available network infrastructure, you can use several methods and features to uplink to the VersaStack environment. If an existing Cisco Nexus environment is present, Cisco recommends using vPCs to uplink the Cisco Nexus 9000 Series Switches that are included in the VersaStack environment into the infrastructure. The previously described procedures can be used to create an uplink vPC to the existing environment.

7

IBM Storwize V7000 storage configuration

This chapter describes the steps that are necessary to configure the Storwize V7000 storage system in the VersaStack environment.

7.1 Secure web access to the IBM Storwize V7000 service and management GUI

Browser access to all system and service IPs is automatically configured to connect securely by using HTTPS and SSL. Attempts to connect through HTTP are redirected to HTTPS.

The system generates its own self-signed SSL certificate. On first connection to the system, your browser might present a security exception because it does not trust the signer; you should allow the connection to proceed.

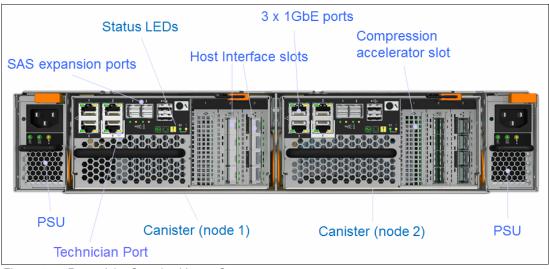


Figure 7-1 shows the rear of the Storwize V7000 Gen2 storage system.

Figure 7-1 Rear of the Storwize V7000 Gen2 storage system

7.2 IBM Storwize V7000 initial configuration setup

To accomplish the initial configuration setup of the IBM Storwize V7000 storage system, complete the following steps:

- 1. Configure an Ethernet port of a PC or notebook to allow DHCP to configure its IP address and DNS settings.
- 2. Connect an Ethernet cable from the PC or notebook Ethernet port to the Ethernet port labeled "T" on the rear of either node canister in the Storwize V7000 control enclosure.
- 3. A few moments after the connection is made, the node uses DHCP to configure the IP address and DNS settings of the PC or notebook.

Note: This step will likely disconnect you from any other network connections that you have on the PC or notebook. If you do not have DHCP on your PC or notebook, you can manually configure it with the following network settings:

- ► IPv4 address: 192.168.0.2
- Mask: 255.255.255.0
- Gateway: 192.168.0.1
- DNS: 192.168.0.1

4. Open a browser and go to https://install, which opens the initialization wizard. Figure 7-2 shows the Welcome window for the wizard.

System Initialization × +	
← ▲ https://install/service/	▽ (
Most Visited 🗍 Getting Started I, Index of IBM Cisco Ver	
	System Initialization ×
	Welcome
	This wizard guides you through the hardware setup process.
	For new installations, locate the customer worksheet and ensure that it has
	been completed by the customer before you begin this procedure.
	Cancel

Figure 7-2 System initialization wizard

- 5. When asked how the node will be used, select As the first node in a new system.
- Follow the instructions that are presented by the initialization tool to configure the system with a management IP address of <<var_cluster_mgmt_ip>>,
 <<var_cluster_mgmt_mask>>, and <<var_cluster_mgmt_gateway>>.
- After you complete the initialization process, disconnect the cable between the PC and notebook and the technician port as directed, and reconnect to your network with your previous settings.
- 8. Click **OK** to redirect your browser to the management GUI at the IP address you configured.

Note: You might have to wait up to 5 minutes for the management GUI to start and become accessible.

- 9. Read and agree to the license agreement by selecting the check box next to it, and then click **Next** to proceed.
- 10.Log in as superuser with a password of passw0rd.
- 11. Change the password for superuser, and then click Log In.

12. Figure 7-3 shows the Storwize V7000 welcome window, which is the first window of System Setup. Click **Next**.

System Setup	х
 Welcome 	Welcome to System Setup
System Name	Congratulations! You now have unmatched performance, availability, advanced functions and highly-scalable capacity right at your fingertips.
Date and Time	Complete the following before continuing:
Licensed Functions	 Attach cables and power on all control and expansion enclosures. Locate licensed function information.
Detected Enclosures	 Locate meansed function mormation. Locate email server IP and ports for sending event notifications. Locate email addresses for local users to receive notifications.
Email Event Notifications	(Optional) Locate NTP server IP address.
Configure Storage	
Summary	
	■ Back Next ► Cancel

Figure 7-3 StorwizeV7000 welcome window

13. The window that is shown in Figure 7-4 opens, where you can change the system name. Change the system name if required, and click **Apply and Next**.

System Setup	x
⊗ Welcome	System Name
System Name	Enter a name for the system:
Date and Time	versastackv7000
Licensed Functions	
Detected Enclosures	
Email Event Notifications	
Configure Storage	
Summary	

Figure 7-4 System Name window

14. The window that is shown in Figure 7-5 opens, where you can set the data and time manually or configure an NTP server. Select NTP Server and enter the NTP server address. Click Apply and Next to view and close the Tasks Completed window.

System Setup		х
@ Welcome		
System Name	Date and Time	
System name	Select time and date settings. You can enter these settings manually or specify a Network Time Protocol (NTP) server to synchronize time on the system.	
Date and Time		
Licensed Functions	O Manually O NTP Server	
Detected Enclosures	IP address: 9.174.128.253	
Email Event Notifications	Time Zone: (GMT-8:00) US Pacific Time	
Configure Storage		
Summary		
	■ Back Apply and Next ► Cance	

Figure 7-5 Date and Time setting window

- 15. Validate that the enclosures that you have connected are detected. If there are any discrepancies, review 5.1, "VersaStack cabling" on page 24. Click **Apply and Next**. View and close the Tasks Completed window.
- 16. The window that is shown in Figure 7-6 on page 47 opens, where you can specify the number of each license that you possess. Licenses are granted based on the number of enclosures. Enter the number for the licensed functions, and then click **Apply and Next**. View and close the Task Completed window.

System Setup	;
 Welcome System Name Date and Time 	Licensed Functions Additional licenses are required to use certain system functions. For auditing purposes, retain the license agreement for proof of compliance.
Licensed Functions	Remote Mirroring: 2 Number of enclosures)
Detected Enclosures Email Event Notifications Configure Storage Summary	External Virtualization: 8 (Number of external enclosures) Real-time Compression: 8 (Number of enclosures)
Need Help	

Figure 7-6 Licensed Functions

17. The window that is shown in Figure 7-7 opens, where you can set up event notifications through email. Select **Yes** to enter the email information for event notification.

System Setup		x
 Welcome System Name Date and Time Licensed Functions Detected Enclosures Email Event Notifications 	Email Event Notifications Call home constantly monitors the health and functionality of your storage system. You and the support center are immediately notified when an event requiring service occurs. A service request is automatically opened and preliminary critical diagnostic data is sent to authorized support personnel. Call home provides: • Up to 45% faster impact resolution time • 24/7 system monitoring • Automatic notification to you and the support center in the event of a system error Do you want to set up email notifications, which includes call home?	
System Location Contact Details Email Servers Email Notifications Configure Storage	⊚ Yes ⊙ No	
Summary		
	Back Next Cancel	

Figure 7-7 Email Event Notifications window

- 18. Enter the system location and contact details of <<var_org>>, <<var_street_address>>, <<var_city>>, <<var_state>>, <<var_zip>>, and <<var_country_code>>, and then click **Apply and Next**. View and close the Tasks Completed window.
- 19.Insert the contact details of <<var_contact_name>>, <<var_email_contact>>, <<var_admin_phone>>, and <<var_city>>, click **Apply and Next**, and click **Close**.
- 20. Enter the email server IP address <<var_mailhost_ip>> and change the port if necessary, and then click **Apply and Next**. View and close the Tasks Completed window. Click **Apply and Next**.
- 21. In the Call Home validation window, click Apply and Next, and then click Close.
- 22. Enter the email addresses for all administrators that should be notified when issues occur and any other parties that need information or inventory by using <<var_email_contact>>. Click Apply and Next. Review and close the Tasks Completed window. Figure 23 shows where you can specify whom receives each email and for what they receive notifications.

System Setup						X
𝞯 Welcome	Email Notifications					
System Name	The call home email to the	e suppor	rt cer	ter is	auto	omatically configured. You
☑ Date and Time	can, optionally, add users	to recei	ve ev	ent n	otific	cations.
☑ Licensed Functions	Email Address ?	8	1	(j)	3	
O Detected Enclosures	callhome0@de.ibm.com	 ✓ ✓ 			Image: Second	$\oplus \oplus$
 Email Event Notifications System Location Contact Details Email Servers Email Notifications 						
Configure Storage						
Summary						
					_	
	Back	Apply	and I	lext 🕨		Cancel

Figure 7-8 Email Notifications window

23. The window that is shown in Figure 7-9 on page 49 opens, where you choose to configure your external storage automatically now or to wait until later. Select **Configure storage now** and then click **Next**.

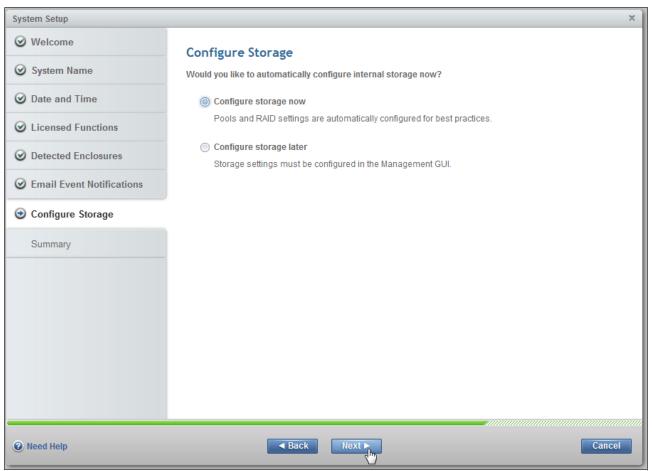


Figure 7-9 Configure Storage window

- 24. Review the summary and click Finish. View and close the Tasks Completed window.
- 25. Click **Cancel** on the Create Hosts window, as these hosts are created after the Cisco Fabric Interconnects are configured. Optionally, you can view an introductory tour of the management GUI by using the link.
- 26.In the window that is shown in Figure 7-10, click the Settings icon in the lower left of the window, and then select **Network**.

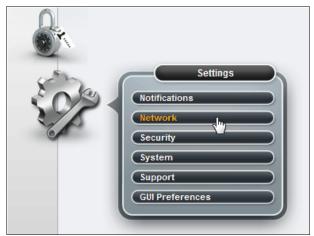


Figure 7-10 Network menu

27. In the window that is shown in Figure 7-11, click the **Service IP Addresses** menu and click port 1 to enter the node management port IP address (<<*var_node01_mgmt_ip>>*), netmask (<<*var_node01_mgmt_mask>>*), and gateway (<<*var_node01_mgmt_gateway>>*). Click **OK** and then click **Close**.



Figure 7-11 Set the service IP for port 1.

- 28. Click the Node Canister drop-down menu item, change the selection to Left, and click the port 1 picture to enter the node management port IP address (<<var_node02_mgmt_ip>>), netmask (<<var_node02_mgmt_mask>>), and gateway (<<var_node02_mgmt_gateway>>). Click OK and then Close.
- 29. In the left menu, hover over each of the icons to become familiar with the GUI options.
- 30. To create a separate administrator user, click the lock icon in the left pane, which opens the Users pane. Click **Create User** and enter the user name (<<*var_admin>>*) and a password (<<*var_password>>*). Click **Create** and then **Close**.
- 31.Log off by selecting the superuser account in the upper right pane and clicking **Log Out**. Log back in by using the admin account that you created.
- 32. Click the fourth icon from the top in the left pane to open the Volumes pane. Click **Create Volume** at the upper left to open the Create Volume wizard.
- 33. Click **Thin-Provision** in the Select a Preset section. Click **mdiskgroup0** in the Select a Pool section.
- 34. To create SAN boot volumes for ESX, in the Volume Details section, enter the following values:
 - Quantity: 2
 - Capacity: 32 GiB
 - Name: vm_host_boot
 - Change the starting number to 1,

Click Create, and then click Close.

Figure 7-12 on page 51 shows the Create Volumes window, which shows the creation of two vm-host-boot volumes.

Create Volumes	x						
Select a Preset Image: Select a Preset Image: Generic Thin-Provision Image: Thin-Provision Mirror Image: Select a Pool Primary Pool: mdiskgrp0							
Volume Details Quantity 2 Capacity 32 GiB Name m_host_boot_ 1 - 2 D Summary: 2 volumes, 64.00 GiB total, 4.29 TiB free in pool							
Advanced Create and Map to Host Cancel							

Figure 7-12 Create two vm-host-boot volumes

- 35. To create a generic VMFS data store for virtual machines, click **Create Volume**, select **Generic** or another preset that you want, and select **mdiskgroup0** for the pool. Enter the following values:
 - Quantity: 1
 - Capacity: 2048 GiB
 - Name: infra_datastore_1

Click Create and then click Close.

36. To create a thin-provisioned VMFS data store, click **Volume**, select **Thin-Provision**, and select **mdiskgroup0** for the pool.

Create Volumes	х						
Select a Preset Image: Select a Preset Generic Thin-Provision Mirror Thin Mirror Compressed Select a Pool Primary Pool: mdiskgrp0							
Volume Details Quantity 1							
Advanced Create and Map to Host Cancel							

Figure 7-13 shows the Create Volumes window, which shows the creation of a thin-provisioned data store.

Figure 7-13 Create a thin-provisioned data store

37. Create the rest of volumes by using the values that are shown in Table 7-1.

Table 7-1 Table of volume names and sizes

Volume name	Size (GiB)	FlashCopy
sql_rdm_data	256	Yes
sql_rdm_log	64	Yes
sql_rdm_quorum	1	No
vm_datastore_1	1024	Yes
vm_datastore_2	256 (thin-provisioned)	Yes
vm_host_boot_1	32	No
vm_host_boot_2	32	No

Figure 7-14 on page 53 shows the final result of volume creation.

Name	State	Capacity	Pool	Host Mappings	UID 📕
infra_datastore_1	✓ Online (formatting)	1.00 TiB	mdiskgrp0	No	6005076802C480B2C400000
infra_datastore_2	✓ Online	256.00 GiB	mdiskgrp0	No	6005076802C480B2C400000
sp_datastore_1	✓ Online (formatting)	2.00 TiB	mdiskgrp0	No	6005076802C480B2C400000
sql_rdm_data	✓ Online (formatting)	256.00 GiB	mdiskgrp0	No	6005076802C480B2C400000
sql_rdm_log	✓ Online (formatting)	64.00 GiB	mdiskgrp0	No	6005076802C480B2C400000
sql_rdm_quorum	✓ Online (formatting)	1.00 GiB	mdiskgrp0	No	6005076802C480B2C400000
vm_host_boot1	✓ Online (formatting)	32.00 GiB	mdiskgrp0	No	6005076802C480B2C400000
vm_host_boot2	✓ Online (formatting)	32.00 GiB	mdiskgrp0	No	6005076802C480B2C400000

Figure 7-14 Final result of volume creation

Note: You might want to create a separate VMFS volume for the swap file. To do so, click **Create Volume**, select **Thin-Provision**, and enter the following details:

- mdiskgrp0
- Quantity: 1
- Capacity: 100 GiB
- Name: infra_swap

Click Create and then Close.

38. Collect the information for the Fibre Channel WWPNs that are used later for SAN boot by selecting the cog icon in the left pane, which opens the Settings menu. Click **Network**, as shown in Figure 7-15.

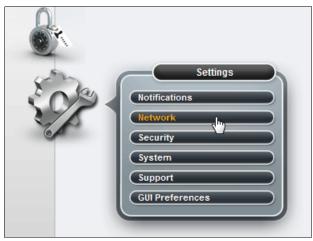


Figure 7-15 Access the FC ports menu

39. Select Fibre Channel Ports in the lower left menu, and then expand the ports 1 - 4 to show the WWPNs, as shown in Figure 7-16.

Network	Fibre Channel Ports						
Management IP Addresses	Each port is configured identically across all nodes in the system. The connection determines with which systems the port is allowed to communicate. Each port is allowed to communicate with hosts and storage systems.						
	E Actio	ns 🔍	Filter		_	Selected 1 Fibre C	Channel I/O port
Service IP Addresses	ID			System Connection	Node	WWPN	IJ
	Θ	1		Any			
Ethernet Ports			1	Any	2(Right)	500507680B214FF5	
			1	Any	4(Left)	500507680B214FF4	
	Θ	2		Any			
iscsi			2	Any	2(Right)	500507680B224FF5	
			2	Any	4(Left)	500507680B224FF4	
Fibre Channel Connectivity		3		Any			
connectivity			3	Any	2(Right)	500507680B234FF5	
			3	Any	4(Left)	500507680B234FF4	
Fibre Channel Ports	Θ	4		Any			
			4	Any	2(Right)	500507680B244FF5	
			4	Any	4(Left)	500507680B244FF4	
	۲	5		Any			
	\oplus	6		Any			
	\oplus	7		Any			
	\oplus	8		Any			

Figure 7-16 Find the FC WWPNs

Note: In this example configuration, we deployed a bloc-only system by using all four Fibre Channel ports. The right node is the configuration node with an ID 2 and the left node is the partner node with an ID of 4.

40. Enter the WWPN numbers that are shown in Table 7-2. They will be required later when you configure the FC zones. The data for the hosts will be collected later in this document. For example, ID 3 on node 1 in Figure 7-16 corresponds to FC_Node1-3 in the spreadsheet.

Source	Switch target	Variable	Customer WWPN
FC_Node1-1	FI-A	var_wwpn_Node1-1-F I-A	
FC_Node1-2	FI-A	var_wwpn_Node1-2-F I-A	
FC_Node1-3	FI-B	var_wwpn_Node1-1-F I-B	
FC_Node1-4	FI-B	var_wwpn_Node1-2-F I-B	
FC_Node2-1	FI-A	var_wwpn_Node2-1-F I-A	
FC_Node2-2	FI-A	var_wwpn_Node2-2-F I-A	
FC_Node2-3	FI-B	var_wwpn_Node2-1-F I-B	

Table 7-2 WWPNs for IBM Storwize V7000 Gen2 storage system

Source	Switch target	Variable	Customer WWPN
FC_Node2-4	FI-B	var_wwpn_Node2-2-F I-B	
vm-host-infra-01-a	FI-A	var_wwpn_VM-Host-I nfra-01-A	
vm-host-infra-01-b	FI-B	var_wwpn_VM-Host-I nfra-01-B	
vm-host-infra-02-a	FI-A	var_wwpn_VM-Host-I nfra-02-A	
vm-host-infra-02-b	FI-B	var_wwpn_VM-Host-I nfra-02-B	

The Storwize V7000 storage system is now configured.

For the examples in this book, we will not be using the Real-time Compression (RtC) feature or the extensive range of replication services. For more information about RtC, see *IBM Real-time Compression in IBM SAN Volume Controller and IBM Storwize V7000*, REDP-4859

For more information about replication services, see *IBM System Storage SAN Volume Controller and Storwize V7000 Replication Family Services*, SG24-7574.

For more information about the Storwize V7000 Gen2 storage system, see *Implementing the IBM Storwize V7000 Gen2*, SG24-8244.

For more information about Storwize software Version 7.4, see *Implementing the IBM Storwize V7000 V7.4*, SG24-7938.

56 VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

8

Cisco Unified Computing System configuration

This chapter describes how to configure the Cisco Unified Computing System (Cisco UCS) for use in a VersaStack environment.

8.1 Performing the initial setup of Unified Computing System 6248 Fabric Interconnect for VersaStack environments

This section provides detailed procedures for configuring the Cisco UCS for use in a VersaStack environment. The steps are necessary to provision the Cisco UCS C-Series and B-Series servers and should be followed precisely to avoid improper configuration.

8.1.1 Cisco UCS 6248 A

To configure the Cisco UCS 6248 A server for use in a VersaStack environment, complete the following steps:

1. Connect to the console port on the first Cisco UCS 6248 fabric interconnect and complete the following prompts with the provided information:

Enter the configuration method: console Enter the setup mode; setup newly or restore from backup.(setup/restore)? Setup You have choosen to setup a a new fabric interconnect? Continue? (y/n): y Enforce strong passwords? (y/n) [y]: yEnter the password for "admin": <<var password>> Enter the same password for "admin": <<var password>> Is this fabric interconnect part of a cluster (select 'no' for standalone)? (yes/no) [n]: y Which switch fabric (A|B): A Enter the system name: <<var ucs clustername>> Physical switch Mgmt0 IPv4 address: <<var ucsa mgmt ip>> Physical switch MgmtO IPv4 netmask: <<var ucsa mgmt mask>> IPv4 address of the default gateway: <<var ucsa mgmt gateway>> Cluster IPv4 address: <<var ucs cluster ip>> Configure DNS Server IPv4 address? (yes/no) [no]: y DNS IPv4 address: <<var nameserver ip>> Configure the default domain name? y Default domain name: <<var dns domain name>> Join centralized management environment (UCS Central)? (yes/no) [n]: Enter

- 2. Review the settings that are output to the console. If they are correct, answer yes to apply and save the configuration.
- 3. Wait for the login prompt and make sure that the configuration process has completed before proceeding. It can take approximately 3 5 minutes.3.

8.1.2 Cisco UCS 6248 B

To configure the Cisco UCS 6248 B server for use in a VersaStack environment, complete the following steps:

 Power on the second module and connect to the console port on the second Cisco UCS 6248 fabric interconnect and complete the following prompts with the provided information:

Enter the configuration method: console Installer has detected the presence of a peer Fabric interconnect. This Fabric interconnect will be added to the cluster. Do you want to continue $\{y|n\}$? y Enter the admin password for the peer fabric interconnect: <<var_password>> Physical switch Mgmt0 IPv4 address: <<var ucsb mgmt ip>> Apply and save the configuration (select 'no' if you want to reenter)? (yes/no): y

8.2 Cisco UCS for IBM Storwize V7000

This section describes the steps to install the Cisco UCS for Storwize V7000.

8.2.1 Logging in to Cisco UCS Manager

To log in to the Cisco UCS environment, complete the following steps:

- 1. Open a web browser and navigate to the Cisco UCS 6248 fabric interconnect cluster address.
- 2. Click the Launch UCS Manager link to download the Cisco UCS Manager software.
- If prompted to accept security certificates, accept as necessary.
- When prompted, enter admin as the user name and enter the administrative password of <<var_password>>.
- 5. Click Login to log in to Cisco UCS Manager.
- 6. Enter the information for Anonymous Reporting if you want and click **OK**.

8.2.2 Upgrading Cisco UCS Manager software to Version 2.2(3d)

This book assumes the use of Cisco UCS Manager Software Version 2.2(3d). To upgrade the Cisco UCS Manager software and the Cisco UCS 6248 Fabric Interconnect software to Version 2.2(3d), see the Cisco UCS Manager Install and Upgrade Guides, found at the following website:

http://www.cisco.com/c/en/us/support/servers-unified-computing/ucs-manager/product
s-installation-guides-list.html

8.2.3 Adding a block of IP addresses for KVM access

To create a block of IP addresses for server Keyboard, Video, Mouse (KVM) access in the Cisco UCS environment, complete the following steps.

Note: This block of IP addresses should be in the same subnet as the management IP addresses for the Cisco UCS Manager.

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Click Pools \rightarrow root \rightarrow IP Pools \rightarrow IP Pool ext-mgmt.
- 3. In the Actions pane, select Create Block of IP Addresses.
- 4. Enter the starting IP address of the block and the number of IP addresses required, and the subnet and gateway information (<<var_In-band_mgmtblock_net>>).
- 5. Click OK to create the IP block.
- 6. Click **OK** in the confirmation message.

8.2.4 Adding a block of IPv4 addresses for KVM access

To create a block of IP addresses for server Keyboard, Video, Mouse (KVM) access in the Cisco UCS environment, complete the following steps:

Note: This block of IP addresses should be in the same subnet as the management IP addresses for the Cisco UCS Manager.

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Select **Pools** \rightarrow **root** \rightarrow **IP Pools** \rightarrow **IP Pool ext-mgmt**, as shown in Figure 8-1.

4
IF SS

Figure 8-1 IP pool ext-mgmnt

- 3. In the Actions pane, select Create Block of IPv4 Addresses.
- 4. Enter the starting IP address of the block and the number of IP addresses required, and the subnet and gateway information (<<var_In-band_mgmtblock_net>>).

Figure 8-2 on page 61 shows the creation of the block of IPv4 addresses.

L	Cre	ate Block of IPv4 Address	es		x
Create a	a Block of IPv4	Addresses			0
From:	192.168.10.41	Size:	D		8 🔹
Subnet Mask:	255.255.255.0	Default Gateway:	192.168.10.1		
Primary DNS:	0.0.0.0	Secondary DNS:	0.0.0.0		
				OK	Cancel

Figure 8-2 Create a block of IPv4 addresses

- 5. Click **OK** to create the IP block.
- 6. Click **OK** in the confirmation message.

8.2.5 Synchronizing the Cisco UCS environment to NTP

To synchronize the Cisco UCS environment to the NTP server, complete the following steps:

- 1. In Cisco UCS Manager, click the Admin tab in the navigation pane.
- 2. Click All \rightarrow Timezone Management, as shown in Figure 8-3.

Fault Summary) 🕘 🗈 New 🚽 🛃 Option:	s 😧 🕕 🎑 Pending Activities 🚺 Exit	
	> 👸 All 🕨 🎯 Time Zone Ma	nagement	
Equipment Servers LAN SAN VM Admin	General Events		
Filter: All	Actions	Properties	
	Add NTP Server	Time Zone: <not set=""></not>	
E All		NTP Servers	
🖭 🔒 User Management		Alter ⇒ Export B Print Print Alter → Export Alter → Alter →	
🖃 🔑 Key Management		Name	Ę
🖅 🖳 Stats Management			^
Time Zone Management			
Management Extension			-
			1
			×
			×

Figure 8-3 Timezone Management

- 3. In the Properties pane, select the appropriate time zone in the Timezone menu.
- 4. Click Save Changes, and then click OK.
- 5. Click Add NTP Server.

6. Enter <<var_global_ntp_server_ip/FQDN>> and click **OK**, as shown in Figure 8-4.

A	Add NTP Server	X
Add	NTP Server	0
	NTP Server: pool.ntp.org	
	ОК	Cancel

Figure 8-4 Add NTP server

7. Click **OK**.

Editing the chassis discovery policy

Setting the discovery policy simplifies the addition of Cisco UCS B-Series chassis and of additional fabric extenders for further Cisco UCS C-Series connectivity.

To modify the chassis discovery policy, complete the following steps:

- 1. In Cisco UCS Manager, click the **Equipment** tab in the navigation pane and select **Equipment** in the list on the left.
- 2. In the right pane, click the **Policies** tab.
- Under Global Policies, set the Chassis/FEX Discovery Policy to match the number of uplink ports that are cabled between the chassis or fabric extenders (FEXes) and the fabric interconnects.
- 4. Set the Link Grouping Preference to **Port Channel**, as shown in Figure 8-5.

Fault Summary	G 💿 🖬 New - 🔀 Options 😧 🕕 Arctivities 🖸 Exit
	>> 🛱 Equipment
Equipment Servers LAN SAN VM Admin	📲 Main Topology View 🔤 Fabric Interconnects 🥪 Servers 🧹 Thermal 👹 Decommissioned 📥 Firmware Management 🗵 Policies
	Global Policies Autoconfig Policies Server Inheritance Policies Blade Server Discovery Policies SEL Policy Power Groups
Filter: All ⊕ ⊕ ⊕ Economent ⊕ ⊕ Chassis ⊕ ⊕ Acd-Mounts ⊕ ⊕ ■ Fabric Interconnects	Chassis/FEX Discovery Policy Action: 2 Link Link Grouping Preference: None Port Channel Rack Server Discovery Policy Action: Immediate User Adknowledged Scrub Policy: <not set=""></not>

Figure 8-5 Link grouping preference

- 5. Click Save Changes.
- 6. Click **OK**.

8.2.6 Enabling the server and uplink ports

To enable the server and uplink ports, complete the following steps:

- 1. In Cisco UCS Manager, click the Equipment tab in the navigation pane.
- 2. Click Equipment \rightarrow Fabric Interconnects \rightarrow Fabric Interconnect A (primary) \rightarrow Fixed Module.
- 3. Expand Ethernet Ports.
- 4. Select the ports that are connected to the chassis, right-click them, and select Configure as Server Port, as shown in Figure 8-6.

Fault Summary	1	A ₂	>> 🗄 Equipment 🕨	Options 😧 🛈 🖾 P
Equipment Servers LAN SAN V	/M Admin		General Faults Even	nts FSM Statistics
Filter: All	-		Fault Summary	• • •
• E			🛛 😣 🔻	΄ 🛆 🛆
Equipment Grassis Ack-Mounts Fabric Interconnects Fixed Module Fixed Module				0 0 Admin Down Idministratively down Disabled
Port 1			Actions	
-I Port 2	Enable			
	Disable			
		r Port		
Port 7 Configure as Upli		k Port		

Figure 8-6 Configure as a server port

- 5. Click **Yes** to confirm server ports and click **OK**.
- 6. Verify that the ports that are connected to the chassis are now configured as server ports, as shown in Figure 8-7.

Fault Summary S V L L L L L L L L L L L L L L L L L L	>> 🛅		Options Options O O				IIII Fixed Module >(]] Ethernet P
	🔍 Filte	er 👄 Export	旑 Print If Role: 🗌 A	ll 🗌 Unco	onfigured 📃	Network 🖌 Serve	r 🔄 FCoE Uplink 🔽 Unified Uplin
Filter: All	Slot	Port ID	MAC	If Role	IfType	Overall Status	Administrative State
t e	1	1	8C:60:4F:5F:7A:28	Server	Physical	1 Up	1 Enabled
Equipment	1	2	8C:60:4F:5F:7A:29	Server	Physical	1 Up	1 Enabled
Chassis Ack-Mounts Ack-Mounts Fabric Interconnects Fabric Interconnect A (primary Fixed Module Action of Port 1 Action of Port 2 Action of Port 3 Action of Port 4 Action of Port 5 Action of Port 5							

Figure 8-7 Verify the server ports

- 7. Select ports 25 and 26 that are connected to the Cisco Nexus switches, right-click them, and select **Configure as Uplink Port**.
- 8. Click **Yes** to confirm the uplink ports and click **OK**.
- 9. Click Equipment \rightarrow Fabric Interconnects \rightarrow Fabric Interconnect B (subordinate) \rightarrow Fixed Module.
- 10. Expand Ethernet Ports.
- 11.Select the ports that are connected to the chassis, right-click them, and select **Configure** as Server Port.
- 12. Click Yes to confirm server ports and click OK.
- 13. Select ports 25 and 26 that are connected to the Cisco Nexus switches, right-click them, and select **Configure as Uplink Port**.
- 14. Click Yes to confirm the uplink ports and click OK.

Changing FI to FC Switching Mode on FI-A and FI-B

Switching FC modes requires the Fabric Interconnects to restart. The restart takes place automatically. When the Fabric Interconnects complete the restart process, a new management session must be established to continue with management and configuration.

Complete the following steps:

1. In the window that is shown in Figure 8-8 on page 65, go to the Equipment tab in the left pane and expand the **Fabric Interconnects** object.

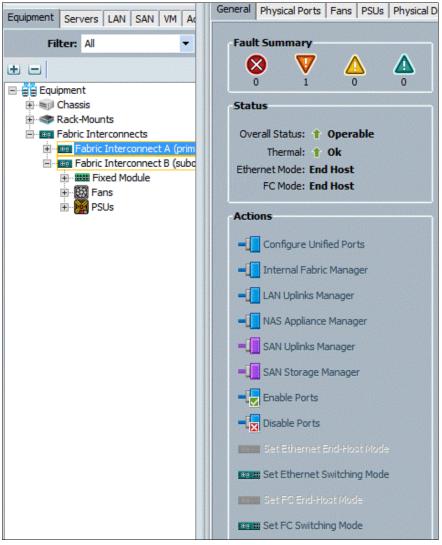


Figure 8-8 Check fabric interconnects

- 2. Select **Fabric Interconnect A**, in the left pane, click the **General** tab, and click **Set FC Switch Mode** in the left pane.
- 3. Click Yes and then OK.
- 4. Wait for the Fabric Interconnects to restart before proceeding. This process takes approximately 5 minutes for the restart of both nodes.

8.2.7 Enabling Fibre Channel ports

To enable the server and FC uplink ports, complete the following steps:

1. On the Equipment tab, select **Fabric Interconnect B**, which should be the subordinate FI, select **Configure Unified Ports**, and click **Yes**, as shown in Figure 8-9.

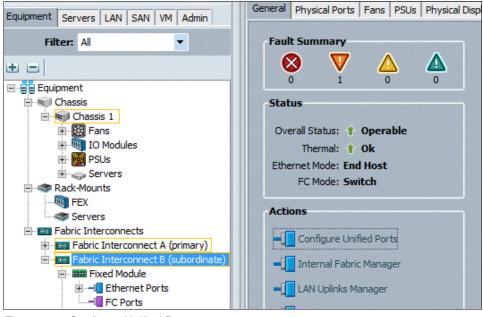


Figure 8-9 Configure Unified Ports

 Slide the bar to the left to select ports 31 - 32 for FC (purple), click Finish, and click Yes in response to the restart message, as shown in Figure 8-10 on page 67. You must log in to the client again after the restart of the FI completes.

	mea C	amouting	Suctom Manager	
Configu		omputing	System Manager	
	re Fixed Mo	dule Ports		(
		аки паки наки наки наки па	TR DATE DATE DATE	
cisco				
V				
Instructions	5			
		determines the type of the ports.		
All	the ports to the left of	^t the slider are Ethernet ports (Blue), w	hile the ports to the right are Fibre Channel ports (Purple).	
Port	Transport	If Role or Port Channel	Desired If Role	
	ether			
ort 18		Unconfigured		
		Linear Council		-
	ether	Unconfigured		
ort 20	ether ether	Unconfigured		
ort 20 ort 21	ether ether ether	Unconfigured Unconfigured		
ort 20 ort 21 ort 22	ether ether ether ether	Unconfigured Unconfigured Unconfigured		
ort 20 ort 21 ort 22 ort 23	ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured		
ort 20 ort 21 ort 22 ort 23 ort 24	ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured		
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25	ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink		
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 26	ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink		
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 26 ort 27	ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured		
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 26 ort 27 ort 28	ether ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured Unconfigured		
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 25 ort 26 ort 27 ort 28 ort 29	ether ether ether ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured Unconfigured Unconfigured	FC Uplink	
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 26 ort 26 ort 26 ort 27 ort 28 ort 29 ort 30	ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured Unconfigured Unconfigured Unconfigured	FC Uplink	
ort 20 ort 21 ort 22 ort 23 ort 24 ort 25 ort 25 ort 27 ort 27 ort 27 ort 27 ort 27 ort 28 ort 29 ort 30 ort 31	ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured Unconfigured Unconfigured Unconfigured Unconfigured	FC Uplink FC Uplink	
Vort 19 Vort 20 Vort 21 Vort 22 Vort 23 Vort 23 Vort 24 Vort 25 Vort 26 Vort 26 Vort 27 Vort 28 Vort 29 Vort 29 Vort 29 Vort 30 Vort 32	ether ether ether ether ether ether ether ether ether ether ether ether ether ether ether	Unconfigured Unconfigured Unconfigured Unconfigured Ethernet Uplink Ethernet Uplink Unconfigured Unconfigured Unconfigured Unconfigured	FC Uplink	

Figure 8-10 Check ports

- 3. Select Fabric Interconnect A (primary), select Configure Unified Ports, and click Yes.
- 4. Slide the bar to the left to select ports 29 32 for FC (purple), click **Finish**, and click **Yes** in response to the restart message. You must log in to the client again after the restart of the FI completes.

8.2.8 Creating storage VSANs

To configure the necessary VSANs and FC Port Channels for the Cisco UCS environment, complete the following steps:

- 1. Select the **SAN** tab at the upper left of the window.
- 2. Expand the Storage Cloud tree.

3. Right-click VSANs, as shown in Figure 8-11.

Equipment Servers LAN	SAN VM Admin			
Filter: All	.			
• •				
🖹 🔘 Storage Cloud				
🗄 🔤 Fabric A				
🗄 🚥 Fabric B				
🖽 🖉 Policies	Show Navigator			
⊞ 🚱 Pools ⊞ 💓 Traffic Mo	Create Storage VSAN			

Figure 8-11 Click VSANs

4. Select Create Storage VSAN. The window that is shown in Figure 8-12 opens.

🗻 Create Sto	rage VSAN
Create Storage VSAN	0
Name: VSAN-A	
FC Zoning Settings	
FC Zoning: Disabled Enabled Do NOT enable local zoning if fabric interconnect is conn	ected to an upstream FC/FCoE switch.
○ Common/Global ● Fabric A ○ Fabric B ○ Both Fa	brics Configured Differently
You are creating a local VSAN in fabric A that maps to a VSAN ID that exists only in fabric A.	A VLAN can be used to carry FCoE traffic and can be mapped to this VSAN.
Enter the VSAN ID that maps to this VSAN.	Enter the VLAN ID that maps to this VSAN.
VSAN ID: 101	FCoE VLAN: 101
	OK Cancel

Figure 8-12 Create storage VSAN-A

- 5. Enter VSAN_A as the VSAN name for Fabric A.
- 6. Select **Enabled** under the FC Zoning Settings.
- 7. Select Fabric A.
- 8. Enter the VSAN ID (<<var_vsan_a_id>>) for Fabric A.
- 9. Enter the FCoE VLAN ID (<<var_vsan_a_id>>) for Fabric A.
- 10. Click OK, and then OK again to create the VSAN.

11. In the window that is shown in Figure 8-11 on page 68, right-click **VSANs** and select **Create Storage VSAN**. The window that is shown in Figure 8-13 opens.

A Create Sto	rage VSAN
Create Storage VSAN	•
Name: VSAN-B FC Zoning Settings FC Zoning: Disabled • Enabled Do NOT enable local zoning if fabric interconnect is conne Common/Global • Fabric A • Fabric B • Both Fab	
You are creating a local VSAN in fabric B that maps to a VSAN ID that exists only in fabric B. Enter the VSAN ID that maps to this VSAN. VSAN ID: 102	A VLAN can be used to carry FCoE traffic and can be mapped to this VSAN. Enter the VLAN ID that maps to this VSAN. FCoE VLAN: 102 OK Cancel

Figure 8-13 Create storage VSAN-B

12. Enter VSAN_B as the VSAN name for Fabric B.

- 13. Select **Enabled** under the FC Zoning Settings.
- 14.Select Fabric B.
- 15.Enter the VSAN ID (<<var_vsan_b_id>>) for Fabric B.
- 16.Enter the FCoE VLAN ID (<<var_vsan_b_id>>) for Fabric B.
- 17.Click **OK**, and then **OK** to create the VSAN.

8.2.9 Configuring the FC storage ports

To configure the FC storage ports, complete the following steps:

- 1. Click the **Equipment** tab at the upper left of the window.
- Click Equipment → Fabric Interconnects → Fabric Interconnect A (primary) → Fixed Module. The window that is shown in Figure 8-14 opens.

Equipment Servers LAN SAN VM Admin	General Faults Events FSM Statistics	
Filter: All	Fault Summary	Physical Display
± =		
E guipment		V Internet and a second s
😟 👘 Chassis	Status	Up 📕 Admin Down 📕 Fail 🔛 Link Down
Rack-Mounts		
Fabric Interconnects	Overall Status: 💔 Failed	Properties
E-Babric Interconnect A (subordinate)	Additional Info: Offline	
Fixed Module	Admin State: Enabled	ID: 29 Slot ID: 1
Ethernet Ports		User Label:
E FC Ports	Actions	WWPN: 20:1D:8C:60:4F:5F:7A:40 Mode: E
		Port Type: Physical Negotiated Speed: Indeterminate
FC Port 30	Enable Port	
FC Port 31		VSAN: Fabric dual/vsan default (1)
FC Port 32	- Disable Port	
+ 😥 Fans		
PSUs	Configure as Uplink Port	License Details
Fabric Interconnect B (primary)	Configure as FC Storage Port	License State: License Ok
Fixed Module	- Configure as FC Storage Port	License Grace Period: 0
E B Fans	- Show Interface	License drate Period.

Figure 8-14 Configure FC port

- 3. Expand the FC Ports object.
- 4. Select FC Port 29, which is connected to the IBM storage array.
- 5. Under the General tab, click Configure as FC Storage Port.
- 6. Click Yes, and then click OK.
- 7. Repeat steps 2 6 for FC ports 30 32.
- Click Equipment → Fabric Interconnects → Fabric Interconnect B (primary) → Fixed Module. The window that is shown in Figure 8-15 opens.

Equipment Servers LAN SAN VM Admin	General Faults Events FSM Statistics	Physical Display
Coupernt Coupernt	Note: Status Note: Status Overall Status: Note: Status Overall Status: Note: Status Additional Info: Offline Admin State: Enabled Additional Enabled Admin State: Enabled Actions Image: Status Image: Status Status	Up Admin Down Fail Link Down Properties ID: 29 Slot ID: 1 User Label: WWN: 20:ID:8C:60:4F:5F:6C:C0 Mode: E Port Type: Physical Negotiated Speed: Indeterminate VSAN: Fabric dual/vsan default (1) V
FC Port 31 FC Port 32 F S Fans F S PSUs	Configure as Upin's Port Configure as PC Storage Port Configure as PC Storage Port Show Interface	License Details License State: License Ok License Grace Period: 0

Figure 8-15 General tab

- 9. Expand the FC Ports object.
- 10. Select FC Port 29, which is connected to the IBM storage array.
- 11. Under the General tab, select Configure as FC Storage Port.
- 12.Click Yes, and then click OK.
- 13. Repeat the steps 8 12 for FC ports 30 32.

8.2.10 Configuring the VSAN for the FC storage ports

To configure VSAN-A and VSAN-B, complete the following steps:

- 1. Click the **Equipment** tab at the upper left of the window.
- 2. Click Equipment \rightarrow Fabric Interconnects \rightarrow Fabric Interconnect A (primary) \rightarrow Fixed Module. The window that is shown in Figure 8-16 opens.

Fault Summary			
	Ġ 🌑 🗉 New 🖌 🛃 Options 😯 🕕 🧥 Pe	nding Activities 0 Exit	
	>> 🛱 Equipment + 🔤 Fabric Interconnects +	Eabric Interconnect ((subordinata))	ad Modula) = I EC Porte) =
1 7 1 4		and the connect A (subordinate) /	
Equipment Servers LAN SAN VM Admin	General Faults Events FSM Statistics		
Filter: All	Fault Summary	Physical Display	
± =	🛛 🛛 🗸 🖉 🛆 🔺		
Equipment		Andreasting and also also also also also also a service and and also also also also also also also also	
± € Chassis	Status	📕 Up 🧱 Admin Down 📕 Fail 🔜 Link Dov	'n
⊞	Overall Status: 1 Up		
E-Babric Interconnects		Properties	
E Fabric Interconnect A (subordinate)	Additional Info:	ID: 29	Slot ID: 1
E Fixed Module	Admin State: Enabled		50010; 1
🗄 🚺 Ethernet Ports		User Label:	
E FC Ports	Actions	WWPN: 20:1D:8C:60:4F:5F:7A:40	Mode: F
FC Port 29		Port Type: Physical	Negotiated Speed: 8 Gbps
FC Port 30	Enable Port		
FC Port 31	= Disable Port	VSAN: Fabric A/vsan VSAN-A (101)	
		Fabric A/vsan VSAN-A (101)	
E Bans	Configure as Uplink Port	License Det Fabric dual/vsan default (1)	<u> </u>
Fabric Interconnect B (primary)		License State: License Ok	
Fixed Module	Configure as FC Storage Port	License Grace Period: 0	
+ BR Fans	Show Interface		
PSUs			

Figure 8-16 Select VSAN

- 3. Expand the **FC Ports** object.
- 4. Select FC Port 29, which is connected to the IBM storage array.
- 5. In the right pane, click the VSAN drop-down menu and select Fabric A / vsan VSAN-A (101).
- 6. Click Save Changes and then click OK.
- 7. Repeat the steps 2 to 6 for FC ports 30 32.
- 8. Click Equipment \rightarrow Fabric Interconnects \rightarrow Fabric Interconnect B (subordinate) \rightarrow Fixed Module. The window that is shown in Figure 8-17 opens.



Figure 8-17 Select VSAN

9. Expand the FC Ports object.

10. Select **FC Port 29**, which is connected to the storage array.

- 11. In the right pane, click the VSAN drop-down menu and select Fabric B / vsan VSAN-B (102).
- 12. Click Save Changes, and then click OK.
- 13. Repeat steps 8 on page 71 12 for FC ports 30 32.
- 14. Verify the roles and statuses of the ports, as shown in Figure 8-18.

	FC Por	ts		an a	and the second second		
Equipment Servers LAN SAN VM Admin	🔍 Filte	er ⇒ Export	🝃 Print 🛛 If Role: 🔽 All 🛛 🔽 Netv	work 🗹 Stor	age 🗹 Monit	or	
Filter: All	Slot	Port ID	WWPN	If Role	If Type	Overall Status	Administrative Stat
	1	29	20:1D:8C:60:4F:5F:6C:C0	Storage	Physical	1 Up	1 Enabled
Equipment	1	30	20:1E:8C:60:4F:5F:6C:C0	Storage	Physical	1 Up	1 Enabled
E Chassis	1	31	20:1F:8C:60:4F:5F:6C:C0	Storage	Physical	1 Up	1 Enabled
E Rack-Mounts	1	32	20:20:8C:60:4F:5F:6C:C0	Storage	Physical	1 Up	1 Enabled
Fabric Interconnect A (subordinate) Fabric Interconnect B (primary) FC Ports FC Ports FC Port 29 FC Port 30 FC Port 31 FC Port 32							

Figure 8-18 Verify roles and statuses

15. You should see the storage arrays WWPN flogi in the Cisco UCS Fabric Interconnect. You can view flogi by connecting to the Cisco UCS Manager cluster IP through SSH:

```
Versastack-FI-B# connect nxos b
Versastack-FI-B(nxos)# sh floqi database
INTERFACE VSAN FCID PORT NAME NODE NAME
fc1/29 102 0x0c0000 50:05:07:68:0b:21:4f:f5 50:05:07:68:0b:00:4f:f5
fc1/30 102 0x0c0020 50:05:07:68:0b:22:4f:f4 50:05:07:68:0b:00:4f:f4
fc1/31 102 0x0c0040 50:05:07:68:0b:22:4f:f5 50:05:07:68:0b:00:4f:f5
fc1/32 102 0x0c0060 50:05:07:68:0b:23:4f:f4 50:05:07:68:0b:00:4f:f4
Total number of f logi = 4.
Versastack-FI-B (nxos) f exit
Versastack-FI-BI connect nxos a
Versastack-FI-A(nxos)# sh flogi database
INTERFACE VSAN FCID PORT NAME NODE NAME
fc1/29 101 0xa90000 50:05:07:68:0b:23:4f:f550:05:07:68:0b:00:4f:f5
fc1/30 101 0xa90020 50:05:07:68:0b:24:4f:f4 50:05:07:68:0b:00:4f:f4
fc1/31101 0xa90040 50:0S:07:68:0b:24:4f:f550:05:07:68:0b:00:4f:f5
fc1/32 101 0xa90160 50:05:07:68:0b:23:4f:f4 50:05:07:68:0b:00:4f:f4
Total number of f \log i = 4.
```

This is also shown in Figure 8-19 on page 73.

```
Versastack-FI-B# connect nxos b
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2014, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under
license. Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or the GNU
Lesser General Public License (LGPL) Version 2.1. A copy of each
such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://www.opensource.org/licenses/lgpl-2.1.php
Versastack-FI-B(nxos) # sh floqi database
        _____
                               _____
INTERFACE
              VSAN FCID
                                       PORT NAME
                                                               NODE NAME
        1020x0c000050:05:07:68:0b:21:4f:f550:05:07:68:0b:00:4f:f51020x0c002050:05:07:68:0b:22:4f:f450:05:07:68:0b:00:4f:f4
fc1/29
fc1/30
               102 0x0c0040 50:05:07:68:0b:22:4f:f5 50:05:07:68:0b:00:4f:f5
fc1/31
               102 0x0c0060 50:05:07:68:0b:23:4f:f4 50:05:07:68:0b:00:4f:f4
fc1/32
Total number of flogi = 4.
Versastack-FI-B(nxos) # exit
Versastack-FI-B# connect nxos a
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2014, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under
license. Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or the GNU
Lesser General Public License (LGPL) Version 2.1. A copy of each
such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://www.opensource.org/licenses/lgpl-2.1.php
Versastack-FI-A(nxos) # sh flogi database
       _____
                               _____
INTERFACE VSAN FCID PORT NAME NODE NAME
              _____
fc1/291010xa9000050:05:07:68:0b:23:4f:f550:05:07:68:0b:00:4f:f5fc1/301010xa9002050:05:07:68:0b:24:4f:f450:05:07:68:0b:00:4f:f4fc1/311010xa9004050:05:07:68:0b:24:4f:f550:05:07:68:0b:00:4f:f5
               101 0xa90160 50:05:07:68:0b:23:4f:f4 50:05:07:68:0b:00:4f:f4
fc1/32
Total number of flogi = 4.
```

Figure 8-19 WWPNs flogi

8.2.11 Creating WWNN pools

To configure the necessary World Wide Node Name (WWNN) pools for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the SAN tab in the navigation pane.
- 2. Click **Pools** \rightarrow **root**.

3. Right-click **WWNN Pools**, as shown in Figure 8-20.

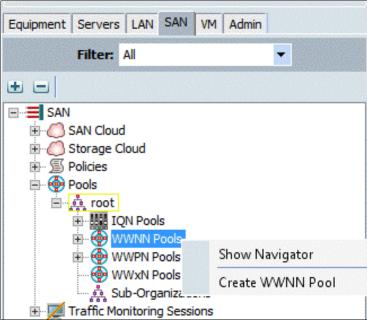


Figure 8-20 Create WWNN Pool

- 4. Select Create WWNN Pool.
- 5. Enter WWNN_Pool as the name of the WWNN pool.
- 6. (Optional) Add a description for the WWNN pool.
- 7. Click Next.
- 8. Click Add to add a block of WWNNs.
- 9. Keep the default block of WWNNs, or specify a base WWNN.
- 10. Specify a size for the WWNN block that is sufficient to support the available blade or server resources, as shown in Figure 8-21.

A	Create WWN Block		x
Crea	ate WWN Block		0
To en strong	20:00:00:25:B5:00:00:00 sure uniqueness of WWNs in the SAN fabric, you are gly encouraged to use the following WWN prefix: D:00:25:b5:xx:xx:xx	Size:	16 🔹
		ОК	Cancel

Figure 8-21 Create WWNN block

11.Click OK.

12. Click Finish, as shown in Figure 8-22 on page 75.

A	Create WW	NN Pool		X
Unified Computing System Manager				
Create WWNN Pool 1. √Define Name and	Add WWN Blocks			0
Description 2. ✓ Add WWN Blocks	Name	From 20:00:00:25:85:00: 20:00:00:25:85:00:0.	To 20:00:00:25:85:00:0	. ^
		H Add 👕 Delete		~
		< Prev Next >	Finish Cano	cel

Figure 8-22 Create WWNN pool

13.Click OK.

8.2.12 Creating WWPN pools

To configure the necessary worldwide port name (WWPN) pools for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the **SAN** tab in the navigation pane.
- 2. Click **Pools** \rightarrow **root**.

Note: In this procedure, two WWPN pools are created: one for fabric A and one for fabric B.

3. Right-click **WWPN Pools**, as shown in Figure 8-23.

Equipment Servers LAN S	AN VM Admin
Filter: All	
• •	
🖃 🕂 🗮 SAN	
🗄 🔘 SAN Cloud	
🗄 🕖 Storage Cloud	
😟 🖉 Policies	
🖻 😨 Pools	
🖃 🧔 root	
IQN Pools	
🗄 🎡 WWNN Poo	
🗄 🧐 WWPN Poo	
🚱 WWxN Poo	
····· 츴 Sub-Organi 표·· 📈 Traffic Monitoring S	

Figure 8-23 Create WWPN Pool

4. Select Create WWPN Pool.

- 5. Enter WWPN_Pool_A as the name of the WWPN pool for Fabric A.
- 6. (Optional) Enter a description for this WWPN pool.
- 7. Click Next.
- 8. Click Add to add a block of WWPNs.
- 9. Specify the starting WWPN in the block for Fabric A, as shown in Figure 8-24.

Create WWN Block		X
Create WWN Block		0
From: 20:00:00:25:B5:01:0A:00 To ensure uniqueness of WWNs in the SAN fabric, you are strongly encouraged to use the following WWN prefix: 20:00:00:25:b5:xx:xx:xx	Size:	32
	ОК	Cancel

Figure 8-24 Create WWN block

Note: For the VersaStack solution, the recommendation is to place 0A in the next-to-last octet of the starting WWPN to identify all the WWPNs in this pool as Fabric A addresses.

- 10. Specify a size for the WWPN block that is sufficient to support the available blade or server resources.
- 11.Click OK.
- 12. Click Finish to create the WWPN pool, as shown in Figure 8-25.

A	Create	WWPN Pool		x
Unified C	omputing	System Mana	ger	
Create WWPN Pool 1. √ <u>Define Name and</u>	Add WWN Blocks	6		0
Description 2. ✓ <u>Add WWN Blocks</u>	Name	From 1:A0 - 20:00:00:25 20:00:00:25:85:01:00:A0	To 20:00:00:25:85:01:00:8F	F
		Add		~
<pre></pre>				

Figure 8-25 Create the WWPN pool

13.Click OK.

- 14. Right-click WWPN Pools.
- 15.Click Create WWPN Pool.
- 16.Enter WWPN_Pool_B as the name for the WWPN pool for Fabric B.
- 17.(Optional) Enter a description for this WWPN pool.
- 18.Click Next.
- 19. Click Add to add a block of WWPNs.
- 20. Enter the starting WWPN address in the block for Fabric B.

Note: For the VersaStack solution, the recommendation is to place 0B in the next to last octet of the starting WWPN to identify all the WWPNs in this pool as Fabric B addresses.

- 21. Specify a size for the WWPN block that is sufficient to support the available blade or server resources.
- 22.Click OK.
- 23.Click Finish.
- 24.Click OK.

Figure 8-26 shows successful pool creation.

	WWPN Pools	
Equipment Servers LAN SAN VM Admin	🛨 🖃 💐 Filter 👄 Export 🏀 Print	
Filter: All	Name	Size Assigned
		32 0
	[20:00:00:25:B5:01:0A:00 - 20:00:00:25	5:B5:01:0A:1F]
🗄 🟉 SAN Cloud	😑 🚯 WWPN Pool WWPN_Pool_B	32 0
🗄 💋 Storage Cloud	[20:00:00:25:B5:01:0B:00 - 20:00:00:25	::B5:01:0B:1F]
	WWPN Pool default	0 0

Figure 8-26 Check pool creation

8.2.13 Creating vHBA templates for Fabric A and Fabric B

To create multiple virtual host bus adapter (vHBA) templates for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the **SAN** tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click vHBA Templates, as shown in Figure 8-27.

Equipment Servers LAN SAN VM	Admin
Filter: All	-
+ =	
SAN	
⊞ Osan Cloud	
🗄 🔘 Storage Cloud	
🖮 📓 Policies	
🗉 🕘 SAN Cloud	
🖮 🧙 root	
🔊 Default vHBA Behavi	or
🗄 🚿 🗐 Fibre Channel Adapt	er Policies
E S LACP Policies	
SAN Connectivity Po	licies
🔊 Storage Connection	Policies
Interstold Policies Interstold Policies	
····· 📅 vHBA Templates	
Sub-Organization	Show Navigator
🕀 💮 Pools	Create vHBA Template
🗄 📈 Traffic Monitoring Sessions	

Figure 8-27 Create vHBA Template

4. Select **Create vHBA Template**. The window that is shown in Figure 8-28 on page 79 opens.

A	Create vHBA Template	X
Create vHBA	Template	0
Name:	vHBA_Template_A	
Description:		
Fabric ID:	• A • B	
Select VSAN:	VSAN-A 🔽 🕂 Create VSAN	
Template Type:	O Initial Template O Updating Template	
Max Data Field Size:	2048	
WWPN Pool:	WWPN_Pool_A(32/32)	
QoS Policy:	<not set=""></not>	
Pin Group:	<not set=""></not>	
Stats Threshold Policy:	default 🗾	
	ОК	Cancel

Figure 8-28 Creating vHBA template

- 5. Enter vHBA_Template_A as the vHBA template name.
- 6. Select A for Fabric ID.
- 7. In the Select VSAN list, select VSAN_A.
- 8. In the WWPN Pool list, select WWPN_Pool_A.
- 9. Click OK to create the vHBA template, and click OK again.
- 10. In the navigation pane, click the **SAN** tab.
- 11.Click **Policies** \rightarrow **root**.
- 12. Right-click vHBA Templates.

13. Select Create vHBA Template. The window that is shown in Figure 8-29 opens.

A	Create vHBA Template	x
Create vHBA	Template	0
Name:	vHBA_Template_B	
Description:	Ψ	
Fabric ID:	O A ● B	
Select VSAN:	VSAN-B Create VSAN	
Template Type:	Initial Template O Updating Template	
Max Data Field Size:	2048	
WWPN Pool:	WWPN_Pool_B(32/32)	
QoS Policy:	<not set=""></not>	
Pin Group:	<not set=""></not>	
Stats Threshold Policy:	default 💌	
	ОК	ncel

Figure 8-29 Create vHBA template

14. Enter vHBA_Template_B as the vHBA template name.

- 15.Select **B** for Fabric ID.
- 16. In the Select VSAN list, select VSAN_B.
- 17. In the WWPN Pool, select WWPN_Pool_B.

18. Click **OK** to create the vHBA template, and click **OK** again.

8.2.14 Creating the storage connection policy for Fabric-A

To create a storage policy for Fabric-A that helps create the FC fabric zoning, complete the following steps:

- 1. Select the **SAN** tab at the upper left of the window.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click **Storage Connection Policies**. The window that is shown in Figure 8-30 on page 81 opens.

Equipment	Servers	LAN SAN	VM	Admin	1
Filter: All					
• •					
	SAN Cloud Storage Clo Policies SAN Clo SAN Clo SAN Clo SAN SAN SAN SAN SAN	oud fault vHBA I re Channel	Adapi ity Po	ter Polici olicies	
	Hv 🛐 vH	eshold Polic 3A Template o-Organizat	es		Storage Connection Policies Create Storage Connection Policy

Figure 8-30 Create Storage Connection Policy

4. Select **Create Storage Connection Policy**. The window that is shown in Figure 8-31 opens.

٨		Create Storage C	onnection Policy	X
Cre	Create Storage Connection Policy			
÷	Name: Fab Description: Zoning Type: O FC Target Endp	None O Single Initiator Si	ngle Target) ම Single Initia	ator Multiple Targets
	WWPN	Path	VSAN	
				OK Cancel

Figure 8-31 Create Storage Connection Policy

- 5. In the Name field, enter the Storage Connection Policy named Fab-A-Infra.
- 6. Select Single Initiator Multiple Targets for Zoning Type.

7. Click the plus icon to add the FC Target Endpoint. The window that is shown in Figure 8-32 opens.

Create FC Target Endpoint	X
Create FC Target Endpoint	0
WWPN: 50:05:07:68:0B:23:4F:F5	
Description: node1-A	
Path: • A • B	
Select VSAN: VSAN VSAN-A (101) 💌 🚹 Create VSAN	
	OK Cancel

Figure 8-32 Create FC Target Endpoint

- 8. In the WWPN field, enter <<*var_wwpn_Node1-switch-A*>> for Node 1 Fabric A.
- 9. Select A for Path.
- 10.Select VSAN_A for the Select VSAN field.
- 11.Click **OK** to create the FC Target Endpoint.
- 12.Repeat steps 7 11 to create the remaining FC target endpoints on fabric path A, as shown in Figure 8-33.

🛦 Cre	ate Storage (Connection Policy		X
Create Storage Connection Policy			0	
Name: Fab-A-Infra				
Description:				
Zoning Type: O None O) Single Initiator S	ingle Target 💿 Single Initiator M	ultiple T	argets
FC Target Endpoints	/ oingle initiator e		anapie in	argets
≪ Filter ⇒ Export > Pr	int			
WWPN	Path	VSAN	T.	
50:05:07:68:0B:23:4F:	. Α	VSAN-A	^	
50:05:07:68:0B:24:4F:	. A	VSAN-A		
50:05:07:68:0B:24:4F:	. A	VSAN-A		H
50:05:07:68:0B:23:4F: A VSAN-A				-
		O		Cancel

Figure 8-33 Ensure that all the policies are created

8.2.15 Creating the Storage Connection Policy for Fabric-B

To create a storage policy for Fabric-B that helps create the FC fabric zoning, complete the following steps:

- 1. Select the **SAN** tab at the upper left of the window.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click Storage Connection Policies.
- 4. Select **Create Storage Connection Policy**. The window that is shown in Figure 8-34 opens.

٨	(Create Storage	Connection Policy		x
Create S	Storage (Connectior	n Policy		0
Na Descript	ame: Fab-B-In	fra			
Zoning Ty			Single Target 💿 Single Initia	tor Multiple Targets	
	er 🖨 Export 🗞				
WWPN	I	Path	VSAN		
				ОКСа	ncel

Figure 8-34 Create Storage Connection Policy

- 5. In the Name field, enter the Storage Connection Policy named Fab-B-Infra.
- 6. Select Single Initiator Multiple Targets for the Zoning Type.

7. Click the plus icon to add the FC Target Endpoint. The window that is shown in Figure 8-35 opens.

A	Create FC Target Endpoint	X		
Create	Create FC Target Endpoint			
WWPN:	50:05:07:68:0B:21:4F:F5			
Description:	node1-B			
	O A O B			
Select VSA	N: VSAN VSAN-B (102) 💌 🕂 Create VSAN			
	OK	Cancel		
	Ŭĸ	Cancel		

Figure 8-35 Create FC Target Endpoint

- 8. In the WWPN field, enter <<var_wwpn_Node1-switch-A>> for Node 1 Fabric B.
- 9. Select **B** for Path.
- 10. For the Select VSAN field, select VSAN_B.
- 11. Click OK to create the FC Target Endpoint.
- 12. Repeat steps 7 11 to create the remaining FC target endpoints on fabric path B, as shown in Figure 8-36.

Equipment Servers LAN SAN VM Admin	Storage Connection Policies			
Filter: All	Name	Description	WWPN	
	🗐 🖉 Fab-B-Infra			
SAN	Fc Target Er	idpoint	50:05:07:68:0B:23:4F:F4	
🗄 💮 SAN Cloud	Fc Target Er	idpoint	50:05:07:68:0B:22:4F:F5	
🗄 🥘 Storage Cloud	Fc Target Er	idpoint	50:05:07:68:0B:22:4F:F4	
E S Policies	Fc Target Er	Idpoint	50:05:07:68:0B:21:4F:F5	
	E-S Fab-A-Infra			
📄 🧔 root		Idpoint	50:05:07:68:0B:23:4F:F4	
Fibre Channel Adapter Policies		idpoint	50:05:07:68:0B:24:4F:F5	
		idpoint	50:05:07:68:0B:24:4F:F4	
SAN Connectivity Policies		idpoint	50:05:07:68:0B:23:4F:F5	
🖽 - 🔊 Storage Connection Policies		authrannadachinannachannya (myöl) (panagaranna		
🗄 🖅 🗐 Threshold Policies				

Figure 8-36 Create the remaining FC target endpoints on fabric path B

Creating a SAN connectivity policy

To create a SAN connectivity policy that is used for automated Fibre Channel zone creation on the Fabric interconnects, complete the following steps:

- 1. Select the SAN tab at the upper left of the window.
- 2. Click **Policies** \rightarrow **root**.
- Right-click SAN Connectivity Policies and select Create SAN Connectivity Policy, as shown in Figure 8-37 on page 85. The window that is shown in Figure 8-38 on page 85 opens.

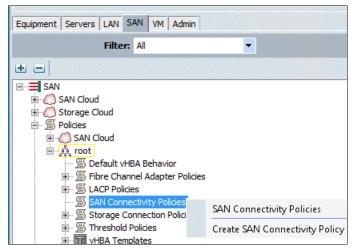


Figure 8-37 Click Create SAN Connectivity Policy

	Create SAN Connection	vity Policy	X
reate SAN Co	onnectivity Policy		0
Name: Dual-Fabric			
A server is identified on a S profile. - World Wide Node Nam		I). Specify how the system should assign a W	WNN to th
WWNN Assignment:	WWNN_Pool(12/16)		
+ Create WWNN Po	ol		
	gned from the selected pool. NNs are displayed after the pool name.		
Name		WWPN	
		elete 🕂 Add 🎫 Modify	
			Cancel

Figure 8-38 Select WWNN_Pool for WWNN assignment

- 4. In the Name field, enter Dual-Fabric.
- 5. For WWNN Assignment, select WWNN_Pool.

6. Click Add at the bottom of the window. The window that is shown in Figure 8-39 opens.

Create vHBA	x
Create vHBA	0
Name: Fabric-A Use vHBA Template: Create vHBA Template vHBA Template: vHBA_Template_A	
Adapter Performance Profile Adapter Policy: VMWare	
OK	cel

Figure 8-39 Create vHBA

- 7. For the Name field, enter Fabric-A.
- 8. Select the Use vHBA Template check box.
- 9. In the vHBA Template menu, select vHBA_Template_A.
- 10. In the Adapter Policy menu, select VMWare.
- 11.Click **OK**. The window that is shown in Figure 8-38 on page 85 opens again. Click **Add**. The window that is shown in Figure 8-40 opens.

Δ	Create vHBA	x
Create vHBA		0
Name: Fabric- Use vHBA Template: V Create vHBA Template	B	
vHBA Template: vHBA_Temp O Adapter Performance Pro Adapter Policy: VMWare		
	OK	cel

Figure 8-40 Select Adapter Policy VMWare

12. For the Name field, enter Fabric B.

13. Select the Use vHBA Template check box.

- 14. In the vHBA Template menu, select vHBA_Template_B.
- 15. In the Adapter Policy menu, select VMware.
- 16.Click **OK** to complete the policy creation, and click **OK** again. The window that is shown in Figure 8-41 opens.

	General VHBA Initiator Groups Events	
quipment Servers LAN SAN VM Admin	A Filter ⇒ Export Print	
Filter: All		
	Name	Storage Connection Policy Name
SAN		<u>^</u>
E SAN Cloud		
E Storage Cloud	A	
Policies	Details	
E OSAN Cloud E A root	General Events	
		<u>^</u>
😟 🛒 Fibre Channel Adapter Policies		
E S LACP Policies	Actions	Properties
SAN Connectivity Policies		
Storage Connection Policies		Name:
Threshold Policies		Description:
VHBA Templates		
		vHBA Initiators
		🕰 Filter 🔿 Export 😓 Print
		E C
		✓
		Specific Storage Connection Policy
		Properties
		Description:
		Zoning Type: O None O Single Initiator Single Target O Single Initiator Multiple Target
		FC Target Endpoints
		A Filter 👄 Export 😂 Print
li 🛛		

Figure 8-41 Dual-Fabric policy

17. Expand the SAN Connectivity Policies and click the Dual-Fabric policy.

18. In the right pane, click the **vHBA Initiator Groups** tab.

19.Click the green add button on the right side. The window that is shown in Figure 8-42 opens.

Name: Fabric-A	ate vHBA Initia	17255-1-7255-1-725-1-727-728-156-1	Create vHBA Initiator G	roup		
Name: Fabric-A cryption: ect vHBA Initiators eect MBA Initiators eect MBA Initiators eect vHBA Initiators eect MBA Initiator Policy Fab-A-Infra Description: Zoring Type: Single Initiator Multiple Targets FC Target Endpoints FT Targ		tor Group)			
cruption: cct vHBA Initiators elect Name Pabric-A Pabric-B create Storage Connection Policy: Fab-A-Infra Create Storage Connection Policy Global storage connection Policy Global storage connection Policy Global storage connection Policy Global storage connection Policy Storage Connection Policy: Fab-A-Infra Description: Zoring Type: Single Initiator Hultiple Targets Ft Target Endpoints Filter = Export Print WPN Path Storage Conference Policy: Fab-A-Infra Description: Zoring Type: Single Initiator Hultiple Targets Ft Target Endpoints Filter = Export Path VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 23-#:FFA Construction Constr	Initiator Group					
cruption: cct vHBA Initiators elect Name Pabric-A Pabric-B create Storage Connection Policy: Fab-A-Infra Create Storage Connection Policy Global storage connection Policy Global storage connection Policy Global storage connection Policy Global storage connection Policy Storage Connection Policy: Fab-A-Infra Description: Zoring Type: Single Initiator Hultiple Targets Ft Target Endpoints Filter = Export Print WPN Path Storage Conference Policy: Fab-A-Infra Description: Zoring Type: Single Initiator Hultiple Targets Ft Target Endpoints Filter = Export Path VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 24-#:FFA A VSAN-A SubSiD7:68:08: 23-#:FFA Construction Constr						
eect vHBA Initiators eect vHBA Initiators eect vHBA Initiators eect vHBA Initiators eect Name Fabric-A Fabric-A Fabric-A Fabric-B Create Storage Connection Policy Fab-A-Infra Create Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Hultiple Targets FC Target Endpoints FIFer P Export Fabric-4 Fifter P Export Fabric-4 VSAN-A Storosor7:68:08:24-#:F5 A VSAN-A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-#:F5 A Storosor7:68:08:23-	0					
elect Name Fabric-A Fabric-A Fabric-A Fabric-B Fabr	cription:					
✓ Fabric-A Fabric-B strage Connection Policy: Fab-A-Infra Storage Connection Policy Global Storage connection Policy Global Storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: File Print WVPN Path VSAN VVPN Path VSAN-A Image: Single Initiator Policy	lect vHBA Initiators					
✓ Fabric-A Fabric-B Storage Connection Policy: Fab-A-Infra Create Storage Connection Policy Global Storage Connection Policy Global Storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: File Print WVPN Path VSAN VVMPN Path VSAN-A Image: Single Initiator Multiple Targets						
□ Fabric-B prage Connection Policy: Fab-A-Infra □ Create Storage Connection Policy Global Storage connection policy defined under org is assigned to this V+BA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Zoning Type: Single Initiator Multiple Targets FtT arget Endpoints Image: Single Initiator Multiple Targets VWPN Path VSAN Solo5:07:68:08:24:4F:F4 A VSAN-A Solo5:07:68:08:24:4F:F5 A VSAN-A Solo5:07:68:08:24:4F:F5 A VSAN-A Solo5:07:68:08:24:4F:F5 A VSAN-A Solo5:07:68:08:24:4F:F4 A VSAN-A						
orage Connection Policy: Fab-A-Infra Slobal Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets F(Target Endpoints F(Tar						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
Global Storage Connection Policy Global storage connection policy defined under org is assigned to this vHBA initiator group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Image: Filter Image: Print WWPN Path VSAN S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:24:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F5 A VSAN-A S0:05:07:68:0B:23:4F:F4 A VSAN-A						
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group. Properties Storage Connection Policy: Fab-A-Infra Description: Zoning Type: Single Initiator Multiple Targets FC Target Endpoints FC Target Endpoint FC Target Endpoints FC Target Endpoints FC Target Endpoi			* 🖬 (Create Storage Conn	ection Policy	
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Zoning Type: Single Initiator Multiple Targets FC Target Endpoints Filter Export Print WWPN Path VSAN P 50:05:07:68:0B:24:4F:F4 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F4 A VSAN-A E	Slobal Storage Connectio Global storage connection po group.	n Policy			ection Policy	
WWPN Path VSAN 50:05:07:68:0B:24:4F:F4 A VSAN-A 50:05:07:68:0B:24:4F:F5 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A	Slobal Storage Connectio Global storage connection po group. Properties	n Policy blicy defined unde			ection Policy	
WWPN Path VSAN 50:05:07:68:0B:24:4F:F4 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A 50:05:07:68:0B:23:4F:F5 A VSAN-A 50:05:07:68:0B:23:4F:F4 A VSAN-A	Global Storage Connection Global storage connection po group. Properties Storage Connection Policy Description	n Policy blicy defined unde : Fab-A-Infra :	e r org is assigned to this vHBA		ection Policy	
WWPN Path VSAN Image: Constraint of the state of	Global Storage Connection Global storage connection po group. Properties Storage Connection Policy Description	n Policy blicy defined unde : Fab-A-Infra :	e r org is assigned to this vHBA		ection Policy	
WWPN Path VSAN Image: Constraint of the state of	Global Storage Connection Global storage connection po group. Properties Storage Connection Policy Description Zoning Type	n Policy blicy defined unde : Fab-A-Infra :	e r org is assigned to this vHBA		ection Policy	
50:05:07:68:0B:24:4F:F4 A VSAN-A A 50:05:07:68:0B:24:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F4 A VSAN-A E	Global Storage Connection Global storage connection po group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints	n Policy blicy defined unde : Fab-A-Infra : : Single Initiator	e r org is assigned to this vHBA		ection Policy	
50:05:07:68:0B:24:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F5 A VSAN-A E 50:05:07:68:0B:23:4F:F4 A VSAN-A Y	Global Storage Connection Global storage connection po group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints ≪ Filter ⇔ Export ⊗ Prir	n Policy blicy defined under : Fab-A-Infra : : Single Initiator	er org is assigned to this vHBA • Multiple Targets	initiator	ection Policy	
50:05:07:68:0B:23:4F:F5 A VSAN-A Image: Constraint of the second sec	Global Storage Connection Global storage connection por group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints ↓ Filter ➡ Export ↔ Prin WWPN	n Policy olicy defined unde : Fab-A-Infra : : Single Initiator nt Path	er org is assigned to this vHBA • Multiple Targets VSAN	initiator	ection Policy	
50:05:07:68:0B:23:4F:F4 A VSAN-A	Global Storage Connection Global storage connection por group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints ↓ Filter ➡ Export ↔ Prir WWPN 50:05:07:68:0B:24:4F:F4	n Policy blicy defined under : Fab-A-Infra : : Single Initiator nt Path A	er org is assigned to this vHBA • Multiple Targets VSAN VSAN-A	initiator	ection Policy	
	Global Storage Connection Global storage connection por group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints ↓ Filter ➡ Export ↔ Prir WWPN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	n Policy blicy defined under Fab-A-Infra Single Initiator nt Path A A	er org is assigned to this vHBA • Multiple Targets VSAN VSAN-A VSAN-A	initiator	ection Policy	
	Global Storage Connection Global storage connection por group. Properties Storage Connection Policy Description Zoning Type FC Target Endpoints ↓ Filter ➡ Export ↔ Prir WWPN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	n Policy blicy defined under Fab-A-Infra Single Initiator nt Path A A A	er org is assigned to this vHBA • Multiple Targets VSAN VSAN-A VSAN-A VSAN-A	initiator	ection Policy	

Figure 8-42 Create vHBA Initiator Group

- 20. In the Name field, enter Fabric-A.
- 21.Select the Fabric-A check box.
- 22. In the Storage Connection Policy menu, select Fab-A-Infra.
- 23.Click **OK**, and then click **OK** again. The window that is shown in Figure 8-41 on page 87 opens again. Click the green add button on the right side. The window that is shown in Figure 8-43 on page 89 opens.

	Create V	HBA Initiator Group		
reate vHBA Initi	ator Group			
IBA Initiator Group				
Name: Fabric-B				
O Description:				
Select vHBA Initiators				
Select		Name		
		Fabric-A		
	✓	Fabric-B		
group. Properties Storage Connection Polic Descriptic	ion Policy policy defined under o cy: Fab-B-Infra on:	org is assigned to this vHBA i	reate Storage Connection I nitiator	Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptio Zoning Typ	ion Policy policy defined under o cy: Fab-B-Infra	org is assigned to this vHBA i		Policy
Global Storage Connection Global storage connection group. Properties Storage Connection Polic Descriptic	ion Policy policy defined under o cy: Fab-B-Infra on: be: Single Initiator Mu	org is assigned to this vHBA i		Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptio Zoning Type FC Target Endpoints	ion Policy policy defined under o cy: Fab-B-Infra on: be: Single Initiator Mu	org is assigned to this vHBA i		Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptio Zoning Type FC Target Endpoints	ion Policy policy defined under of cy: Fab-B-Infra on: be: Single Initiator Mu rint	org is assigned to this vHBA i ultiple Targets	nitiator	Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptio Zoning Typ FC Target Endpoints M Filter 🖨 Export 🚱 P WWPN	ion Policy policy defined under of ty: Fab-B-Infra on: be: Single Initiator Mu rint rint Path 4 B	org is assigned to this vHBA i ultiple Targets VSAN	nitiator	Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptio Zoning Typ FC Target Endpoints Kilter Storage Policy WWPN 50:05:07:68:0B:22:4F:F4	ion Policy policy defined under of cy: Fab-B-Infra on: be: Single Initiator Mu rint rint Path 4 B 5 B	org is assigned to this vHBA i ultiple Targets VSAN VSAN-B	nitiator	Policy
Global Storage Connection group. Properties Storage Connection Polic Descriptic Zoning Typ FC Target Endpoints FC Target Endpoints WWPN 50:05:07:68:08:22:4F:F4 50:05:07:68:08:21:4F:F5	ion Policy policy defined under of cy: Fab-B-Infra on: be: Single Initiator Mu rint rint Path 4 B 5 B 4 B	org is assigned to this vHBA i ultiple Targets VSAN VSAN-B VSAN-B	nitiator	Policy
Global Storage Connection group. Properties Storage Connection Polic Description Zoning Typ FC Target Endpoints ✓ Filter ➡ Export ☜ P WWPN 50:05:07:68:08:22:4F:F4 50:05:07:68:08:22:4F:F4	ion Policy policy defined under of cy: Fab-B-Infra on: be: Single Initiator Mu rint rint Path 4 B 5 B 4 B	org is assigned to this vHBA i ultiple Targets VSAN VSAN-B VSAN-B VSAN-B	nitiator	Policy

Figure 8-43 Create vHBA Initiator Group

24. In the Name field, enter Fabric-B.

- 25.In the Select vHBA Initiators pane, select the Fabric-B check box.
- 26.In the Storage Connection Policy menu, Select Fab-B-Infra.
- 27.Click **OK**, and then click **OK** again.

8.2.16 Acknowledging Cisco UCS chassis and FEX modules

To acknowledge all the Cisco UCS chassis and external 2232 FEX modules, complete the following steps:

1. In Cisco UCS Manager, click the **Equipment** tab in the navigation pane, as shown in Figure 8-44.



Figure 8-44 Equipment tab in the navigation pane

- 2. Expand Chassis and select each chassis that is listed.
- 3. Right-click each chassis and select Acknowledge Chassis, click Yes, and then click OK.
- 4. If C-Series servers are part of the configuration, expand Rack Mounts and FEX.
- 5. Right-click each FEX that is listed and select **Acknowledge FEX**.
- 6. Click Yes, and then click OK.

8.2.17 Creating uplink port channels to Cisco Nexus switches

To configure the necessary port channels out of the Cisco UCS environment, complete the following steps:

1. In Cisco UCS Manager, click the LAN tab in the navigation pane.

Note: In this procedure, two port channels are created: one from fabric A to both Cisco Nexus switches and one from fabric B to both Cisco Nexus switches.

- 2. Click LAN \rightarrow LAN Cloud and expand Fabric A.
- 3. Right-click **Port Channels** and select **Create Port Channel**, as shown in Figure 8-45 on page 91. The window that is shown in Figure 8-46 on page 91 opens.

Equipment Servers LAN SAN V	/M Admin				
Filter: All	-				
e e					
E					
🖹 🦳 LAN Cloud					
E Fabric A					
Port Channels					
🗈 🚽 Uplink Eth Inte	LAN Uplinks Manager				
VLAN Optimiza	Show Navigator				
	Create Port Channel				
😽 QoS System Class					

Figure 8-45 Create Port Channel

A	Create Port Channel	x
Unified Co	omputing System	Mar
Create Port Channel 1. √ <u>Set Port Channel Name</u> 2. □ <u>Add Ports</u>	Set Port Channel Name	0
	< Prev Next > Finish	Cancel

Figure 8-46 Set Port Channel Name

- 4. Enter 13 as the unique ID of the port channel.
- 5. Enter vPC-13-Nexus as the name of the port channel.
- 6. Click **Next**. The window that is shown in Figure 8-47 opens.

Unified C	ompi	Create F			Man	ager		X
Create Port Channel 1. √Set Port Channel Name	Add Port		51	GIII	Main	agei		0
2. √ <u>Add Ports</u>	Ports				Ports in the p	port channel		
	Slot Port 1 25 1 26	MAC 8C:60:4F:5F:7A:40 8C:60:4F:5F:7A:41	₽	>>	Slot ID	Port	MAC	P
			~	<<				~
					<	Prev Next 2	> Finish	Cancel

Figure 8-47 Add Ports

- 7. Select the following ports to be added to the port channel:
 - Slot ID 1 and port 25
 - Slot ID 1 and port 26
- 8. Click >> to add the ports to the port channel.
- 9. Click **Finish** to create the port channel, as shown in Figure 8-48.

A			Create	e Port Ch	annel				X
Unified C	om	pι	utin	g S	yst	em	Μ	anager	
Create Port Channel 1. √ <u>Set Port Channel Name</u> 2. √ Add Ports	Add	Po	rts						0
- Mad Fores	Por	ts				Ports	in the po	rt channel	
	Sl	Port	MAC	Ę	>>	Slot ID	Port	MAC	E\$
				^	<<	1	25	8C:60:4F:5F:7A:40	^
						1	26	8C:60:4F:5F:7A:41	
				×					<u> </u>
						< Prev	N	ext > Finish	Cancel

Figure 8-48 Click Finish

10.Click OK.

- 11. In the navigation pane, click $\text{LAN} \rightarrow \text{LAN}$ Cloud and expand Fabric B.
- 12. Right-click **Port Channels** and select **Create Port Channel**. The window that is shown in Figure 8-49 opens.

A	Create Port Channel	X
Unified Co	omputing System	Mana
Create Port Channel	Set Port Channel Name	0
 √<u>Set Port Channel Name</u> 2. □_{Add Ports} 		
	ID: 0	
	Name: UPC-14-Nexus	
	< Prev Next > Finish	Cancel

Figure 8-49 Set Port Channel Name

13. Enter 14 as the unique ID of the port channel.

- 14. Enter vPC-14-NEXUS as the name of the port channel.
- 15.Click Next.
- 16.Select the following ports to be added to the port channel:
 - Slot ID 1 and port 25
 - Slot ID 1 and port 26

17.Click >> to add the ports to the port channel.

18. Click Finish to create the port channel.

19.Click OK.

8.2.18 Creating MAC address pools

To configure the necessary MAC address pools for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Click **Pools** \rightarrow **root**.

Note: In this procedure, two MAC address pools are created, one for each switching fabric.

3. Right-click **MAC Pools** under the root organization and select **Create MAC Pool** to create the MAC address pool, as shown in Figure 8-50.

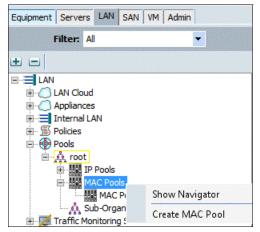


Figure 8-50 Create MAC Pool

- 4. Enter MAC_Pool_A as the name of the MAC pool.
- 5. (Optional) Enter a description for the MAC pool.
- 6. Click Next.

7. Click Add. The window that is shown in Figure 8-51 opens.

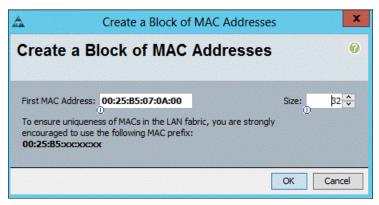


Figure 8-51 MAC address size pool

8. Specify a starting MAC address.

Note: For the VersaStack solution, the recommendation is to place 0A in the next-to-last octet of the starting MAC address to identify all of the MAC addresses as Fabric A addresses.

- Specify a size for the MAC address pool that is sufficient to support the available blade or server resources.
- 10.Click OK.
- 11.Click Finish.
- 12. In response to the confirmation message, click OK.
- Right-click MAC Pools under the root organization and select Create MAC Pool to create the MAC address pool.
- 14.Enter MAC_Pool_B as the name of the MAC pool.
- 15. (Optional) Enter a description for the MAC pool.
- 16.Click Next.
- 17.Click Add. The window that is shown in Figure 8-52 opens.

Create a Block of MAC Addresses		x
Create a Block of MAC Addresses		0
First MAC Address: 00:25:B5:07:0B:00 To ensure uniqueness of MACs in the LAN fabric, you are strongly encouraged to use the following MAC prefix: 00:25:B5:xx:xx:xx	Size:	32 🗘
	ОК	Cancel

Figure 8-52 MAC address size pool (2)

18. Specify a starting MAC address.

Note: For the VersaStack solution, the recommendation is to place 0B in the next to last octet of the starting MAC address to identify all the MAC addresses in this pool as Fabric B addresses.

- 19. Specify a size for the MAC address pool that is sufficient to support the available blade or server resources.
- 20.Click OK.
- 21.Click Finish.
- 22. In response to the confirmation message, click OK.

Figure 8-53 shows the results of MAC pool creation.

	MAC Pools		
Equipment Servers LAN SAN VM Admin	🛨 🖃 🕰 Filter 👄 Export 🈓 Print		
Filter: All	Name	Size	Assigned
• •	MAC Pool MAC_Pool_B	32	0
E. LAN	[00:25:B5:07:0B:00 - 00:25:B5:07:0B:1F]		
EAN Cloud	MAC Pool MAC_Pool_A	32	0
	[00:25:B5:07:0A:00 - 00:25:B5:07:0A:1F]		
⊡	MAC Pool default	0	0
Polices			
a root			
IP Pools			
MAC Pools			
MAC Pool MAC_Pool_A			
MAC Pool MAC_Pool_B			
MAC Pool default			

Figure 8-53 MAC pools created

8.2.19 Creating an UUID suffix pool

To configure the necessary universally unique identifier (UUID) suffix pool for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the **Servers** tab in the navigation pane.
- 2. Click **Pools** \rightarrow **root**.

3. Right-click **UUID Suffix Pools** and select **Create UUID Suffix Pool**, as shown in Figure 8-54.

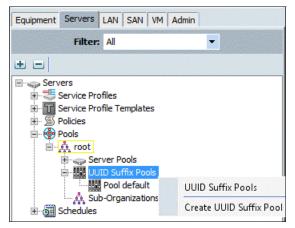


Figure 8-54 Create UUID Suffix Pool

- 4. Enter UUID_Pool as the name of the UUID suffix pool.
- 5. (Optional) Enter a description for the UUID suffix pool.
- 6. Keep the prefix at the derived option.
- 7. Click Next.
- 8. Click Add to add a block of UUIDs.
- 9. Keep the From field at the default setting.
- 10. Specify a size for the UUID block that is sufficient to support the available blade or server resources, as shown in Figure 8-55.

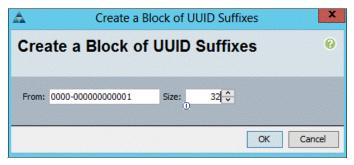


Figure 8-55 Add a block of UUIDs

11.Click OK.

12. Click Finish, as shown in Figure 8-56 on page 97, and click OK.

Create UUID Suffix Pool							
Unified C	omputing	System	Mana	agei			
Create UUID Suffix Pool 1. √ <u>Define Name and</u>	Add UUID Block	S		0			
2. √ <u>Add UUID Blocks</u>	Name	From 01 - 0000-00 0000-00000 Add Delete	To 00 0000-0000	0000 ^ ~			
		< Prev Next >	Finish	Cancel			

Figure 8-56 Add UUID blocks

8.2.20 Creating a server pool

To configure the necessary server pool for the Cisco UCS environment, complete the following steps.

Note: Consider creating unique server pools to achieve the granularity that is required in your environment.

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Pools** \rightarrow **root**.
- 3. Right-click Server Pools and select Create Server Pool, as shown in Figure 8-57.

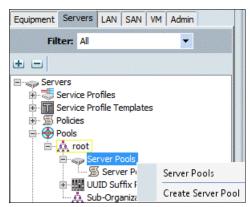


Figure 8-57 Create Server Pool

- 4. Enter Infra_Pool as the name of the server pool.
- 5. (Optional) Enter a description for the server pool.
- 6. Click Next.
- Select two (or more) servers to be used for the VMware management cluster and click >> to add them to the Infra_Pool server pool.
- 8. Click Finish.
- 9. Click **OK**.

Figure 8-58 shows the results of this procedure.

Create Server Pool 1. √ <u>Set Name and Description</u> 2. √ <u>Add Servers</u>	Add Ser		3 7	stem			- J				۲
- TAU Servers	Servers						Pooled Ser	vers			
	Chassis ID	Slot ID	Serial	Cores Enabled	Ę		Chassis ID	Slot ID	Serial	Cores Enabled	Ę
	1	3	FLM19135F21	20			1	1	FLM191	20	
	1	4	FLM19135F6U	20			1	2	FLM191	20	
					~	>>					¥
						<<	Details				
	Мо	del:									
							Мо	del:			
	Serial Numb	ber:					Serial Numb	per:			
								L			
	Vend	for:					Vend	tor:			

Figure 8-58 Create a server pool

8.2.21 Creating virtual local area networks

To configure the necessary virtual local area networks (VLANs) for the Cisco UCS environment, complete the following steps:

1. In Cisco UCS Manager, click the LAN tab in the navigation pane.

Note: In this procedure, four VLANs are created. The default VLAN ID 1 is used for Management, VLAN ID 30 is used for vMotion traffic, VLAN ID 40 is for Windows Cluster traffic, VLAN ID 50 is used for CSV traffic, and VLAN ID 60 is used for Backup traffic.

- 2. Click LAN \rightarrow LAN Cloud.
- 3. Right-click **VLANs** and select **Create VLANs**, as shown in Figure 8-59. The window that is shown in Figure 8-60 on page 99 opens.

Equipment Servers LA	AN SAN VM Admin							
Filter: All								
± =								
E LAN								
🗄 🕜 LAN Cloud								
🕀 🚥 Fabric A								
🕀 💷 Fabric B								
🚽 🙀 QoS Syste								
LAN Pin G								
🖭 🗐 🗐 Threshold	l Policies							
VLAN Gro	ups							
🗄 🙆 Appliances	Show Navigator							
🗄 📃 Internal L/	Create VLANs							

Figure 8-59 Create VLANs

- 4. Enter vMotion as the name of the VLAN to be used for vMotion traffic.
- 5. Keep the Common/Global option selected for the scope of the VLAN.
- 6. Enter <<var_vMotion_vlan_id>> as the ID of the management VLAN.
- 7. Keep the Sharing Type as None.
- 8. Click **OK**, and then click **OK** again.

A	Create VLANs	X
Create VLAN	ls	0
VLAN Name/Prefix:	vMotion	Ê
Multicast Policy Name:	<not set=""> Image: Create Multicast Policy</not>	
You are creating globa	Common/Global Fabric A Fabric B Both Fabrics Configured Differently I VLANs that map to the same VLAN IDs in all available fabrics.	′ ≡
	AN IDs.(e.g. "2009-2019", "29,35,40-45", "23", "23,34-45")	
VLAN IDs: 30		
Sharing Type: No 	ne 🔘 Primary 🔘 Isolated 🔘 Community	
<		~
<u> </u>	Check Overlap OK Cance	3

Figure 8-60 Create VLANs

9. Right-click VLANs and select Create VLANs.

10. Enter WinClus as the name of the VLAN to be used for Windows cluster heartbeat traffic.

- 11.Keep the Common/Global option selected for the scope of the VLAN.
- 12.Enter the <<var_WinClus_vlan_id>> for the Windows cluster VLAN.
- 13.Keep the Sharing Type as None.
- 14. Click **OK**, and then click **OK** again.
- 15. Right-click VLANs and select Create VLANs.
- 16.Enter WinCSV as the name of the VLAN to be used for Cluster Shared Volume traffic.
- 17.Keep the Common/Global option selected for the scope of the VLAN.
- 18.Enter the <<var_WinCSV_vlan_id>> as the ID of the CSV VLAN.
- 19.Keep the Sharing Type as None.
- 20. Click **OK**, and then click **OK** again.
- 21. Right-click VLANs and select Create VLANs.
- 22. Enter Backup as the name of the VLAN to be used for the Backup traffic.
- 23.Keep the Common/Global option selected for the scope of the VLAN.
- 24.Enter the <<var_Backup_vlan_id>> for the Backup VLAN.
- 25.Keep the Sharing Type as None.
- 26. Click **OK**, and then click **OK** again.

Figure 8-61 shows the final result of this procedure.

	VLANs								
Equipment Servers LAN SAN VM	🕰 Filter 👄 Export 🏠 Print								
Filter: LAN Cloud	Name	ID	Type	Transport	Native	VLAN Sharing			
± =	VLAN Backup (60)	60	Lan	Ether	No	None			
E	VLAN WinCSV (50)	50	Lan	Ether	No	None			
Emer Fabric A	VLAN WinClus (40)	40	Lan	Ether	No	None			
🖶 👜 Fabric B	VLAN default (1)	1	Lan	Ether	Yes	None			
QoS System Class	VLAN vMotion (30)	30	Lan	Ether	No	None			
LAN Pin Groups LAN Pin Groups VLAN Groups VLAN Groups VLAN Backup (60) VLAN WinCSV (50) VLAN WinClus (40) VLAN default (1) VLAN vMotion (30)									

Figure 8-61 VLANs created

8.2.22 Creating a host firmware package

The administrator can use firmware management policies to select the corresponding packages for a server configuration. These policies often include packages for adapter, BIOS, board controller, FC adapters, host bus adapter (HBA) option ROM, and storage controller properties.

To create a firmware management policy for a server configuration in the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click **Host Firmware Packages** and select **Create Host Firmware Package**, as shown in Figure 8-62.

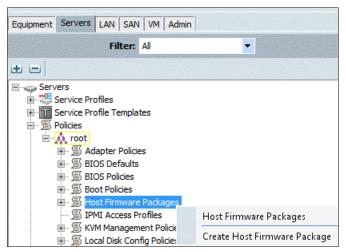


Figure 8-62 Create Host Firmware Package

- 4. Enter VM-Host-Infra as the name of the host firmware package.
- 5. Leave Simple selected.

- 6. Select the Version 2.2(3c) for Blade Servers. Also, select Version 2.2(3c) for the Rack Package if you use rack servers.
- 7. Click **OK** to create the host firmware package, and click OK again.

Figure 8-63 shows the final result of this procedure.

A	Creat	e Host Firm	nware Package		x
Create Ho	ost Firmwa	are Pac	kage		0
Name: VM	-Host-Infra				
Description:					
How would you	like to configure	e the Host Fi	rmware Package?	⊙ Simple ○ Advan	nced
Blade Package:	2.2(3c)B	-			
Rack Package:	2.2(3c)C	•			
				OK Can	cel

Figure 8-63 Firmware packages that are created

8.2.23 Setting jumbo frames in Cisco UCS Fabric

To configure jumbo frames and enable quality of service (QoS) in the Cisco UCS fabric, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- Click LAN → LAN Cloud → QoS System Class. The window that is shown in Figure 8-64 opens.

Equipment Servers LAN SAN VM Ad	General Events	SM								
Filter: LAN Cloud	Priority	Enabled	Co5	Packet Drop	Weight		Weight (%)	мти		Multicast Optimized
• -	Platinum		5		10	•	N/A	normal	•	
E Claud	Gold		4	✓	9	•	N/A	9216	-	
Fabric A	Silver		2	✓	8	-	N/A	normal	•	
Fabric B Gos System Class	Bronze		1	✓	7	-	N/A	normal	-	
LAN Pin Groups	Best Effort		Any	V	5	-	50	normal	-	
VLAN Groups	Fibre Channel	V	3		5	-	50	fc	-	N/A
⊡										

Figure 8-64 QoS System Class

- 3. In the right pane, click the **General** tab.
- 4. On the Best Effort row, enter 9216 in the box under the MTU column.
- 5. Click Save Changes at the bottom of the window.

6. Click **OK**. The window that is shown in Figure 8-65 opens.

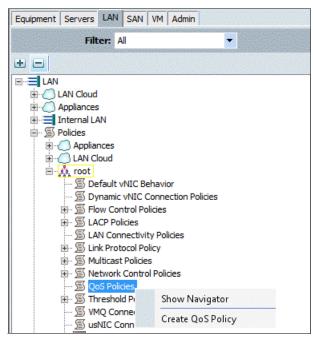


Figure 8-65 Create a QoS Policy

- 7. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 8. Click LAN \rightarrow Policies \rightarrow root \rightarrow QoS Policies.
- 9. Right-click QoS Policies and select Create QoS Policy.
- 10. Enter a name and select **Gold** from the drop-down list as the Priority and leave the rest of the settings at their defaults, as shown in Figure 8-66.

A	Create QoS Policy	X
Create Q	oS Policy	0
Name: Jumbol Gress	rame	
Priority:	Gold	
Burst(Bytes):	10240	
Rate(Kbps):	line-rate	
Host Control:	None O Full	
		OK Cancel

Figure 8-66 Select Gold

8.2.24 Creating a local disk configuration policy

The procedure in this section creates a SAN boot disk policy. A local disk configuration for the Cisco UCS environment is necessary if the servers in the environment do not have a local disk.

Note: This policy should not be used on servers that contain local disks.

To create a local disk configuration policy for SAN-Boot, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click Local Disk Config Policies and select Create Local Disk Configuration Policy, as shown in Figure 8-67.

Equipment	Servers	LAN	SAN	VM	Admin	
		F	ilter:	All		
± =						
Serv						
	Service Pro					
	Service Pro	ofile Te	emplati	es		
• 5						
.	🗛 root					
	🖻 🖉 Ad			s		
	BI S BI					
	BI					
	⊞ SB0					
	E S Ho				-	
	IPI					
	È SKV		-			
	亩~ ⑤ Lo 亩~ ⑤ Ma					Local Dick Confin Delicies
	-					Local Disk Config Policies
		_		rmwa	are P	Create Local Disk Configuration Policy
	E S Po			Policie	PS .	

Figure 8-67 Create Local Disk Configuration Policy

The window that is shown in Figure 8-68 opens.

🔺 Cre	ate Local Disk Configuration Policy	X
Create Local Disk	Configuration Policy	0
Description: Mode: FlexFlash FlexFlash State: If FlexFlash State is disabled, S Please ensure SD cards are not in	SAN-Boot No Local Storage D Disable Enable D cards will become unavailable immediately, use before disabling the FlexFlash State.	
FlexFlash RAID Reporting State:	Disable Enable	OK Cancel

Figure 8-68 Create the policy

- 4. Enter SAN-Boot as the local disk configuration policy name.
- 5. Change the mode to **No Local Storage**.
- 6. Click **OK** to create the local disk configuration policy, and click **OK** again.

8.2.25 Creating a Network control policy for Cisco Discovery Protocol

To create a network control policy that enables Cisco Discovery Protocol (CDP) on virtual network ports, complete the following steps:

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click **Network Control Policies** and select Create Network Control Policy, as shown in Figure 8-69 on page 105. The window that is shown in Figure 8-70 on page 105 opens.

Equipment Servers LAN SAN VM Admin	
Filter: All	-
.	
E LAN	
LAN Cloud	
Appliances	
Internal LAN	
S Default vNIC Behavior	
S Dynamic vNIC Connection Po	icies
E S Flow Control Policies	
E S LACP Policies	
🗐 LAN Connectivity Policies	
🗉 🗐 Link Protocol Policy	
🖭 🗐 Multicast Policies	
🖽 🖅 🔊 Network Control Policies	
🔊 QoS Policies	Show Navigator
Image: Interstation of the second	Create Network Control Policy

Figure 8-69 Create Network Control Policy

A	Create Network Control Poli	icy	×
Create Netw	ork Control Policy		0
Name: Description:	Enable_CDP		
CDP: (MAC Register Mode:	Disabled Enabled Only Native Vlan All Host Vlans		
-	Link Down		
MAC Security Forge: • Allow	Deny		
		OK	Cancel

Figure 8-70 Create the network control policy

- 4. Enter Enable_CDP as the policy name.
- 5. For CDP, select the **Enabled** option.
- 6. Click **OK** to create the network control policy, and click OK again.

8.2.26 Creating a power control policy

To create a power control policy for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.

3. Right-click **Power Control Policies** and select Create Power Control Policy. The window that is shown in Figure 8-71 opens.

A	Create Power Control Policy	x
Create	Power Control Policy	0
Description: Power Ca If you ch power gr no-cap, No 0	apping oose cap, the server is allocated a certain amount of power based on its priority within its oup. Priority values range from 1 to 10, with 1 being the highest priority. If you choose the server is exempt from all power capping.	er
than is curre priority.	ently available. With sufficient power, all servers run at full capacity regardless of their	
	OK Can	cel

Figure 8-71 Create Power Control Policy

- 4. Enter No-Power-Cap as the power control policy name.
- 5. Change the Power Capping setting to No Cap.
- 6. Click **OK** to create the power control policy, and click **OK**.

8.2.27 Creating a server pool qualification policy (optional)

To create an optional server pool qualification policy for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the **Servers** tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click Server Pool Policy Qualifications and select Create Server Pool Policy Qualification. The window that is shown in Figure 8-72 on page 107 opens.

aming										
Name: UCSB-200-M4										
O Description:										
This server pool policy qualification wil	l apply to new or re-disco	overed servers. Exist	ing serve	rs are n	iot qu	alified until the	ey are re	-discovered	1	
Actions	Qualifications									
		1 ton								
Create Adapter Qualifications		r 👄 Export 😹 Print								
Create Chassis/Server Qualification		r 👄 Export 📚 Print Max		From	То	Architect	Speed	Stepping	Power Gr	Ę
Create Chassis/Server Qualification		1		From	То	Architect	Speed	Stepping	Power Gr	E
Create Chassis/Server Qualifications		1		From	То	Architect	Speed	Stepping	Power Gr	-
Create Chassis/Server Qualifications Create Memory Qualifications Create CPU/Cores Qualifications Create Storage Qualifications		1		From	То	Architect	Speed	Stepping	Power Gr	-
Create Chassis/Server Qualifications	Name	1		From	То	Architect	Speed	Stepping	Power Gr	-

Figure 8-72 Create Server Pool Policy Qualification

- 4. Enter UCSB-B200-M4 as the name for the policy.
- 5. Select **Create Server PID Qualifications**. The window that is shown in Figure 8-73 opens.

A	Create Server PID Qualifications	X
Create Serve	er PID Qualifications	0
PID (RegEx): UCSB-2	00-M4	
	ОК Са	ancel

Figure 8-73 Create Server PID Qualifications

- 6. Enter UCSB-B200-M4 as the PID.
- 7. Click **OK** to create the server pool qualification policy.
- 8. Click **OK**, and then click **OK** again.

8.2.28 Creating a server BIOS policy

The following policies are for optimal performance for VMware. Depending on your requirements, you can change the settings as needed. For more information, see your Cisco UCS documentation.

To create a server BIOS policy for the Cisco UCS environment, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click BIOS Policies and select Create BIOS Policy.

4. Enter VM-Host-Infra as the BIOS policy name and select the options that are shown in Figure 8-74.

	Create BIOS Policy
Unified C	omputing System Manager
Chinica C	Processor
ate BIOS Policy	FIOCESSO
1. √ <u>Main</u> 2. √ <u>Processor</u>	
3. 🗋 Intel Directed IO	Turbo Boost: 🔘 disabled 💿 enabled 🕥 Platform Default
4. □ _{RAS Memory} 5. □ _{Serial Port}	Enhanced Intel Speedstep: O disabled enabled Platform Default
6. 🗋 <u>USB</u>	Hyper Threading: O disabled O enabled O Platform Default
7. D <u>pci</u> 8. D <u>opi</u>	Core Multi Processing: all
9. DILOM and PCIe Slots	Execute Disabled Bit: O disabled I enabled Platform Default
10. D _{Boot Options} 11. D _{Server Management}	Virtualization Technology (VT): Odisabled Oenabled OPlatform Default
	Hardware Pre-fetcher: O disabled O enabled O Platform Default
	Adjacent Cache Line Pre-fetcher: O disabled O enabled O Platform Default
	DCU Streamer Pre-fetch: O disabled O enabled O Platform Default
	DCU IP Pre-fetcher: O disabled O enabled O Platform Default
	Direct Cache Access: O disabled • enabled • Platform Default
	Processor C State: O disabled O enabled O Platform Default
	Processor C1E: O disabled O enabled O Platform Default
	Processor C3 Report: O disabled O acpi-c2 O acpi-c3 O Platform Default
	Processor C6 Report: O disabled O enabled O Platform Default
	Processor C7 Report: O disabled O enabled O Platform Default
	CPU Performance: enterprise high-throughput hpc Platform Default
	Max Variable MTRR Setting: 🔘 auto-max 🔵 8 💿 Platform Default
	Local X2 APIC: O xapic O x2apic O auto O Platform Default
	Power Technology: custom
	Energy Performance
	Frequency Floor Override: Odisabled Oenabled Platform Default
	P-STATE Coordination: O hw-all O sw-all O sw-any O Platform Default
	DRAM Clock Throttling: Platform Default
	Channel Interleaving: Platform Default
	Rank Interleaving: Platform Default
	Demand Scrub: O disabled O enabled O Platform Default
	Patrol Scrub: O disabled O enabled O Platform Default
	Altitude: Platform Default
	<pre></pre>

Figure 8-74 Create BIOS Policy

5. Click **Next** to open the Intel Directed IO window and select the options that are shown in Figure 8-75 on page 109.

Unified	C	omputing System Manager	
reate BIOS Policy 1. √ _{Main}	^	Intel Directed IO	Q
2. $\sqrt{\frac{Processor}{1 \text{ Intel Directed IO}}}$ 3. $\sqrt{\frac{1 \text{ Intel Directed IO}}{RAS Memory}}$ 5. $\square \frac{Serial Port}{USB}$	I	VT For Directed IO: disabled enabled Platform Default Interrupt Remap: disabled enabled Platform Default	
7. D <u>PCI</u> 8. D <u>QPI</u> 9. D <u>LOM and PCIe Slots</u> 10. D <u>Boot Options</u>		Coherency Support: O disabled O enabled Platform Default ATS Support: O disabled O enabled Platform Default Pass Through DMA Support: O disabled O enabled Platform Default	

Figure 8-75 Intel Directed IO

6. Click **Next** to open the RAS Memory window and select the options that are shown in Figure 8-76.

A		Create BIOS Policy
Unified	C	omputing System Manager
Create BIOS Policy 1. √Main	^	RAS Memory Ø
2. $\sqrt{\frac{Processor}{1}}$ 3. $\sqrt{\frac{Intel Directed IO}{4}}$ 4. $\sqrt{\frac{RAS Memory}{S}}$ 5. $\square \frac{Serial Port}{USB}}$	=	Memory RAS Config: maximum-performance NUMA: Odisabled enabled Platform Default UV DDR Mode: power-saving-mode performance-mode auto Platform Default
7. 8. 9. 100 And PCIe Slots	~	DRAM Refresh Rate: Platform Default
		< Prev Next > Finish Cancel

Figure 8-76 RAS Memory

- 7. Click Finish to create the BIOS policy.
- 8. Click **OK**.

8.2.29 Creating a vNIC/vHBA placement policy for VM infrastructure hosts

To create a vNIC/vHBA placement policy for the infrastructure hosts, complete the following steps:

- 1. In Cisco UCS Manager, click the **Servers** tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.

3. Right-click **vNIC/vHBA Placement Policies** and select **Create Placement Policy**. The window that is shown in Figure 8-77 opens.

	Create Placement Policy	×
Create Place	ement Policy	Ø
Virtual Slot Mapping S	Name: VM-Host-Infra cheme: • Round Robin • Linear Ordered	
④ Filter ➡ Export Virtual Slot	Selection Preference	
Virtual Slot	Selection Preference	
Virtual Slot	Selection Preference Assigned Only	

Figure 8-77 Create Placement Policy

- 4. Enter VM-Host-Infra as the name of the placement policy.
- 5. Click 1 and select Assigned Only.
- 6. Click **OK**, and then click **OK** again.

8.2.30 Updating the default Maintenance Policy

To update the default Maintenance Policy, complete the following steps:

- 1. In Cisco UCS Manager, click the **Servers** tab in the navigation pane. Figure 8-78 on page 111 shows the Servers tab.
- 2. Click **Policies** \rightarrow **root**.
- 3. Click Maintenance Policies \rightarrow default.
- 4. Change the Reboot Policy to User Ack.
- 5. Click Save Changes.
- 6. Click **OK** to accept the change.

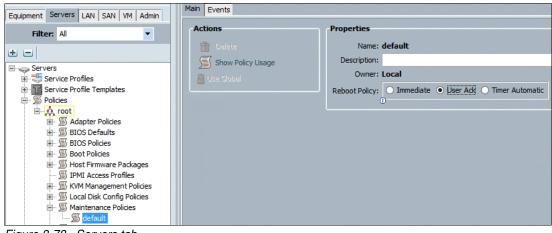


Figure 8-78 Servers tab

8.2.31 Creating vNIC templates

To create multiple virtual network interface card (vNIC) templates for the Cisco UCS environment, complete the following steps.

Note: The recommendation is to not select the Enable Failover option if the network adapters are going be teamed up later in the OS/hypervisor. In this example, because we are teaming the vNICs in this VersaStack environment, the Enable Failover option is left clear.

- 1. In Cisco UCS Manager, click the LAN tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.

3. Right-click vNIC Templates and select Create vNIC Template. The window that is shown in Figure 8-79 opens.

A	Create	vNIC Template		X
Create vNIC Tem	plate			0
11				^
Name: vNIC_	Template_A			
Description:				
Fabric ID: 💿 Fal	bric A i 🔿 Fabric B 🛛	Enable Failover		
Targ	et			
	lapter 1			
If VM is selected, a port profile	me exists, and updat	ting template is selected, it will be overw	ritten	
A Filter = Export > Print				
Select	Name	Native VLAN	Ę	
	default	0	<u> </u>	
	Backup WinCSV	0		
	WinClus	Ö		
	vMotion	0	_	
Create VLAN MTU: 9000 Warning Make sure that the MTU has th corresponding to the Egress pr MAC Pool: MAC_F	iority of the selected			
QoS Policy: Jumbo	Frame 🔻			
Network Control Policy: Enable	_CDP 🔻			
Pin Group: <not s<="" td=""><td>et> 🔻</td><td></td><td></td><td></td></not>	et> 🔻			
Stats Threshold Policy: default	t 👻			
Connection Policies Dynamic vNIC OusNIC	○ VMQ	_		
Dynamic vNIC Connection Po	icy: <notset></notset>			~
ر < المقاومة ا				>
			ОК Са	incel

Figure 8-79 Create the vNIC template

- 4. Enter vNIC_Template_A as the vNIC template name.
- 5. Keep Fabric A selected.
- 6. Select the Enable Failover check box.

- 7. Under Target, make sure that the VM check box is not selected.
- 8. Select **Updating Template** as the Template Type.
- 9. Under VLANs, select the check boxes for **Default (Mgmt)**, **WinClus**, **WinCSV**, and **Backup**.
- 10.Set Default as the native VLAN.
- 11.For MTU, enter 9000.
- 12. In the MAC Pool list, select **MAC_Pool_A**.
- 13. In the Network Control Policy list, select Enable_CDP.
- 14. Click **OK** to create the vNIC template, and click OK again.
- 15. In the navigation pane, select the LAN tab.
- 16.Click **Policies** \rightarrow **root**.

17. Right-click vNIC Templates and select Create vNIC Template. The window that is shown in Figure 8-80 opens.

		Create VN	IC Template		x
reate vN	IC Tem	plate			0
					<u>^</u>
N	lame: vNIC_1	remplate_B			
Descrip	otion:				
Fabr	AND SHARE DURING THE PARTY OF	oric A 💿 Fabric B 📃 Er	nable Failover		
	Targe	:t			
	✓ Ad				
	VM				
Warning					
		by the same name will be	e created. emplate is selected, it will be overw	ritten	
If a port profile o	T the same hai	ne exists, and updating t	emplate is selected, it will be overvi	vinten	
Template 1		ial Template 💿 Updatin	g Template		
VLANs	0				
🕰 Filter 🖨 Exp	ort 🕞 Print				
Select	1~~	Name	Native VLAN	E.	
	7	default	۲		
		Backup	0		
	2	WinCSV	0	=	
		WinClus	0		
L	<u>'</u>	vMotion	0	<u> </u>	
Warning Make sure that the corresponding to		e same value in the QoS s iority of the selected QoS ool_B(32/32)			
Warning Make sure that th corresponding to MAC	the MTU has the top of the Egress prive Pool: MAC_PO	iority of the selected QoS			
Warning Make sure that th corresponding to MAC QoS P	0 he MTU has the the Egress pri Pool: MAC_Po D volicy: DumboF	iority of the selected QoS ool_B(32/32) rame			
Warning Make sure that th corresponding to MAC QoS P Vetwork Control P	the MTU has the the Egress pri Pool: MAC_Po Dicy: DumboF Dicy: Enable_	iority of the selected QoS ool_B(32/32) irame 			
Warning Make sure that th corresponding to MAC QoS P Vetwork Control P	0 he MTU has th the Egress pri Pool: MAC_P Olicy: JumboF olicy: Enable_ roup: <not se<="" td=""><td>iority of the selected QoS ool_B(32/32) irame _CDP et></td><td></td><td></td><td></td></not>	iority of the selected QoS ool_B(32/32) irame _CDP et>			
Warning Make sure that ti corresponding to MAC QoS P Vetwork Control P Pin G	O He MTU has the the Egress pri Pool: MAC_Pri olicy: JumboF olicy: Enable_ roup: <not default<="" olicy:="" se="" td=""><td>iority of the selected QoS ool_B(32/32) irame _CDP et></td><td></td><td></td><td></td></not>	iority of the selected QoS ool_B(32/32) irame _CDP et>			
Warning Make sure that th corresponding to MAC QoS P Vetwork Control P Pin Gi Stats Threshold P	the MTU has the the Egress pri Pool: MAC_P(Dicy: Jumbof rolicy: Enable_ roup: <not se<br="">rolicy: default icies</not>	iority of the selected QoS ool_B(32/32) frame _CDP et>			
Warning Make sure that ti corresponding to MAC QoS P Network Control P Pin G Stats Threshold P Connection Poli	O He MTU has the the Egress pri Pool: MAC_P Olicy: JumboF Olicy: Enable_ roup: <not c<="" default="" icies="" olicy:="" se="" td=""><td>iority of the selected QoS ool_B(32/32) frame _CDP et></td><td></td><td></td><td></td></not>	iority of the selected QoS ool_B(32/32) frame _CDP et>			
Warning Make sure that ti corresponding to MAC QoS P Network Control P Pin G Stats Threshold P Connection Poli	the MTU has the the Egress pri Pool: MAC_Pri olicy: JumboF olicy: Enable_ roup: <not se<br="">olicy: default icies C usNIC</not>	iority of the selected QoS ool_B(32/32) irame _CDP et> VMQ	Policy.		~

Figure 8-80 Create vNIC Template

- 18. Enter vNIC_Template_B as the vNIC template name.
- 19.Select Fabric B.
- 20. Select the Enable Failover check box.

- 21.Select Updating Template as the template type.
- 22.Under VLANs, select the check boxes for **Default (Mgmt)**, **WinClus**, **WinCSV**, and **Backup**.
- 23.Set Default as the native VLAN.
- 24. For MTU, enter 9000.
- 25.In the MAC Pool list, select **MAC_Pool_B**.
- 26. In the Network Control Policy list, select Enable_CDP.
- 27. Click OK to create the vNIC template, and click OK again.

8.2.32 Creating boot policies

This procedure applies to a Cisco UCS environment in which two FC interfaces are on cluster node 1 and two FC interfaces are on cluster node 2.

Two boot policies are configured in this procedure. The first policy configures the primary target to be fcp_a and the second boot policy configures the primary target to be fcp_b.

To create boot policies for the Cisco UCS environment, complete the following steps.

Note: You use the WWPN variables that were logged in the storage section WWPN table.

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click **Policies** \rightarrow **root**.
- 3. Right-click Boot Policies and select Create Boot Policy, as shown in Figure 8-81.

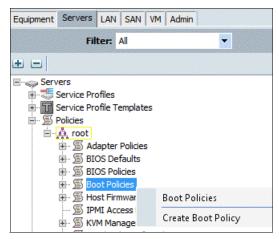


Figure 8-81 Create Boot Policy

The window that is show in Figure 8-82 opens.

		Cre	ate Boot P	olicy				
reate Boot Policy								(
Name: Boo Description: Reboot on Boot Order Change: Inforce vNIC/vHBA/ISCSI Name: Boot Mode: INARNINGS: he type (primary/secondary) does no he effective order of boot devices wit Finforce vNIC/vHBA/ISCSI Name it is not selected, the vVIICs/vHBA/S	egacy t indic hin th	y ○ Uefi ate a boot order presence. e same device dass (LAN/St ected and the vNIC/vHBA/s	SCSI does not	exist, a config error will be r	eported.		·	
Local Devices	-	Boot Order	Order 1	VNIC/VHBA/iSCSI VNIC	Туре	Lun ID	WWN	
Add Local Floppy Add Remote Floppy Add Remote Virtual Drive CLIMC Mounted vMedia VNIICs VHBAS ©								~

Figure 8-82 Add CD/DVD

- 4. Enter Boot-Fabric-A as the name of the boot policy.
- 5. (Optional) Enter a description for the boot policy.
- 6. Keep the Reboot on Boot Order Change check box clear.
- 7. Expand the Local Devices drop-down menu and click Add CD/DVD (you should see Local and Remote disabled).
- 8. Scroll down on the left side, expand the **vHBAs** drop-down menu, and click **Add SAN Boot**. The window that is shown in Figure 8-83 on page 117 opens.

A	Add SAN Boot	X
Add	SAN Boot	0
VHBA:	Fabric-A	
Type:	Primary O Secondary	
		OK Cancel

Figure 8-83 Add the SAN boot initiator

- 9. In the Add SAN Boot dialog box, enter Fabric-A in the vHBA field.
- 10. Make sure that the **Primary** radio button is selected as the SAN boot type.
- 11. Click **OK** to add the SAN boot initiator.
- 12. From the vHBA drop-down menu, select Add SAN Boot Target. The window that is shown in Figure 8-84 opens.

🔺 A	dd SAN Boot Target	x
Add SAN B	oot Target	0
Boot Target LUN:	0	
Boot Target WWPN:	50:05:07:68:0B:24:4F:F4	
Туре:	Primary O Secondary	
	ОК	Cancel

Figure 8-84 Add the primary SAN boot target

13.Keep 0 as the value for Boot Target LUN.

- 14. Enter the WWPN for node 1 going to switch A (<< var_wwpn_Node1-switch-A>>).
- 15.Keep the Primary radio button selected as the SAN boot target type.

- 16.Click **OK** to add the SAN boot target.
- 17. From the vHBA drop-down menu, select **Add SAN Boot Target**. The window that is shown in Figure 8-85 opens.

A	Add SAN Boot Target		x
Add SAN	Boot Target		0
Boot Target LU	IN: 0		
Boot Target WWP	N: 50:05:07:68:0B:24:4F:F5		
Тур	e: O Primary O Secondary		
		OK Cance	el

Figure 8-85 Add the secondary SAN boot target

- 18.Keep 0 as the value for Boot Target LUN.
- 19.Enter the WWPN for node 2 going to switch A (<< var_wwpn_Node2-switch-A>>).
- 20.Click OK to add the SAN boot target.
- 21.From the vHBA drop-down menu, select **Add SAN Boot**. The window that is shown in Figure 8-86 opens.

A	Add SAN Boot	x
Add	SAN Boot	0
vHBA:	Fabric-B	
Type:	Primary O Secondary	
	OK Cano	:el

Figure 8-86 Add SAN boot

- 22. In the Add SAN Boot dialog box, enter Fabric-B in the vHBA box.
- 23. The SAN boot type should automatically be set to Secondary.
- 24. Click OK to add the SAN boot initiator..
- 25. From the vHBA drop-down menu, select **Add SAN Boot Target**. The window that is shown in Figure 8-87 on page 119 opens.

4	Add SAN Boot Target
Add SA	N Boot Target 🤨
Boot Targ	et LUN: 0
Boot Target	WWPN: 50:05:07:68:0B:22:4F:F4
	Type: O Primary O Secondary
	OK Cancel

Figure 8-87 Add the primary SAN boot target

- 26.Keep 0 as the value for Boot Target LUN.
- 27.Enter the WWPN for node 2 switch B (<<var_wwpn_Node2-switch-B>>).
- 28.Keep Primary as the SAN boot target type.
- 29. Click **OK** to add the SAN boot target.
- 30. From the vHBA drop-down menu, select **Add SAN Boot Target**. The window that is shown in Figure 8-88 opens.

	Add SAN Boot	x
Add	SAN Boot	0
vHBA:	Fabric-B	
Type:	Primary Secondary	
	O	Cancel

Figure 8-88 Add the secondary SAN boot target

- 31.Keep 0 as the value for Boot Target LUN.
- 32.Enter the WWPN for Node 1 switch B (<<var_wwpn_Node1-Switch-B>>).
- 33. Click **OK** to add the SAN boot target.

34.Click	OK, and th	en OK agair	to create th	e boot policy,	, as shown in	Figure 8-89.

	(Create Boot	Policy				-
eate Boot Policy							
Name: Bo	ot-Fabric-A						
Description:							
eboot on Boot Order Change:							
force vNIC/vHBA/iSCSI Name:							
Boot Mode: 💿	Legacy 🔿 Uefi						
	/iSCSI are selected if they exist, otherwise the vNI	CIVIDAJISCSI	with the lowest PCIe bus scar	i order is used.			
Local Devices	Boot Order	CIVIDAJISCSI	with the lowest PCLE bus scar	i order is used.			
Local Devices	Boot Order Boot Crder	Order	VNIC/VHBA/ISCSI VNIC	Type	Lun ID	WWN	
Local Devices	Boot Order Boot Order Filter = Export Print Name Color CD/DVD	Order 1			Lun ID	WWN	
Local Devices	 Boot Order ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■	Order	VNIC/VHBA/ISCSI VNIC	Туре	Lun ID	WWN	
Local Devices	Boot Order	Order 1		Type Primary			
Local Devices (CIMC Mounted vMedia (vNICs (vHBAs (Boot Order	Order 1	VNIC/VHBA/ISCSI VNIC	Type Primary Primary	0	WWN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	
Local Devices	Boot Order	Order 1	VNIC/VHBA/ISCSI VNIC	Type Primary	0	50:05:07:68:0B:24:4F:F4	
Local Devices (CIMC Mounted vMedia (vNICs (vHBAs (Boot Order	Order 1	VNIC/VHBA/ISCSI VNIC	Type Primary Primary Secondary	0	50:05:07:68:0B:24:4F:F4	
Local Devices	Boot Order Image: San secondary	Order 1	VNIC/VHBA/ISCSI VNIC	Type Primary Primary Secondary Secondary	0 0 0	50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	
Local Devices	 Boot Order Filter Seport Print Filter Print Filter Print Filter Seport Print Filter P	Order 1	VNIC/VHBA/ISCSI VNIC	Primary Primary Secondary Primary	0 0 0	50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5 50:05:07:68:08:22:4F:F4	
Local Devices	Boot Order Image: Solution of the second and	Order 1 2	VNIC/VHBA/ISCSI VNIC	Type Primary Primary Secondary Primary Secondary Primary Secondary	0 0 0	50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5 50:05:07:68:08:22:4F:F4	
Local Devices	Boot Order Image: Solution of the second and	Order 1 2	VNIC/VHBA/ISCSI VNIC	Type Primary Primary Secondary Primary Secondary Primary Secondary	0 0 0	50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5 50:05:07:68:08:22:4F:F4	

Figure 8-89 Create the boot policy

35. Right-click **Boot Policies** again and select **Create Boot Policy**. The window that is shown in Figure 8-90 on page 121 opens.

		Crea	te Boot F	Policy				X
Create Boot Polic	у							Ø
	Boot-Fabric-B							
Description:								
Reboot on Boot Order Change:								
Enforce vNIC/vHBA/iSCSI Name:								
Boot Mode:	Legacy O Uefi							
Local Devices	Boot O	rder & Filter 👄 Export 🔂 Print				_		
CIMC Mounted vMedia	Name		Order	vNIC/vHBA/iSCSI vNIC	Туре	Lun ID	WWN	
		ocal CD/DVD	1					₽
VNICs			-					₽
vNICs			2	Fabric-B	Primary			
vNICs vHBAs		an SAN primary SAN Target primary	2	Fabric-B	Primary Primary	0	50:05:07:68:0B:22:4F:F4	
vHBAs		SAN primary	2	Fabric-B			50:05:07:68:0B:22:4F:F4 50:05:07:68:0B:22:4F:F5	
vHBAs		SAN primary SAN Target primary SAN Target secondary SAN secondary	2	Fabric-B Fabric-A	Primary			
vHBAs		SAN primary SAN Target primary SAN Target secondary SAN secondary SAN secondary	2		Primary Secondary Secondary Primary	0	50:05:07:68:0B:22:4F:F5 50:05:07:68:0B:24:4F:F4	
VHBAs Add SAN Boot Add SAN Boot Target		SAN primary SAN Target primary SAN Target secondary SAN secondary	2		Primary Secondary Secondary	0	50:05:07:68:0B:22:4F:F5	~
vHBAs		SAN primary SAN Target primary SAN Target secondary SAN secondary SAN secondary		Fabric-A	Primary Secondary Secondary Primary Secondary	0	50:05:07:68:0B:22:4F:F5 50:05:07:68:0B:24:4F:F4	
VHBAs Add SAN Boot Add SAN Boot Target		SAN primary SAN Target primary SAN Target secondary SAN secondary SAN secondary			Primary Secondary Secondary Primary Secondary	0	50:05:07:68:0B:22:4F:F5 50:05:07:68:0B:24:4F:F4	~

Figure 8-90 Create the boot policy

36. Enter Boot-Fabric-B as the name of the boot policy.

37.(Optional) Enter a description of the boot policy.

38.Keep the **Reboot on Boot Order Change** check box clear.

39. From the Local Devices drop-down menu, select Add CD/DVD.

40. From the vHBA drop-down menu, select Add SAN Boot.

41. In the Add SAN Boot dialog box, enter Fabric-B in to the vHBA box.

42. Make sure that the Primary radio button is selected as the SAN boot type.

43. Click **OK** to add the SAN boot initiator.

44. From the vHBA drop-down menu, select Add SAN Boot Target.

45.Keep 0 as the value for Boot Target LUN.

46.Enter the WWPN for <<var_wwpn_Node1-Switch-B>>.

47.Keep Primary as the SAN boot target type.

48. Click **OK** to add the SAN boot target.

49. From the vHBA drop-down menu, select Add SAN Boot Target.

50.Keep 0 as the value for Boot Target LUN.

51.Enter the WWPN for <<var_wwpn_Node2-Switch-B>>.

52. Click **OK** to add the SAN boot target.

- 53. From the vHBA menu, select Add SAN Boot.
- 54. In the Add SAN Boot dialog box, enter Fabric-A into the vHBA box.
- 55. The SAN boot type should automatically be set to Secondary, and the Type option should be unavailable.
- 56.Click **OK** to add the SAN boot initiator.
- 57. From the vHBA menu, select Add SAN Boot Target.
- 58.Keep 0 as the value for Boot Target LUN.
- 59.Enter the WWPN for <<var_wwpn_Node2-switch-A >>.
- 60.Keep Primary as the SAN boot target type.
- 61. Click **OK** to add the SAN boot target.
- 62. From the vHBA drop-down menu, select Add SAN Boot Target.
- 63.Keep 0 as the value for Boot Target LUN.
- 64.Enter the WWPN for <<var_wwpn_Node1-switch-A >>.
- 65. Click **OK** to add the SAN boot target.
- 66. Click OK, and then click OK again to create the boot policy.

8.2.33 Creating service profile templates

In this procedure, two service profile templates are created: one for Fabric A boot and one for Fabric B boot. The first profile is created and then cloned and modified for the second host.

To create service profile templates, complete the following steps:

- 1. In Cisco UCS Manager, click the **Servers** tab in the navigation pane.
- 2. Click Service Profile Templates \rightarrow root.
- 3. Right-click **root** and select **Create Service Profile Template** to open the Create Service Profile Template wizard. The window that is shown in Figure 8-91 on page 123 opens.

<u>A</u>	Create Service Profile Template
Unified C	omputing System Manager
Create Service Profile Template 1. √ <u>Identify Service Profile</u> <u>Template</u> 2. □ <u>Networking</u>	Identify Service Profile Template Vou must enter a name for the service profile template and specify the template type. You can also specify how a UUID will be assigned to this template and enter a description. Name: VII-Host-Infra-Fabric-A
3. □ <u>Storage</u> 4. □ <u>Zoning</u> 5. □ <u>VNIC/VHBA Placement</u> 6. □ <u>vMedia Policy</u> 7. □ <u>Server Boot Order</u> 8. □ Maintenance Policy	The template will be created in the following organization. Its name must be unique within this organization. Where: org-root The template will be created in the following organization. Its name must be unique within this organization. Type: Initial Template Updating Template
9. D <u>Server Assignment</u> 10. D <u>Operational Policies</u>	Specify how the UUID will be assigned to the server associated with the service generated by this template.
	The UUID will be assigned from the selected pool. The available/total UUIDs are displayed after the pool name.
	Optionally enter a description for the profile. The description can contain information about when and where the service pro-
	< Prev Next > Finish Cancel

Figure 8-91 Identify the service profile template

- 4. Identify the Service Profile Template:
 - a. Enter VM-Host-Infra-Fabric-A as the name of the service profile template. This service profile template is configured to boot from node 1 on fabric A.
 - b. Select the Updating Template radio button.
 - c. Under UUID, select **UUID_Pool** as the UUID pool.
 - d. Click Next.

- 5. Configure the Networking options:
 - a. Keep the default setting for Dynamic vNIC Connection Policy.
 - b. Select the Expert radio button to configure the LAN connectivity.
 - c. Click **Add** to add a vNIC to the template. The window that is shown in Figure 8-92 opens.

A	Create vNIC	X
Create vNIC		0
Name: vNIC-A		
Use vNIC Template:		
Create vNIC Template		
vNIC Template: vNIC_Template_A		
0	J	
Adapter Performance Profile		
Adapter Policy: VMWare	Create Ethernet Adapter Policy	
		OK Cancel

Figure 8-92 Create vNIC

- d. In the Create vNIC dialog box, enter vNIC-A as the name of the vNIC.
- e. Check the Use vNIC Template check box.
- f. In the vNIC Template list, select vNIC_Template_A.
- g. In the Adapter Policy list, select VMWare.
- h. Click **OK** to add this vNIC to the template.
- i. On the Networking window of the wizard, click **Add** to add another vNIC to the template. The window that is shown in Figure 8-93 on page 125 opens.

A	Create vNIC	X
Create vNIC		0
		<u>^</u>
Name: vNIC-B Use vNIC Template: Create vNIC Template vNIC Template: vNIC_Template_B		=
Adapter Performance Profile Adapter Policy: VMWare	Create Ethernet Adapter Policy	
	[OK Cancel

Figure 8-93 Add the vNIC to the template

- j. In the Create vNIC box, enter vNIC-B as the name of the vNIC.
- k. Select the Use vNIC Template check box.
- I. In the vNIC Template list, select vNIC_Template_B.
- m. In the Adapter Policy list, select VMWare.
- n. Click OK to add the vNIC to the template. The window that is shown in Figure 8-94

A	Create S	ervice Profile Template		X
Unified C	omputing \$	System Ma	nager	
Create Service Profile Template 1. √ <u>Identify Service Profile</u> <u>Template</u> 2. √Networking	Networking Optionally specify LAN co	onfiguration information.		0
3. D <u>Storage</u> 4. D <u>Zoning</u> 5. D <u>vNIC/vHBA Placement</u>	Dynamic vNIC Connection Policy:	Select a Policy to use (no Dynamic v	NIC Policy by default) 💌	Create Dynamic vNIC C
6. L. <u>vMedia Policy</u> 7. Server Boot Order 8. L. <u>Maintenance Policy</u> 9. <u>Server Assignment</u>		ike to configure LAN connectivi		o vNICs 🔿 Use Connect
10. Departional Policies	Name	MAC Address	Fabric ID	Native VLAN
		Derived	derived	
	-WIC VNIC-B	Derived	derived	
				~
	<	III		>
			< Prev Next >	Finish Cancel

Figure 8-94 Both vNICs created

- o. Review the table in the Networking window to make sure that both vNICs were created.
- p. Click Next. The window that is shown in Figure 8-95 opens.

eate Service Profile Template 1. √Identify Service Profile	Storage Optionally specify disk policies and SAN con	figuration information.	
Template 2. VNetworking 3. VStorage 4. Zoning 5. VNIC/VHBA Placement 6. VMedia Policy 7. Server Boot Order 8. Maintenance Policy 9. Server Assignment 10. Operational Policies	Select a local disk configuration policy. Local Storage: SAN-Boot Create Local Disk Configuration Policy	Mode: No Local Storage Protect Configuration: Yes For Protect Configuration is set, the local disk configuration is preserved if the service profile is disassociated with the server. In that case, a configuration error will be raised when a new service profile is associated with that server if the local disk configuration in that profile is different. HortPath For Protect State is disabled, SD cards will come unavailable immediately. Base ensure SD cards are not in use before disabling the flexFlash State. For Protect State is disabled, SD cards will come unavailable immediately. Base ensure SD cards are not in use before disabling the flexFlash State. For Protect State is Cards are not in use before the state is disabled, SD cards will Contect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards are not in use before the state is disabled. For Protect SD cards ar	
		FlexFlash State: Disable If FlexFlash State is disabled, SD cards will become unavailable immediately. Please ensure SD cards are not in use before disabling the FlexFlash State.	y Po

Figure 8-95 Configure the Storage options

- 6. Configure the Storage options:
 - a. Choose a local disk configuration policy:
 - If the server in question has local disks, choose Default from the Local Storage list.
 - If the server in question does not have local disks, select SAN-Boot.
 - b. Select the Use Connectivity Policy radio button to configure the SAN connectivity.
 - c. For the SAN connectivity Policy, select Dual-Fabric.
 - d. Click Next.
- 7. Accept the zoning options and click Next, as shown in Figure 8-96.

A	Create Service Profile Template	x
Unified C	Computing System Manager	
Create Service Profile Template 1. √ <u>Identify Service Profile</u> <u>Template</u> 2. √ <u>Networking</u>	Zoning Specify zoning information Zoning configuration involves the following steps:	•
3. √ <u>Storage</u> 4. √ <u>Zoning</u> 5. □ <u>vNIC/vHBA Placement</u> 6. □ <u>vMedia Policy</u> 7. □ <u>Server Boot Order</u> 8. □ <u>Maintenance Policy</u>		=
9. Server Assignment 10. Operational Policies	Fabric-A A Fabric-B B Fabric-B B Fabric-B Fabric-A Fabric-B Fabric-A Fabric-B Fab-A-Infra Fabric-B Fab-B-Infra Fabric-B Fab-B-Infra Storage Initiator Fabric-B Fab-B-Infra	
	< III < Prev Next > Finish Car	> >

Figure 8-96 Zoning options

The window that is shown in Figure 8-97 opens.

A	Create Service Pr	ofile Template		X
Unified (Computing Syst	em Manage	r	
eate Service Profile Template 1. √Identify Service Profile Template 2. √Networking 3. √Storage 4. √Zoning 5. √NNIC/VHBA Placement 6. ↓Media Policy 7. ↓Server Boot Order 8. ↓Maintenance Policy 9. ↓Server Assignment 10. ↓Operational Policies	VNIC/VHBA Placement Specify how vNICs and vHBAs are pl vNIC/vHBA Placement specifies how vNICs and vHB in a server hardware configuration independent way	aced on physical network adapters As are placed on physical network adapter y. Create Placement Policy mechanism of placing vNICs and vHBAs o Network Interface connection specified b etwork Interface connection is used by vN	s (mezzanine) n physical network ad elow. This assignment IC or vHBA or it can b	can be
	VNICS VHBAS Name C >> assign >> << remove <<	Virtual Network Interfaces Policy (read Name Virtual VCon 1 VHBA Fabric-A VHBA Fabric-B VIIC VNIC-A VIIC VNIC-A VCon 2 VCon 3 III	d only) Order 1 2 3 4	Selection Prefe Assigned Only All v

Figure 8-97 Set the vNIC/vHBA placement options

- 8. Set the vNIC/vHBA placement options:
 - a. In the Select Placement list, choose the VM-Host-Infra placement policy.
 - Select vCon1 and assign the vHBAs/vNICs to the virtual network interfaces policy in the following order:
 - i. vHBA Fabric-A
 - ii. vHBA Fabric-B
 - iii. vNIC-A
 - iv. vNIC-B
 - c. Review the table to verify that all vNICs and vHBAs were assigned to the policy in the appropriate order.
 - d. Click Next.

9. Click **Next** to bypass the vMedia policy window. The window that is shown in Figure 8-98 opens.

	Create	Service P	rofile Template				
Unified (Computing Sy	/ste	m Mana	ger			
eate Service Profile Template 1. √Identify Service Profile	Server Boot Order Optionally specify the boot pol	icy for this	service profile template.				(
Template 2. √Networking 3. √Storage 4. √Zoning 5. √yNIC/VHBA Placement 6. √yMedia Policy 7. √Server Boot Order 8. Maintenance Policy 9. Server Assignment 10. Operational Policies	Select a boot policy. Boot Policy: Boot-Fabric-A Name: Boot- Description: Reboot on Boot Order Change: No Enforce vNIC/vHBA/ISCSI Name: Yes Boot Mode: Legac	Fabric-A	Create Boot Policy				
	WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with If Enforce VIIC/VHBA/ISCS If it is not selected, the vNICs/vHBA/SIG Boot Order Image: Control of the selected of	in the same o s selected an	device class (LAN/Storage/iSC id the vNIC/vHBA/iSCSI does	not exist, a con	nfig error will	be reported.	used.
	The type (primary/secondary) does not it The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name it If it is not selected, the vNICs/vHBAs/iSC Boot Order	in the same o s selected an	device class (LAN/Storage/iSC id the vNIC/vHBA/iSCSI does	not exist, a con	nfig error will	be reported.	
	The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/ISC Boot Order	in the same c s selected an CSI are selec	levice class (LAN/Storage/iSC d the vNIC/vHBA/iSCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/is	nfig error will SCSI with the	be reported. I lowest PCIe bus scan order is	Ē
	The type (primary/secondary) does not if The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/ISC Boot Order	in the same of selected an CSI are selected of CSI are selected of CSI are selected of CSI are selected of the	levice class (LAN/Storage/iSC d the vNIC/vHBA/iSCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/is	nfig error will SCSI with the	be reported. I lowest PCIe bus scan order is	Ē
	The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice class (LAN/Storage/iSC d the vNIC/vHBA/iSCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/is	nfig error will SCSI with the	be reported. I lowest PCIe bus scan order is	Ē
	The type (primary/secondary) does not if The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSC Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice class (LAN/Storage/iSC d the vNIC/vHBA/iSCSI does ted if they exist, otherwise th vNIC/vHBA/iSCSI vNIC	not exist, a cor e vNIC/vHBA/s Type Primary Primary	offig error will SCSI with the Lun ID	be reported. lowest PCIe bus scan order is WWN 50:05:07:68:08:24:4F:F4	Ē
	The type (primary/secondary) does not if The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSC Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice dass (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC Fabric-A	not exist, a con e vNIC/vHBA/IS Type Primary Primary Secondary	fig error will SCSI with the	be reported. lowest PCIe bus scan order is	Ē
	The type (primary/secondary) does not if The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSCSI Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice class (LAN/Storage/iSC d the vNIC/vHBA/iSCSI does ted if they exist, otherwise th vNIC/vHBA/iSCSI vNIC	not exist, a con e vNIC/vHBA/IS Type Primary Primary Secondary Secondary	fig error will SCSI with the Lun ID 0 0	be reported. lowest PCIe bus scan order is WWN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	Ę
	The type (primary/secondary) does not it The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSCSI Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice dass (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC Fabric-A	not exist, a cor wNIC/VHBA/IS Type Primary Primary Secondary Primary Primary	htig error will SCSI with the Lun ID 0 0	be reported. lowest PCIe bus scan order is WWN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5 50:05:07:68:08:22:4F:F4	Ę
	The type (primary/secondary) does not if The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSCSI Boot Order	in the same of selected an CSI are selected an CSI are selected an CSI are selected an CSI are selected and the selected and	levice dass (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC Fabric-A	not exist, a con e vNIC/vHBA/IS Type Primary Primary Secondary Secondary	fig error will SCSI with the Lun ID 0 0	be reported. lowest PCIe bus scan order is WWN 50:05:07:68:08:24:4F:F4 50:05:07:68:08:24:4F:F5	used.

Figure 8-98 Set the server boot order

10.Set the Server Boot Order:

- a. In the Boot Policy list, select **Boot-Fabric-A**.
- b. Review the table to verify that all boot devices were created and identified. Verify that the boot devices are in the correct boot sequence.
- c. Click Next.

The window that is shown in Figure 8-99 opens.

A	Create Service Profile Template	x
Unified C	computing System Manager	
Create Service Profile Template 1. <u>✓ Identify Service Profile</u> <u>Template</u>	Maintenance Policy Specify how disruptive changes such as reboots, network interruptions, and firmware upgrades should be applied to the server associated with this service profile.	0
2. √ <u>Networking</u> 3. √ <u>Storage</u> 4. √ <u>Zoning</u> 5. √ <u>wNIC/vHBA Placement</u> 6. √ <u>wMedia Policy</u> 7. √ <u>Server Boot Order</u> 8. √ <u>Maintenance Policy</u> 9. □Server Assignment	Maintenance Policy Select a maintenance policy to include with this service profile or create a new maintenance policy that will be accessible to all service profiles.	_
10. Doperational Policies	Maintenance Policy: default	~
	< Prev Next > Finish (Cancel

Figure 8-99 Add a maintenance policy

11.Add a Maintenance Policy:

- a. Select the default maintenance policy.
- b. Click Next. The window that is shown in Figure 8-100 opens.

A	Create Service Profile Template	X
Unified C	computing System Manager	
Create Service Profile Template 1. √Identify Service Profile	Server Assignment Optionally specify a server pool for this service profile template.	0
Template 2. √ Networking 3. √ Storage 4. √ Zoning 5. √ whIC/WHBA Placement 6. √ whedla Policy 7. √ Server Boot Order 8. √ Maintenance Policy 9. √ Server Assignment 10. □ Operational Policies	Select the power state to be applied when this profile is associated with the server.	^ =
	Firmware Management (BIOS, Disk Controller, Adapter) If you select a host firmware policy for this service profile, the profile will update the firmware on the server that it is associated with. Otherwise the system uses the firmware already installed on the associated server. Host Firmware: VM-Host-Infra Image: Create Host Firmware Package	×
	< Prev Next > Finish	Cancel

Figure 8-100 Specify the server assignment

- 12. Specify the Server Assignment:
 - a. In the Pool Assignment list, select Infra_Pool.
 - b. (Optional) Choose a Server Pool Qualification policy.
 - c. Select **Down** as the power state to be applied when the profile is associated with the server.
 - d. Expand **Firmware Management** at the bottom of the window and select **VM-Host-Infra** from the Host Firmware list.
 - e. Click Next. The window that is shown in Figure 8-101 opens.

A	Create Service Profile Template		x
Unified C	omputing System Manager		
Create Service Profile Template 1. √ <u>Identify Service Profile</u>	Operational Policies Optionally specify information that affects how the system operates.	(8
Template 2. √ Networking 3. √ Storage 4. √ Zoning 5. √ vNIC/vHBA Placement 6. √ vMedia Policy 7. √ Server Boot Order	BIOS Configuration If you want to override the default BIOS settings, select a BIOS policy that will be associated with this service profile BIOS Policy: VM-Host-Infra Create BIOS Policy Create BIOS Policy	8	
 ✓<u>Maintenance Policy</u> ✓<u>Server Assignment</u> ✓<u>Operational Policies</u> 	External IPMI Management Configuration Management IP Address	8	
	Monitoring Configuration (Thresholds)	8	
	Power Control Policy Configuration	8	
	Power control policy determines power allocation for a server in a given power group. Power Control Policy: No-Power-Cap		
	Scrub Policy	8	
	KVM Management Policy	8	
	< Prev Next > Finish	Cancel	

Figure 8-101 Add operational policies

13.Add Operational Policies:

- a. In the BIOS Policy list, select VM-Host-Infra.
- b. Expand **Power Control Policy Configuration** and choose **No-Power-Cap** in the Power Control Policy list.
- 14. Click **Finish** to create the service profile template.
- 15. Click **OK** in the confirmation message.
- 16.Click the **Servers** tab in the navigation pane.
- 17.Click Service Profile Templates \rightarrow root.

18. Right-click the previously created VM-Host-Infra-Fabric-A template and select **Create a Clone**. The window that is shown in Figure 8-102 opens.

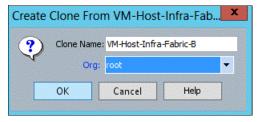


Figure 8-102 Create a clone

19. In the dialog box, enter VM-Host-Infra-Fabric-B as the name of the clone, select **root** for the Org field, and click **OK**.

20.Click OK.

21. Choose the newly cloned service profile template and click the **Boot Order** tab, as shown in Figure 8-103.

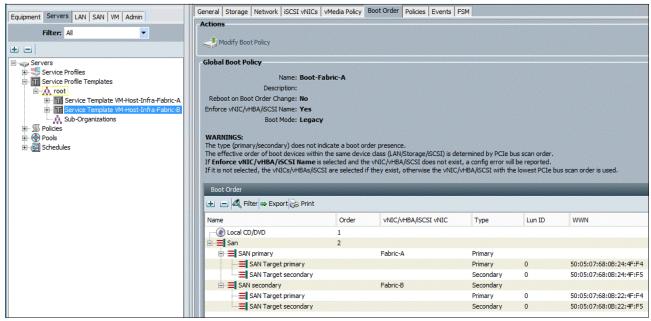


Figure 8-103 Click the Boot Order tab

22. Click Modify Boot Policy. The window that is shown in Figure 8-104 on page 133 opens.

•		Modify Boo	t Policy				
Iodify Boot Policy							(
Boot Policy: Boot-Fabric-B	🚹 Crea	ate Boot Policy					
Name: Boot-	Fabric-B						
Description:							
Reboot on Boot Order Change: No							
Enforce vNIC/vHBA/iSCSI Name: Yes							
Boot Mode: Legac	Ξ γ						
	Y						
WARNINGS:							
WARNINGS: The type (primary/secondary) does not i	indicate a boo		'SI) is determine	d by PCTe b	is scap order		
WARNINGS:	indicate a boo in the same d	device class (LAN/Storage/iSC					
WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with	indicate a boo in the same d is selected an	device class (LAN/Storage/iSC ad the vNIC/vHBA/iSCSI does	not exist, a con	fig error will	be reported.	ised.	
WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC	indicate a boo in the same d is selected an	device class (LAN/Storage/iSC ad the vNIC/vHBA/iSCSI does	not exist, a con	fig error will	be reported.	ised.	
WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/i5CSI Name i If it is not selected, the vNICs/vHBAs/ISO Boot Order	indicate a boo in the same d is selected an	device class (LAN/Storage/iSC ad the vNIC/vHBA/iSCSI does	not exist, a con	fig error will	be reported.	ised.	
WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC	indicate a boo in the same d is selected an	device class (LAN/Storage/iSC ad the vNIC/vHBA/iSCSI does	not exist, a con	fig error will	be reported.	ised.	
WARNINGS: The type (primary/secondary) does not i The effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/ISC Boot Order	indicate a boo in the same d is selected an	device class (LAN/Storage/iSC ad the vNIC/vHBA/iSCSI does	not exist, a con	fig error will	be reported.	used.	
WARNINGS: The type (primary/secondary) does not i the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSC Boot Order	indicate a boo in the same d is selected an CSI are select	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/iS	fig error will CSI with the	be reported. lowest PCIe bus scan order is u		
WARNINGS: The type (primary/secondary) does not if the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBA/iSC Boot Order	indicate a boo in the same d is selected an CSI are select	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/iS	fig error will CSI with the	be reported. lowest PCIe bus scan order is u	Ę	
WARNINGS: The type (primary/secondary) does not if the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC Boot Order	indicate a boo in the same d is selected an CSI are select Order 1	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI does ted if they exist, otherwise th	not exist, a con ne vNIC/vHBA/iS	fig error will CSI with the	be reported. lowest PCIe bus scan order is u	Ę	
WARNINGS: The type (primary/secondary) does not if the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC Boot Order	indicate a boo in the same d is selected an CSI are select Order 1	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI closes ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC	not exist, a con ne vNIC/vHBA/iS	fig error will CSI with the	be reported. lowest PCIe bus scan order is u	Ę	
WARNINGS: The type (primary/secondary) does not if the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC Boot Order	indicate a boo in the same d is selected an CSI are select Order 1	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI closes ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC	not exist, a con he vNIC/vHBA/IS Type Primary	fig error will CSI with the	be reported. lowest PCIe bus scan order is u WWN	Ę	
WARNINGS: The type (primary/secondary) does not it The effective order of boot devices with If Enforce vNIC/VHBA/ISCSI Name i If it is not selected, the vNICs/vHBA/SO Boot Order	indicate a boo in the same d is selected an CSI are select Order 1	device class (LAN/Storage/ISC d the vNIC/vHBA/ISCSI closes ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC	not exist, a con ne vNIC/vHBA/IS Type Primary Primary	fig error will CSI with the Lun ID	be reported. Iowest PCIe bus scan order is u WWN 50:05:07:68:0B:22:4F:F4	Ę	
WARNINGS: The type (primary/secondary) does not if the effective order of boot devices with If Enforce vNIC/vHBA/iSCSI Name i If it is not selected, the vNICs/vHBAs/iSC Boot Order	indicate a boo in the same d is selected an CSI are select Order 1	device dass (LAN/Storage/ISC di the vNIC/vHBA/ISCSI does ted if they exist, otherwise th vNIC/vHBA/ISCSI vNIC Fabric-B	not exist, a con ne vNIC/vHBA/IS Type Primary Primary Secondary	fig error will CSI with the Lun ID	be reported. Iowest PCIe bus scan order is u WWN 50:05:07:68:0B:22:4F:F4	Ę	

Figure 8-104 Modify Boot Policy

23.In the Boot Policy list, select **Boot-Fabric-B**.

24.Click **OK**, and then click **OK** again.

25. In the right pane, click the **Network** tab and then click **Modify vNIC/HBA Placement**. The window that is shown in Figure 8-105 opens.

Statistic Stati			Modify vNIC/vHB	A Placement		
erver hardware configuration independent way.				ers		(
VIICs with the face connection provides a mechanism of placing vIICs and vHBAs on physical network adapters. VIICs and vHBAs are assigned to one of Virtual Network Interface connection specified below. This assignment can be erformed explicitly by selecting which Virtual Network Interface connection is used by vNIC or vHBA or it can be done utomatically by selecting "any". VIICs vHBAs placement on physical network interface is controlled by placement preferences. ease select one Virtual Network Interface and one or more vNICs or vHBAs VIICs vHBAs Name Order Selection Preference VIICs vHBAs >> assign >> Virtual Network Interface Bolicy (read only) VIICs vHBAs Name Order Selection Preference >> assign >> virtual Network Interface Bolicy (read only) Image: Selection Preference VIICs vHBAs virtual Network Interface Bolicy (read only) Image: Selection Preference VIICs vHBAs virtual Network Interface Bolicy (read only) Image: Selection Preference VIICs vHBA virtual Network Interface Bolicy (read only) Image: Selection Preference VIICs vHBA virtual Network Interface Bolicy (read only) Image: Selection Preference VIICs vVIIC vVIIC-A 1 Image: Selection Preference Image: Selection Preference VVIIC vVIIC-A				oters (mezzanine)		
VIICs and vHBAs are assigned to one of Virtual Network Interface connection specified below. This assignment can be done utomatically by selecting which Virtual Network Interface connection is used by vNIC or vHBA or it can be done utomatically by selecting "any". VIICs/VHBA placement on physical network interface is controlled by placement preferences. ease select one Virtual Network Interface and one or more vNICs or vHBAs VIICs vHBAs VIICs vHBAs Name Virtual Network Interface and one or more vNICs or vHBA Name Virtual Network Interface Policy (read only) VIICs vHBAs Virtual Network Interface Policy (read only) VIICs vHBAs Virtual Network Interface Policy (read only) VIICs vHBAs Virtual Network Interface Policy (read only) Name Virtual Network Interface Policy (read only) VIICs vHBAs VIICs vIIC vIIC vIIC A Selection Preference VVIIC vIIC vIIC VIIC VIIC A Selection VIIC vIIC VIIC A VIIC vIIC VIIC VIIC VIIC A VIIC vIIC VIIC VIIC VIIC A VIIC VIIC VIIC VIIC A VIIC VIIC VIIC VIIC A VIIC VIIC VIIC VIIC VIIC A VIIC VIIC VIIC VIIC A VIIC VIIC VIIC VIIC	elect Placement: VM-Ho	ost-Infra	Create Placement Policy			
Name Image: Construction of the second o	NICs and vHBAs are ass erformed explicitly by se utomatically by selecting	signed to one of Virtual l electing which Virtual Ne g "any".	Network Interface connection specifie etwork Interface connection is used by	d below. This assignmen vNIC or vHBA or it can	it can be	
Name Le All >> assign >>			one or more vNICs or vHBAs			
>> assign >>	ase select one Virtual f		one or more vNICs or vHBAs Virtual Network Interfaces Policy (r	ead only)	Selection Preference	
>> assign >> Image: WHBA Fabric-A 2 Image: WHBA Fabric-A 3 Image: WhIC VNIC VNIC VNIC VNIC VNIC VNIC VNIC VN	vNICs vHBAs		one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name	ead only)		
<< remove <	Ase select one Virtual M VNICs VHBAs		one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name Profile VCon 1	ead only) Order		
Image: Write Write B All Image: Signature B All Image: Signature B All Image: Signature B All Image: Signature B All	Ase select one Virtual M VNICs VHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name Profile vCon 1 VHBA Fabric-B VHBA Fabric-A	ead only) Order 1		
「⑤ vCon 3 All 「⑤ vCon 4 All	Ase select one Virtual M VNICs VHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name Profile vCon 1 VHBA Fabric-B VHBA Fabric-A VHBA Fabric-A	ead only) Order 1 2		
S vCon 4 All	Ase select one Virtual M VNICs VHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P	ead only) Order 1 2 3	Assigned Only	
	vNICs vHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P	ead only) Order 1 2 3	Assigned Only	
✓ Move Up V Move Down	vNICs vHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P-S vCon 1 VHBA Fabric-B VHBA Fabric-A VHIC vNIC-A VNIC vNIC-B VNIC vNIC-B VCon 2 VCon 3	ead only) Order 1 2 3	Assigned Only All All	
	vNICs vHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P-S vCon 1 VHBA Fabric-B VHBA Fabric-A VHIC vNIC-A VNIC vNIC-B VNIC vNIC-B VCon 2 VCon 3	ead only) Order 1 2 3	Assigned Only All All	
	vNICs vHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P-S vCon 1 VHBA Fabric-B VHBA Fabric-A VHIC vNIC-A VNIC vNIC-B VNIC vNIC-B VCon 2 VCon 3	ead only) Order 1 2 3 4	Assigned Only All All All	
	vNICs vHBAs	Network Interface and	one or more vNICs or vHBAs Virtual Network Interfaces Policy (r Name P-S vCon 1 VHBA Fabric-B VHBA Fabric-A VHBA Fabric-A VHIC vNIC-A VNIC vNIC-B VNIC vNIC-B VCon 2 VCon 3	ead only) Order 1 2 3 4	Assigned Only All All All	

Figure 8-105 Modify vNIC/HBA Placement

26.Select VM-Host-Infra, expand vCon 1, and move vHBA Fabric-B ahead of vHBA Fabric-A in the placement order.

27. Click **OK**, and then click **OK** again.

8.2.34 Creating service profiles

To create service profiles from the service profile template, complete the following steps:

- 1. In Cisco UCS Manager, click the Servers tab in the navigation pane.
- 2. Click Service Profile Templates \rightarrow root \rightarrow Service Template VM-Host-Infra-Fabric-A.
- Right-click VM-Host-Infra-Fabric-A and select Create Service Profiles from Template, as shown in Figure 8-106 on page 135. The window that is shown in Figure 8-107 on page 135 opens.

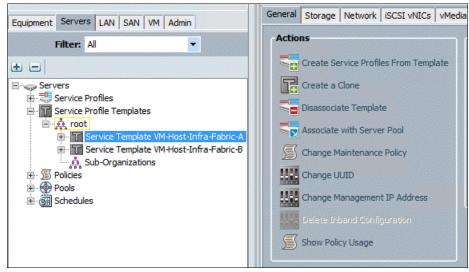


Figure 8-106 Create Service Profiles from Template

Create Service Profiles From Template					
Create Service Profiles From Template					
Naming Pref Name Suffix Starting Numb Number of Instance	0				
	OK	cel			

Figure 8-107 Create Service Profiles from Template

- 4. Enter VM-Host-Infra-0 as the Naming Prefix.
- 5. Enter 1 as the Name Suffix Starting Number.
- 6. Enter 1 as the Number of Instances.
- 7. Click OK to create the service profile.
- 8. Click **OK** in the confirmation message..
- 9. Click Service Profile Templates \rightarrow root \rightarrow Service Template VM-Host-Infra-Fabric-B.

10. Right-click VM-Host-Infra-Fabric-B and select Create Service Profiles from Template. The window that is shown in Figure 8-108 opens.

Create Service Profiles From Template					
Create Service Profile	es From Template 🛛 🥹				
Naming Prefix: VM-Hos	t-Infra-0				
Name Suffix Starting Number: 2					
Number of Instances: 1					
	OK Cancel				

Figure 8-108 Create Service Profiles from Template

- 11. Enter VM-Host-Infra-0 as the service profile prefix.
- 12. Enter 2 as the Name Suffix Staring Number.
- 13. Enter 1 as the Number of Instances.
- 14. Click **OK** to create the service profile.
- 15. Click **OK** in the confirmation message.
- 16. Verify that the service profiles VM-Host-Infra-01 and VM-Host-Infra-02 are created, as shown in Figure 8-109. The service profiles are automatically associated with the servers in their assigned server pools.

Canada Landara Landara Landara	Boot Order	Virtual Machines	FC Zones	Policies	Server Details	CIMC Sessions	FSM	VIF Paths	Faults	Events
Equipment Servers LAN SAN VM Admin	General	Stor	age	Network	k	iSCSI vNICs		٧M	edia Policy	
Equipment Servers LAN SAN VM Admin Filter: Al Service Profiles Service Profiles WH-tost-Infra-01 WH-tost-Infra-01 WH-tost-Infra-01 WH-tost-Infra-Fabric-A WH-tost-Infr	General Fault Summa Overal Status Overal Status Status Det Desired Por As Assign Note: The Power Sta It may be actual va	Stor	age		UUID Po Associa Service Profil	ISCSI VNICs	WAF file is not m file template ce profile, p Infra-01 -1128-11(c id id-pool-UUI id-pool-UUI Infra-Fabr	vM CMING odifiable becaus e VH-Host-Inf wease unbind it 1 e5-0000-0000 D_Pool Tic-A	edia Policy e it is bound ra-Fabric- <i>F</i> from the tem	to L
	Actions				Assigned	Server or Server Po				
	Boot Ser					Server Pool: Infra ool Qualification: UCSB estrict Migration: No	2010/01/02/03/53			

Figure 8-109 Verify that the service profiles are created

17. Verify that the FC zones are created after the service profile assignment, as shown in Figure 8-110 on page 137.

r: All								0000000000	
	Name	Initiator WWPN	Target WWPN	Initia	Admi	Ope	Fabr	VSA	Zone.
	ucs_Versastack-FI_A_1_VM-Host-Infra-01_Fabric-A	20:00:00:25:B5:01:0A:0F		Fabric-A	Applied	Active	Α	101	1
rs	FC Target 50:05:07:68:0B:24:4F:F4		50:05:07:68:0B:24:4F:F4						
ice Profiles oot	ucs_Versastack-FI_A_2_VM-Host-Infra-01_Fabric-A	20:00:00:25:B5:01:0A:0F		Fabric-A	Applied	Active	Α	101	2
M-Host-Infra-01	FC Target 50:05:07:68:0B:24:4F:F5		50:05:07:68:0B:24:4F:F5						
VM-Host-Infra-02	ucs_Versastack-FI_A_3_VM-Host-Infra-01_Fabric-A	20:00:00:25:B5:01:0A:0F		Fabric-A	Applied	Active	Α	101	3
ub-Organizations			50:05:07:68:0B:23:4F:F4						
ofile Templates			50:05:07:68:0B:23:4F:F5						
			50:05:07:68:0B:24:4F:F4						
	FC Target 50:05:07:68:0B:24:4F:F5		50:05:07:68:0B:24:4F:F5						
	🖶 🚍 ucs_Versastack-FI_B_1_VM-Host-Infra-01_Fabric-B	20:00:00:25:85:01:08:0F		Fabric-B	Applied	Active	В	102	1
			50:05:07:68:0B:21:4F:F5						
			50:05:07:68:0B:22:4F:F4						
			50:05:07:68:0B:22:4F:F5						
	FC Target 50:05:07:68:0B:23:4F:F4		50:05:07:68:0B:23:4F:F4						
	ucs_Versastack-FI_B_2_VM-Host-Infra-01_Fabric-B	20:00:00:25:B5:01:0B:0F		Fabric-B	Applied	Active	в	102	2
	FC Target 50:05:07:68:0B:22:4F:F4		50:05:07:68:0B:22:4F:F4						
	ucs_Versastack-FI_B_3_VM-Host-Infra-01_Fabric-B	20:00:00:25:B5:01:0B:0F		Fabric-B	Applied	Active	В	102	3
	FC Target 50:05:07:68:0B:22:4F:F5		50:05:07:68:0B:22:4F:F5						

Figure 8-110 Verify FC zones

18.After completing all the previous steps, power on the servers and you should see the SAN-Boot LUNs during BIOS POST, as shown in Figure 8-111.

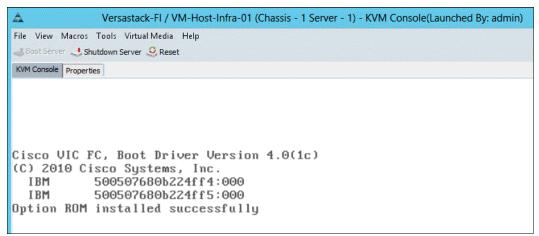


Figure 8-111 SAN-Boot LUNs during BIOS POST

8.3 Backing up the Cisco UCS Manager configuration

It is recommended you backup your Cisco UCS Manager configuration. For more information about this topic, see the *Cisco UCS Manager GUI Configuration Guide, Release 2.2*, found at:

http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/sw/gui/config/guide/2-2
/b_UCSM_GUI_Configuration_Guide_2_2/b_UCSM_GUI_Configuration_Guide_2_2_chapter_010
1010.html

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9

SAN boot

This chapter describes how to add the host mappings for the host profiles that are created through Cisco UCS Manager to the Storwize V7000 storage system, connect to the boot LUNs, and perform the initial ESXi installation. The WWPNs for the hosts are to complete the steps in this chapter.

9.1 Adding hosts and mapping the boot volumes on the Storwize V7000 system

To add hosts and map the boot volumes on the Storwize V7000 storage system, complete the following steps:

- 1. Open the Storwize V7000 management GUI by navigating to <<*var_cluster_mgmt_ip>>* and log in with your superuser or admin account.
- 2. In the left pane, click the Host icon, which is the fourth icon down, and click Hosts.
- 3. Click Create Host in the upper left menu to start the Create Host wizard.

Figure 9-1 shows the Add Host window, which shows options for FC and iSCSI hosts.

🗥 versa		losts					
	+ Add Host I≡ Action	ıs QI					
	Name		Status	Host Type		Host Mappings d.	
		Add Ho	Choose the Host Type	•	Cance	iSC SI Host	x

Figure 9-1 Add a host on the Storwize V7000 storage system

- 4. Select the Fibre Channel Host option.
- 5. For Host Name, enter vm-host-infra-01.
- 6. For Fibre Channel Ports, click the drop-down menu and select or input the WWPNs for the A path vHBAs (<<var_wwpn_vm-host-infra-01-a>>) and click Add Port to List.
- Click the drop-down menu again, and select or input the host B port (<<wwpn_vm-host-infra-01-b>>) and click Add Port to List.
- 8. Leave Advanced Settings as the default and click Create Host.
- 9. Click Close.

Note: If the hosts are powered on and zoned correctly, they appear in the selection dropdown or, if you type in the WWPN, you should see green check marks for each WWPN.

- 10.Click Create Host to create the second host.
- 11.Select the Fibre Channel Host option.
- 12. For Host Name, enter vm-host-infra-02.
- 13.For Fibre Channel Ports, select the drop-down menu and select the WWPNs for the A path vHBAs (<<*var_wwpn_vm-host-infra-02-a>>*) and click **Add Port to List**.
- 14.Select the B port by selecting the variable for the B path (<<wwpn_vm-host-infra-02-b>>) and click Add Port To List.
- 15. Leave the Advanced Settings as the default and click Create Host.
- 16.Click Close.

Figure 9-2 shows creating the host vm-host-infra-02. The FC ports appear in the drop-down menu.

Add Host		х
	Host Name (optional): vm-host-infra-02	
Port Definitions	Add Port to List Rescan You have not added any WWPNs yet.	
Advanced Settings		
I/O Group	Host Type	
✓ io_grp0	Generic (default)	
✓ io_grp1	HP/UX	
✓ io_grp2	OpenVMS	
✓ io_grp3	TPGS	
Advanced	Add Host Cancel	

Figure 9-2 Create vm-host-infra-02

- 17.Click the Volumes icon in the left pane, then click the volumes menu item to display the created volumes.
- 18.Right-click the volume vm_host_boot_1 and select Map to Host.

			0		
	+ Create Volumes	E Actions	Q Filter		
	Name		State	Capacity	Pool
	infra_datastor	re_1	✓ Online (formatting)	1.00 TiB	mdiskgrp0
	infra_datastor	re_2	✓ Online	256.00 GiB	mdiskgrp0
	sp_datastore_	1	✓ Online (formatting)	2.00 TiB	mdiskgrp0
	sql_rdm_data		✓ Online (formatting)	256.00 GiB	mdiskgrp0
	sql_rdm_log		✓ Online (formatting)	64.00 GiB	mdiskgrp0
	sql_rdm_quor	rum	✓ Online	1.00 GiB	mdiskgrp0
	vm_host_boo	t 1	✓ Online	32.00 GiB	mdiskgrp0
	vm_host_bo .			32.00 GiB	mdiskgrp0
		Create Volu	imes		
		Map nos	t		
-		Unmap All	Hosts		
-		View Mapp	ed Hosts		
I		Duplicate V	/olume		
		Move to An	other I/O Group		
		Rename			
		Shrink			
		Expand			
200		Migrate to	Another Pool		
N.		Export to In	nago Modo		

Figure 9-3 shows mapping the first boot LUN to the first host.

Figure 9-3 Showing mapping a volume to host

- 19. Right-click **vm-host-infra-01** and click **Map to Host**. Then, in the drop-down menu, select **Map Volumes** and then click **Close**.
- 20.Right-click vm_host_boot_02 and click Map to Host. Then, in the drop-down menu, select Map Volumes and then click Close.
- 21. Power on the servers and verify that the boot LUNs appear during the BIOS POST, as shown in Figure 9-4.

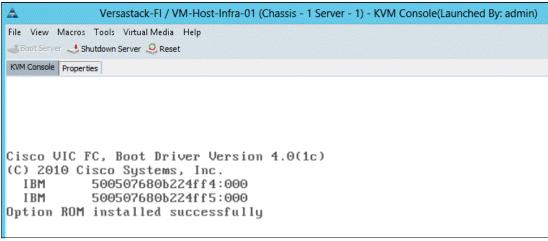


Figure 9-4 Boot LUNS

Note: In this VersaStack environment, there are two paths to the boot LUN, so it appears twice.

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10

VersaStack VMware ESXi 5.5 Update 2 SAN boot installation

This chapter provides detailed instructions for installing VMware ESXi 5.5 Update 2 in a VersaStack environment. After the procedures are completed, two SAN-booted ESXi hosts are provisioned. These deployment procedures are customized to include the environment variables.

Note: Several methods exist for installing ESXi in a VMware environment. These procedures focus on how to use the built-in Keyboard, Video, Mouse (KVM) console and virtual media features in Cisco Unified Computing System (Cisco UCS) Manager to map remote installation media to individual servers and connect to their boot logical unit numbers (LUNs). This method uses the Cisco Custom ESXi 5.5.0 U2 GA ISO file, which is downloaded from the following URL. This file is required for this procedure because it contains custom Cisco drivers, which reduce the number of installation steps.

https://my.vmware.com/web/vmware/details?downloadGroup=OEM-ESXI55U2-CISCO&produ
ctId=353

10.1 The Cisco UCS 6200 Fabric Interconnect Cisco UCS Manager

The administrator can use KVM to begin the installation of the operating system (OS) through remote media. It is necessary to log in to the Cisco UCS environment to run the IP KVM.

To log in to the Cisco UCS environment, complete the following steps:

- 1. Download the Cisco Custom ISO for ESXi from the VMware website.
- 2. Open a web browser and enter the IP address for the Cisco UCS cluster address. This step starts the Cisco UCS Manager application.

Note: You need Java Runtime Environment 1.6 or higher to run this application.

Figure 10-1 shows the Cisco Unified Computing System Manager start window, which has options to start Cisco UCS Manager and the KVM manager.

🗱 Cisco UCS Manager	× +			_ 0 ×
← 🔒 https://192.168.10.10		⊽ C Q. Search	☆ 自 ♥ ↓	☆ 9 ≡
		Cisco Unified Computing System (UCS) Manager Single point device management for Cisco UCS 2.2(3c)		
		Launch UCS Manager Launch KVM Manager		
		Requires Java Runtime Environment 1.6 or higher		
		Do Not Show Again?		
		Information Dashboard		
		Centralized hardware inventory, centralized faults/togs, and up to one year of statistics		
		Download UCS Central		
https://192.168.10.10/ucsm/ucsm.jr		O009-2014 Closo Systems, be All rights reasoned. The promote the control of the data reasoned. The promote the control of the data is a control of the second		

Figure 10-1 Cisco Unified Computing System Manager start window

- 3. Log in to Cisco UCS Manager by using the admin user name and password.
- 4. From the main menu, click the **Servers** tab.
- 5. Click Servers \rightarrow Service Profiles \rightarrow root \rightarrow vm-host-infra-01.
- 6. Right-click vm-host-infra-01 and select KVM Console.
- 7. Click Servers \rightarrow Service Profiles \rightarrow root \rightarrow vm-host-infra-02.
- 8. Right-click vm-host-infra-02 and select KVM Console Actions \rightarrow KVM Console.

Figure 10-2 on page 147 shows using UCS manager to start KVM on vm-host-infra-01.

A	Cisco Unified Computing S	System Manager - Versastack-
Fault Summary	Admin	Policies Server Details C
Filter: All	General Storage	Network iSCSI vNIC:
Servers Service Profiles Service Profile	Show Navigator Boot Server Shutdown Server Reset KVM Console SSH to CIMC for So Rename Service Profile	
Service Profile Templati Service Profile Templati Service Templa Service Templa Service Templa Service Templa	Create a Clone Create a Service Profile Template Disassociate Service Profile Change Service Profile Association	

Figure 10-2 Start KVM in Cisco UCS

10.2 Setting up a VMware ESXi installation

This section describes how to complete the VMware ESXi installation.

10.2.1 ESXi hosts vm-host-infra-01 and vm-host-infra-02

To prepare the server for the OS installation, complete the following steps on each ESXi host:

1. In the KVM window, click the Virtual Media tab.

Figure 10-3 shows the location of the Activate Virtual Devices option in The Virtual Media menu.



Figure 10-3 Virtual Media menu

- 2. Click Activate Virtual Devices, select Accept this Session, and then click Apply.
- 3. Click Virtual Media \rightarrow Map CD/DVD, then browse to the ESXi installer ISO image file and click Open.
- 4. Click Map Device to map the newly added image.

Figure 10-4 shows mapping the ESXi 5.5.0 u2 custom ISO that was downloaded from the VMWare website.

<u>A</u>	Virtual Media - Map CD/DVD
Drive/Image File:	-2068190-custom-Cisco-5.5.2.3.iso 🔻 Browse
	✓ Read Only
	Map Det Cancel

Figure 10-4 Map the ESXi 5.5.0 u2 custom ISO

- 5. Click the **KVM** tab to monitor the server boot.
- 6. If the server is powered on, first shut down the server, then start the server by clicking **Boot Server** and clicking **OK**, and then click **OK** again.

10.3 Installing ESXi

This section describes how to install ESXi.

10.3.1 ESXi hosts vm-host-infra-01 and vm-host-infra-02

To install VMware ESXi on to the SAN-bootable LUN of the hosts, complete the following steps on each host:

1. On start, the machine detects the presence of the ESXi installation media. Select the ESXi installer from the menu that opens.

Note: You might have to press F6 and force the host to boot from the vDVD.

Figure 10-5 on page 149 shows the ESXi Boot device list that is accessed by pressing F6 repeatedly.



Figure 10-5 Boot device list

- 2. After the installer has finished loading, press Enter to continue with the installation.
- 3. Read and accept the user license agreement (EULA). Press F11 to accept and continue.
- Select the IBM LUN that was previously set up as the installation disk for ESXi and press Enter to continue with the installation.

Figure 10-6 shows the available local and remote disks.



Figure 10-6 The boot LUN that is mapped to vm-host-infra-01

- 5. Select the appropriate keyboard layout and press Enter.
- 6. Enter and confirm the root password and press Enter.
- The installer issues a warning that existing partitions will be removed from the volume. Press F11 to continue with the installation.
- 8. After the installation is complete, click the check icon to clear the Mapped ISO (located in the Virtual Media tab of the KVM console) to unmap the ESXi installation image.

9. The Virtual Media window might issue a warning stating that it is preferable to eject the media from the guest. Because the media cannot be ejected and it is read-only, simply click **Yes** to unmap the image.

10. From the KVM tab, press Enter to restart the server.

10.4 Setting up management networking for ESXi hosts

Adding a management network for each VMware host is necessary for managing the host. To add a management network for the VMware hosts, complete the following steps on each ESXi host.

10.4.1 ESXi Host vm-host-infra-01

To configure the vm-host-infra-01 ESXi host with access to the management network, complete the following steps:

- 1. After the server has finished restarting, press F2 to customize the system.
- 2. Log in as root and enter the corresponding password.
- 3. Click the Configure the Management Network option and press Enter.
- 4. Click the VLAN (Optional) option and press Enter.
- 5. Enter the <<var_ib-mgmt_vlan_id>> and press Enter.
- 6. From the Configure Management Network menu, click IP Configuration and press Enter.
- Select the Set Static IP Address and Network Configuration option by using the Spacebar.
- Enter the IP address for managing the first ESXi host: <<var_vm_host_infra_01_ip>>.
- 9. Enter the subnet mask for the first ESXi host.
- 10. Enter the default gateway for the first ESXi host.

Figure 10-7 on page 151 shows setting the IP address, subnet mask, and default gateway from the ESXi host.

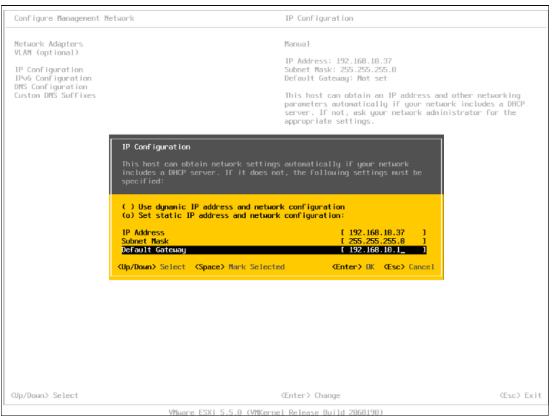


Figure 10-7 IP configuration on ESXi 5.5.0

11. Press Enter to accept the changes to the IP configuration.

12. Click the IPv6 Configuration option and press Enter.

13. Using the spacebar, clear Enable IPv6 (restart required) and press Enter.

14. Click the DNS Configuration option and press Enter.

Note: Because the IP address is assigned manually, the DNS information must also be entered manually.

15. Enter the IP address of the primary DNS server.

16.Optional: Enter the IP address of the secondary DNS server.

17. Enter the fully qualified domain name (FQDN) for the first ESXi host.

18. Press Enter to accept the changes to the DNS configuration.

19. Press Esc to exit the Configure Management Network submenu.

20. Press Y to confirm the changes and return to the main menu.

21. The ESXi host restarts. After restart, press F2 and log back in as root.

- 22.Click **Test Management Network** to verify that the management network is set up correctly and press Enter.
- 23. Press Enter to run the test.

24. Press Enter to exit the window.

25. Press Esc to log out of the VMware console.

10.4.2 ESXi Host vm-host-infra-02

To configure the vm-host-infra-02 ESXi host with access to the management network, complete the following steps:

- 1. After the server has finished restarting, press F2 to customize the system.
- 2. Log in as root and enter the corresponding password.
- 3. Click the Configure the Management Network option and press Enter.
- 4. Click the VLAN (Optional) option and press Enter.
- 5. Enter the <<var_ib-mgmt_vlan_id>> and press Enter.
- From the Configure Management Network menu, select IP Configuration and press Enter.
- Select the Set Static IP Address and Network Configuration option by using the Spacebar.
- Enter the IP address for managing the second ESXi host: <<var_vm_host_infra_02_ip>>.
- 9. Enter the subnet mask for the second ESXi host.
- 10. Enter the default gateway for the second ESXi host.
- 11. Press Enter to accept the changes to the IP configuration.
- 12. Click the IPv6 Configuration option and press Enter.
- 13. Using the spacebar, clear Enable IPv6 (restart required) and press Enter.
- 14. Click the DNS Configuration option and press Enter.

Note: Because the IP address is assigned manually, the DNS information must also be entered manually

- 15. Enter the IP address of the primary DNS server.
- 16.Optional: Enter the IP address of the secondary DNS server.
- 17. Enter the FQDN for the second ESXi host.
- 18. Press Enter to accept the changes to the DNS configuration.
- 19. Press Esc to exit the Configure Management Network submenu.
- 20. Press Y to confirm the changes and return to the main menu.
- 21. The ESXi host restarts. After the restart completes, press F2 and log back in as root.
- 22. Click **Test Management Network** to verify that the management network is set up correctly and press Enter.
- 23. Press Enter to run the test.
- 24. Press Enter to exit the window.
- 25. Press Esc to log out of the VMware console.

10.5 vSphere setup

In this section, you set up the vSphere environment by using Windows 2012 and a SQL Server. The virtual machines that are used in this procedure are installed on a local data store on VersaStack for any greenfield deployments; however, these VMs can be installed on a different ESX clustered system or physical hardware if you want. This procedure uses the volumes that were created for VMFS Datastores.

10.5.1 Downloading the VMware vSphere Client and vSphere Remote CLI

To download the VMware vSphere Client and install Remote CLI, complete the following steps:

- 1. Open a web browser on the management workstation and navigate to the VM-Host-Infra-01 management IP address.
- 2. Download and install both the vSphere Client and the Windows version of vSphere Remote Command-Line Interface.

Note: These applications are downloaded from the VMware website.

Logging in to VMware ESXi hosts by using the VMware vSphere Client

You must log in to both hosts.

ESXi Host vm-host-infra-01

To log in to the vm-host-infra-01ESXi host by using the VMware vSphere Client, complete the following steps:

- 1. Open the recently downloaded VMware vSphere Client and enter the IP address of vm-host-infra-01 as the host you are trying to connect to: <<var_vm_host_infra_01_ip>>.
- 2. Enter root for the user name.
- 3. Enter the root password.
- 4. Click Login to connect.

ESXi Host vm-host-infra-02

To log in to the vm-host-infra-02 ESXi host by using the VMware vSphere Client, complete the following steps:

- Open the recently downloaded VMware vSphere Client and enter the IP address of vm-host-infra-02 as the host you are trying to connect to: <<var_vm_host_infra_02_ip>>.
- 2. Enter root for the user name.
- 3. Enter the root password.
- 4. Click Login to connect.

10.6 Setting up VMkernel ports and the virtual switch

For each ESXi host, the steps in the section that follows must be repeated.

10.6.1 ESXi Host vm-host-infra-01

Repeat the steps in this section for all the ESXi hosts.

To set up the VMkernel ports and the virtual switches on the vm-host-infra-01 ESXi host, complete the following steps:

- 1. From each vSphere Client, select the host in the inventory.
- 2. Click the **Configuration** tab.
- 3. Click Networking in the Hardware pane.
- 4. Click **Properties** on the right side of vSwitch0.
- 5. Select the vSwitch configuration and click Edit.
- 6. From the General tab, change the MTU to 9000.
- 7. Click **OK** to close the properties for vSwitch0.
- 8. Select the Management Network configuration and click Edit.
- 9. Change the network label to VMkernel-MGMT and make sure that the **Management Traffic** check box is checked.
- 10. Click **OK** to finalize the edits for Management Network.
- 11.Select the VM Network configuration and click Edit.
- 12.Change the network label to VM-Production and enter <<var_devmgmt_vlan_id>> in the VLAN ID (Optional) field.
- 13. Click **OK** to finalize the edits for VM Network.
- 14.Click Add to add a network element.
- 15.Select VMkernel and click Next.
- 16.Change the network label to VMkernel-vMotion and enter <<var_vmotion_vlan_id>> in the VLAN ID (Optional) field.

Important: Whenever you define multiple networks across hosts, the syntax must be the same on those hosts.

17. Select the Use this port group for vMotion check box.

- 18. Click Next to continue with the vMotion VMkernel creation.
- 20. Click **Next** to continue with the vMotion VMkernel creation.
- 21. Click Finish to finalize the creation of the vMotion VMkernel interface.
- 22.Select the VMkernel-vMotion configuration and click Edit.
- 23. Change the MTU to 9000.
- 24. Click **OK** to finalize the edits for the VMkernel-vMotion network.

- 25. Click Add and select Virtual Machine Network, and then click Next.
- 26.Change the network label to VM-WinCSVand enter <<var_vmwincsv_vlan_id>> in the VLAN ID (Optional) field.
- 27. Click Next, and click Finish to complete the creation of the VM-WinCSV network.
- 28. Click Add and select Virtual Machine Network, and then click Next.
- 29.Change the network label to VM-WinClus and enter <<var_winclus_vlan_id>> in the VLAN ID (Optional) field.
- 30. Click Next, and click Finish to complete the creation of the VM-WinClus network.
- 31. Click Add and select Virtual Machine Network, and then click Next.
- 32. Change the network label to VM-Backup and enter <<var_vmbackup_vlan_id>> in the VLAN ID (Optional) field.
- 33. Click Next, and click Finish to complete the creation of the VM-Backup network.
- 34. Close the dialog box to finalize the ESXi host networking setup.

Figure 10-8 shows the vSwitch setup on vm-host-infra-01.

Summary Virtual Machines Resource All	location Performance Configuration Local Users & Groups Events Permissions
Hardware	View: vSphere Standard Switch
Health Status	Networking
Processors	
Memory	Standard Switch: vSwitch0 Remove Properties
Storage	Virtual Machine Port Group
Networking	🖓 VM-backup 🧕 🔶 🗰 vmnic0 40000 Full 🖓
Storage Adapters	VLAN ID: 60
Network Adapters	Virtual Machine Port Group
Advanced Settings	VM-WinClus
Power Management	VLAN ID: 50
Software	Virtual Machine Port Group VM-WinCSV
Licensed Features	VLAN ID: 40
Time Configuration	Virtual Machine Port Group
DNS and Routing	VM-Production
Authentication Services	VMkernel-vMotion
Virtual Machine Startup/Shutdown	vmk1 : 192.168.30.2 VLAN ID: 30
Virtual Machine Swapfile Location	-VMkemel Port
Security Profile	
Host Cache Configuration	vmk0 : 192.168.10.37
System Resource Allocation	

Figure 10-8 vSwitch setup

		vSwitch0 Properties		_ D X
orts Network Adapters	0	Add	Adapter Wizar	d 🗖 🗖
Network Adapter Speet	Adapter Selection New adapters vSphere stand	may be taken from a pool of u	inused ones, or trai	nsferred from an existing
	Adapter NIC Order Summary		here standard swite	ving list. If you select an adapter that is ch, it will be removed from that vSphere
		Name	Speed	Network
		Unclaimed Adapters Cisco Systems Inc		et NIC
		vmnic1	40000 Full	128.0.0.1-255.255.255.254
Add				
	Help	171		< Back Next > Cancel

Figure 10-9 shows adding the second vmNIC on vm-host-infra-01.

Figure 10-9 Add the second vmNIC

- 35. You must now assign another physical adapter to the switch to provide redundancy and load balancing features in this environment. To achieve this goal, use the NIC teaming feature that is available in vSwitch.
- 36. Click the properties of Vswitch0 on the Configuration Networking tab, click the **Network** Adapters tab, click Add, select vmNIC1, click Next, click Next, click Finish, and click Close.
- 37.Make sure that both vmNICs are in the active/active configuration, as shown in Figure 10-10 on page 157.

orts Network Adap	ers	Ø		vSwitch0 Properties	
Configuration	Summary 120 Ports		ity Traffic Shaping	NIC Teaming	
VM-WinClus VM-WinCSV VM-Production	Virtual Machin Virtual Machin Virtual Machin	Load Balanci	ng:	Route based on the originating) virtual port ID 💌
VM-WinCSV VM-Production VM-Backup VMkernel-vMo		e P Notify Switch	over Detection: nes:	Link status only Yes	<u>•</u>
Q VMKernel-MG	T vMotion and If	···· Failback:		Yes	
				s for this port group. In a failover situati crified below.	on, standby
		Select active adapters act	and standby adapter tivate in the order spe Speed		on, standby Move Up
		Select active adapters act	and standby adapter tivate in the order spe Speed Spters	cified below.	
		Select active adapters act Name Active Ada IIII vmnii IIII vmnii IIII vmnii	and standby adapter tivate in the order spe speed apters c0 40000 Full c1 40000 Full	cified below.	Move Up
		Select active adapters act Name Active Ada www.mnie	and standby adapter tivate in the order spe Speed Spters C0 40000 Full C1 40000 Full dapters	crified below. Networks 128.0.0.1-191.255.255.254	Move Up

Figure 10-10 vmNICs in the Active Adapters list

10.7 Mapping the required VMFS Datastores

In this section, you map the VMFS Datastores to the hosts.

10.7.1 Mapping the VMFS Datastores to the first host

Note: The second host will be mapped after the cluster is created.

To map the VMFS Datastores to the first host, complete the following steps:

- 1. Log in to the IBM Storwize V7000 management GUI.
- 2. Select the volumes icon in the left pane and click the Volumes menu item.
- 3. Right-click the infra_datastore_1 volume, infra_datastore_2, sql_rdm_data, sql_rdm_log, and sql_rdm_quorum, and click **Map to Host**.
- 4. Select vm-host-infra-1, click Map Volumes, and then click Close.

ESXi Host vm-host-infra-01

To mount the required data stores, complete the following steps on the first ESXi host:

- 1. From the vSphere Client, select vm-host-infra-01 in the inventory.
- 2. Click the **Configuration** tab to enable the configurations.
- 3. Click Storage in the Hardware pane.
- 4. In the Datastore area, click Add Storage to open the Add Storage wizard.
- 5. Select Disk/Lun and click Next.

- 6. Select the **1 TB Datastore** LUN and click Next.
- 7. Accept the default VMFS setting and click Next.
- 8. Click Next for the disk layout.
- 9. Enter infra_datastore_1 as the data store name.
- 10.Click Next to retain the maximum available space.
- 11.Click Finish.
- 12. Click Add Storage to open the Add Storage wizard.

13.Select Disk/Lun and click Next.

- 14. Select the 256 GB Datastore LUN and click Next.
- 15. Accept the default VMFS setting and click Next.

16.Click **Next** for the disk layout.

- 17.Enter infra_datastore_2 as the data store name.
- 18. Click **Next** to retain the maximum available space.
- 19.Click Finish.

ESXi Hosts vm-host-infra-01 and vm-host-infra-02

To configure Network Time Protocol (NTP) on the ESXi hosts, complete the following steps on each host:

- 1. From each vSphere Client, select the host in the inventory.
- Click the Configuration tab to enable the configurations.
- 3. Click **Time Configuration** in the Software pane.
- 4. Click Properties at the upper right side of the window.
- 5. At the bottom of the Time Configuration dialog box, click **Options**.
- 6. In the NTP Daemon Options dialog box, complete the following steps:
 - a. Click General in the left pane and select Start and stop with host.
 - b. Click NTP Settings in the left pane and click Add.
- In the Add NTP Server dialog box, enter <<var_global_ntp_server_ip>> as the IP address
 of the NTP server and click OK.
- In the NTP Daemon Options dialog box, select the Restart NTP Service to Apply Changes check box and click OK.
- 9. In the Time Configuration dialog box, complete the following steps:
 - a. Select the NTP Client Enabled check box and click OK.
 - b. Verify that the clock is now set to the correct time.

Note: The NTP server time might vary slightly from the host time.

10.8 Storage I/O Control

Storage I/O Control (SIOC) allows for an increase in the number of VMs per data store by monitoring data store latency and adjusting the I/O load that is sent to it.

To configure SIOC, complete the following steps:

- 1. On vm-host-infra-01, go to Configuration and then click Storage in the left pane.
- 2. Right-click the first data store and select Properties.
- 3. Select the Storage I/O Control check box.
- 4. Click Close.
- 5. Repeat steps 1 4 for every data store on both hosts.

Figure 10-11 shows the properties of a boot LUN with SIOC enabled.

vm-host-infra-01.versastack.local ¥Mware E5Xi, 5.5.0, 2068190									
Summary Virtual Machines Performance	Con	figuration Tasks	& Ever	nts Alarms	Permissions Maps	Stor	age Views 🛛 H	lardware Statu	5
Hardware	View	n Datastores [evices						
Processors	Data	stores							
Memory	Ide	ntification	~ S	itatus	Device	Drive	Туре	Capacity	
 Storage 	8	host-infra-01-bo	t (Normal	IBM Fibre Channel.	. Non-S	5SD	24.50 GB	7
Networking		Infra_Datastore	1	🦻 Normal	IBM Fibre Channel.	. Non-S	5SD	1,023.75 G	414
Storage Adapters	2)			host-infra-	01-bo	ot-1 Prope	orties	
Network Adapters					nostinita	01 00		Artico	
Advanced Settings		Volume Propert	es						
Power Management		General				1	Format —		
Software		Datastore Name	hos	st-infra-01-boot-	1 Rename.	••	File System		VMFS
		Total Capacity:	24.	50 GB	Increase.		Maximum F	ile Size:	2.001
Licensed Features							Block Size:		1 MB
Time Configuration			rol —						
DNS and Routing		Enabled			Advanced				
Authentication Services		Enabled							
Power Management		Extents					Extent Devi	ce	
Virtual Machine Startup/Shutdown		A VMFS file system						elected on the l	eft resi
Virtual Machine Swapfile Location		extents, to create	a singi	e logical volume.			disk described	Delow.	
Security Profile		Extent			Capa	ity 📗	Device		
Host Cache Configuration		IBM Fibre Channe	Disk (naa.6005076400	081 24.62	GB	IBM Fibre	Channel Disk ((naa
System Resource Allocation									
Agent VM Settings							Primary P	artitions	
Advanced Settings							1. Legac	y MBR	

Figure 10-11 Enable SIOC

10.9 VersaStack VMware vCenter 5.5 Update 2

The procedures in the following subsections provide instructions for installing VMware vCenter 5.5 Update 2 in a VersaStack environment. This section focuses on the simple installation of vCenter Server on a Windows virtual machine. This section does not provide the steps or instructions to create and build virtual machines for vCenter Server and Active Directory that are used in this environment. For more information about vCenter Server installation methods and their hardware and software requirements, see the ESXi and vCenter Server 5.5 documentation on the VMware website.

To install VMware vCenter 5.5 Update 2, an accessible Windows Active Directory (AD) Domain is necessary. If an existing AD Domain is not available, an AD virtual machine or AD pair can be set up in this VersaStack environment. For more information, see Appendix A, "Windows Active Directory and running configurations" on page 467.

10.9.1 Installation steps for a simple installation of vCenter Server 5.5

To perform a simple installation of vCenter Server 5.5, complete the following steps:

- Mount the vSphere 5.5 installation media, navigate to the VMware vCenter 5.5 Update 2 (VIMSetup) ISO, select it, and click **Open**.
- 2. In the left pane, click Simple Install and then click Install.

Figure 10-12 shows the vSphere vCenter installation window.

🖁 ¥Mware vCenter Installer	× 🗆 .
vmware vSphere 5.5	
VMware vCenter Server Simple Install Custom Install vCenter Single Sign-On vSphere Web Client vCenter Inventory Service vCenter Server VMware vCenter Desktop Client VMware vSphere Client VMware vSphere Client VMware vCenter Support Tools vSphere Update Manager vSphere ESXI Dump Collector vSphere Syslog Collector vSphere Auto Deploy vSphere Authentication Proxy Host Agent Pre-Upgrade Checker vCenter Certificate Automation Tool	Simple Install Simple Install installs vCenter Single Sign-On, vSphere Web Client, vCenter Inventory Service, and vCenter Server on the same host or virtual machine. Atternatively, to customize the location and set up of each component, use the Custom Install method to install the components separately. Install components in this order: • vCenter Single Sign-On • vSphere Web Client • vCenter Inventory Service • vCenter Server For a list of information you need to install these components, see the installation checklist: http://www.mware.com/info?id=1266 Prerequisites: None
	Explore Media Exit

Figure 10-12 vCenter installation window

Note: If any of the prerequisites are not met, they are listed in the right pane under Prerequisites.

3. Click **Yes** if there is a User Account Control warning.

Figure 10-13 on page 161 shows the vCenter Single Sign On installation window

🚰 ¥Mware vCenter Install	er			_ 🗆 🗡
Maro yEnk				
vmware vSpł	lere 5.5			
VMware vCenter Serve	r	Simple	e Install	
Simple Install	🙀 Simple Install	Setup	_ 🗆 X	Center Inventory
Custom Install		A		
vCenter Single Sig	vmware		Welcome to the vCenter Single Sign-On	use the Custom
vSphere Web Clier			Setup	ts in this order:
vCenter Inventory §			This Setup Wizard will install the vCenter Single Sign-On Service. Click Next to continue or Cancel to exit the Setup	
vCenter Server			Wizard.	
VMware vCenter Deski				
VMware vSphere Clie				installation checklist:
VMware vCenter Supp		HOLD IN SOME		installation checklist.
vSphere Update Man;				
vSphere ESXi Dump (Copyright © 1998-2014 VMware, Inc. All rights reserved.	
vSphere Syslog Colle			This product is protected by U.S. and international copyright and intellectual property laws. VMware products are covered	
vSphere Auto Deploy	Single Sign	i On	by one or more patents listed at http://www.ymware.com/go/patents.	
vSphere Authenticatic				
Host Agent Pre-Upgra			Back Next Cancel	
vCenter Certificate Au			Boox Hoxe Carley	
				_
			Install	
				J
				Explore Media Exit

Figure 10-13 vCenter Single Sign On

- 4. Click Next to install vCenter Single Sign On.
- 5. Accept the terms of the license agreement and click Next.
- 6. In the Prerequisites window, click Next.

🖶 Simple Install	×
Simple Install Prerequisites Check	
Host name is VERSA-VCENTER FQDN is versa-vcenter.ppt.lab.cisco.com IP Address is 10.29.151.102 Machine is joined to ppt.lab.cisco.com DNS resolution is successful	
Add ppt.lab.cisco.com as a native Active Directory identity source.	
Back Next	Cancel

Figure 10-14 shows the Simple Install Prerequisites Check dialog box.

Figure 10-14 vCenter Simple Install Prerequisites Check

Enter and confirm <<var_password>> for the administrator user. Click Next.
 Figure 10-15 shows the vCenter Single Sign-On Information dialog box.

🙀 Simple Install		×
	n-On Information r administrator account in default domain	
<u>D</u> omain Name:	vsphere.local	
<u>U</u> ser name:	Administrator	
<u>P</u> assword:	•••••	
<u>C</u> onfirm Password:	••••••	
	Back Next	Cancel

Figure 10-15 vCenter Single Sign-On Information window

Note: This dialog box shows information that is related to a domain with the name vsphere.local. This is not a domain that is auto-detected within the existing environment, but a new domain that is used internally by vSphere. The administrator@vsphere.local account performs the same function as the admin@System-Domain account in previous versions of vSphere.

- 8. In the Site window, click Next.
- 9. Accept the Default HTTPS port and click Next.

Figure 10-16 shows the port settings for a vCenter simple installation.

🖥 Simple Install	×
Simple Install Port Settings Enter the connection information for vCenter Single Sign-On.	
Setup will open the HTTPS port in the firewall if the Windows Firewall/Interne Sharing service is running on the system.	t Connection
HTTP <u>S</u> port: 7444	
Back Next	Cancel

Figure 10-16 vCenter Simple Install Port Settings

10.Click Next.

11. Review the window and click **Install**. This process takes approximately 20 minutes, during which time multiple windows launch.

🔯 Simple Install	×
Simple Install Information Review install options	
You have selected:	
New install	
Configured as first server in domain	
Domain name is vsphere.local	
HTTPS port is 7444	
Site name is Default-First-Site	
Lookup service will be installed and configured new	
Back Install	Cancel

Figure 10-17 shows the vCenter Simple Install Information window for review.

Figure 10-17 vCenter Simple Install Information Review

12. Enter Yes in the SSL window that opens.

- 13. Enter the license key for the vCenter Server.
- 14. Select Install a Microsoft SQL Server 2008 Express instance database solution for vCenter Server and then click Next.
- 15.Click **Next** to use the SYSTEM Account.
- 16. Click Next to accept the default ports.

Figure 10-18 on page 165 shows the window for configuring the default vCenter ports.

1ware vCenter I	Installer	_
	🐺 YMware vCenter Simple Install 🛛 🛛 🗙	
	Configure Ports	
	Enter the connection information for vCenter Server.	
	vCenter Server HTTP port: 80	
	vCenter Server HTTPS port: 443	
	Heartbeat port (UDP): 902	
	Web Services HTTP port: 8080	
	Web Services HTTPS port: 8443	
	Web Services Change Service Notification port: 60099	
	vCenter Server LDAP port: 389	
	vCenter Server SSL port: 636	
	☐ Increase the number of available ephemeral ports	
	This option prevents the pool of available ephemeral ports from being exhausted if vCenter Server powers on more than 2000 virtual machines simultaneously on a host.	
	InstallShield	
	< Back Next > Cancel	
		1

Figure 10-18 Configure the default vCenter Ports

17.Select the appropriate inventory size. Click Next.

18. Click **Install**. A new installer window starts and completes in approximately 10 minutes. 19. Click **Finish**, and then **OK**.

10.10 Setting up a vCenter Server

In this section, you learn how to set up a vCenter Server.

10.10.1 vCenter Server VM

To set up vCenter Server on the vCenter Server VM, complete the following steps:

- 1. Using the vSphere Client, log in to the newly created vCenter Server as the VersaStack admin user or administrator@vsphere.local.
- 2. Click File \rightarrow New \rightarrow Datacenter to create a data center.
- 3. Right-click the data center and enter VersaStack_DC_1 as the data center name.
- 4. Right-click the newly created VersaStack_DC_1 data center and select New Cluster.
- 5. Name the cluster VersaStack_Management and select the check boxes for **Turn On vSphere HA** and **Turn on vSphere DRS**.
- 6. Click Next.

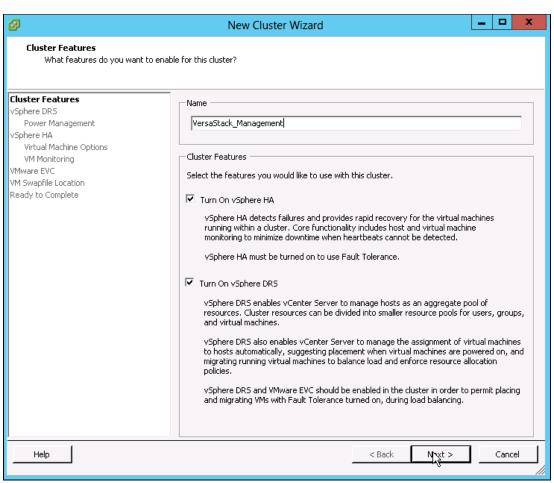


Figure 10-19 shows creating the VersaStack_Management cluster on the vCenter.

Figure 10-19 Create VersaStack_Management cluster on the vCenter

- 7. Accept the defaults for vSphere DRS. Click Next.
- 8. Accept the defaults for Power Management. Click Next.
- 9. Accept the defaults for vSphere HA. Click Next.

10. Accept the defaults for Virtual Machine Options. Click Next.

- 11. Accept the defaults for VM Monitoring. Click Next.
- 12. Accept the defaults for VMware EVC. Click Next.

Important: If mixing Cisco UCS B or C-Series M3 and M4 servers within a vCenter cluster, it is necessary to enable VMware Enhanced vMotion Compatibility (EVC) mode. For more information about setting up EVC mode, see Enhanced vMotion Compatibility (EVC) Processor Support, found at the following website:

http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=dis
playKC&externalId=1003212

13. Select Store the swapfile in the same directory as the virtual machine. Click Next.

14.Click Finish.

15. Right-click the newly created VersaStack_Management cluster and select Add Host.

- 16.In the Host field, enter either the IP address or the host name of the vm-host-infra-01 host. Enter root as the user name and the root password for this host. Click **Next**.
- 17.Click Yes.
- 18.Click Next.
- 19. Select **Assign a New License Key to the Host**. Click **Enter Key** and enter a vSphere license key. Click **OK**, and then click **Next**.
- 20.Click Next.
- 21.Click Next.
- 22. Click Finish. The vm-host-infra-01 host is added to the cluster.
- 23. Repeat this procedure to add vm-host-infra-02 to the cluster.

10.11 Mapping the data stores on the IBM Storwize V7000 second host after enabling the cluster

To map the data stores on the IBM Storwize V7000 second host after enabling the cluster, complete the following steps:

- 1. Open the web client for the Storwize V7000 storage system.
- 2. Click the Volumes icon in the left pane and select Volume to open the Volumes window.
- Right-click the volumes infra_datastore_1, infra_datastore_2, sql_rdm_data, sql_rdm_log, and sql_rdm_quorum, and select Map to Host.
- Select vm-host-infra-02 and select Map Volumes.
- 5. Click Map All Volumes and click Close.
- 6. Click Close again.
- 7. In vSphere in the left pane, right-click the VersaStack_Management cluster and click **Rescan for Datastores**.
- 8. Click **OK**.

10.12 Optional: Adding domain account permissions

This section describes how to add a user to provide admin and login permissions in the vSphere web client and VSphere client. Complete the following steps:

- Open a browser and enter https://<<vSphere_ip>>:9443/vsphere-client/ to open the vSphere web client.
- Log in as administrator@vsphere.local with the admin password.
- Click the Administration item in the left pane
- 4. Select the **Configuration and Identity Sources** tab and validate that the domains that you require are listed. You can add other required domain sources by clicking the green +.

vmware [®] vSphere Web Cli	ient 🔒 🗗		ひ I Administr	ator@VSPHERE.L0	DCAL → I Help →
🖣 Home 🕨 🔊 🖡	SSO Configuration for VCENTER.VersaStack.local				
Administration	Policies Identit	y Sources Certifi	cates		
	+ -			Q Filter	•
Roles	Name	Server URL	Туре	Domain	Alias
▼ Single Sign-On	-			vsphere.local	-
Users and Groups Configuration			Local OS	VCENTER (def	-
 ✓ Licensin 					
Licenses					
Reports					
Client Plug-Ins					
vCenter Server Extensions					
	M				2 items 📑 🗸

Figure 10-20 shows the Identity Sources tab, where you can add more domains.

Figure 10-20 Identity Sources tab

- 5. Select the Home button at the upper left.
- 6. Click vCenter to show the vCenter window.
- 7. Click vCenter Servers under the Inventory list.
- 8. Click the vCenter server name in the left pane, and click the Manage tab in the right pane.
- 9. Click Permissions.
- 10.Click the green + sign to add a user. Select **Add** in the Add Permission window. Select the domain, and highlight the user.
- 11.Click Add, and then click OK.
- 12. For an assigned roll, select the administrator and then click **OK**. You may now log in as that user in your vSphere web client.
- 13.Open the vSphere Client application, log in as the administrator account, and right-click the vCenter name in the upper left and click **Add Permissions**.

Figure 10-21 shows the start of the process for adding a permission to vCenter.

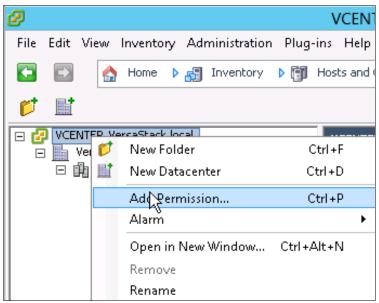


Figure 10-21 Add a permission

14.Click Add.

15. Select the correct domain in the drop-down menu.

- 16. Highlight a user and click Add, and then click OK.
- 17. Change the Assigned Role to **Administrator** in the drop-down menu, and click **OK**. You may now log off as administrator and back in as that domain user in the vSphere Client.

In this chapter, you set up two blades with Cisco Custom ESXi 5.5.0 U2 GA, set them up to SAN boot, and then configured the network settings and Storage I/O Control for these hosts. Finally, you set up vCenter Server 5.5 and created a VersaStack management cluster.

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11

SQL Server setup and failover cluster implementation

This chapter provides detailed instructions about how to accomplish the following tasks:

- Creating virtual machines (VMs)
- Installing Windows Server 2012 R2
- Preparing the virtual machines for clustering
- Windows Server failover cluster installation
- SQL Server failover cluster installation
- Modify vSphere HA and DRS settings to use WSFC VMs

This following VMware link leads to a PDF for setting up failover clustering and the Microsoft cluster service:

https://pubs.vmware.com/vsphere-55/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcente
r-server-55-setup-mscs.pdf

11.1 Creating virtual machines

In this section, you create two VMs, one on each ESXi host. Using the information that is shown in Table 11-1, you create a VM named SQLVM01 on the vm-host-infra-01 ESXi host and a second VM named SQLVM02 on the vm-host-infra-02 ESXi host.

Table 11-1	Virtual	machines
	viituai	machines

VM name	ESXi hosting the VM	vCPU	Memory	Bootdisk size	Boot disk store location	No. of network adapters	No. of shared RDMs
SQL VM01	vm-host-infra-01	4	16 GB	100 GB	Infra_Datastore_1	3	3
SQL VM02	vm-host-infra-02	4	16 GB	100 GB	Infra_Datastore_1	3	3

Complete the following steps:

- 1. Open a browser to the vSphere web client by using the following URL:
 - https://<<vSphere_ip>>:9443/vsphere-client/
- 2. Log in as administrator@vsphere.local with the admin password, as shown in Figure 11-1.

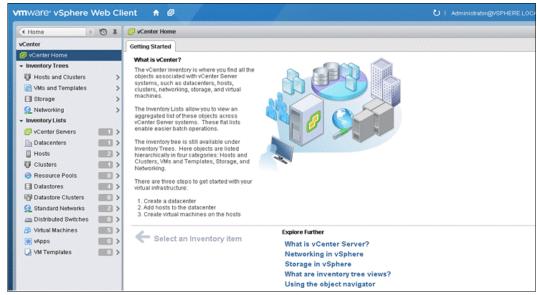


Figure 11-1 vSphere web client

- 3. Click Hosts and Clusters under Inventory Trees.
- 4. Under the Inventory List, right-click vm-host-infra-01 and select New Virtual Machine.
- 5. In the New Virtual Machine wizard, enter a name for the VM, select a data center, and click **Next**, as shown in Figure 11-2 on page 173.

1 Select creation type	Enter a name for the virtual machine.	
 1a Select a creation type 	Win2K12R2_VM	
2 Edit settings	Virtual machine names can contain up to 80 characters	and they must be unique within
2a Select a name and folder		
2b Select a compute resourc	Q Search	
2c Select storage	✓ I VCENTER.VersaStack.local	
2d Select compatibility	▷ B VersaStack_DC_1	
2 e Select a guest OS		Select a datacente
2f Customize hardware		machine in.
3 Ready to complete		

Figure 11-2 New Virtual Machine

6. Select a compute resource to host this VM and click Next, as shown in Figure 11-3.

🔁 New Virtual Machine		• •	
 Select creation type 1 a Select a creation type Edit settings 2 a Select a name and folder 2 b Select a compute resource 2 c Select storage 2 d Select compatibility 2 e Select a guest OS 	Q Search ✓ Im VersaStack_DC_1 ✓ Im VersaStack_Management Im vm-host-infra-01.versastack.local Im vm-host-infra-02.versastack.local	Select a cluster, host, vApp virtual machine.	
2f Customize hardware 3 Ready to complete			-
	Back	xt Finish Cancel	

Figure 11-3 Select compute resource

 In Select Storage, choose Infra_Datastore_1 as the storage location for the VM's disk and click Next. In this environment, this data store is used to store the VM's boot disks. (See Figure 11-4.)

1 Select creation type	VM Storage Policy: None		• 0			
 1 a Select a creation type 2 Edit settings 	The following datastores are ac virtual machine configuration fil			t you selected. Select	the destination dat	tas
 2a Select a name and folder 	Name	Capacity	Provisioned	Free	Туре	
 2b Select a compute resource 	Infra_Datastore_1	1,023.75 GB	977.00 MB	1,022.80 GB	VMFS 5	
2c Select storage	Protect_Datastore_1	1,023.75 GB	129.07 GB	926.68 GB	VMFS 5	
 2d Select compatibility 	Infra_Datastore_2	255.75 GB	14.70 GB	241.05 GB	VMFS 5	
2e Select a guest OS	host-infra-01-boot-1	24.50 GB	940.00 MB	23.58 GB	VMFS 5	
2f Customize hardware						
3 Ready to complete						
4					Interesteres consecutives	

Figure 11-4 Select storage

8. In the Select Compatibility window, select **ESXi 5.5 and Later** to create a VM Version 10. Click **Next** (see Figure 11-5).

🔁 New Virtual Machine	(?) »
 1 Select creation type 1 a Select a creation type 2 Edit settings 2 a Select a name and folder 2 b Select a compute resource 	The host or cluster supports more than one VM ware virtual machine version. Select a compatibility for the virtual mach Compatible with: ESXi 5.5 and later This virtual machine (VM version 10) provides the best performance and latest features in ESXi 5.5.
 2c Select storage 2d Select compatibility 2e Select a sweet 00 	
2e Select a guest OS 2f Customize hardware 3 Ready to complete	
4	: Back Next Finish Cancel

Figure 11-5 Select compatibility

9. In the Select a Guest OS window, choose **Windows** from the drop-down list next to Guest OS Family and select **Microsoft Windows Server 2012 (64-bit)** as the Guest OS version. Click **Next** (see Figure 11-6).

1 New Virtual Machine					(? H
 Select creation type 1 Select a creation type 2 Edit actions 	Identifying the gues installation.	st operating system here allows the wiza	d to provide th	e appropriate defaults fo	or the operating system
 2 Edit settings 2a Select a name and folder 2b Select a compute resource 	Guest OS Family: Guest OS Version:	Windows Microsoft Windows Server 2012 (64-bit)	 ▼) :
 2c. Select storage 2d Select compatibility 2e Select a guest OS 					
2f Customize hardware 3 Ready to complete					
4			Back	Next Fin	ish Cancel

Figure 11-6 Select a Guest OS

10.In the Customize hardware window:

- a. Assign memory and vCPUs according to the requirement.
- b. Assign an appropriate hard disk size for OS.
- c. Select Thick Provision Eager Zeroed for Disk provisioning.
- d. Select LSI Logic SAS as the SCSI controller type.
- e. Select VM-Production from the drop-down list for the Network Adapter 1.
- f. Map and mount the Windows Server 2012 R2 installation ISO file. (See Figure 11-7.)

🔁 New Virtual Machine		•
1 Select creation type	Virtual Hardware VM Options	SDRS Rules
 1 a Select a creation type 		
2 Edit settings	* Memory	16384 V MB V
 2 a Select a name and folder 	👻 🛄 *New Hard disk	100 GB V
2b Select a compute resource	Maximum Size	1,022.80 GB
 2c Select storage 	VM storage policy	None 🔹 🖬
2d Select compatibility	Location	Infra_Datastore_1
2e Select a guest OS 2f Customize hardware 3 Ready to complete	Disk Provisioning	Thick provision lazy zeroed Thick provision eager zeroed Thin provision
5 Ready to complete	Shares	Normal + 1000
	Limit - IOPs	Unlimited
	Virtual Flash Read Cache	0 GB Advanced
	Virtual Device Node	SCSI(0:0) New Hard disk
		O IDE(0:0)
		O SATA(0:0) New CD/DVD Drive
	Disk Mode	Dependent Dependent disks are included in snapshots. Independent - Persistent
		Changes are immediately and permanently written to disk. Persistent disks are not affected by snapshots. O Independent - Nonpersistent Changes to this disk are discarded when you power off or revert to the snapshot.
	▶ Ⅰ New SCSI controller	LSI Logic SAS
	▶ 📷 *New Network	WM-Production
	▶ 💿 *New CD/DVD Drive	Datastore ISO File
	🕨 🗐 Video card	Specify custom settings
	▶ 🔅 VMCI device	
	▶ 🝥 New SATA Controller	
	▶ Other Devices	
	New device:	Select Add
		Compatibility: ESXi 5.5 and later (VM version 10
		:: Back Next Finish Cancel

Figure 11-7 Customize hardware

11. In the Ready to complete window, click **Finish** (see Figure 11-8 on page 177).

🔁 New Virtual Machine		
1 Select creation type	Provisioning type:	Create a new virtual machine
 1a Select a creation type 	Virtual machine name:	Win2K12R2_VM
2 Edit settings	Folder:	VersaStack_DC_1
 2a Select a name and folder 	Host:	vm-host-infra-01.versastack.local
✓ 2b Select a compute resource	Datastore:	Infra_Datastore_1
✓ 2c Select storage	Guest OS name:	Microsoft Windows Server 2012 (64-bit)
✓ 2d Select compatibility	CPUs:	4
✓ 2e Select a guest OS	Memory:	16 GB
 2f Customize hardware 	NICs:	1
✓ 3 Ready to complete	NIC 1 network:	VM-Production
	NIC 1 type:	E1000E
	SCSI controller 1:	LSI Logic SAS
	Create hard disk 1:	New virtual disk

Figure 11-8 Ready to complete

12. Select the newly created VM, right-click it, and click Edit Settings.

13. Select Network from the drop-down list next to New Device and click Add (Figure 11-9).

Virtual Hardware VM O	tions SDRS Rules VApp Op	tions
CPU	4	Ð
	🚐 New Hard Disk 📃 📃	MB -
Metwork adapter 1 O O CD/DVD drive 1	Network	Connected Connected
 Video card VMCI device SATA controller 0 Other Devices 	CD/DVD Drive Floppy Drive S S Serial Port Parallel Port Host USB Device	
	USB Controller	
New device:	SCSI Controller SATA Controller	Add

Figure 11-9 Edit Settings

14.Add the other two network adapters that will be used for the Windows server failover cluster, as shown in Figure 11-10 on page 179.

	4 ▼ ● 16384 ▼ MB ▼	
🛲 Memory 🚐 Hard disk 1	16384 V MB V	
🚐 Hard disk 1		
	100 GB V	
G SCSI controller 0	LSI Logic SAS	
飅 Network adapter 1	VM-Production Connected	
i CD/DVD drive 1	Datastore ISO File	
Video card	Specify custom settings	
🔅 🎲 VMCI device		
▶ 🍥 SATA controller 0		
• Other Devices		
🕨 🧱 New Network	VM-WinClus 🗸 Connect	
🛛 飅 New Network	VM-WinCSV 🔹 Connect	

Figure 11-10 Add network adapters

15. Repeat the steps 3 on page 172 to 14 on page 178 to create the second VM on vm-host-infra-02.

11.1.1 Installing Windows Server 2012 R2

This section provides instructions about how to install Windows Server 2012 R2 on the newly created VMs. To install the OS on both VMs, complete the following steps:

1. Go to the **Edit Settings** of the VM that was created in 11.1, "Creating virtual machines" on page 172, mount the Windows server ISO image, and power on the VM to begin the installation.

2. Select the appropriate language and other preferences and click **Next** (see Figure 11-11).

Mindows Setup	
Windows Server 2012 R2	
Languag <u>e</u> to install: <mark>English (United States)</mark>	_
Time and currency format: English (United States)	
Keyboard or input method: US	
Enter your language and other preferences and click "Next" to continue.	
© 2013 Microsoft Corporation. All rights reserved.	Next

Figure 11-11 Select preferences

- 3. In the next window, click Install now.
- 4. In the next window, select the operating system to install and click Next.
- 5. Accept the license terms and click Next.
- 6. Select Custom: Install Windows only (advanced) and click Next.
- 7. Select the disk to install Windows and click Next (see Figure 11-12 on page 181).

Where do you v	want to install Win	dows?		
Name		Total size	Free space	Туре
🚙 Drive 0 Una	Illocated Space	100.0 GB	100.0 GB	
<u>R</u> efresh <u>L</u> oad driver	Delete	E ormat	<mark>∦</mark> N <u>e</u> w	

Figure 11-12 Choose where to install

8. The installation begins and restarts the VM upon completion.

9. Provide a password for the VM's built-in administrator account (see Figure 11-13).

Ø		WK12R2 on vm-host-infra-02.versastack.local	_ D X
File View VM			
	S 🔯 🖓 🗊 🖻		
	Setting	rc	
	Jerni	js	
	Type a password for t	he built-in administrator account that you can use to sign in to this computer.	
	User name	Administrator	
	Password		
	Reenter password		
			≡
el _e ,			
07		Finish	
			~
To release cursor, pre	ss CTRL + ALT		

Figure 11-13 Password

11.1.2 Preparing the virtual machines for clustering

This section provides instructions about preparing the VMs for setting up WSFC later. This section describes the following topics:

- Renaming and assigning IP addresses to network adapters
- Enabling jumbo frames for CSV traffic
- Configuring a network adapter binding order
- Installing Windows updates and adding roles and features
- Adding a hard disk (RDM) to the first VM
- Adding a hard disk (RDM) to the second VM
- Preparing the disk for cluster use

11.1.3 Renaming and assigning IP addresses to network adapters

To rename and assign IP addresses to the network adapters, complete the following steps on both VMs:

- 1. Log in to the VM by using the administrator account.
- 2. Rename the computer host name and restart the VM.
- 3. Optionally, rename the adapters according to their role for easy identification and troubleshooting purposes, as shown in Figure 11-14 on page 183.

Name	InterfaceDescription	ifIndex	Status	MacAddress	LinkSpeed
Ethernet1 Ethernet2 Public	Intel(R) 82574L Gigabit Network Co#3 Intel(R) 82574L Gigabit Network Co#2 Intel(R) 82574L Gigabit Network Conn	27	Uр Uр Uр	00-50-56-B4-0B-1B 00-50-56-B4-27-77 00-50-56-B4-3E-62	1 Gbps 1 Gbps 1 Gbps
PS C:\Users\administrato	NERGAETAEK, Roome NotAdopton, News "Et				
PS C:\Users\administrato	r.VERSASTACK> Rename-NetAdapter -Name "Et r.VERSASTACK> Rename-NetAdapter -Name "Et r.VERSASTACK> Get-NetAdapter				
PS C:\Users\administrato	r.VERSASTACK> Rename-NetAdapter -Name "Et		-NewName F		LinkSpee

Figure 11-14 Adapters

To rename the network adapters to reflect their role, gather network adapter information from the VM settings, such as MAC address and which virtual switch it is connected to, as shown in Figure 11-15.

vCenter 🕨 🔁 🖡	SQLVM02 Actions -				
	Getting Started Summary	Monitor Manage Related Objects			
VCENTER.VersaStack.local	A				
 VersaStack_DC_1 Spectrum Control 	▼ VM Hardware				
 Spectrum Protect 	▶ CPU	4 CPU(s), 0 MHz used			
🕨 🧰 Templates	▶ Memory	16384 MB, 163 MB used			
SQLVM01	▶ Hard disk 1	100.00 GB			
WK12R2	▶ i CD/DVD drive 1	Connected 🖉 -			
	Video card	8.00 MB			
	▶ Other	Additional Hardware			
	Network adapter 1	VM-Production (connected)			
	Network adapter 2				
	MAC Address	00:50:56:b4:0b:1b			
	DirectPath I/O	Not supported			
	Network	VM-WinClus (connected)			
	✓ Network adapter 3				
	MAC Address	00:50:56:b4:27:77			
	DirectPath I/O	Not supported			
	Network	VM-WinCSV (connected)			
	Compatibility	ESXi 5.5 and later (VM version 10)			

Figure 11-15 Gather network information

4. Assign static IP addresses to the network interfaces. An example of assigning IP addresses by using PowerShell is shown in Figure 11-16.

PS C:\Users\admini	
IPAddress	: 192.168.40.52
	: 31
	: Private_WinClus
	: IPv4
	: Unicast
PrefixLength	: 24
PrefixOrigin	: Manual
5uffixOrigin	: Manual
	: Tentative
	: Infinite ([TimeSpan]::MaxValue)
	: Infinite ([TimeSpan]::MaxValue)
	: False
PolicyStore	: ActiveStore
	: 192.168.40.52
	: 31
	: Private_WinClus
AddressFamily	: IPv4
Гуре	: Unicast
	24
	Manual
	: Manual
	Invalid
	: Infinite ([TimeSpan]::MaxValue)
andine	: Infinite ([TimeSpan]::MaxValue)
reterredLitetime	: Infinite ([limespan]::Maxvalue)
5kipAsSource	: False
SkipAsSource PolicyStore	
SkipAsSource PolicyStore PS C:\Users\admini	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 24
SkipAsSource PolicyStore P5 C:\Users\admini IPAddress	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 24 : 192.168.50.52
SkipAsSource PolicyStore P5 C:\Users\admini IPAddress	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 24
SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 24 : 192.168.50.52 : 27
SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 24 : 192.168.50.52
SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias AddressFamily	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4
SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias AddressFamily Fype	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPV4 : Unicast
SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias AddressFamily Type PrefixLength	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24
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SkipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias AddressFamily Type PrefixLength PrefixOrigin SuffixOrigin	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPV4 : Unicast : 24 : Manual : Manual
skipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias VidressFamily PrefixLength PrefixDrigin SuffixOrigin SuffixOrigin SuffixOrigin	: False : PersistentStore strator.VER5ASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Tentative
SkipAsSource PolicyStore S C:\Users\admini IPAddress InterfaceIndex InterfaceAlias AddressFamily Type PrefixLength PrefixDrigin SuffixOrigin SuffixOrigin AddressState AlidLifetime	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPV4 : Unicast : 24 : Manual : Manual : Manual : Tertative : Infinite ([TimeSpan]::MaxValue)
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kipAsSource olicyStore S C:\Users\admini PAddress InterfaceIndex InterfaceAlias uddressFamily ype refixLength refixOrigin udfrixOrigin udfrixOrigin ddressState (alidLifetime referredLifetime referredLifetime	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Manual : Tentative : Infinite ([TimeSpan]::MaxValue) : False
kipAsSource PolicyStore SC:\Users\admini PAddress InterfaceIndex InterfaceAlias UddressFamily Ype PrefixLength PrefixOrigin SuffixOrigin SuffixOrigin SuffixOrigin SuffixOrigin State PreferredLifetime PreferredLifetime	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Tentative : Infinite ([TimeSpan]::MaxValue) : Infinite ([TimeSpan]::MaxValue)
skipAsSource PolicyStore PS C:\Users\admini IPAddress InterfaceIndex InterfaceAlias ViddressFamily PrefixLength PrefixDrigin SuffixOrigin VafixOrigin VidfessState ValidLifetime PreferedLifetime SkipAsSource PolicyStore	: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Manual : Tentative : Infinite ([TimeSpan]::MaxValue) : False
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SkipAsSource PolicyStore PolicyStore S C:\Users\admini IPAddress InterfaceIndex InterfaceAlias VaddressFamily Vype PrefixDrigin VadfressState ValidLifetime PreferredLifetime PreferredLifetime PreferredLifetime PrefixOrigin UpAddress InterfaceIndex InterfaceIndex InterfaceAlias VadfressFamily Vype PrefixLength PrefixOrigin SuffixOrigin	<pre>: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Tentative : Infinite ([TimeSpan]::MaxValue) : Infinite ([TimeSpan]::MaxValue) : False : ActiveStore : 192.168.50.52 : 27 : Private_WinCSV : IPv4 : Unicast : 24 : Manual : Manual : Manual : Manual : Manual : Manual</pre>
SkipAsSource PolicyStore PolicyStore PolicyStore SC:\Users\admini IPAddress InterfaceIndex InterfaceAlias ddressFamily YrefixOrigin SuffixOrigin SuffixOrigin ddressState PreferedLifetime SkipAsSource PolicyStore InterfaceIndex InterfaceAlias ddressFamily YrefixLength PrefixOrigin SuffixOrigin SuffixOrigin SuffixOrigin SuffixOrigin SuffixOrigin SuffixOrigin	<pre>False PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 27 Private_WinCSV IPv4 Unicast 24 Manual Manual Tentative Infinite ([TimeSpan]::MaxValue) Infinite ([TimeSpan]::MaxValue) False ActiveStore 192.168.50.52 27 Private_WinCSV IPv4 Unicast 24 Manual Inficast 24 Manual Inficast 24 Manual Inficast 24 Manual Invalid</pre>
SkipAsSource PolicyStore PolicyStore PolicyStore SC:\Users\admini PolicyStore InterfaceIndex InterfaceAlias ValidufesFamily PrefixOrigin Validufettime PreferredLifetime PreferredLifetime PreferredLifetime PreferredLifetime NitherfaceIndex InterfaceIndex InterfaceAlias ValicyStore PrefixLength PrefixOrigin Validufetime	<pre>: False : PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 : 192.168.50.52 : 27 : Private_WinCSV : IPv4 Unicast : 24 : Manual : Manual : Tentative : Infinite ([TimeSpan]::MaxValue) : Infinite ([TimeSpan]::MaxValue) : False : ActiveStore : 192.168.50.52 : 27 Private_WinCSV : IPv4 Unicast : 24 : Manual : Manual : Manual : Invalid : Inrinite ([TimeSpan]::MaxValue)</pre>
SkipAsSource PolicyStore PolicyStore PolicyStore SC:\Users\admini IPAddress InterfaceIndex InterfaceAlias VdressFamily Type PrefixOrigin SuffixOrigin VdressState PreferredLifetime PreferredLifetime PrefixOrigin SuffixOrigin	<pre>False PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 27 Private_WinCSV IPv4 Unicast 24 Manual Manual Tentative Infinite ([TimeSpan]::MaxValue) Infinite ([TimeSpan]::MaxValue) False ActiveStore 192.168.50.52 27 Private_WinCSV IPv4 Unicast 24 Manual Inficast 24 Manual Inficast 24 Manual Inficast 24 Manual Invalid</pre>
kipAsSource PolicyStore SC:\Users\admini PAddress InterfaceIndex InterfaceAlias VdressFamily ype PrefixLength PrefixOrigin VdfisOrigin VdfessState AlidLifetime PreferredLifetime NetfaceIndex InterfaceAlias VdressFamily ype PrefixOrigin VfreixLength PrefixOrigin VfreixLength PrefixOrigin VdfessState AlidLifetime YreferredLifetime	<pre>False PersistentStore strator.VERSASTACK> New-NetIPAddress -ifIndex 27 -IPAddress 192.168.50.52 -PrefixLength 2 192.168.50.52 27 Private_WinCSV IPv4 Unicast 24 Manual Tentative Infinite ([TimeSpan]::MaxValue) False ActiveStore 192.168.50.52 27 Private_WinCSV IPv4 Unicast 24 Manual Manual Manual Invalid Invalid Invalid Invalid Infinite ([TimeSpan]::MaxValue)</pre>

Figure 11-16 Assign IP addresses

11.1.4 Enabling jumbo frames for CSV traffic

To enable jumbo frames for the CSV traffic, complete the following steps on both VMs:

- 1. Click Settings \rightarrow Network and Internet \rightarrow Network and Sharing Center \rightarrow Change Adapter Settings.
- 2. Right-click the Private_WinCSV network adapter, select Properties, and click Configure.
- 3. In the advanced settings, set the Jumbo Packet property value to 9014 bytes, as shown in Figure 11-17 on page 185.

Intel(R) 8	2574L Gi	gabit l	Netwo	rk Con	nection #2	Prope ×
	Advanced	Driver	Details	Events	1	
	erty you warr				twork adapter. I then select its	
Property:				V	alue:	
Flow Co Gigabit I Interrupt IPv4 Ch Large S Large S Locally Log Link Maximur Maximur	Master Slave Moderation Moderation ecksum Offle	Mode Rate Dad V2 (IPv4 V2 (IPv6 Address t RSS Pro RSS Qu			9014 Bytes	~
					ОК	Cancel

Figure 11-17 Jumbo packet

11.1.5 Configuring the network adapters binding order

To configure the network adapters binding order, complete the following steps on both VMs:

- 1. Click Control Panel \rightarrow Network and Internet \rightarrow Network Connections.
- 2. Press the Alt key.
- 3. Click Advanced and select Advanced settings.

4. Use the Up and Down arrow buttons to configure the adapters binding order, as shown in Figure 11-18.

Advanced Settings	x
Adapters and Bindings Provider Order	
Connections are listed in the order in which they are accessed by network services.	
Connections:	
	t l
Bindings for Private_WinClus:	
✓ → Internet Protocol Version 4 (TCP/IPv4)	τ
✓ - Internet Protocol Version 6 (TCP/IPv6)	1
Client for Microsoft Networks	
 ✓ ▲ Internet Protocol Version 4 (TCP/IPv4) ✓ ▲ Internet Protocol Version 6 (TCP/IPv6) 	
	L
ОК	Cancel

Figure 11-18 Binding order

11.1.6 Installing Windows updates and adding roles and features

To install the latest Windows updates and add the roles and features that are required for WSFC and SQL Server FCI, complete the following steps on both VMs:

- 1. Install the latest updates and patches from the Microsoft website and make sure that the current version of the VMware tool is running.
- 2. Join the computer to an Active Directory domain and restart the machine.
- 3. Click Server Manager → Add Roles and Features and install the .NET Framework 3.5 and Failover Clustering features, as shown in Figure 11-19 on page 187.

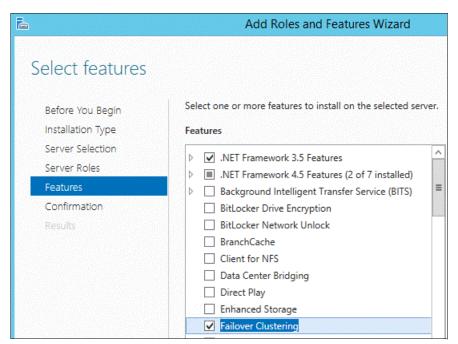


Figure 11-19 Add roles and features

11.1.7 Adding hard disks (RDMs) to the first virtual machine node

This section provides detailed instructions about how to map the shared LUNs that are presented to ESXi hosts as RDMs to the VMs. An RDM in physical compatible mode is required for clustering VMs running on different ESXi hosts. After the completion of this task, these RDMs are used for creating Windows server failover clustering and installing SQL Server failover cluster instance.

Complete the following steps:

- 1. In the vSphere Web Client navigator, select the newly created VM, right-click it, and select **Edit settings**.
- 2. On the Customize hardware window, click the Virtual Hardware tab.
- 3. Click the New Device drop-down menu, select SCSI Controller, and click Add.
- 4. Make sure that the SCSI Controller type is LSI Logic SAS, and SCSI Bus Sharing is Physical, as shown in Figure 11-20.

	LSI Logic SAS		
SCSI Bus Sharing	None	•	
Change Type	LSI Logic SAS	•	
✓ G *SCSI controller 1	LSI Logic SAS		
SCSI Bus Sharing (*)	Physical		
Change Type	LSI Logic SAS	-	

Figure 11-20 Add disks

5. Click the **New Device** drop-down menu, select **RDM Disk**, and click **Add**, as shown in Figure 11-21.

/irtual Hardware VM Optio	ons SDRS Rules vApp Options
CPU	4 🔹 🐨
Memory	16384 V MB V
🚍 Hard disk 1	100 GB 👻
G SCSI controller 0	LSI Logic SAS
属 Network adapter 1	VM-Production Connected
📷 Network adapter 2	VM-WinClus Connected
属 Network adapter 3	VM-WinCSV Connected
OD/DVD drive 1	Datastore ISO File
💻 Video card	Specify custom settings
le SATA controller 0	
I device	
Other Devices	
ScSI controller	LSI Logic SAS
New device:	Add

Figure 11-21 Select RDM

6. From the list, select an unformatted LUN that will be used as the witness disk for creating the Windows server failover cluster, as shown in Figure 11-22.

lame	Identifier	Path ID	LUN	Capacity	Drive Type	Hardware Acce.
IBM Fibre Channel Disk (naa.60050764008180c29800000000000004)	/vmfs/dev	/vmfs/dev	3	256.00 GB	Non-SSD	Supported
BM Fibre Channel Disk (naa.60050764008180c29800000000000000)	/vmfs/dev	/vmfs/dev	5	64.00 GB	Non-SSD	Supported
BM Fibre Channel Disk (naa.60050764008180c29800000000000006)	/vmfs/dev	/vmfs/dev	6	1.00 GB	Non-SSD	Supported
BM Fibre Channel Disk (naa.60050764008180c298000000000000b)	/vmfs/dev	/vmfs/dev	2	256.00 GB	Non-SSD	Supported

Figure 11-22 Select the failover cluster witness disk

7. Repeat steps 5 on page 188 and 6 on page 188 to add the other unformatted LUNs.

The system creates RDM disks that map your VM to the target LUN. The RDM disk is shown in the list of virtual devices as a new hard disk, as shown in Figure 11-23.

Virtual Hardware VM Options	SDRS Rules	vApp Option	IS	
CPU	4	-	0	
Memory	16384	-	MB	
Hard disk 1	100	×	GB 🖵	
SCSI controller 0	LSI Logic SA	S		
🕨 📻 Network adapter 1	VM-Product	ion	🔹 🗹 Connected	
🕨 飅 Network adapter 2	VM-WinClus	S	🔹 🗹 Connected	
Metwork adapter 3	VM-WinCSV	/	🔹 🗹 Connected	
▶ Image: Solar transformed by the second second	Datastore IS	Datastore ISO File		
Video card	Specify cust	tom settings	-	
▶ ⊚ SATA controller 0				
🕨 🌼 VMCI device				
 Other Devices 				
New SCSI controller	LSI Logic SA	S		
🕨 🛄 New Hard disk	1	×	GB	
🕨 🛄 New Hard disk	64	*	GB 🔻	
🕨 🛄 New Hard disk	256	* *	GB 🖵	
New device:	🔒 RDM D	Disk	Add	

Figure 11-23 New disk

- 8. Click the arrow next to New Hard disk and select the following settings:
 - a. Location: Store with VM
 - b. Compatibility Mode: Physical
 - c. Virtual Device Node: SCSI(1:0)

Use the newly created SCSI 1 controller because you cannot use SCSI 0.

9. Click **OK**.

10. Repeat steps 8 on page 189 and 9 on page 189 for the other two new hard disks; for the one for Virtual Device mode, select **SCSI(1:1)** for the second new disk and **SCSI(1:2)** for the third new disk, as shown in Figure 11-24.

irtual Hardware VM Options	SDRS Rules vApp Options				
🔜 New Hard disk	□ GB ▼				
Location	Store with the virtual machine				
Compatibility Mode	Physical 🔹				
Physical LUN	/vmfs/devices/disks/naa.60050764008180c29800000000000000				
Shares	Normal 🚽 1000				
Limit - IOPs	Unlimited •				
Virtual Flash Read Cache	0 GB 🖌 Advanced				
Virtual Device Node	● SCSI(1:0) ▼				
	○ [IDE(0:0)]				
	○ SATA(0:0) CD/DVD drive 1				
Disk Mode	Dependent				
	Dependent disks are included in snapshots.				
	 Independent - Persistent Changes are immediately and permanently written to disk. Persistent disks are not affected by snapshots. 				
	Independent - Nonpersistent				
	Changes to this disk are discarded when you power off or				
🚍 New Hard disk	0				
New Hard disk Location	Changes to this disk are discarded when you power off or revert to the snapshot.				
	Changes to this disk are discarded when you power off or revert to the snapshot. 64 GB				
Location	Changes to this disk are discarded when you power off or revert to the snapshot. 64 GB Store with the virtual machine				
Location Compatibility Mode	Changes to this disk are discarded when you power off or revert to the snapshot. 64 GB Changes to this disk are discarded when you power off or revert to the snapshot. 64 Physical Physical				
Location Compatibility Mode Physical LUN	Changes to this disk are discarded when you power off or revert to the snapshot. 64				
Location Compatibility Mode Physical LUN Shares	Changes to this disk are discarded when you power off or revert to the snapshot.				
Location Compatibility Mode Physical LUN Shares Limit - IOPs	Changes to this disk are discarded when you power off or revert to the snapshot. 64				
Location Compatibility Mode Physical LUN Shares Limit - IOPs Virtual Flash Read Cache	Changes to this disk are discarded when you power off or revert to the snapshot.				

Figure 11-24 Select SCSI

11.1.8 Adding hard disks (RDMs) to the second virtual machine node

To allow shared access to clustered services and data, point the witness disk of the second node to the same location as the first node's witness disk. Point the additional shared storage disks to the same location as the first node's shared storage disks.

Complete the following steps:

- 1. In the vSphere Web Client navigator, select the newly created second VM, right-click it, and select **Edit settings**.
- 2. On the Customize hardware window, click the Virtual Hardware tab.
- 3. Click the New Device drop-down menu, select SCSI Controller, and click Add.
- 4. Make sure that the SCSI Controller type is LSI Logic SAS, and that the SCSI Bus Sharing is Physical, as shown in Figure 11-25.

→ G SCSI controller 0	LSI Logic SAS
SCSI Bus Sharing	None
Change Type	LSI Logic SAS
✓ G *SCSI controller 1	LSI Logic SAS
SCSI Bus Sharing (*)	Physical 🗸
Change Type	LSI Logic SAS

Figure 11-25 Select LSI Logic SAS

5. Click the **New Device** drop-down menu, select **Existing Hard Disk**, and click **Add**, as shown in Figure 11-26.

SQLVM02 - Edit Settings	3 H
Virtual Hardware VM Optio	ns SDRS Rules vApp Options
▶ ■ CPU	4 🗸
🕨 🏧 Memory	16384 V (MB V
▶ 🔜 Hard disk 1	100 GB V
▶ 🛃 SCSI controller 0	LSI Logic SAS
▶ 🛃 SCSI controller 1	LSI Logic SAS
▶ m Network adapter 1	VM-Production
▶ 📷 Network adapter 2	VM-WinClus 🔹 Connect
Network adapter 3	VM-WinCSV ▼ Connect
▶ 🛞 CD/DVD drive 1	Client Device
▶ 🛄 Video card	Specify custom settings
▶ 🝥 SATA controller 0	
VMCI device	
▶ Other Devices	
New device:	🚘 Existing Hard Disk 🔹 Add
Compatibility: ESXi 5.5 and lat	ter (VM version 10) OK Cancel

Figure 11-26 Existing hard disk

6. In Disk File Path, browse to the location of the witness disk that is specified for the first node, as shown in Figure 11-27.

Datastores	Contents	Information	
host-infra-02-boot-2	A SQLVM01.vmdk	Name:	SQLVM01_1.vmdk
🗕 🗐 Infra_Datastore_1	B SQLVM01_1.vmdk	Size:	1.00 GB
▶ 🛅 .sdd.sf		Modified:	6/18/2015 12:07
▶ 🥅 WK12R2			
▶ 🛅 .vSphere-HA			
W2K12R2-Template			
D T SQLVM01			
▶ 🛅 SQLVM02			
Protect_Datastore_1			
Infra_Datastore_2			
ile Type: Compatible Virtual Dis	ks(*.vmdk, *.dsk, *.raw)	-	

Figure 11-27 Browse to location

7. Select the same SCSI(1:0) virtual device node that was selected for the first VM's shared storage disk and click **OK**.

The virtual device node settings for this VM's shared storage must match the corresponding virtual device node for the first VM, as shown in Figure 11-28.

🗗 SQLVM02 - Edit Settings	3	++		
Virtual Hardware VM Options	SDRS Rules vApp Options			
VMCI device		•		
 Other Devices 				
👻 🛄 New Hard disk	1 GB 🔻			
Disk File	[Infra_Datastore_1] SQLVM01/SQLVM01_1.vmdk			
Physical LUN				
Shares	Normal 🚽 1000			
Limit - IOPs	Unlimited 🔹			
Virtual Flash Read Cache	0 GB 🔹 Advanced			
Virtual Device Node	⊙ SCSI(1:0) ▼			
	○ [IDE(1:0)] ▼			
	O SATA(0:0) CD/DVD drive 1 ▼			
Disk Mode	 Dependent Dependent disks are included in snapshots. 			
	 Independent - Persistent Changes are immediately and permanently written to disk. Persistent disks are not affected by snapshots. 			
	 Independent - Nonpersistent Changes to this disk are discarded when you power off or revert to the snapshot. 	•		
New device:	Existing Hard Disk 🔹 Add			
Compatibility: ESXi 5.5 and later (V	M version 10) OK Cancel	D.		

Figure 11-28 New hard disk

8. Repeat the steps 5 on page 192 - 7 to add the remaining RDM disks.

11.1.9 Preparing the disks for cluster use

Complete the following steps:

- 1. Log in to the first VM node.
- 2. From Server Manager, click File and Storage Services \rightarrow Volumes \rightarrow Disks
- 3. Select an offline disk, right-click it, and select **Bring Online**, as shown in Figure 11-29 on page 195.

b			Sen	ver Man	ager	nininininininin	
\mathbf{E}	- •• Volur	mes • D	isks		• 3	· ۲ ا	Manage To
m	Servers		SKS disks 4 total				
	Volumes	Filter			Q	(≣) ▼	
ii i	Disks	ruer			~		••••
	Storage Pools	Number	Virtual Disk	Status	Capacity	Unallocated	Partition
		▲ SQ	LVM01 (4)				
		0		Online	100 GB	0.00 B	MBR
		1		Offline	1.00 GB	1.00 GB	Unknown
		2		Offline	256 GB	256 GB	Unknown
		3			64.0 GB	64.0 GB	Unknown
			New Volume	***			
			Bring Online				
			Take Offline				

Figure 11-29 Bring disks online

4. After the disk comes online, right-click it and select Initialize, as shown in Figure 11-30.

b		r Manager	
\mathbf{E}	🗸 🔹 🕶 Volui	mes • Disks	- 🍘 🚩 ма
111 1 111	Servers Volumes Disks	DISKS All disks 4 total	
	Storage Pools	Number Virtual Disk SQLVM01 (4) 0	Status Capacity Unalloca Online 100 GB 0.00 B
		1 New Volume 2 Bring Online 3 Take Offline Initialize Reset Disk	line 1.00 GB 1.00 GB line 256 GB 256 GB line 64.0 GB 64.0 GB

Figure 11-30 Initialize disks

5. Repeat steps 3 on page 194 and 4 to bring online the other disks and initialize them.

- 6. Right-click the 1 GB disk and create a simple volume for the witness disk by using the default settings.
- Right-click the other shared disks that are used later by SQL Server to create a simple volume by using the settings that are shown in Figure 11-31. These disks are used later for the SQL Server FCI.

a	Nev	v Volume Wizard		_ 🗆 X
Select file system	settings			
Before You Begin Server and Disk Size Drive Letter or Folder	File system: Allocation unit size: Volume label:	NTFS 64K SQL-DATA	•	
File System Settings Confirmation Results	Short file names (8		nded) acter extensions) are req but make file operation	and a second a second

Figure 11-31 Select settings

8. Log in to the second VM node and only bring the disks online because they are shared drives that are already initialized and formatted on the first VM node.

11.1.10 Windows server failover cluster installation

This section provides detailed instructions about how to set up a two-node Windows server failover cluster on the VMs. This section focuses on validating and setting up failover cluster on VMs. After the completion of this task, a SQL Server 2014 failover cluster instance can be installed.

Complete the following steps:

- 1. Click Server Manager \rightarrow Tools and select Failover Cluster Manager.
- 2. In the Failover Cluster Manager window, click **Validate Configuration** under the Management section, as shown in Figure 11-32 on page 197.

u	Failover Cluster Manager		
File Action View Help			
🍓 Failover Cluster Manager	Failover Cluster Manager	^	Actions
	Create failover clusters, validate hardware for potential failover clusters, and perform configuration changes to your failover clusters. and perform configuration changes to your failover clusters. Overview A failover cluster is a set of independent computers that work together to increase the availability of server roles. The clustered servers (called nodes) are connected by physical cables and by software. If one of the nodes fails, another node begins to provide services. This process is known as failover. Clusters A Management To begin to use failover clustering, first validate your hardware configuration, and then create a cluster. After these steps are complete, you can manage the cluster. Managing a cluster can include copying roles to it from a cluster running Vindows Server 2012 R2. Vindows Server 2012, or Windows Server 2008 R2. Winduste Configuration Create Cluster Connect to Cluster		Failover Cluster Manager Image: State Configuration Create Cluster Connect to Cluster View Refresh Properties Help
	More Information		

Figure 11-32 Validate configuration

3. In the Before You Begin window, click Next.

4. Enter the host names of the nodes or browse and select them and click **Next**, as shown in Figure 11-33.

Select S	ervers or a Cluste	ər	
Before You Begin Select Servers or a Cluster		rvers, add the names of all the servers. ster, add the name of the cluster or one of its nodes.	
Testing Options Confirmation	Enter name:		Browse
Validating Summary	Selected servers:	SQLVM01.VersaStack.local SQLVM02.VersaStack.local	Add
			Remove
		< Previous	Next > Canc

Figure 11-33 Enter host names

- 5. In the confirmation window, click **Next** to start the validation.
- 6. After the validation process is complete, review the report and fix any errors, as shown in Figure 11-34 on page 199.

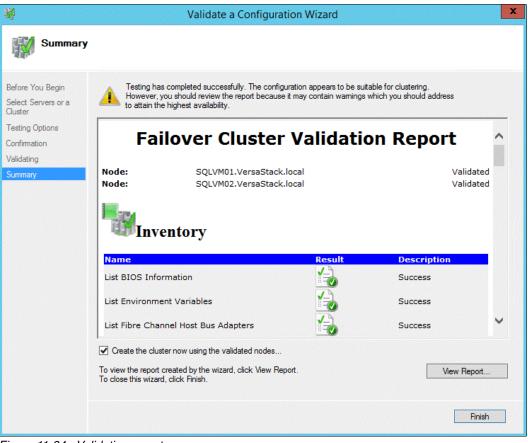


Figure 11-34 Validation report

7. If the validation is successful without any issues, select **Create the cluster using the validated nodes** check box and click **Finish**.

8. Enter a cluster name and IP address for the cluster and click **Next**, as shown in Figure 11-35.

Access F	Point for Admir		Create Cluster Wizard g the Cluster	_x
Before You Begin Select Servers Access Point for Administering the Cluster Confirmation	Cluster Name:	VMW		e IPv4 addresses could not be configured e network is selected, and then type an
Creating New Cluster Summary		V	Networks 192.168.10.0/24	Address
				evious Next > Cancel

Figure 11-35 Create cluster

9. Review the settings in the Confirmation window, select the **Add all eligible storage to the cluster** check box, and click **Next**, as shown in Figure 11-36.

1) 1)		Create Cluster Wizard	x
Confirma	tion		
Before You Begin Select Servers	You are ready to creat The wizard will create	e a cluster. your cluster with the following settings:	
Access Point for Administering the Cluster	Cluster: Node:	VMW_WSFC_CLUS SQLVM02.VersaStack.local	^
Confirmation	Node: IP Address:	SQLVM01.VersaStack.local 192.168.10.53	
Creating New Cluster Summary			
Cannary			
			\sim
	Add all eligible store	age to the cluster.	
	To continue, click Next	t.	
		(Densitive) Month 2	Canada
		< Previous Next >	Cancel

Figure 11-36 Confirmation

10.After the cluster is created successfully, click **Finish** in the summary window, as shown in Figure 11-37.

		Create Cluster Wizard	x
Summary			
Before You Begin Select Servers Access Point for	You have succ	cessfully completed the Create Cluster Wizard.	
Access Point for Administering the Cluster		Create Cluster	^
Confirmation			
Creating New Cluster	Cluster:	VMW_WSFC_CLUS	
Summary	Node:	SQLVM02.VersaStack.local	
	Node:	SQLVM01.VersaStack.local	
	Quorum:	Node and Disk Majority (Cluster Disk 1)	
	IP Address:	192.168.10.53	
			\sim
	To view the report crea To close this wizard, cl	ated by the wizard, click View Report. ick Finish.	View Report
			:::: Finish

Figure 11-37 Cluster created

11. In the Failover Cluster Manager window, verify that the statuses of Cluster Core Resources, Network, and Storage are all online, as shown in Figure 11-38.

堪	Failover Cluste	r Manager		
File Action View Help				
🗢 🔿 🙍 🖬 🚺 🖬				
Failover Cluster Manager	Cluster VMW_WSFC_CLUS.VersaStack.lo	cal		
⊿ WW_WSFC_CLUS.VersaSta Roles	Summary of Cluster VMW V	VSEC CLUS		
Modes	VMW_WSFC_CLUS has 0 clustered	San a she ta na an		
Storage Networks	Name: VMW_WSFC_CLUS.VersaStack.local	Networks: Cluster Ne	twork 1, Cluster Net	work_
Cluster Events	Current Host Server: SQLVM02 Recent Cluster Events: None in the last hou	Subnets: 3 IPv4 and	0 IPv6	
	Witness: Disk (Cluster Disk 1)			
	✓ Configure			
	✓ Navigate			
	Cluster Core Resources			
	Name		Status	In
	Storage		-	
	🗉 🧮 Cluster Disk 1		🕜 Online	
	Server Name		0	
	Name: VMW_WSFC_CLUS IP Address: 192.168.10.53		 Online Online 	
			The Online	
	< III			>

Figure 11-38 Verify status

12. Right-click only those Cluster Disks that will be used by SQL Server and select **Add to Cluster Shared Volumes**, as shown in Figure 11-39. Do not add the Witness Disk to the Cluster Shared Volumes.

4		Failover Clus	ter Manager		
File Action View Help Image: Cluster Manager Image: Cluster Manager Image: Cluster Manager					
▲ WMW_WSFC_CLUS.VersaSta Roles	Disks (3) Search		Q	Queries 🔻 🔒 🔻	•
Modes	Name	Status	Assigned To	Owner Node	1
⊿ 📇 Storage	📇 Cluster Disk 1	Online	Disk Witness in Quorum	SQLVM02	
Disks	📇 Cluster Disk 2	(Online	Available Storage	SQLVM02	
Pools Networks Cluster Events	Cluster Disk 3	Take Offline	r Shared Volumes	SQLVM02	>
	V Cluster Disk	2020 2020 2020 2020 2020 2020			
	Volumes (1)	More Actions	•		
	SQL-LOG (F:)	Remove Properties			

Figure 11-39 Add to cluster

13. Verify that the Cluster Shared Volumes status is online, as shown in Figure 11-40.

뷉		Failover Clu	ster Manager		
File Action View Help Image: Constraint of the second seco					
Hailover Cluster Manager	Disks (3)				
⊿ WMW_WSFC_CLUS.VersaSta Roles	Search		Q.	Queries 🔻 🔛 🔻	•
Nodes	Name	Status	Assigned To	Owner Node	
🔺 📇 Storage	📇 Cluster Disk 1	(Online	Disk Witness in Quorum	SQLVM02	
Disks	📇 Cluster Disk 2	🕜 Online	Cluster Shared Volume	SQLVM01	
Pools	📇 Cluster Disk 3	🕜 Online	Cluster Shared Volume	SQLVM02	
Cluster Events	<	Ш			>
		2 ClusterStorage\Volum	ne1)		

Figure 11-40 Verify the online status

11.1.11 SQL Server failover cluster installation

This section provides instructions about how to install the SQL Server 2014 failover cluster instance. Before carrying out the installation of SQL Server FCI, gather the required information, such as the SQL Server cluster name and cluster IP address. To start the installation of SQL Server FCI, complete the following steps:

- 1. Install SQL Server FCI on the first node
- 2. Add the second node to the SQL Server FCI

11.1.12 Installing the SQL Server FCI on the first node

Complete the following steps:

- 1. In the vSphere Web Client navigator, select the VM that is now WSFC node 1.
- 2. Right-click the VM, select **Edit Settings**, and map the SQL Server 2014 ISO image file to the DVD drive.
- Log in to the VM by using the appropriate domain credentials and browse to the DVD drive to start the SQL Server installation wizard.

4. In the Installation window, click **New SQL Server failover cluster installation**, as shown in Figure 11-41.

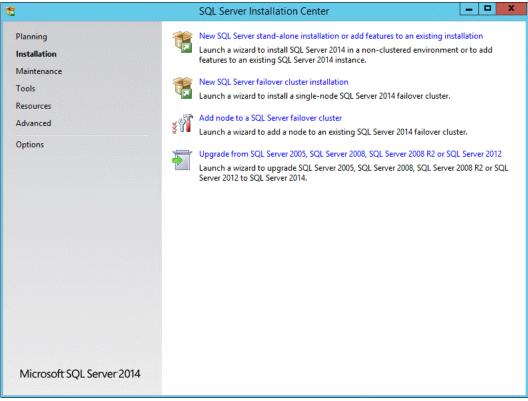


Figure 11-41 SQL FCI installation

- 5. In the Product Key window, enter the product key and click **Next**. For our example, we used the Evaluation edition.
- 6. In the License Terms window, read and accept the license terms to install the SQL Server installation and click **Next**.
- 7. In the Global Rules window, the setup procedure automatically advances to the next window if there are no rule errors.
- The Microsoft Update window opens next if the Microsoft Update check box in Control Panel\All Control Panel Items\Windows Update\Change settings is not checked. Putting a check in the Microsoft Update page changes the computer settings to include the latest updates when you scan for Windows Update.
- In the Product Updates window, the latest available SQL Server product updates are displayed. If no product updates are discovered, SQL Server Setup does not display this window and auto advances to the Install Setup Files window.
- 10. In the Install Setup files window, the setup shows the progress of downloading, extracting, and installing the Setup files. If an update for SQL Server Setup is found, and is specified to be included, that update also is installed.
- 11. The Install Failover Cluster Rules window runs the rules that are essential for a successful SQL Server cluster creation. Confirm that this step displays no errors and verify the warnings. Click **Next**.

12. In the Setup Role window, select the **SQL Server Feature Installation** radio button to install the SQL Server engine components and click **Next**, as shown in Figure 11-42.

1	Install a SQL Server Failover Cluster
Setup Role	
Click the SQL Server Feature feature role to install a speci	e Installation option to individually select which feature components to install, or click a ific configuration.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Feature Configuration Rules Ready to Install Installation Progress Complete	 Inte Configuration. SQL Server Feature Installation Install SQL Server Database Engine Services, Analysis Services, Reporting Services, Integration Services, and other features. SQL Server PowerPivot for SharePoint Install PowerPivot for SharePoint on a new or existing SharePoint server to support PowerPivot data access in the farm. Optionally, add the SQL Server relational database engine to use as the new farm's database server. Add SQL Server Database Relational Engine Services to this installation.
	< Back Next > Cancel Help

Figure 11-42 Setup role

13. In the Feature Selection window, choose the Database Engine services and the Management Tools and click **Next**, as shown in Figure 11-43.

1	Install a SQL Server Failover Cluster
Setup Role	
Click the SQL Server Feature feature role to install a speci	Installation option to individually select which feature components to install, or click a fic configuration.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Rules Feature Configuration Rules Ready to Install Installation Progress Complete	 SQL Server Feature Installation Install SQL Server Database Engine Services, Analysis Services, Reporting Services, Integration Services, and other features. SQL Server PowerPivot for SharePoint Install PowerPivot for SharePoint on a new or existing SharePoint server to support PowerPivot data access in the farm. Optionally, add the SQL Server relational database engine to use as the new farm's database server. Add SQL Server Database Relational Engine Services to this installation.
	< Back Next > Cancel Help

Figure 11-43 Choose features

14. The Feature Rule window shows the rule executions and automatically advances if all rules pass.

15. In the Instance Configuration window, specify the SQL Server Network Name and the Instance ID and click **Next**, as shown in Figure 11-44.

1	Install a SQ	Server Failover Cluster	_ 🗆 X
Instance Configuration	n		
Specify the name and instance	e ID for the instance of SQL Ser	ver. Instance ID becomes part of the installation path.	
Product Key License Terms	Specify a network name for your failover cluster on the r	the new SQL Server failover cluster. This will be the nam network.	e used to identify
Global Rules	SQL Server Network Name:	SQLCLUS	
Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role	 Default instance Named instance: 	MSSQLSERVER	
Feature Selection			
Feature Rules	Instance ID:	MSSQLSERVER	
Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration	SQL Server directory: Detected SQL Server instance	C:\Program Files\Microsoft SQL Server\MSSQL12.MSSC es and features on this computer:	lserver
Server Configuration	Instance Cluster	Network Name Features Edition	Version Inst
Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete			
	<	Ш	>
		< Back Next > Cano	el Help

Figure 11-44 Instance configuration

16. In the Cluster Resource Group window, select the SQL Server cluster resource group name from the list or create a resource group and click **Next**, as shown in Figure 11-45.

5		Install a SQ	L Server Fai	over Cluster			_ _ ×
Cluster Resource Grou	qı						
Create a new cluster resource	group for your	SQL Server failover	cluster.				
Product Key License Terms Global Rules	failover clu	ame for the SQL Se ster resources will b v cluster resource gr	e placed. You	can choose to use			
Microsoft Update	SQL Ser	ver cluster resource	group name:	SQL Server (MSS	QLSERVER)		~
Setup Role	Qualified	Name	Message				
Feature Selection		Available Storage	The cluster of	roup 'Available St	orage' is reserved	by Windows Faile	over Clustering
Feature Bules		Cluster Group	The cluster of	roup 'Cluster Gro	up' is reserved by	Windows Failover	r Clustering an
Instance Configuration							
Cluster Resource Group							
Cluster Disk Selection							
Cluster Network Configuration							
Server Configuration							
Database Engine Configuration							
Feature Configuration Rules							
Ready to Install							
Installation Progress							
Complete							Refresh
				_			
				< Back	Next >	Cancel	Help

Figure 11-45 Cluster resource

17. In the Cluster Disk Selection window, select the shared cluster disks from the list, as shown in Figure 11-46 on page 209. These disks were added to be part of the Guest cluster. Click **Next**.

5		Install a	SQL Server Failover Cluster
Cluster Disk Selection			
Select shared cluster disk reso	urces for your S	QL Server failove	er cluster.
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role		e for all database Disk 2	e included in the SQL Server resource cluster group. The first drive will be used as the is, but this can be changed on the Database Engine or Analysis Services configuration
Feature Selection	Available sh	ared disks:	
Feature Rules	Qualified	Disk	Message
Instance Configuration Cluster Resource Group		Cluster Disk 1	The disk resource 'Cluster Disk 1' cannot be used because it is a cluster quorum dri
Cluster Disk Selection	0	Cluster Disk 2	
Cluster Network Configuration		Cluster Disk 3	
Server Configuration			
Database Engine Configuration			
Feature Configuration Rules			
Ready to Install			
Installation Progress			Refresh
Complete			
			< Back Next > Cancel Help

Figure 11-46 Cluster disk selection

18. In the Cluster Network Configuration window, provide the public connectivity IP details for the SQL Server failover cluster and click **Next**, as shown in Figure 11-47.

1			Inst	all a SQL Serve	r Failover Clust	er	>
Cluster Network Confi	gura	tion					
Select network resources for yo			lover clu	ster.			
Product Key	Sper	ify the ne	twork se	ttings for this failo	ver cluster:		
License Terms	-	IP Type		Address	Subnet Mask	Subnet(s)	Network
Global Rules	_	IP Type		192.168.10.54	255.255.255.0	192.168.10.0/24	Cluster Network
Microsoft Update		IPV4		192.106.10.34	233.233.233.0	192.100.10.0/24	Cluster Network
Install Setup Files							
nstall Failover Cluster Rules							
Setup Role							
Feature Selection							
Feature Rules							
nstance Configuration							
Cluster Resource Group							
Cluster Disk Selection							
Cluster Network Configuration							
Server Configuration							
Database Engine Configuration							
eature Configuration Rules							
Feature Configuration Rules Ready to Install							
Feature Configuration Rules Ready to Install Installation Progress							Refresh
Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete					< Bac	k Next> C	Refresh

Figure 11-47 Cluster network configuration

19. In the Server Configuration window, specify the service accounts and collation configuration details and click **Next**, as shown in Figure 11-48.

1	Install a SQL Server	Failover Cluster			
Server Configuration					
Specify the service accounts an	d collation configuration.				
Product Key License Terms	Service Accounts Collation				
License Terms Global Rules	Microsoft recommends that you use a s	eparate account for each SQL Se	erver service.		
Microsoft Update	Service	Account Name	Password	Startup Type	
Install Setup Files	SQL Server Agent	VERSASTACK\Administrator	•••••	Manual	~
install Failover Cluster Rules	SQL Server Database Engine	VERSASTACK\Administrator	•••••	Manual	~
Setup Role	SQL Full-text Filter Daemon Launcher	NT Service\MSSQLFDLaunc		Manual	
Feature Selection	SQL Server Browser	NT AUTHORITY\LOCAL SE		Automatic	~
Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress					
Complete					

Figure 11-48 Server configuration

20. In the Database Engine Configuration window, specify the database engine authentication security mode, administrators, and data directory details, as shown in Figure 11-49 on page 211. In the Data Directories tab, make sure that the root directory and the temp database directory are set. Click **Next**.

1	Install a SQ	L Server Failover Cluster	- 🗆 X
Database Engine Config	guration		
Specify Database Engine auther	ntication security mode, administr	ators and data directories.	
Product Key	Server Configuration Data Dir	rectories FILESTREAM	
License Terms Global Rules	Data root directory:	C:\ClusterStorage\Volume2\	
Microsoft Update	System database directory:	C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data	
Install Setup Files Install Failover Cluster Rules	User database directory:	C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data	
Setup Role	User database log directory:	C:\ClusterStorage\Volume1\MSSQL12.MSSQLSERVER\MSSQL\Data	
Feature Selection Feature Rules	Temp DB directory:	C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data	
Instance Configuration	Temp DB log directory:	C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data	
Cluster Resource Group	Backup directory:	C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Backup	
Cluster Disk Selection			
Cluster Network Configuration			
Server Configuration			
Database Engine Configuration			
Feature Configuration Rules			
Ready to Install			
Installation Progress			
Complete			
		< Back Next > Cancel	Help

Figure 11-49 Database engine configuration

21. The Feature Configuration Rules automatically runs the Feature configuration rules. Verify the output and click **Next**.

22. In the Ready to Install window, verify the installation options and click **Install** to start the SQL Server Failover Cluster installation, as shown in Figure 11-50.

Ready to Install		
Verify the SQL Server 2014 feat	ures to be installed.	
Product Key	Ready to install the SQL Server 2014 failover cluster:	
License Terms Global Rules Microsoft Update Install Setup Files Install Failover Cluster Rules Setup Role Feature Selection Feature Configuration Cluster Configuration Cluster Nick Selection Cluster Nick Selection Cluster Nick Selection Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	Edition: Evaluation Action: InstallEfailoverCluster Prerequisites Aready installed: To be installed from media: Microsoft Visual Studio 2010 Redistributables Instance Configuration Instance INSQLSERVER Instance Configuration Instance Directory: C:\Program Files\Microsoft SQL Server\ Shared cemponent root directory Shared feature directory: C:\Program Files\Microsoft SQL Server\ Shared feature directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data Update Enabled: False Update Enabled: False Update Source MU Protextup Type: Manual Service Configuration Service Configuration Startup Type: Manual Directory System database directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data User database directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data User database directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data TempDB directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data TempDB directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\Data TempDB directory: C:\ClusterStorage\Volume2\MSSQL12.MSSQLSERVER\MSSQL\D	

Figure 11-50 Ready to install

23. After the installation is complete, verify the installation summary and click **Close** to close the wizard, as shown in Figure 11-51 on page 213.

	Install a SQL Server Failover	Cluster
Complete Your SQL Server 2014 failow	er cluster installation is complete.	
Product Key License Terms Global Rules Microsoft Update Install Setup Files Install Setup Files Install Failover Cluster Rules Setup Role Feature Rules Instance Configuration Cluster Resource Group Cluster Disk Selection Cluster Network Configuration Server Configuration Database Engine Configuration Feature Configuration Rules Ready to Install Installation Progress Complete	installed. By default, the Help Viewer component u can use the Help Library Manager component to d	Status Succeeded Succeeded

Figure 11-51 Complete

11.1.13 Adding a second node to the SQL Server FCI

This section explains the procedure to add the second VM node to the SQL Server Failover Cluster Instance that was created in 11.1.12, "Installing the SQL Server FCI on the first node" on page 203. Complete the following steps:

1. Start the SQL Server installation wizard from the mounted SQL Server DVD drive.

2. In the Installation window, click the **Add node to a SQL Server Failover Cluster**, as shown in Figure 11-52.

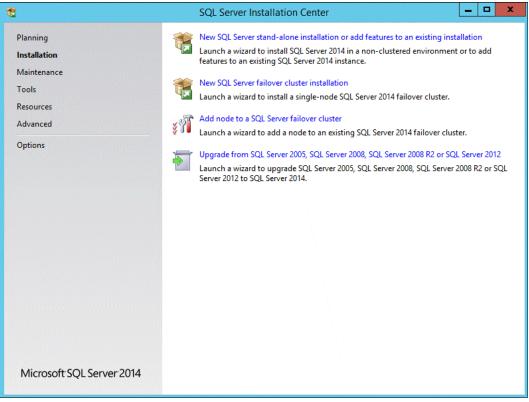


Figure 11-52 Add node

- 3. In the Product Key window, enter the product key details and click Next.
- 4. In the License Terms window, read and accept the license terms and click Next.
- 5. In the Global Rules window, the setup procedure automatically advances to the next window if there are no rule errors.
- 6. The Microsoft Update window opens next if the Microsoft Update check box in Control Panel\All Control Panel Items\Windows Update\Change settings is not checked. Putting a check in the Microsoft Update window changes the computer settings to include the latest updates when you scan for Windows Update. Click Next.
- In the Product Updates window, the latest available SQL Server product updates are displayed. If no product updates are discovered, SQL Server Setup does not open this page and automatically advances to the Install Setup Files window.
- In the Install Setup files window, Setup shows the progress of downloading, extracting, and installing the setup files. If an update for SQL Server Setup is found, and is specified to be included, that update also is installed.
- The Add Node Rules window runs the rules that are essential for adding the node to the SQL Server cluster. Confirm that this step shows no errors and verify the warnings. Click Next.

If there is a failure, it must be corrected before the setup is run,

10. In the Cluster Node Configuration window, verify the existing SQL Server Failover Cluster details and click **Next**, as shown in Figure 11-53.

5		Add a Fail	lover (Cluster Node			X
Cluster Node Configur	ration						
Add a node to an existing SQL	Server failover cluste	er.					
Product Key License Terms Global Rules Microsoft Update	SQL Server ins		MSSO	QLSERVER			
Install Setup Files Add Node Rules Cluster Node Configuration Cluster Network Configuration Service Accounts Feature Rules	Disk Space Requirements:						
	Instance Name	Cluster Network Name		Features	Nodes		
Ready to Add Node Add Node Progress Complete	MSSQLSERVER	SQLCLUS		SQLEngine, SQ	SQLVM01		
				< Back	Next > Cancel	Hel	p

Figure 11-53 Cluster Node Configuration - part 1

11. In the Cluster Network Configuration window, select the public connectivity network settings for the failover cluster and click **Next**, as shown in Figure 11-54.

1		Ado	d a Failover Clu	uster Node		_ D X
Cluster Network Conf						
The current node that is being shown are the previously con						
Product Key	Specify the r	etwork se	ttings for this faile	over cluster:		
License Terms Global Rules	IP Туре	DHCP	Address	Subnet Mask	Subnet(s)	Network
Microsoft Update	✓ IPv4		192.168.10.54	255.255.255.0	192.168.10.0/24	Cluster Network
Cluster Network Configuration Service Accounts Feature Rules Ready to Add Node Add Node Progress Complete						
						Refresh
				< Back	Next > Car	icel Help

Figure 11-54 Cluster Network Configuration - part 2

- 12. In the Service Accounts window, specify the passwords for the service accounts that are configured for the cluster and click **Next**.
- 13. The Feature Rule window shows the rule executions and automatically advances if all the rules pass.

14. In the Ready to Add Node window, verify the summary of the settings and click **Install**, as shown in Figure 11-55.

5	Add a Failover Cluster Node	x
Ready to Add Node Verify the SQL Server 2014 fe	atures to be installed as part of the add node operation.	
Product Key License Terms Global Rules Microsoft Update Install Setup Files Add Node Rules Cluster Node Configuration Cluster Network Configuration Service Accounts Feature Rules Ready to Add Node Add Node Progress Complete	Ready to add this node to the SQL Server 2014 failover cluster: Summary Edition: Evaluation Action: AddNode Prerequisites Already installed: Windows PowerShell 2.0 Microsoft .NET Framework 3.5 Microsoft Sudio 2010 Redistributables Microsoft Visual Studio 2010 Redistributables Microsoft Visual Studio 2010 Shell General Configuration Features Database Engine Services SQL Server Replication Full-Text and Semantic Extractions for Search Data Quality Services Management Tools - Basic Management Tools - Complete Configuration Files\Microsoft SQL Server\120\Setup Bootstrap\Log\20150622_162329\ConfigurationFile.in	

Figure 11-55 Ready to Add Node

15. After the installation is complete, verify the installation summary and click **Close** to close the wizard, as shown in Figure 11-56.

Complete		
Your SQL Server 2014 failove	er cluster add node operation is complete.	
Product Key icense Terms	Information about the Setup operation or possible next	steps:
Global Rules	Feature	Status
	🖉 Management Tools - Complete	Succeeded
Vicrosoft Update	Management Tools - Basic	Succeeded
nstall Setup Files	Oatabase Engine Services	Succeeded
Add Node Rules	Data Quality Services	Succeeded
Cluster Node Configuration	Full-Text and Semantic Extractions for Search	Succeeded
Cluster Network Configuration	SQL Server Replication	Succeeded
	SQL Browser	Succeeded
ervice Accounts	SQL Writer	Succeeded
eature Rules	SQL Client Connectivity	Succeeded
leady to Add Node	SQL Client Connectivity SDK	Succeeded
Add Node Progress	Setup Support Files	Succeeded
Complete		
	Details:	
	Viewing Product Documentation for SQL Serve	er
	installed. By default, the Help Viewer component u can use the Help Library Manager component to de	nage the documentation for SQL Server have been ises the online library. After installing SQL Server, you ownload documentation to your local computer. For more QL Server (< <u>http://go.microsoft.com/fwlink/?LinkID=</u>
	Microsoft Update	
	For information about how to use Microsoft Update Microsoft Update (< <u>http://go.microsoft.com/fwlink/</u>	
	Camplee	
	Summary log file has been saved to the following location	on:
		strap\Log\20150622_162329

Figure 11-56 Complete

The setup is now complete, as shown in Figure 11-57 on page 219.

<u>u</u>		Failo	ver Cluster	r Manager		
File Action View Help						
🗢 🄿 🙍 📰						
📲 Failover Cluster Manager	Roles (1)					
⊿ WWW_WSFC_CLUS.VersaSta Roles	Search				P Queries	•
Nodes	Name	Status	Туре	Owner Node	Priority	Information
⊿ 📇 Storage ﷺ Disks	SQL Server (MSSQLSERVER)	💿 Running	Other	SQLVM01	Medium	
Pools						
Networks	<	Ш				>
闘 Cluster Events	V SQL Server (MSSQL	SERVER)			Preferred Owr	ners: <u>Any node</u>
	Name			Status	Information	
	Server Name					
	표 📑 Name: SQLCLUS			🕥 Online		
	Other Resources					
	🚱 SQL Server			🕥 Online		
	强 SQL Server Agent			💿 Online		

Figure 11-57 Setup complete

11.1.14 Modifying the vSphere HA and DRS settings for the WSFC VMs

When using WSFC in a vSphere HA or DRS environment, you must configure the hosts and VMs to use certain settings. To configure the use of WSFC in a vSphere HA and DRS environment, complete the following steps:

- 1. Create anti-affinity rules.
- 2. Enable strict enforcement of anti-affinity rules.
- 3. Set the DRS automation level for clustered virtual machines.
- 4. Configure vSphere DRS groups and VM-Host affinity rules with clustered virtual machines.

11.1.15 Creating anti-affinity rules

When you cluster VMs across physical hosts in a vSphere environment, you should keep the VMs on different physical hosts. When you enable vSphere HA and DRS in an environment where VMs are clustered across physical hosts, there are situations where the VMs might run on the same host because of their capabilities. Therefore, to avoid situations where clustered VMs run on the same host, you must configure VM-VM anti-affinity rules by completing the following steps:

- 1. In the vSphere Web Client, go to the cluster.
- 2. Click the Manage tab.

3. Click Settings \rightarrow DRS Rules, and click Add, as shown in Figure 11-58.

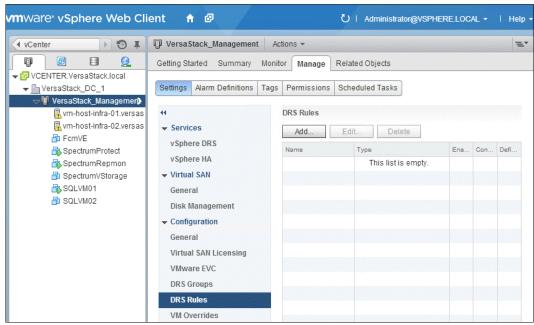


Figure 11-58 DRS rules

4. Enter a name for the rule in the Rule dialog box, as shown in Figure 11-59 on page 221.

🚯 Vers	aStack_Management - Create DRS Rule		? >>
Name:	WSFCAnti-Affinity		
	✓ Enable rule.		
Type:	Separate Virtual Machines		•
Descrip	tion:		
The liste	ed Virtual Machines must be run on separate hosts.		
Add.	. Remove		
Members	5		
		OK Ca	ncel

Figure 11-59 Create DRS Rule

5. From the Type drop-down menu, select the **Separate Virtual Machines** rule and click **Add**.

6. Select the two VMs to which the rule applies and click **OK** twice, as shown in Figure 11-60.

Add Rule Member	×
Filter (2) Selected Objects	
	Q Filter -
Name	
🔲 🗗 SpectrumProtect	
FcmVE	
🔲 🋅 SpectrumRepmon	
SQLVM01	
SQLVM02	
🔲 🗗 SpectrumVStorage	
	- 24,000 - 20,000 - 2
86	6 items
	OK Cancel

Figure 11-60 Add Rule Member

11.1.16 Enabling strict enforcement of anti-affinity rules

Setting the vSphere DRS advanced option "ForceAffinePoweron" to "1" enables strict enforcement of the anti-affinity rules. Complete the following steps:

- 1. In the vSphere Web Client, go to the cluster.
- 2. Click the Manage tab.
- 3. Click **Settings**, and under vSphere DRS, click **Edit**. The window that is shown in Figure 11-61 on page 223 opens.

	ent - Edit Cluster Settings			4 (?)			
vSphere DRS	Turn ON vSphere DRS			-			
v\$phere HA	► DRS Automation	DRS Automation Fully Automated					
	► Power Management	Power Management Off					
	+ Advanced Options						
	Configuration Parameters	Add Delete					
		Option	Value				
		ForceAffinePoweron	1				
				Ŧ			
				•			

Figure 11-61 Set the DRS options

- 4. Expand Advanced Options and click Add.
- 5. Enter "ForceAffinePoweron" into the Option column,
- 6. Enter "1" into the Value column and click OK.

11.1.17 Setting the DRS automation level for clustered virtual machines

You must set the automation level of all VMs in a WSFC cluster to Partially Automated. Migration of WSFC clustered VMs is not recommended. Complete the following steps:

- 1. Browse to the cluster in the vSphere Web Client object navigator.
- 2. Click the Manage tab and click Settings.
- 3. Under Services, click Edit. The window that is shown in Figure 11-62 opens.

VersaStack_Management - Edit (Cluster Settings	() M
vSphere DRS	☑ Turn ON vSphere DRS	
vSphere HA	- DRS Automation	
	Automation Level	 Manual vCenter Server will suggest migration recommendations for virtual machines. Partially Automated Virtual machines will be automatically placed onto hosts at power on and vCenter Server will suggest migration recommendations for virtual machines. Fully Automated Virtual machines will be automatically placed onto hosts when powered on, and will be automatically migrated from one host to another to optimize resource usage.
	Migration Threshold	Conservative Aggressive Apply priority 1, priority 2, and priority 3 recommendations. vCenter Server will apply recommendations that promise at least good improvements to the cluster's load balance.
	Virtual Machine Automation	✓ Enable individual virtual machine automation levels. Override for individual virtual machines can be set from the VM Overrides page.
	 Power Management 	Off
4	Advanced Ontions	Evenend for advanced entione
		OK Cancel

Figure 11-62 Automation level

- 4. Expand **DRS Automation**, and under Virtual Machine Automation, select the **Enable** individual virtual machine automation levels check box and click **OK**.
- 5. Under Configuration, select VM Overrides and click Add, as shown in Figure 11-63.

vmware [®] vSphere Web Cl	ient 🔒 🗗		U Administrat	or@VSPHERE.LO	CAL 👻 Help 🕇
🔹 vCenter 🕑 🖡	VersaStack_Management	Actions 👻			=*
Image: Constraint of the second se	Getting Started Summary Me	onitor Manage	Related Objects		
VersaStack_DC_1 VersaStack_Managemen	Settings Alarm Definitions Ta	ags Permissions	Scheduled Tasks		
	 ✓ Services vSphere DRS 	VM Overrides	Edit Delet	e	
	vSphere HA	Name		vSphere DRS Aut	vSphere HA Rest
	 Virtual SAN General Disk Management Configuration General Virtual SAN Licensing VMware EVC DRS Groups DRS Rules 		This list is	empty.	
	VM Overrides Host Options				

Figure 11-63 VM overrides

- 6. Click the plus button, select the WSFC VMs in the cluster, and click OK.
- 7. Click the **Automation level** drop-down menu, select **Partially Automated**, and click **OK**, as shown in Figure 11-64.

F (2)			
SQLVM01	Automation level:	Partially Automated	•
SQLVM02	VM restart priority:	Use Cluster Settings	•
	Host isolation response:	Use Cluster Settings	•
	VM Monitoring:	Use Cluster Settings	•
	VM monitoring sensitivity:	-	•
		S	
	▶ vSphere DRS	Fully Automated	
	▶ vSphere HA	Expand for details	

Figure 11-64 Choose settings

11.1.18 Using vSphere DRS groups and VM-Host affinity rules with clustered virtual machines

Create two types of DRS groups by using the vSphere Web Client.

- VM DRS groups containing at least one VM
- Host DRS groups containing at least one host

Then, set up VM-Host affinity rules for DRS groups (WSFC).

A VM-Host anti-affinity rule establishes an anti-affinity relationship between a VM DRS group and a host DRS group.

Because vSphere HA does not obey VM-VM anti-affinity rules, it might put clustered VMs that are meant to stay apart on the same host. So, you also must create a VM-Host anti-affinity rule by setting up DRS groups and by using VM-Host anti-affinity rules, which are obeyed by vSphere HA.

For a cluster of VMs across physical hosts, each WSFC VM must be in a different VM DRS group, and linked to a different host DRS group with the affinity rule "Must run on hosts in group".

Table 11-2 shows a configuration example where we created two VM DRS groups and two host DRS groups that are mapped as shown in the table.

VM DRS group name	Member VM name	Mapped host DRS group name	Member host name
VMGroup_01	SQLVM01	HostGroup_01	vm-host-infra-01
VMGroup_02	SQLVM02	HostGroup_02	vm-host-infra-02

Table 11-2 Configuration example

11.1.19 Creating a virtual machine DRS group (WSFC)

Before you can create a VM-Host affinity rule, you must create the host DRS group and the VM DRS group to which the rule applies.

For a cluster of VMs across physical hosts, create one VM DRS group for each MSCS VM. For example, VMGroup_01 contains SQLVM01 and VMGroup_02 contains SQLVM02. Complete the following steps:

- 1. Browse to the cluster in the vSphere Web Client navigator.
- 2. Click the Manage tab.

3. Click Settings, click DRS Groups, and click Add, as shown in Figure 11-65.

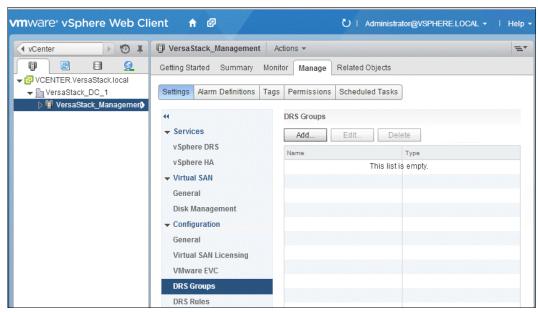


Figure 11-65 Add DRS groups

The window that is shown in Figure 11-66 opens.

🚯 Vers	aStack_Management	- Create DR	S Group	(? H
Name:	VMGroup_01			
Type:	VM DRS Group			:
Add	Remove			
Members	1			
🚯 sqi	LVM01			
			ОК	Cancel

Figure 11-66 Create DRS group

- 4. In the DRS Group dialog box, enter a name for the group.
- 5. Select VM DRS Group from the Type drop-down box and click Add.
- 6. Select the check box next to a VM to add it. Continue this process until all the wanted VMs are added.
- 7. For a cluster of VMs across physical hosts, add one MSCS VM per group.
- 8. Click **OK**. Figure 11-67 on page 227 shows the completed process.

vmware [®] vSphere Web Cl	ient 🔒 🖉	ل Adm	inistrator@VSPHERE.LOCAL	
vCenter	DVersaStack_Management	Actions -		
	Getting Started Summary Mo	onitor Manage Related Obje	ects	
CENTER.VersaStack.local OrsaStack_DC_1 VersaStack Managemen	Settings Alarm Definitions Ta	gs Permissions Scheduled T	asks	
	••	DRS Groups	DRS Groups	
	▼ Services	Add Edit	Delete	
	vSphere DRS	Name	Туре	
	vSphere HA	P VMGroup_01	VM DRS Group	
	✓ Virtual SAN	P VMGroup_02	VM DRS Group	
	General Disk Management Configuration General Virtual SAN Licensing VMware EVC	Add Remove VMGroup_01 Group Members		
	DRS Groups	SQLVM01		

Figure 11-67 Complete

11.1.20 Creating a host DRS group (WSFC)

Before you can create a VM-Host affinity rule, you must create the host DRS group and the VM DRS group to which the rule applies.

For a cluster of VMs across physical hosts, create groups with sets of hosts that do not overlap to ensure that the VMs that are placed in different host groups do not ever run on the same host simultaneously. Complete the following steps:

- 1. Browse to the cluster in the vSphere Web Client navigator.
- 2. Click the Manage tab.
- 3. Click Settings, click DRS Groups, and click Add.

4. In the DRS Group dialog box, enter a name for the group, as shown in Figure 11-68.

🚯 Vers	aStack_Management - Create DRS Group	(? H
Name:	HostGroup_01	
Type:	Host DRS Group	
Add	Remove	
Members	i	
🖟 vm-	host-infra-01.versastack.local	
		OK Cancel

Figure 11-68 Create host DRS group

- 5. Select Host DRS Group from the Type drop-down box and click Add.
- 6. Click the check box next to a host to add it. Continue this process until all the wanted hosts are added.
- 7. Click OK, as shown in Figure 11-69.

vm ware [®] vSphere Web Cl	ient 🔒 🖉	کا Adm	inistrator@VSPHERE.LOCA	
✓ vCenter	🗊 VersaStack_Management	Actions -		
VCENTER.VersaStack.local	Getting Started Summary Mo	nitor Manage Related Obje	cts	
✓ ✓ ✓	Settings Alarm Definitions Ta	gs Permissions Scheduled T	Scheduled Tasks	
	•	DRS Groups		
		Add Edit	Delete	
	vSphere DRS	Name	Туре	
	vSphere HA	P VMGroup_01	VM DRS Group	
	▼ Virtual SAN	P VMGroup_02	VM DRS Group	
	General Disk Management Configuration General Virtual SAN Licensing	DRS Group Members Add Remove VMGroup_01 Group Members	=	
	VMware EVC	SQLVM01		
	DRS Groups			

Figure 11-69 Add host group

11.1.21 Setting up the VM-Host affinity rules for DRS groups (WSFC)

Create VM-Host affinity rules to specify whether the members of a selected VM DRS group can run on the members of a specific host DRS group by completing the following steps:

- 1. Browse to the cluster in the vSphere Web Client navigator.
- 2. Click the Manage tab.
- 3. Click Settings, click DRS Rules, and click Add.
- 4. In the DRS Rule dialog box, enter a name for the rule.
- 5. From the Type menu, select Virtual Machines to Hosts.
- 6. Select the VM DRS group and the host DRS group to which the rule applies. For example, select VMGroup_1 and HostGroup_1.
- 7. Select Must run on hosts in group and click OK, as shown in Figure 11-70.

🚯 Vers	saStack_Management - Create DRS Rule	?	**
Name:	VM_Host_DRS_GROUP_01		1
	☑ Enable rule.		
Type:	Virtual Machines to Hosts	•	
Descrip	tion:		
	nachines that are members of the Cluster DRS VM Group VMGroup_01 m lost group HostGroup_01.	ust	::
VM Grou	p:		
VMGrou	up_01	•	
Mustru	in on hosts in group	•	
Host Gro	pup:		
HostGr	oup_01	•	
4			•
	ОК Са	ncel)_

Figure 11-70 Select settings

The setup is now complete.

230 VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

12

IBM Spectrum Control integration

This chapter describes how the Spectrum Control software suite complements the built-in functions of the VersaStack hardware components. It covers how the IBM Tivoli Productivity Center SmartCloud Virtual Storage Edition and IBM FlashCopy Manager offer the following functions:

- ► Cloud-enabled, pro-active, and event driven storage management
- Real-time performance monitoring, historical data analysis, and automated reporting
- Advanced data protection technologies that use hardware-assisted snapshots
- VMware vCenter and VMware Web Client integration

12.1 Spectrum Control overview

This section describes the components of IBM SmartCloud Virtual Storage Center (VSC) that are applicable to the VersaStack setup. This section also describes the VSC offerings and licensing model overview.

VSC Version 5.2 provides efficient virtualization, management, and data protection for heterogeneous storage environments. VSC helps IT storage managers migrate to an agile cloud-based storage environment and manage it effectively without having to replace existing storage systems. This powerful offering removes the physicality of storage, and also the complexity that is associated with managing multivendor infrastructures.

VSC V5.2 offers a storage virtualization platform, capabilities for storage virtualization management, and instant copy management. VSC V5.2 delivers to customers, under one licensed software product, the complete set of functions that are available in the IBM Tivoli Storage Productivity Center, the functions and capabilities that are associated with the IBM System Storage SAN Volume Controller (including copy services), and the capabilities of the IBM Tivoli Storage FlashCopy Manager. With VSC, you can now get all of the advanced capabilities of what was previously Tivoli Storage Productivity Center Standard Edition, and with the IBM SmartCloud VSC 5.2 license, you get all of the advanced analytics functions. This powerful solution enables organizations to optimize provisioning, capacity, availability, reporting, and management for virtual storage.

12.2 Storage hypervisor

This section introduces the concepts of *server hypervisor* and *storage hypervisor*. It also has an overview of the IBM Storage Hypervisor, which is integrated with the VSC V5.2.

Server hypervisor

In cloud computing, a *server hypervisor* has the following key attributes, which provide effective resource utilization, cost savings, and flexibility to the business:

- Pooled physical resources are consumed by virtual machines, resulting in high asset utilization.
- Virtual machines are mobile, giving administrators their choice of physical server and location.
- A common set of value capabilities and centralized management are provided for virtual machines, regardless of what physical server on which they are running.

Storage hypervisor

A *storage hypervisor* is a rapidly emerging way of describing the same value aspects, but in a storage context:

- Consolidation and cost: Storage pooling increases utilization and decrease costs.
- Business availability: Data mobility of virtual volumes can improve availability.
- Application support: Tiered storage optimization aligns storage costs with required application service levels.

IBM Storage Hypervisor

The IBM Storage Hypervisor offers the following features (shown in Figure 12-1):

- Virtualizes storage resources from multiple arrays, vendors, and data centers, which are pooled together and accessed from anywhere.
- ► Standardized storage services are selected from a service catalog.
- ► Storage volumes move dynamically based on workload balancing policies.
- ► Self-service provisioning uses automation to allocate capacity.
- Pay-per-use storage resources, so users are aware of the impact of their consumption and service-level choices.

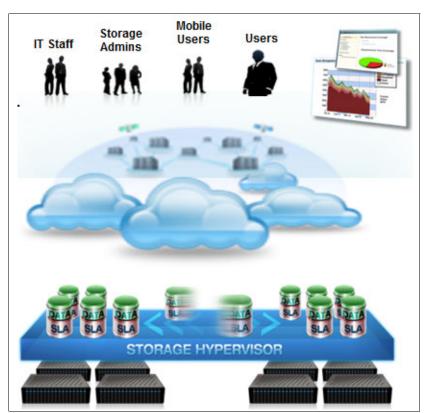


Figure 12-1 IBM Storage Hypervisor

IBM Storage Hypervisor is part of the VSC V5.2, which includes storage virtualization, storage virtualization management, and storage snapshot management that are tightly integrated with advanced analytics to deliver a robust storage cloud solution. This solution ultimately helps businesses to optimize provisioning, capacity, availability, data protection, reporting, and management for virtualized storage.

12.3 IBM SmartCloud Virtual Storage Center component model

As shown in Figure 12-2, VSC V5.2 includes core functions from three IBM offerings; Storage management through IBM Tivoli Storage Productivity Center, storage virtualization through IBM System Storage SAN Volume Controller, and application-aware data protection through IBM Tivoli Storage FlashCopy Manager.

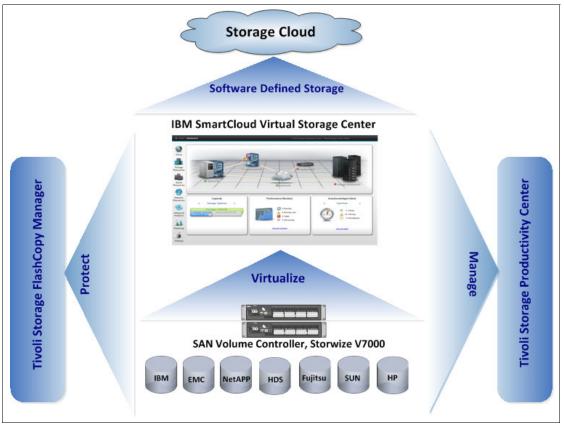


Figure 12-2 Overview diagram of IBM SmartCloud Virtual Storage Center

12.3.1 Storage management

The storage management component in IBM SmartCloud VSC V5.2 provides advanced storage infrastructure and data management capabilities. The Tivoli Storage Productivity Center component that is available in VSC includes all the capabilities of Tivoli Storage Productivity Center V5.2. It uniquely provides all the advanced functions that were available in the past as part of Tivoli Storage Productivity Center Standard Edition and Tivoli Storage Productivity Center for Replication. Unique to the VSC V5.2 Storage Analytics Engine is data management with file system and database scanning and analysis, data placement, user quotas, and an advanced management GUI to help simplify virtual storage administration.

The storage management component of the VSC solution improves visibility, control, and automation for data and storage infrastructures, including storage systems, devices, and SAN fabrics, and is integrated with SAN Volume Controller functions for auto-tiering and workload-aware placement across the data center.

Tivoli Storage Productivity Center, the storage management component of VSC, helps simplify provisioning, performance management, and data replication processes (Figure 12-3).

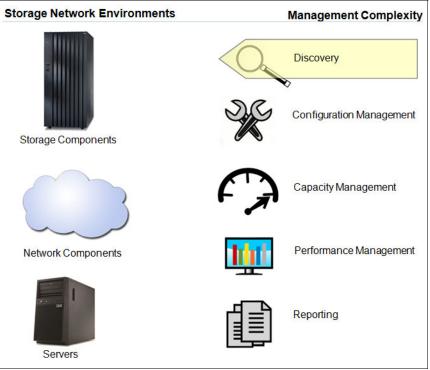


Figure 12-3 VSC storage management and Tivoli Storage Productivity Center

IBM Tivoli Storage Productivity Center provides these capabilities, all from a single GUI:

- Database, host, file-system, and file-level capacity analytics
- Storage performance management
- ► Tiered storage analysis
- Trend analysis
- SAN planning and provisioning
- Performance optimization
- SAN fabric performance management

Note: For more information about VSC offerings and licensing, see 12.6, "IBM SmartCloud Virtual Storage Center offerings" on page 250.

Tivoli Storage Productivity Center can generate threshold alerts and forward them to SNMP receivers. Tivoli Storage Productivity Center provides many ready-to-use reports, as shown in Figure 12-4.

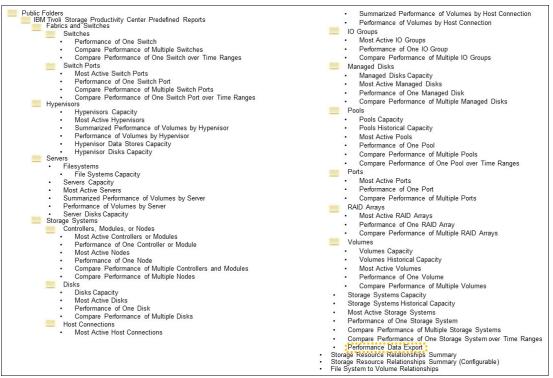


Figure 12-4 Tivoli Storage Productivity Center reports that are ready to use

These reports can be scheduled to run periodically. Additional custom reports can be created with IBM Cognos®.

For more information about IBM Cognos reports, see "Enhanced reporting with IBM Cognos" in *IBM Tivoli Storage Productivity Center V5.1 Technical Guide*, SG24-8053.

12.3.2 Storage virtualization

The IBM SAN Volume Controller virtualization engine moves the storage control function into the storage network, allowing disk storage to be managed as a single virtual pool, which supports many disk vendors (Figure 12-5).

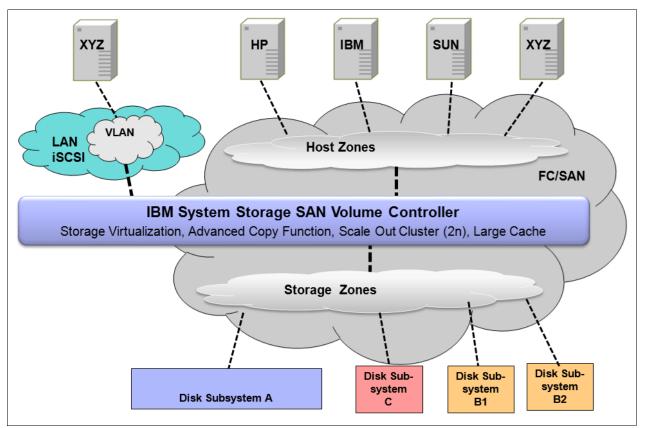


Figure 12-5 SAN Volume Controller conceptual and topology overview

SAN Volume Controller can pool storage volumes into a reservoir of capacity for centralized management. Virtualization with SAN Volume Controller eliminates the boundaries among disk and flash systems, which simplifies management and enables IT operations to focus on managing storage as a resource to meet business requirements rather than as a set of boxes. The RAID array from an external storage system or from internal disks (a Storwize V7000 storage system, as shown in our example in Figure 12-5) is presented to a SAN Volume Controller or Storwize V7000 storage system as *Managed Disks (MDisks)*. A set of MDisks forms a storage pool from which extents are taken to create the volumes, which can be identified by logical unit numbers (LUNs). The volumes, now in virtualized mode, are presented to the hosts. In this sense, the hosts no longer see the back-end disks directly, and the SAN Volume Controller or Storwize V7000 storage system behaves like a controller that is provisioning LUNs to the hosts.

To achieve multi-tenancy over the same physical SAN infrastructure, storage pools can be created that are specific to each tenant from a specific set of managed disks and assign them to the specific tenant hosts, as shown in Figure 12-6.

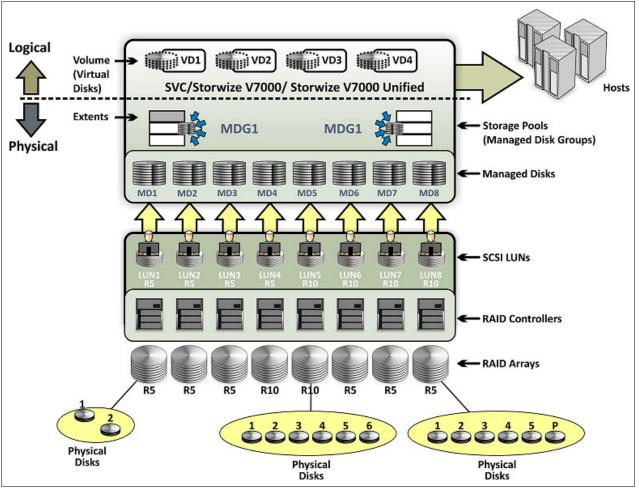


Figure 12-6 SAN Volume Controller storage virtualization concepts summary

The SAN Volume Controller component of VSC reduces labor, reduces and removes planned migration outages, and improves utilization. Storage virtualization with IBMSAN Volume Controller supports a heterogeneous, multivendor environment, with common management and services. SAN Volume Controller allows for nondisruptive changes to the storage environment without impacting host applications. SAN Volume Controller with Infrastructure Lifecycle Management (ILM) intelligent storage analytics provides policy-based automated data placement and tier movement.

Here are the key characteristics of SAN Volume Controller:

- ► Highly scalable: A SAN Volume Controller *cluster* scales horizontally through the addition of node pairs to a maximum of four node pairs (or eight nodes) per cluster.
- Host-independent: Supports multiple operating systems, including Windows, Linux, IBM AIX®, HP-UX, and so on.
- Storage controller-independent: Supports storage from multiple vendors, including IBM, EMC, HDS, Oracle, Hewlett-Packard, and others.

SAN Volume Controller offers the following services:

- Creation and management of storage pools that are attached to the SAN.
- Block-level virtualization.
- Provision of advanced functions across the SAN, such as advanced copy services (point-in-time copy, instant copy, synchronous remote copy, Metro Mirror and asynchronous remote copy, and Global Mirror).
- ► Thin provisioning.
- Real-time compression: The IBM Real-time Compression option can be added as a separately priced license. For more information about this topic, see 12.6, "IBM SmartCloud Virtual Storage Center offerings" on page 250.
- Data migration: Move volumes within or between storage controllers (within the same physical virtualization boundary).
- Growing or shrinking volumes.
- IBM Easy Tier helps administrators control storage growth more effectively by balancing MDisks within a pool, and by moving low-activity or inactive data into a hierarchy of lower-cost storage. Administrators can free disk space on higher-value storage for more important, active data.

The SAN Volume Controller has been incorporated into the IBM Spectrum family as Spectrum Virtualize and is incorporated in the IBM Storwize V7000 storage system that is part of the VersaStack offering.

12.3.3 Application-aware data protection

With the Tivoli Storage FlashCopy Manager component of VSC, the data backup and restore component in IBM SmartCloud VSC V5.2 provides fast application-aware backups and restores by suing advanced snapshot technologies that are available with IBM storage systems (Figure 12-7).

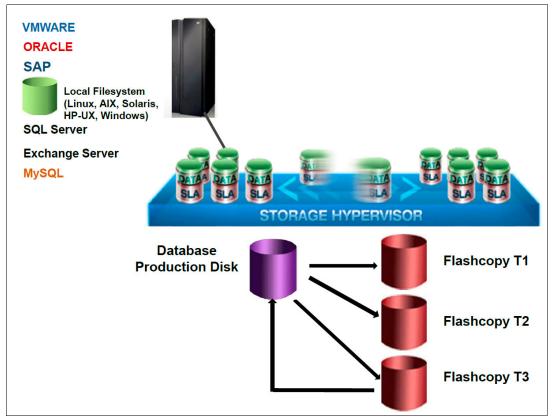


Figure 12-7 High-level overview of Tivoli Storage FlashCopy Manager application-aware copy solution

FlashCopy Manager uses advanced IBM storage hardware snapshot technology to help create a high-performance, low-impact application data protection solution. The Storage FlashCopy function operates at the level of virtual volumes (VDisks), that is, it copies whole volumes. The FlashCopy function is intended to create copies of data that may be used for purposes such as disk-to-disk backups, parallel processing (multiple applications processing different copies of the same data), and testing by using a copy of production data. The copy that is created by the FlashCopy function can be used almost immediately. SAN Volume Controller within the Storwize V7000 storage system can perform a background copy of all data from the source to the target or it can copy data only when an update occurs. It delivers high levels of data protection for business-critical applications through integrated application snapshot backup and restore capabilities.

Storage administrators can control the speed of the background copy to limit the impact that the copy has on other SAN Volume Controller activities. The first time that FlashCopy is used, the copy takes place as *normal*, which means that a full copy of data occurs from the source to the target VDisk. When changes are made, only the changes are copied to the target. A total of 256 copies can be made from the same source VDisk, which can be incremental or non-incremental, or a mix of both.

FlashCopy integrates with IBM System Storage DS8000®, FlashSystem V840, IBM SAN Volume Controller, IBM Storwize V7000 and V5000 storage systems, and IBM XIV® Storage System products. For Microsoft Windows environments, Tivoli Storage FlashCopy Manager also supports other hardware that can perform Microsoft Volume Shadow Copy Services (VSS) functions, such as IBM N Series, and IBM System Storage DS3000, DS4000®, and DS5000[™].

Here is an explanation of the FlashCopy Manager solution (see Figure 12-7 on page 240):

- Starting at the left, the Application system, which is also called the Production system, has the production database on it. More important, this is the data that you want to protect. The applications can be Oracle, SQL, IBM DB2®, SAP, Exchange, files systems, or VMware. FlashCopy Manager also provides the interfaces for custom applications to take snapshots of the data.
- 2. Following the black arrow, you see that the application data is on the LUN that sits on the SAN Volume Controller and on its back-end storage. Using FlashCopy Manager, when you take the backup of the database, you have local snapshot versions that represent the application data at some point. When you want to restore the data, use FlashCopy Manager to restore from any one of these snapshot versions, including the latest of a point-in-time snapshot. If you have Tivoli Storage Manager, you can then offload your backups to Tivoli Storage Manager and manage your data through Tivoli Storage Manager.

12.4 IBM SmartCloud Virtual Storage Center features

VSC helps reduce storage administration complexity and costs in the following ways:

- Improving storage utilization
- ► Making better use of existing storage and controlling storage growth expenditures
- Improving application availability and simplified data migrations
- Making changes to storage and moving data without taking down applications
- Simplifying storage management
- Improving efficiency and productivity for storage management staff
- > Providing advantages with a software-defined storage architecture model
- ► Enabling greater choice (lower cost) when buying storage and lowering software costs
- Improving application recovery time and recovery point objectives (RTO and RPO)
- Providing application-aware hardware-based snapshots
- Providing network-based replication

Here are the outstanding features of IBM SAN Volume Controller:

- Efficient by design
- Self-optimizing
- Cloud agility

12.4.1 Efficient by design

Organizations must spend less of their IT budgets on storage and storage administration so that they can spend more on new, revenue-generating initiatives. VSC has built-in efficiency features that help users avoid purchasing add-ons or additional licenses or deal with complicated integration issues.

VSC has these advanced efficiency features:

Storage virtualization

This is a foundational technology for clouds and software-defined environments. Without virtualization, storage capacity utilization averages about 50%, but virtualized storage enables up to 90% utilization by enabling online data migration for load balancing. With VSC, you can virtualize your storage resources from multiple storage systems and vendors. Pooling storage devices enables you to access capacity from any storage system, which is a significant advantage over the limitations that are inherent in traditional storage.

► Simplified user experience

VSC provides an advanced GUI and a VMware vCenter plug-in to reduce administration complexity. Administrators can do common tasks consistently, over multiple storage systems, even those from different vendors. The IBM storage GUI enables simplified storage provisioning with intelligent presets and embedded preferred practices, and integrates context-sensitive performance management throughout.

Near-instant, application-aware backup and restore

To reduce downtime in high-availability virtual environments, critical applications such as email and databases require near-instant backups that have little or no impact on application performance. Application-aware snapshot backups can be performed frequently throughout the day to reduce the risk of data loss. VSC simplifies administration and recovery from snapshot backups.

12.4.2 Self-optimizing

Self-optimizing storage adapts automatically to workload changes to optimize application performance, eliminating most manual tuning efforts. IBM SmartCloud VSC includes these self-optimizing features:

► IBM Tiered Storage Optimizer

VSC uses performance metrics, advanced analytics, and automation to enable storage optimization on a large scale. It can optimize storage volumes across different storage systems and virtual machine vendors and brands. The Tiered Storage Optimizer feature can reduce the unit cost of storage by as much as 50%, based on deployment in a large IBM data center.

► IBM Easy Tier

VSC helps optimize flash storage with automated tiering for critical workloads. Easy Tier helps make the best use of available storage resources by automatically moving the most active data to the fastest storage tier, which helps applications and virtual desktop environments run up to three times faster.

Thin provisioning and efficient remote mirroring

Thin provisioning helps automate provisioning and improve productivity by enabling administrators to focus on overall storage deployment and utilization, and also on longer-term strategic requirements without being distracted by routine storage-provisioning requests. IBM Metro Mirror and Global Mirror functions automatically copy data to remote sites as it changes, enabling fast failover and recovery. These capabilities are integrated into the advanced GUI, so that they become easier to deploy.

12.4.3 Cloud agility

Cloud computing is all about agility. Storage for clouds must be as flexible and service-oriented as the applications it supports. VSC can convert existing storage into a private storage cloud with no "rip and replace" required. The solution enables you to adapt to the dynamic storage needs of cloud applications by providing storage virtualization, automation, and integration for cloud environments.

Here are the agile features of the solution:

OpenStack cloud application provisioning

VSC includes an OpenStack Cinder volume driver that enables automated provisioning by using any of the storage systems that are controlled by VSC. OpenStack cloud applications can access multiple storage tiers and services, without added complexity.

► Self-service portal

VSC can provide provisioning automation for self-service storage portals (such as IBM SmartCloud Storage Access), which enable immediate responses to service requests while eliminating manual administration tasks.

Pay-per-use invoicing

VSC integrates with IBM SmartCloud Cost Manager and other chargeback systems to enable flexible usage accounting for storage resources. VSC can become the single source for usage metrics across storage area networks (SANs), network-attached storage, and direct-attached storage.

12.5 IBM SmartCloud Virtual Storage Center interfaces

External Clients from Software Defined Environment OpenStack SmartCloud Storage Access IBM Cloud Orchestrator VMware **IBM SmartCloud Virtual Storage Center** Multi Vendor a 107 W The second Storage Disk XIV -FlashSystem Systems DS8000 V840 SVC TPC

IBM focuses on supporting four software-defined environments (SDE), shown in Figure 12-8.

Figure 12-8 Interfaces to IBM SmartCloud Virtual Storage Center

Here are the four SDEs:

OpenStack open source code can manage compute, network, and storage resources.

IBM

Non-IBM

- ► IBM SmartCloud is based on OpenStack with added value IBM proprietary features.
- ► IBM Cloud Orchestrator is for storage provisioning, orchestration, and automation.
- VMware runs primarily on x86-based servers.

The interface features are summarized in Table 12-1.

OpenStack software	IBM SmartCloud and IBM Orchestrator	VMware
IBM is a platinum sponsor of the OpenStack Foundation.	IBM Cloud Manager with OpenStack is based on OpenStack open source code, with value-added proprietary features from IBM.	VMware is entirely proprietary, but has a large market share for the x86-based server infrastructure.
OpenStack open source code can manage IBM compute, network, and storage resources.	IBM Cloud Manager with OpenStack and IBM Cloud Orchestrator support various server hypervisors and interfaces.	IBM was VMware's first OEM and joint development partner (since 1998). IBM continues this strong partnership. IBM Global Services is one of VMware's largest customers, using VMware in many of their client solutions.
IBM offers Cinder interfaces on most of its major storage products for block storage access and supports Swift interfaces for object storage access.	IBM SmartCloud Storage Access and IBM Cloud Orchestrator provide self-provisioning and orchestration capabilities.	VMware vStorage API for data protection (VADP), VMware Site Recovery Manager (SRM), VMware vSphere storage APIs: Array integration (VAAI), VMware vCenter.

Table 12-1 Comparison of virtual storage interfaces to a software-defined environment

An overview of the VMware VSC interface that is being used in the VersaStack setup is provided in 12.5.1, "VMware" on page 245.

12.5.1 VMware

VMware provides server virtualization on an Intel based architecture. Here are the core components of the VMware solution:

- VMware ESX and ESXi based hypervisor
- VMware vSphere vCenter for providing management capabilities
- vSphere vMotion to combat planned downtime
- VMware vCenter Site Recovery Manager to automate end-to-end recovery processes for virtual applications

Figure 12-9 shows the vSphere suite in a more comprehensive way. vSphere is a product suite that is similar to the Microsoft Office suite, which contains Microsoft Office Word, Excel, Access, PowerPoint, and so on. VMware vSphere suite includes an ESXi hypervisor, vCenter, and vSphere client. ESXi is a hypervisor that is installed on a physical machine. The vSphere client is installed on the VMware administrator's notebook or desktop computer and is used to access the ESXi server to install and manage virtual machines on the ESXi server. The vCenter server is installed as a virtual machine on top of the ESXi server. The vCenter server is a vSphere component that is mostly used in a large environment where there are many ESXi servers and several virtual machines. The vCenter server can also be accessed by vSphere client for management purposes. So, the vSphere client is used to access the ESXi server.

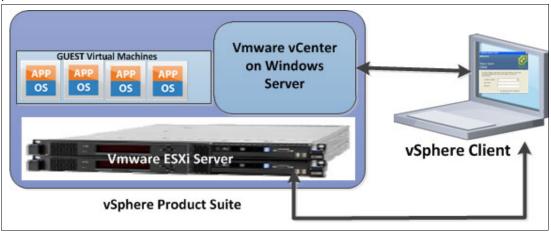


Figure 12-9 VMware vSphere Suite overview

VMware servers hypervisor

VMware ESX and VMware ESXi are hypervisors that allow you to abstract processor, memory, storage, and networking resources into multiple VMs that can run unmodified operating systems and applications. VMware ESX and VMware ESXi are designed to reduce server sprawl by running applications on virtual machines that consist of fewer physical servers. VMware ESX and VMware ESXi hosts can be organized into clusters. This configuration allows ESX to provide flexibility in terms of what virtual machines are running on what physical infrastructure.

VMware vCenter

vCenter is the management software suite that is used to manage the virtual machines inside an ESX or ESXi host. When you allocate resources such as memory, storage, networking, or processors to a virtual machine, a vCenter server manages how these resources are allocated and maintained. vCenter can manage a single ESX or ESXi hosts and clusters of hosts. VMware vCenter has several features that allow for mobility of VMs between ESX hosts and storage. These features can add to the availability of the VMs running in a cluster.

VMware vMotion

vMotion is a technology that is designed to combat planned downtime. vMotion is used to move VMs between host and data stores to allow scheduled maintenance procedures to proceed without affecting VM availability or performance. It is included in the Enterprise and Enterprise Plus versions of VMware vSphere. It is shown in Figure 12-10.

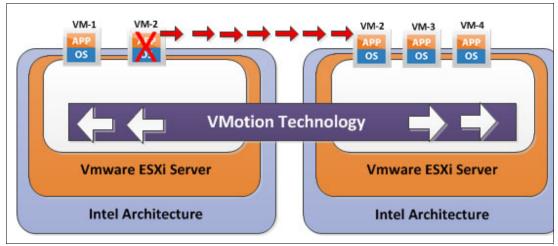


Figure 12-10 VMware vMotion

VMware Host vMotion

Host vMotion eliminates the need to schedule application downtime for planned server maintenance. It does so through live migration of virtual machines across servers with no disruption to users or loss of service.

This process is managed from a vCenter server, which maintains client or application access to a VM while it is moving between physical servers. In a SAN Volume Controller stretched cluster solution, this feature is useful for moving VMs between two failure domains. You might need to move VMs to load-balance across failure domains or because a failure domain needs an outage for maintenance.

VMware Storage vMotion

Storage vMotion eliminates the need to schedule application downtime because of planned storage maintenance or during storage migrations. It does so by enabling live migration of virtual machine disks (VMDK) with no disruption to users or loss of service. The vCenter server manages the copy of data from one data store to another. With vStorage APIs for Array Integration (VAAI), this process can be offloaded to the storage system, saving resources on both the vCenter host and data network.

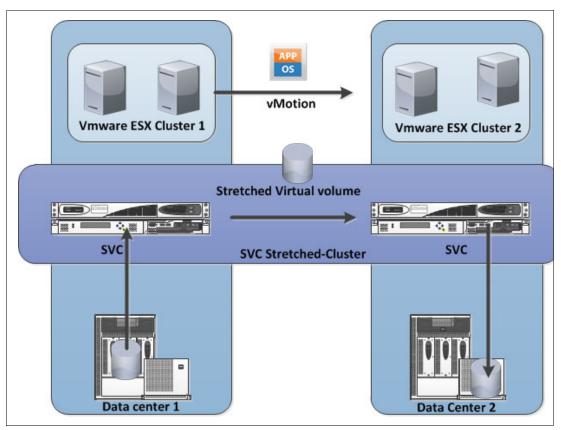


Figure 12-11 illustrates the use of VMware Storage vMotion in a SAN Volume Controller stretched cluster solution.

Figure 12-11 VMware Storage vMotion

In a SAN Volume Controller stretched cluster solution, this feature is useful for moving a virtual machine's VMDK file between two systems. You might move this file to ensure that it is on the same failure domain as the VM, or to migrate off a storage device that is becoming obsolete or is undergoing maintenance, as shown in Figure 12-11.

For more information about Storage vMotion, see the following website:

http://www.vmware.com/files/pdf/VMware-Storage-VMotion-DS-EN.pdf

VMware vCenter Site Recovery Manager

Site Recovery Manager integrates with VMware vCenter server, and underlying storage replication products, to automate end-to-end recovery processes for virtual applications. It provides a simple interface for setting up recovery plans that are coordinated across all infrastructure layers. Recovery plans can be tested non-disruptively as frequently as required to ensure that the plan meets availability objectives. At the time of a failure domain failover or migration, Site Recovery Manager automates both the failover and failback processes. It ensures fast and highly predictable RPOs and RTOs.

For more information about vCenter Site Recovery Manager, see the following website:

http://www.vmware.com/products/site-recovery-manager/overview.html

VMware Distributed Resource Scheduler

Distributed Resource Scheduler (DRS) dynamically balances computing capacity across a collection of hardware resources that are aggregated into logical resource pools. It continuously monitors utilization across resource pools and intelligently allocates available resources among the VMs that are based on predefined rules that reflect business needs and changing priorities. When a VM experiences an increased load, VMware DRS automatically allocates more resources by redistributing VMs among the physical servers in the resource pool.

VMware DRS migrates and allocates resources by using a set of user-defined rules and policies. These rules and policies can be used to prioritize critical or high performing VMs, ensure that particular VMs never run on the same storage or host, or save on power and cooling costs by powering off ESX servers that are not currently needed.

For more information about Distributed Resource Manager, see the following website:

http://www.vmware.com/pdf/vmware_drs_wp.pdf

VSC and VMware integration

VSC and VMware are integrated by using Tivoli Storage Productivity Center plug-ins, as shown in Figure 12-12.

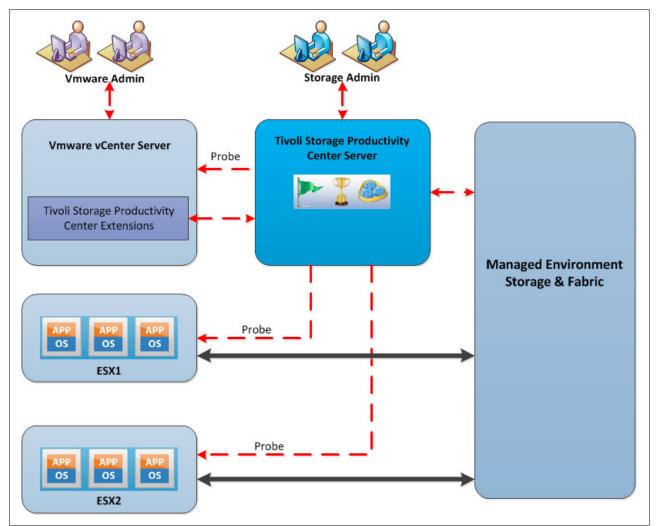


Figure 12-12 VSC and VMware integration topology

The VMware vCenter web client extension provides the following features to VMware administrators:

- Visualization of connections:
 - End-to-end, from storage volume to VM
 - Storage details, such as pools, volumes, and attributes
 - Performance charts
- Automated policy-based storage provisioning, based on the storage services catalog:
 - Block volumes
 - File shares
 - Service class characteristics (storage tier, data protection, compression, encryption, and so on)
- vSphere API for Storage Awareness (VASA):
 - Alerts for performance, errors, and capacity thresholds
 - Availability of volumes, pools, storage systems, and paths
 - Tivoli Storage Productivity Center service classes can be used as VASA capabilities
- Additional storage reports are available in the vCenter admin GUI:
 - Fabric connectivity
 - Storage performance
 - Storage mappings

12.6 IBM SmartCloud Virtual Storage Center offerings

VSC V5.2 has the following offerings:

- ► IBM SmartCloud Virtual Storage Center V5.2
- IBM SmartCloud Virtual Storage Center Entry V5.2
- IBM SmartCloud Virtual Storage Center for Storwize Family V5.2

The *VSC V5.2* license is an offering to be used with the System Storage SAN Volume Controller and is a software entitlement to run both the external virtualization, FlashCopy, and remote copy services features. The only feature of the SAN Volume Controller that is not included in the IBM SmartCloud VSC V5.2 license entitlement is the Real-Time Compression option, which can be added as a separately priced license. This license does not include the hardware nodes that are required for a complete SAN Volume Controller implementation.

IBM SmartCloud VSC Entry V5.2 provides external virtualization, FlashCopy, and remote copy services software entitlement in smaller SAN Volume Controller configurations. Also, for deployment in midrange environments, a Storwize V5000 or V7000 storage system can be used as the virtualization engine in a VSC configuration, and in this case the offering that is used is the *IBM SmartCloud Virtual Storage Center for Storwize Family V5.2*.

The versions of code that are available through IBM SmartCloud VSC 5.2 for download for the System Storage SAN Volume Controller and the Tivoli Storage FlashCopy Manager are the same as the versions available for download if these products were downloaded independently of IBM SmartCloud VSC 5.2. In the case of Tivoli Storage Productivity Center, the code is the same as the independent product, but the VSC license enables the Storage Advanced Engine functions to be used.

12.6.1 License model overview

IBM Virtual Storage Center can help customers to migrate easily their storage to a virtual environment and manage storage efficiently. IBM VSC licensing charges are based on the entire managed capacity, which is in contrast to SAN Volume Controller, where FlashCopy and Metro Mirror or Global Mirror can be licensed on virtual capacity for those functions only. The managed capacity model avoids over-provisioning, which can become expensive with SAN Volume Controller. Table 12-2 compares the current IBM VSC and IBM Tivoli Storage Productivity Center licensing options and features. The sections after the tables have more details about each of the IBM Virtual Storage Center licenses.

Product name	Licensing usage	Tivoli Storage Productivity Center license	FlashCopy Manager license	SAN Volume Controller license ^a	Storwize license ^b
VSC	Per terabyte (greater than 250 TB or greater than two I/O groups). For example, with the VSC license, you can have 100 TB and grow to 300 TB. This is not possible with VSC Entry, which is limited to less than 250 TB.	Tivoli Storage Productivity Center Advanced	•	•	
VSC Entry	Per terabyte (less than 250 TB and less than two I/O groups).	Tivoli Storage Productivity Center Advanced	✓	~	
VSC for Storwize Family	Per enclosure.	Tivoli Storage Productivity Center Advanced	✓		✓
Tivoli Storage Productivity Center	Per terabyte.	Tivoli Storage Productivity Center			
Tivoli Storage Productivity Center Select	Per enclosure.	Tivoli Storage Productivity Center Select			

Table 12-2 Current 5.x VSC and Tivoli Storage Productivity Center licensing by offerings

a. SAN Volume Controller License includes Base, and FlashCopy and Remote Copy (Metro Mirror and Global Mirror) licenses.

b. The Storwize license included in VSC for Storwize Family is for external virtualization only. The base virtualization license must be configured for each Storwize enclosure as usual.

12.6.2 VSC for Storwize Family license

Are you managing a small to medium storage configuration (100 TB - 1 PB) where the storage virtualization investment is largely with Storwize V7000 or Storwize V5000 storage systems, which might manage some variety of storage systems under them? Then, consider using the VSC for Storwize Family license.

VSC for Storwize Family license features

This license offers these features:

- Restricted to deployment on Storwize V7000 and V5000 hardware.
- Per enclosure price metric.
- No restrictions on the number of enclosures.
- ► Includes all features of VSC (external virtualization, Mirroring, and Advanced Analytics).
- The license does not include base software license for Storwize enclosures.

The VSC for Storwize Family license aligns perfectly with the V7000 Storwize component of the VersaStack solution and enhances this offering by providing these functions.

12.7 VersaStack Spectrum Control

This section demonstrates how we integrated VersaStack components in the example Spectrum Control environment by performing the following actions:

- Deploy the connections to the hardware infrastructure
- Set up and use monitoring and alerting
- Enable provisioning to the hypervisor
- Create departments and applications to group resources
- Monitor and protect the SQL cluster environment

12.7.1 Tivoli Productivity Center Virtual Storage Edition Installation

The Tivoli Productivity Center Virtual Storage Edition (VSC) Version 5.2.6 is deployed on a Windows 2012 virtual machine running on one of the VMware ESXi hosts in the VersaStack environment.

You can install Tivoli Storage Productivity Center in single-server or multiple-server environments. In a single-server environment, all components are installed on one server.

In a single-server environment, when you install Tivoli Storage Productivity Center, the following components are installed:

- Database repository
- Tivoli Storage Productivity Center servers, which are composed of the following components:
 - Data server
 - Device server
 - Alert server
 - Replication server
 - Stand-alone GUI
 - Web-based GUI
 - Command-line interface (CLI)
 - Storage Resource agent
- Cognos Business Intelligence reports (optional)

In this example, we followed the steps that are outlined at the following website:

http://www.ibm.com/support/knowledgecenter/SSNE44_5.2.6/com.ibm.tpc_V526.doc/fqz0_ t_installing_main.html

A field guide that is published on the VSC IBM developerWorks® Wiki (https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20Smar tCloud%20Virtual%20Storage%20Center/page/IBM%20SmartCloud%20Virtual%20Storage%20Ce nter%20Wiki) provides detailed installation instructions about how to deploy Tivoli Storage Productivity Center V5.2.3 on Windows:

https://www.ibm.com/developerworks/community/wikis/form/anonymous/api/wiki/b6f0fb0 6-4200-4f2f-9a10-382bddf87c6f/page/f84056cf-76e7-4389-8796-907d9231b2eb/attachment /9d24b843-e00e-4790-b4b5-70e6469fedd0/media/TPC_523_Field_Install_Guide.pdf

The same instructions apply to our Tivoli Productivity Center Virtual Storage Edition V5.2.6.

After the Tivoli Productivity Center Virtual Storage Edition is deployed, you can start the main Web GUI interface, and you will be presented with a window that similar to Figure 12-13, which shows the Virtual Storage Center Web GUI with a Storwize V7000 storage system configured.

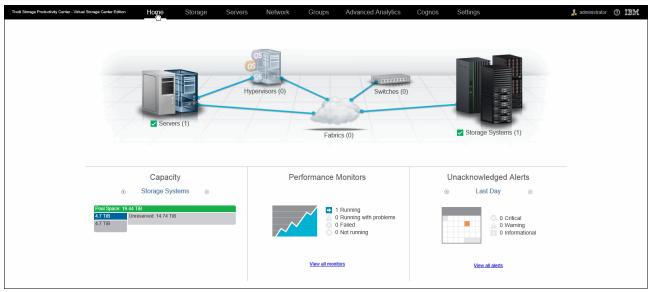


Figure 12-13 Virtual Storage Center Web GUI

By default, a Storage Resource Agent (SRA) is deployed on the system on which the Virtual Storage Center has been installed. This agent performs initial SAN discovery.

Note: If the VSC is deployed in a virtual machine, an SRA on physical server with access to the SAN is required to have fabric-based discovery. The configuration that is described in this book is fully virtual. As a result, the fabric and switches are not discovered automatically.

In the subsequent sections, we add the Storwize V7000 storage system and the VMware vCenter hypervisor and deploy SRAs on the SQL cluster members.

12.7.2 Integrating the Storwize V7000 storage system with Spectrum Control

Adding the Storwize V7000 storage system as a new storage device to the VSC follows an easy to use, wizard-driven approach. Within the VSC Web GUI, double-click the **Storage Systems** section, and then click **Add Storage System**.



Figure 12-14 shows the VSC Add Storage System Wizard.

Figure 12-14 Add Storage System

Click the Storwize Family icon and enter the IP/DNS and login credentials for your Storwize V7000 storage system.

Figure 12-15 on page 255 shows VSC discovering the Storwize V7000 storage system.

Add Storage System		
Discover		
Host name or IP address:	v7000.versastack.local	
Storwize Family Ruthentication:	User Name and Password	
User name:	superuser	
Password:	••••••]
Need Help Ack	Next ► Cance	

Figure 12-15 Discover V7000

Every device in the VSC environment must be probed at regular intervals for configuration changes. As part of the initial registration, you will be prompted to schedule a probe and enable performance monitoring if it is applicable for that specific device.

Figure 12-16 shows VSC scheduling the storage system probe and enabling performance monitoring.

Add Storage	System			
Configure				
	Display name:	Storwize V7000 Ver	rsaStack	
Storwize Family	Location:	San Jose		× ~
Otorwize F dring	Data Collection			
	Probe:	16:45 PDT	✓ Every day	\checkmark
		 Run initial probe 	immediately	
	Performance monitor:	Enabled	✓ Every minute	\sim
0	 Back 	Configure	re	Cancel

Figure 12-16 Schedule a probe for V7000

Optionally, you can specify a location where the system is, which allows for logical grouping and classification later.

Figure 12-17 shows that the Storwize V7000 storage system was successfully added through VSC.

Configure Storage Systems
Storwize V7000 VersaStack in San Jose is configured.
✓ Details
An initial probe is collecting data about the resource. Subsequent probes are scheduled daily at 16:45. A performance monitor is scheduled to collect performance data every minute after the initial probe is done.
Close

Figure 12-17 Storwize V7000 configuration successful

You are redirected to the Storage Systems section, where the Storwize V7000 storage system is now listed.

Figure 12-18 shows the VSC Storage Systems overview with the Storwize V7000 storage system present.

	Storage Sy 1 Normal 0 Warning 0 Error	/stems	i				
Block Storage	File Storage	😣 Alerts	8 Threshold	Violations Task	s Performance		
+ Add Storage Sys	tem 🗄 Actions 🔻						
Name	Sta	tus 🔻	Probe Status	Performance M	Physical Allocation (%)	Pool Capacity (GiB)	Available P
Storwize V7000 V	/ersaStack 🗸	Normal	Successful	Running	36%	19,900.00)

Figure 12-18 Storage Systems overview

Managing the storage infrastructure

Double-clicking the Storwize V7000 VersaStack entry in the VSC Storage Systems pane opens the Overview window, as shown in Figure 12-19 on page 257.

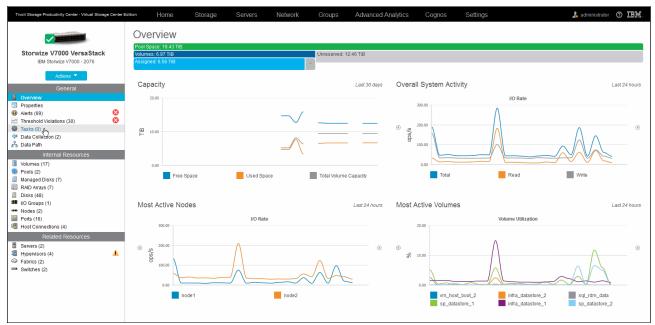


Figure 12-19 Storwize V7000 overview

Throughout the whole VSC GUI, a unified approach is used to chart graphical data and to group resources for the selected device into three categories:

- General
 - Overview: This category brings you back to the graphical charts. These charts can be toggled and provide summarized data for the following items:
 - Capacity
 - Overall System Activity
 - Most Active Nodes
 - Most Active Volumes
 - Most Active Pools
 - MDisk Activity
 - Space by Host
 - Space by Pool
 - Space by Volume
 - Space by Tier

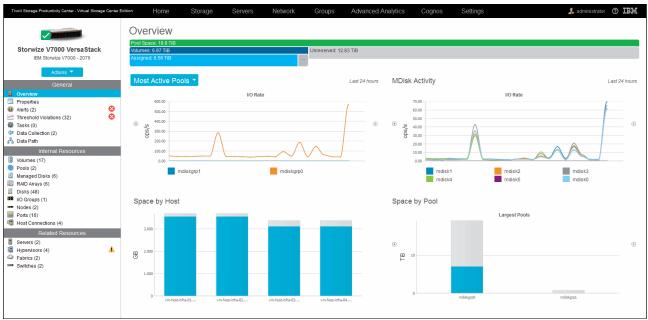
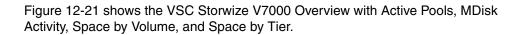


Figure 12-20 shows the VSC Storwize V7000 Overview with Active Pools, MDisk Activity, Space by Host, and Space by Pool.

Figure 12-20 Storwize V7000 Overview - Alternative Data Graphs



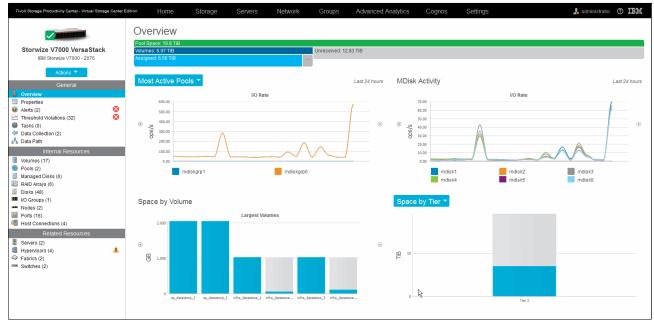


Figure 12-21 Storwize V7000 Overview - Alternative Data Graphs 2

 Properties: Provides a summarized overview of the system, including details such as model number, serial number with tabs for high-level configurations, capacity, and performance. Figure 12-22 shows the VSC Storwize V7000 Properties for editing the custom tags.

	Properties	
Storwize V7000 VersaStack	General Configuration	Capacity Performance
IBM Storwize V7000 - 2076	Name	Storwize V7000 VersaStack
Actions 🕆	Status	Vormal
General	Vendor	IBM
Overview	Туре	Storwize V7000 - 2076
Properties Alerts (2)	Model	24F
Threshold Violations (32)	Serial Number	00000100208030A6
Tasks (0) Data Collection (2)	Firmware	7.5.0.0 (build 115.50.1506041858900)
Data Collection (2) Data Path	Turbo Performance	Active
Internal Resources	IP Address	192.168.10.19
Volumes (17)	Probe Status	Successful
Pools (2) Managed Disks (6)	Probe Schedule	 Daily. Next run at Jun 29, 2015 16:45:00 PDT
RAID Arrays (6)	Performance Monitor Status	Running
 Disks (48) I/O Groups (1) 	Performance Monitor Interval (min)	1
Nodes (2)	Time Zone	US/Pacific
Ports (16)	Data Source Count	1
Host Connections (4) Related Resources	Location	San Jose 🗸
Servers (2)	Custom Tag 1	No Custom Tag 🗸
Hypervisors (4)	Custom Tag 2	No Custom Tag 🗸
General Fabrics (2)	Custom Tag 3	No Custom Tag 🗸
— Switches (2)		
		Save Cancel
		K-

Figure 12-22 Storwize V7000 Properties - Custom Tags

 Alerts: Gives you the alerts that are related to this device only, as opposed to system-wide alerts. For more information about alerts, see 12.7.3, "Monitoring and alerting" on page 266.

Figure 12-23 shows the VSC Storwize V7000 Overview Alerts.

Tivoli Storage Productivity Center - Virtual Storage Center Edit	ion Home	Storage	Servers	8 Network	Groups	Advanced Analytics
Storwize V7000 VersaStack IBM Storwize V7000 - 2076		Alerts (2) 1 Critical (1) 1 Warning (1) 0 Information	onal			
General	Alerts Defin	itions Notif	ication Setti	nas		
Overview						
Properties	8 Refresh 🔢	Actions 🔻				
Alerts (2)	C 19/1			1	▼ Interr	- I D
Thre-hold Violations (32)	Condition		everity	Last Occurrence		al Resource
Tasks (0)	Total I/O rate thresh	old 🛛 😣	Critical	Jun 29, 2015 10:45:48	PDT 🚟 <u>io</u>	<u>grp0</u>
Data Collection (2)	Total data rate thres	hold 🥼	Warning	Jun 29, 2015 10:44:46	PDT 🛛 🚟 <u>io</u>	<u>grp0</u>
🖧 Data Path						

Figure 12-23 Storwize V7000 - Alerts

 Threshold Violations: Shows any violations for the thresholds that you have filtered for this specific device. In our example, we set an aggressive warning (1500 ops/s) and critical (2000 ops/s) for the Total I/O Rate Threshold.

Figure 12-24 shows the VSC Storwize V7000 Overview Threshold Violations.

Tivoli Storage Productivity Center - Virtual Storage Ce	nter Edition Home	Storage Servers	Network Groups	Advanced Analytic	cs Cognos	Settings		🔒 adminis	rator 🤿 IBM.
Storwize V7000 VersaStack IBM Storwize V7000 - 2076	~~~~	hreshold Violation	าร	ŀ\$					
General	2 Refresh	15 *						Q -	Filter
Overview	Time	Condition	Severity	Internal Resource	Boundary	Critical Boundary	Warning Boundary	Measured	
Properties Alerts (2)	Jun 24, 2015 14:40:18 Pt		Warning	io grp0	Stress	2.000 ops/s	1,500 ops/s	measurea	1.931.00 ops ^
	Jun 24, 2015 14:40:18 Pt		Critical	io grp0	Stress	300 MiB/s	250 MiB/s		496.81 MiE
Tasks (0)	Jun 24, 2015 16:56:22 PE		Critical	io grp0	Stress	2,000 ops/s	1,500 ops/s		2.227.02 ops
Data Collection (2)	Jun 24, 2015 16:59:22 Pt		Warning	io grp0	Stress	300 MiB/s	250 MiB/s		253.94 MiE
a Data Path	Jun 24, 2015 18:24:25 Pt		A Warning	io grp0	Stress	2.000 ops/s	1,500 ops/s		1.845.60 ops
Internal Resources	Jun 25, 2015 10:33:54 Pt		A Warning	io grp0	Stress	300 MiB/s	250 MiB/s		254.71 MiE
Volumes (17)	Jun 25, 2015 10:37:54 Pt	DT Total I/O Rate	A Warning	io grp0	Stress	2,000 ops/s	1,500 ops/s		1,620.53 ops
Pools (2)	Jun 25, 2015 12:51:58 Pt	DT Total I/O Rate	A Warning	🗯 io grp0	Stress	2.000 ops/s	1,500 ops/s		1.717.53 ops
Managed Disks (6)	Jun 25, 2015 12:51:58 Pt	DT Total Data Rate	🚫 Critical	io grp0	Stress	300 MIB/s	250 MiB/s		483.23 MIE
RAID Arrays (6)	Jun 26, 2015 10:14:37 Pt	DT Total Data Rate	Warning	io grp0	Stress	300 MiB/s	250 MiB/s		276.31 MiE
Disks (48)	Jun 26, 2015 10:18:37 Pt	DT Total I/O Rate	A Warning	📾 jo grp0	Stress	2,000 ops/s	1,500 ops/s		1,540.87 ops
I/O Groups (1)	Jun 26, 2015 12:07:40 Pt	DT Total I/O Rate	A Warning	🗰 jo grp0	Stress	2,000 ops/s	1,500 ops/s		1,878.77 ops
 Nodes (2) Ports (16) 	Jun 26, 2015 13:07:42 PE	DT Total I/O Rate	🚫 Critical	io grp0	Stress	2,000 ops/s	1,500 ops/s		3,248.42 ops
Host Connections (4)	Jun 26, 2015 13:15:05 PE	DT Write-Cache Delay Percentag	e 🚫 Critical	mode1	Stress	10 %	3 %		47.92
	Jun 26, 2015 13:33:06 Pt	DT Peak Back-end Write Respon	se 🛕 Warning	mode1	Stress	30,000 ms	10,000 ms		14,874.938 n
Related Resources	Jun 26, 2015 13:33:06 Pt	DT Back-end Write Response Tir	ne 👍 Warning	disk1	Stress	120 ms/op	80 ms/op		81.236 ms/
Servers (2) Hypervisors (4)	Jun 26, 2015 14:08:07 PE	DT Total I/O Rate	🚫 Critical	io grp0	Stress	2,000 ops/s	1,500 ops/s		5,392.07 ops
Hypervisors (4) A Fabrics (2)	Jun 26, 2015 14:14:07 Pt	DT Total Data Rate	🔥 Warning	io grp0	Stress	300 MiB/s	250 MiB/s		255.37 MiE
Switches (2)	Jun 26, 2015 15:08:08 Pt	DT Total I/O Rate	🔥 Warning	io grp0	Stress	2,000 ops/s	1,500 ops/s		1,502.80 ops
omenes (2)	Jun 26, 2015 17:15:12 PE	DT Total I/O Rate	🔥 Warning	📾 jo grp0	Stress	2,000 ops/s	1,500 ops/s		1,816.12 ops
	Jun 27, 2015 02:17:29 Pt	DT Total I/O Rate	🔥 Warning	io grp0	Stress	2,000 ops/s	1,500 ops/s		1,603.92 ops
	Jun 27, 2015 18:50:58 Pt	DT Total I/O Rate	🔥 Warning	🛲 <u>io_grp0</u>	Stress	2,000 ops/s	1,500 ops/s		1,548.13 ops
	Jun 00 0015 06:00:10 Dr	DT Tatal Data Data	Critical	a ara0	Otrago	200 MiD/s	OEO MID/s		207.00 Mil

Figure 12-24 Storwize V7000 - Threshold Violations

- Tasks: Shows the VSC Auto-Tiering or Provisioning functions that can trigger tasks for the storage system. These tasks can be to up- or down-tier a volume, volume creation, and so on, that are either scheduled to run automatically or wait for administrator approval before execution.
- Data Collection: Shows the status of the Probe execution and Performance monitors for the storage subsystem. You can use it to schedule the probing, stop or start performance monitoring, and review the associated log files.

Figure 12-25 on page 261 shows the VSC Storwize V7000 status of the Data Collection engine.

Tivoli Storage Productivity Center - Virtual Storage Center E	dition Home S	Storage Servers	Network	Groups	Advanced Analytics	Cognos	Settings	🤽 administrator	o ibm
Storwize V7000 - 2076	Da 100100 010011)	ta Collection							
General Cverview Properties Alerts (2)	Last Successful P	robe	Jun 29	, 2015 11:38:31 PI	DT			Actions 🔻	•
Threshold Violations (32)	Schedule Average Duration		Daily. N 1 minu		2015 16:45:00 PDT				
Internal Resources Volumes (17) Pools (2)	Performation							Actions 🔻	
 Managed Disks (6) RAID Arrays (6) Disks (48) 	Last Successful M Interval Last Day Success		Jun 29 Every n 100	, 2015 12:55:37 P ninute	DT				
I/O Groups (1) Nodes (2) Ports (16) Host Connections (4)	Latest Error		None						
Related Resources Related Resources Servers (2) Fabrics (2) Sarbics (2)									

Figure 12-25 Storwize V7000 - Data Collection

 Data Path Topology View: Gives you an overview and the data path of all connected resources to the storage devices. If you right-click any of these resources, you can either open the properties or to jump directly to the overview pane of that specific device.

Figure 12-26 shows the VSC Storwize V7000 data path topology view with system summary.

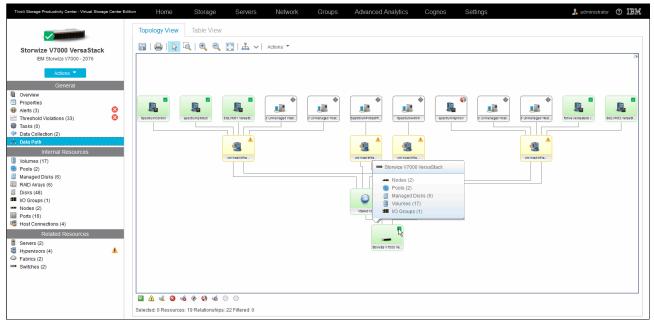


Figure 12-26 Storwize V7000 - Topology View

Note: Using the stand-alone VSC GUI, you can also create regular inventory snapshots of the whole environment that is managed by VSC, giving you point-in-time tracking of all the changes that are made to the environment. Likewise, you can perform a Configuration Analysis of your fabric that is based on industry preferred practices.

Example 12-1 shows the configuration analysis.

Example 12-1 Configuration analysis

2015-06-29 14:09:17.495-0700 GEN7090I: Checking/waiting for other running analyzer(s) 2015-06-29 14:09:17.589-0700 GEN7098I: The data scope for this configuration analysis job run: All Fabrics 2015-06-29 14:09:17.589-0700 GEN7107I: The following configuration analysis policies have been selected: 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 1, description=Each connected computer and storage subsystem port must be in at least one zone in the specified zone sets. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 2, description=Each HBA accesses storage subsystem ports or tape ports, but not both. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 3, description=Each volume is accessed only by computers running the same type and version of operating system. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 4, description=Each zone contains only HBAs from a single vendor. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 5, description=Each zone contains only a single model of storage subsystem. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 6, description=Each zone is part of a zone set. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 7, description=Each host must be zoned so that it can access all of its assigned volumes. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 8, description=Each computer has only HBAs of the same model and firmware version. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 9, description=For each host type and operating system, every HBA of a given model must have the same firmware and driver version. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 10, description=Every SAN switch of a given model must have the same firmware version. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 11, description=Every storage subsystem of a given model must have the same firmware version. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 14, description=Replication Plan is intact with respect to the SRG(s) and the replication session associated during planning through SAN Planner. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 15, description=All the source volumes involved in Metro Mirror Failover/Failback sessions are conforming to 1:4 primary to secondary LSS for a failback direction scenario. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 16, description=Inter/intra site connectivity is valid for replication plan deployments. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 12, description=Each fabric may have a maximum of x zones. 2015-06-29 14:09:17.589-0700 GEN7097I: The configuration analysis policy: name=Policy 13, description=Each zone may have a maximum of x zone members.

2015-06-29 14:09:17.589-0700 GEN7096I: The configuration analysis job run has started. 2015-06-29 14:09:19.009-0700 GEN7093I: No policy violations occurred during this configuration analysis job run. 2015-06-29 14:09:19.009-0700 GEN7092I: The configuration analysis job run completed successfully.

Figure 12-27 shows the VSC Stand-alone GUI slidable configuration history.

=	IBM Tivoli Storage Productivity Center: SpectrumControl Configuration History	_ 0 ×
File View Connection Preferences Window Help		
$\Rightarrow \Rightarrow \blacksquare \Rightarrow \times \Rightarrow$		۲
Annual NAS Server Entry History Agregator History Agregator History Agregator History Research for Databases Configuration History Sections of Databases Configuration History Center Data Manager Storage Resource Groups Storage Resource Groups Storage Resource Groups Storage Resource Groups Configuration History Configuratio	Configuration History © Overview	Locate: v Find

Figure 12-27 Configuration History

- Internal Resources: Groups the corresponding device-specific resources. From within each resource, you can directly jump to the performance metrics for that specific resource. For the Storwize V7000 storage system, the following resources are shown:
 - Volumes
 - Pools
 - Managed Disks
 - RAID Arrays
 - Disks
 - I/O Groups
 - Nodes

In our example configuration, only half of the Storwize V7000 ports are actively connected to the Cisco UCS fabric interconnects. To avoid the system giving an error status, we have acknowledged this status from within the Internal Resources window, as shown in Figure 12-28.

Addons Ports Performance General Image: Display in the second sec	Q • Filter
Image: Status Status Speed (WWPN Connected Resource Connected Port View Properties F4 Connected Resource Connected Port View Performance F4 Connected Resource Connected Resource View Performance F4 Connected Resource F4 View Performance F4	Q Filter
Name Status Speed () WWPH Connected Resource Connected Resource Status Status Status Speed () WWPH Connected Resource Connected Resource Status Imode1, FC Port 5 Stopped Wew Properties F4 Status Imode1, FC Port 5 Stopped Wew Properties F4 Status Imode1, FC Port 5 Stopped Unachnowledge Status F4 Unachnowledge Status Imode1, FC Port 7 Stopped Unachnowledge Status F4 Unachnowledge Status F4 Imode1, FC Port 7 Stopped Unachnowledge Status Unachnowledge Status F4 Imode1, FC Port 7 Stopped Unachnowledge Status Internal Resources Imode2, FC Port 11 Stopped Stopped Stopped Status Stopped Stopped Stopped Stopped Status Imode2, FC Port 10 Stopped Stopped Stopped Status Stopped Stopped Stopped Stopped	
Name Name <th< td=""><td></td></th<>	
Basis (0) Im node1, FC Pott 5 Stopped Wew Properties F4 View Profentes Im ode1, FC Pott 5 Stopped View Profentes F4 View Profentes Im ode1, FC Pott 5 Stopped Unacknowledge Status F4 Internal Resources Im ode2, FC Pott 15 Stopped Unacknowledge Status F4 Internal Resources Im ode2, FC Pott 15 Stopped 50507800324FF5 50507800324FF5 Solid (2) Im ode2, FC Pott 15 Stopped 50507800324FF5 50507800324FF5	
ata Collection (2) Im nde1, FC Pot6 Stopped Wew Performance Internal Resources Im nde2, FC Pot18 Stopped Unacknowledge Status, IF4 Internal Resources Im nde2, FC Pot18 Stopped 500507800334FF5 Ionices (77) Im nde2, FC Pot19 Stopped 500507800334FF5 Ionices (2) Im nde2, FC Pot120 Stopped 500507800334FF5	
ata Path Im node1, FC Port 7 Stopped Unacknowledge Status 4 Internal Resources Im node2, FC Port 7 Stopped 500507800334FF5 4 Jumes (17) Im node2, FC Port 19 Stopped 500507800334FF5 500507800334FF5 Jumes (17) Im node2, FC Port 19 Stopped 500507800334FF5 500507800334FF5	
Internal Resources Image: node2, FC Port 18 vs Stopped 500507680B314FF5 obumes (17) Image: node2, FC Port 19 vs Stopped 500507680B324FF5 ools (2) Image: node2, FC Port 20 vs Stopped 500507680B334FF5	
Journes (17) Image: mode2, FC Port 19 vs/s Stopped 500507800B324FF5 sools (2) Image: mode2, FC Port 20 vs/s Stopped 500507800B334FF5	
AND Arrays (6) 📓 node1, FC Port 0 💆 Operational 8 5005076808214FF4 🚥 Versastack-FLE 📓 Port 130	
isks (48) Binode1, FC Port 1 2 Operational 8 500507680B224FF4 - Versastack-FLB Port 132	
0 Groups (1) Groups (1	
oddes (2) Image: Control of the control o	
Million (4) ■ note2, FC Port 14 🗹 Operational 8 500507860B214FF5 = Versastack-FLB 📓 Port 129	
Related Resources and node2, FC Port 15 🗹 Operational 8 5005076808224FF5 = Versastack-FLB 📓 Port 131	
Related Resolutes and the solution of the solu	
ervers (2) Bin ode2, FC Port 17 🔽 Operational 5005076808244FF5	
ppensos (+) A because of the second	
whiches (2)	

Figure 12-28 Storwize V7000 Internal Resources

Note: Every column view in the VSC GUI can be customized to show related information by selecting the column check mark in the upper right corner of the table.

Figure 12-29 shows the VSC Storwize V7000 adding additional content to the column view.

Storwize V7000 - 2076		Ports 8 Normal 0 Warning 0 Error	≼ 8 Error - Acknowledged				
Actions Ceneral Overview		formance					Q V Filter
Properties	E Actions ▼			1	1		Priller'
	3 Name		▼ Speed (WWPN	Connected Resource	Connected Port	Connected WWPN	
	ode1, FC Port 4		500507680B314FF4				Name
asks (0) ata Collection (2)	anode1, FC Port 5		500507680B324FF4				✓ Status
ata Collection (2) ata Path	anode1, FC Port 6		500507680B334FF4				Acknowledged
	anode1, FC Port 7		500507680B344FF4				Speed (Gbps)
Internal Resources	node2, FC Port 18		500507680B314FF5				VWPN
olumes (17)	anode2, FC Port 19		500507680B324FF5				FC Port Id
ools (2) lanaged Disks (6)	anode2, FC Port 20		500507680B334FF5				Connected Resource
AID Arrays (6)	anode2, FC Port 21		500507680B344FF5				Connected Port
isks (48)	anode1, FC Port 0		8 500507680B214FF4	Versastack-FI-B	Port 130	201E8C604F5F6CC0	Connected NPIV Ports
O Groups (1)	anode1, FC Port 1	_	8 500507680B224FF4	Versastack-FI-B	Port 132	20208C604F5F6CC0	
lodes (2)	node1, FC Port 2		500507680B234FF4				Connected WRYPN
orts (16)	node1, FC Port 3		500507680B244FF4				Show Select/Deselect All
ost Connections (4)	anode2, FC Port 14		8 500507680B214FF5	Versastack-FI-B	Bort 129	201D8C604F5F6CC0	hestore Default View
Related Resources	node2, FC Port 15		8 500507680B224FF5	Versastack-FI-B	Port 131	201F8C604F5F6CC0	-
ervers (2)	node2, FC Port 16		500507680B234FF5				
	node2, FC Port 17	Operational	500507680B244FF5				
abrics (2)							
witches (2)							

Figure 12-29 Storwize V7000 - Add Columns

After you have specified the information that you want to display, you can also export this information as a CSV, PDF, or HTML file through Actions/Export in all of the column table views.

- Related Resources are similar to Internal Resources, and Related Resources provides you with information about equipment that interacts with the Storwize V7000 storage system and its resources grouped by the following categories:
 - Servers
 - Hypervisors
 - Fabrics
 - Switches

You can use the Servers and Hypervisors resources to also display co-related information from their specific detail panes and have a Disk Mapping Section outlining the disks that they use on the Storwize V7000 storage system.

Figure 12-30 shows the VSC Storwize V7000 Related Resources for Servers with an additional information column selection.

Tivoli Storage Productivity Center - Virtual Storage Center Edition	Home Stora	ge Serve	ers Networ	k Groups	Advanced Analytics	Cognos	Settings	🤱 administrator 🛛 🕐) IBM
Storwize V7000 Versa Stack	Serve	mal ning							
Actions 🔻	Servers Disk Mapping								
Overview Properties	E Actions ▼							Q - Filter	
Alerts (3)	Name	Status 🔻	Probe Status	OS Type	OS Version Tota	I Disk Space (GiB)	Diek Spaco	from Storwize V7	
Threshold Violations (33)	SQLVM01.VersaStack.local	Normal	Warning	Windows	6.2		1 Disk Space	Probe Schedule	~
Tasks (0)	SQLVM02.VersaStack.local	Normal	A Warning	Windows	6.2		56.00		
Data Collection (2) Data Path								Acknowledged	
								Agent State	
Internal Resources								 OS Type 	
Volumes (17) Pools (2)								 OS Version 	1
Managed Disks (6)								IP Address	
RAID Arrays (6)								Domain Name	
Disks (48)								Cluster	
I/O Groups (1)								Virtual Machine	
Nodes (2)								Hypervisor	
Ports (16)								Hypervisor Cluster	
Host Connections (4)								Disks	
Related Resources								 Disks assigned from Storage Systems 	
Servers (2)								Disks assigned from Storwize V7000 VersaStack	
Hypervisors (4)								Used Space (%)	^
Fabrics (2) Switches (2)									
Switches (2)								Total Disk Space (GiB)	
								Disk Space from Storage Systems (GiB)	
								 Disk Space from Storwize V7000 VersaStack (Gill 	iB)
								Available Disk Space (GiB)	
	Showing 2 items Selected 0 item	ns						File System Capacity (GiB)	

Figure 12-30 Storwize V7000 - Related Resources Servers

Fabrics shows the fabric and switch relationships for the connected Storwize V7000 storage system, where Switches also take you directly to the performance pane of the corresponding switch.

This completes the functional overview of the Storwize V7000 storage system from within the VSC Web GUI. The next section describes the performance monitoring capabilities, and you can define which alerts to be generated and thresholds to be set.

12.7.3 Monitoring and alerting

The Storwize V7000 storage has built-in, 5-minute, and sample-based performance monitoring, as shown in Figure 12-31.



Figure 12-31 Storwize V7000 - Performance Monitoring

Tivoli Productivity Center Virtual Storage Center Edition enhances the real-time performance monitoring of the managed resources such as the Storwize V7000 storage system through the following features:

- Unlimited performance data capturing
- Granular performance metrics on the following levels:
 - I/O Group level
 - Node level
 - Port level
 - Pool/Volume level
 - Managed Disk/RAID Array/Disk level
- Holistic performance monitoring from server/hypervisor over fabric/switch to the storage system
- Customizable threshold settings with co-related alert triggers and actions

In this section, you perform the following tasks:

- Set the retention parameters for the performance data.
- Configure the system-wide alert notifications.
- Define performance thresholds and custom alerts.
- Correlate volume and I/O group performance.

History Retention

Review the History Retention settings by clicking the **VSC Web GUI Settings** drop-down menu, as shown in Figure 12-32 on page 267.

Tivoli Storage Productivity Center - Virtual Stor	age Center Edit	tion H(ome	Storage	Servers	Network	Groups
History Save	Reten Restore		Cancel				
Capacity History							
Daily:	12 🌲	weeks					
Weekly:	24 🌲	weeks					
Monthly:	24 🌲	months	Specify how	long to retain same	ble data that is	1	
Performance Data Sample: Hourly: Daily:	2 ‡ 4 ‡ 52 ‡	weeks K weeks weeks	collected by p represents th performance data is collect can require s database rep determined to	beformance monit ne data that is colle monitor is run. Be tded frequently, reta igginficant disk spa oository. The requir by the types of switt d number of volum	ors. Sample data ected each time a cause sample ining that data ce in the ed disk space is ches, storage		
Other							
Data for missing resources:	2 🌲	weeks					
Alert logs:	4 🗘	weeks					
Job logs:	5 🌲	runs					

Figure 12-32 Virtual Storage Center - History Retention

The performance data is stored in the DB2 database of the Virtual Storage Center. You can increase the retention period if you have allocated enough disk capacity on the Virtual Storage Center system itself. The hardware requirements are outlined in the support document that is found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg27039550

Alert Notifications

Within the Virtual Storage Center, alerts and notifications can be sent to three different receivers in parallel: Email, SNMP, and IBM Netcool® / OMNIbus.

To configure the targets for the Alert Notifications, go to **Settings/Alert Notifications** in the VSC Web GUI, as shown in Figure 12-33.

Tivoli St	lorage Productivity Center - Vir	ual Storage Center Edition	Home	Storage	Servers	Network	Groups	Advanced Analytics	Cognos	Settings
	Email		lert Notif	fications						
Ţ	SNMP	Save	Cancel							
*	Netcool/OMNIbus	Email server for ser Reply to address:		ifications oversastack.local						
		Mail server:	192.168.10.	29						
		Port:	25			\$				
			Test	Rem	iove					
		Global email notifica Configuration Alerts								
		🖌 Email opsadmi		al						
		Performance Thresh								
		🖌 Email opsadmi	n@versastack.loca	al						

Figure 12-33 Alert Notifications - Email

Complete the reply to, mail server, and port settings and click the test button to verify email reception.

Example 12-2 shows the sample email that is generated by the Alert Notification email test.

Example 12-2 Alert email verification

```
SRV0785I: This email is a test of the alert notification configuration in Tivoli
Storage Productivity Center. Receiving this message indicates that email
notification is configured correctly.
```

You can specify up to two SNMP destinations by providing the community, host name, or IP address and port settings.

Example 12-3 shows the SNMP trap of a failed VSC Job.

Example 12-3 Sample VSC SNMP trap

20:38:51 2015/06/24 ZBXTR	AP 192.168.155.18
PDU INFO:	
version	0
community	public
errorstatus	0
receivedfrom	UDP: [192.168.155.18]:61914->[192.168.155.23]:162
messageid	0
notificationtype	TRAP
errorindex	0
requestid	0
transactionid	3
VARBINDS:	
DISMAN-EVENT-MIB::sysUp	<pre>TimeInstance type=67 value=Timeticks: (385718) 1:04:17.18</pre>
SNMPv2-MIB::snmpTrapOID	.0 type=6 value=OID: TIVOLI-SRM-MIB::jobFailedTrap

```
TIVOLI-SRM-MIB::scheduleName
                                type=4 value=STRING:
"administrator.Probe linux tsm71lnx.ibmdemo.local"
 TIVOLI-SRM-MIB::scheduleType type=4 value=STRING: "Probe"
 TIVOLI-SRM-MIB::scheduleRun
                                type=4 value=STRING: "3"
 TIVOLI-SRM-MIB::alertType
                                type=4 value=STRING: "Scheduled Job Failed"
 TIVOLI-SRM-MIB::alertName
                                type=4 value=STRING:
"administrator.probeFailedAlertConditionName 7065"
 TIVOLI-SRM-MIB::serverName type=4 value=STRING: "Data Manager server on
tpc52.ibmdemo.local"
 TIVOLI-SRM-MIB::alertID
                                type=4 value=STRING: "6001"
 TIVOLI-SRM-MIB::alertURL
                                type=4 value=STRING:
"https://TPC52.ibmdemo.local:9569/srm/gui#alerts?id=6001"
 TIVOLI-SRM-MIB::resourceURL
                                type=4 value=STRING:
"https://TPC52.ibmdemo.local:9569/srm/gui#resources?type=servers&id=7065"
 SNMP-COMMUNITY-MIB::snmpTrapAddress.0 type=64 value=IpAddress: 192.168.155.18
  SNMP-COMMUNITY-MIB::snmpTrapCommunity.0 type=4 value=STRING: "public"
 SNMPv2-MIB::snmpTrapEnterprise.0 type=6 value=OID: TIVOLI-SRM-MIB::srmServer
```

Instructions about how to configure your SNMP server and where to obtain the VSC MIB files can be found at the following website:

http://www.ibm.com/support/knowledgecenter/SSNE44_5.2.6/com.ibm.tpc_V526.doc/fqz0_ t_configuring_snmp_alerts.html

Alternatively, supply the host name or IP address for the IBM Netcool / OMNIbus server.

Defining performance thresholds

With the system-wide notifications set, proceed with creating a performance threshold alert and apply a custom alert notification to it. Notification settings can be system-wide, device-specific, and event-specific. Figure 12-34 shows how you can override the global notification settings for the Storwize V7000 storage system itself, and set custom notifications for the Storwize V7000 storage system.

Storwize V7000 VersaStack IBM Storwize V7000 - 2076	Alerts Alerts 1 Critical S Warning 0 Informational C
Cverview Properties Alerts (6)	Alerts Definitions Edit Specify how you want to be notified: Configuration alerts Override Global Email Notification Settings Planal opsadmin@versastack.local Netcool / OMNbus SNMP Windows log Performance threshold alerts Override Global Email Notification Settings Performance threshold alerts Override Slobal Email Notification Settings Performance threshold alerts Override Slobal Email Notification Settings SthuP Windows log Sympers alerts: Suppress alerts unless thresholds are violated more than once within the following length of time: minutes Suppress alerts if thresholds are violated within the following length of time after the first occurrence: 60 minutes

Figure 12-34 Storwize V7000 - custom notification settings

You can distinguish between configuration and performance alerts routing, for example, the configuration alerts to the infrastructure team and the performance alerts to the application team in your organization. By default, repeating performance alerts are suppressed within the first 60 minutes on subsequent occurrences.

If you switch back to the Definitions tab, you can toggle and customize alerts for the following alert types:

- Storage Systems
- Nodes
- Pools
- Volumes
- Disks
- Performance

Figure 12-35 on page 271 shows setting the I/O threshold rates for the Storwize V7000 storage system.

Tivoli Storage Productivity Center - Virtual Storage Center	Edition Home Storage Servers Network Groups Advar	nced Analytics Cognos Settings 🎝 administrator 🧭 IBM.
Storwize V7000 VersaStack IBM Storwize V7000 - 2076 Actions	Alerts S 1 Critical S Varning 0 Informational	
General	Alerts Definitions Notification Settings Total I	I/O Rate Threshold
Overview Properties	Storage System Nodes Pools Volumes Disks Performance	
Alerts (6)		Bottom 10
Threshold Violations (36)		our 6 hours 12 hours 1 day 1 week 1 month
Tasks (0)		00.00
Data Collection (2)	Loss of Signal Rate Threshold	
Internal Resources Volumes (17) Volumes (17) Pools (2) Managed Disks (6) Disks (46) UO Groups (1) Nodes (2) Ports (16) Post Connections (4) Redited Resources Servers (2) Fabrics (2) Switches (2)	Non-prefered Node Usage Percentage Threshold Port Send Bandwidth Percentage Threshold Port Receive Bandwidth Percentage Threshold Port to Local Node Send Response Time Threshold Port to Local Node Send Queue Time Threshold Port to Local Node Send Queue Time Threshold	00.00 0.

Figure 12-35 Storwize V7000 - I/O Threshold Customization

With the new thresholds defined, you can override the email notification by sending it to the storage admin team email of storadmin@versastack.local.

Figure 12-36 shows setting the custom I/O threshold notifications for the Storwize V7000 storage system and exploring the Run script option.

Tivoli Storage Productivity Center - Virtual Storage Center E								💄 administrator	() IBM
Twol Storage Productivity Genter - Vertical Storage Center E Storrwize V7000 Versa Stack IBM Storwize V7000 - 2076 Centeral Cen	Alerts	tification Settings ational transformer and the settings did deferentage Thresto creatage Thresto creatage Thresto creatage Thresto creatage Thresto appoint the setting and the setting the setting and the setting the setting the setting the setting and the the setting a	Network	Threshol n when this aler elected S ettings im@versastack.l	d Settings Is generated eled File	Select Fi • Script name • Upload scrit	le : ot PartReser 51 Parameter 30- Parameter 30- Parameter 30-	Browse. No file selected ent: SpectrumCentrol -Controller or IVO groups 22 -Resource names rray or Managed Disk Names rr4 = <threshold-< td=""><td></td></threshold-<>	
	Total Port Data Rate Threes Total Port VO Rate Threesh Primitive Sequence Protoc Total VO Rate Threeshold Total DOas Rate Threeshold Wrate-cache Delay Percen Zero Buffer Credit Timer Th Zero Buffer Credit Timer Th	ld ol Error Rate Threshold age Threshold ge Threshold	00000						

Figure 12-36 Storwize V7000 Custom Notifications

Another option is to have a script run when the alert is being triggered. These scripts are run by the Storage Resource Agents in your environment. By default, a Storage Resource Agent is deployed on the Virtual Storage Center itself.

These scripts can trigger corrective actions directly against the storage system by using remote CLI or interact with the VSC itself to create or run scheduled tasks. They can also run scripts and commands directly on the host operating system of the SRA. You can, for example, trigger the Analyze Tiering for the storage system to have VSC automatically up- or down-tier the volumes to optimize the I/O load whenever a high-level or low-level threshold is passed.

Correlating performance data

In the example environment, we set two threshold alerts for Total Data Rate and Total I/O Rate.

Figure 12-37 shows the VSC Storwize V7000 triggered threshold violations.

Tivoli Storage Productivity Center - Virtual Storage Center E	dition Home S	torage Servers	Network	Groups Advanced Ana	lytics Cognos	Settings		🗼 administrator 🛛 🚺	BM.
Storwize V7000 VersaStack IBM Storwize V7000 - 2078 Actions		eshold Violati 1 Critical Stress 5 Warning Stress Critical Idle Warning Idle	ons						
General	Ø Refresh ⋮≣ Actions ▼							Q Y Filter	
Overview Properties		Condition	Severity	Internal Resour	ce Boundary	Critical Boundary	Warning Boundary	Measured Value	IL.
Properties Alerts (6)	Jun 30, 2015 06:05:46 PDT	Total Data Rate	🔥 Warning	io grp0	Stress	300 MiB/s	250 MiB/s	265.18 Mi	lie ^
Threshold Violations (36)	Jun 30, 2015 06:05:46 PDT	Total I/O Rate	🔥 Warning	io_grp0	Stress	2,000 ops/s	1,500 ops/s	1,543.60 op	ps
Tasks (0)	Jun 30, 2015 04:04:42 PDT	Total I/O Rate	🔥 Warning	io grp0	Stress	2,000 ops/s	1,500 ops/s	1,553.93 op	ps
Data Collection (2)	Jun 29, 2015 13:08:15 PDT	Total I/O Rate	🔺 Warning	Oqrp oj	Stress	2,000 ops/s	1,500 ops/s	1,527.68 op	ps
n Data Path	Jun 29, 2015 10:47:11 PDT	Total I/O Rate	😣 Critical	io grp0	Stress	2,000 ops/s	1,500 ops/s	2,229.67 op	ps

Figure 12-37 Threshold violations

As an example, we investigate what was causing the Total Data Rate alert by double-clicking the alert itself, as shown in Figure 12-38 on page 273.

io_grp	ю Т	otal Data Rate				Ju	n 30, 2015 10:3	4:54 PDT
🚫 То	otal	Data Rate						
Boundary 1	type:	Stress						2
Measured	value:	300.04 MiB/s		400.00			300.04 MiB/s	
Critical bo	undaŋ	y: 300 MiB/s	s/B/s	300.00		Ì	Total Data Ra Jun 30, 2015,	
Warning b	ounda	ry: 250 MiB/s	Σ	100.00		l		_
Resources	s:	Storwize V7000 Ve In the storwize V7000 Ve In the store of the sto	rsaStack	0.00	09	10	11 12	- 1
Top Contril	buting	Volumes:						
E Actio	ns 🔻					Q	▼ Filter	
Rank	^	Name	Hosts	Read	I/	Write I/	Total I/	Rea IJ
	1	sp_datastore_1	2		0.45	1,531.33	1,531.78	^
	2	🚦 sql_rdm_data	2		148.52	0.25	148.77	
	3	infra_datastore_1	2		1.32	39.75	41.07	=
	4	<pre>vm_host_boot_1</pre>	🖥 <u>vm-host-inf</u>		1.27	1.02	2.28	
	5	<pre>vm_host_boot_2</pre>	🖥 vm-host-inf		0.93	0.70	1.63	
	6	sp_datastore_2	2		0.17	2.30	2.47	
<	7	III	🖳 vm-host-inf		0.60	0.45	1.05	>
Showing 1	11 iten	ns Selected 0 items				Refres	hed a few mome	ents ago
			Close					

Figure 12-38 Total Data Rate Alert Detail

The details inform you about the measured value when the alert occurred. You can also hover over the chart itself to get more data samples. The column chart indicates that the sp_datastore_1 (which hosts the Spectrum Protect Tivoli Storage Manager server in our example environment) has the highest write rate with the highest read coming from the clustered data volume from the SQL Server.

If you do not know what system is causing the load, you can double-click, for example, sp_datastore_1 to get more information. We are interested in finding out the disk mappings on this data store, so go to the corresponding tab, as shown in Figure 12-39.

	Easy Tier Managed Disks Host Connections Disk Mappings Relationships Performance
	I≣ Actions ▼
	Server or Hypervisor Virtual Machine 🔺 Visible OS Type File System File System Type
Volumes	📲 <u>vm-host-infra-02.versastac</u> 🖥 <u>fcmve.versastack.local</u> Yes Linux 🛍 <u>kmfs/volumes/</u> VMFS
	📳 <u>vm-host-infra-02.versastac</u> SLES11SP3 Yes SUSE Linu 🛍 <u>/vmfs/volumes/</u> VMFS
	📳 <u>vm-host-infra-01.versastac</u> 🖥 <u>spectrumprotect</u> Yes Linux 🖆 <u>/vmfs/volumes/</u> VMFS
	📳 <u>vm-host-infra-02.versastac</u> 🖥 <u>spectrumrepmon</u> Yes Windows 🍋 <u>/vmfs/volumes/</u> VMFS
	🗐 <u>vm-host-infra-01.versastac</u> SpectrumVStorage Yes Microsoft W 🛍 <u>vmfs/volumes/</u> VMFS

Figure 12-39 Data store volume disk mappings

The Spectrum Protect virtual machine is hosted on the vm-host-infra-01 hypervisor. Clicking the link takes you directly to the overview pane of that system, as shown in Figure 12-40.

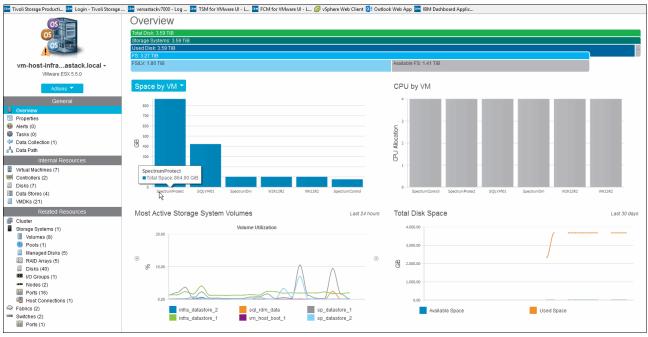


Figure 12-40 Hypervisor overview

The sp_datastore_1 is one of the most active volumes, followed by the sp_datastore_2. Navigating to the volumes by using the related sources on the left side gives an overview of all the volumes that are related to this hypervisor.



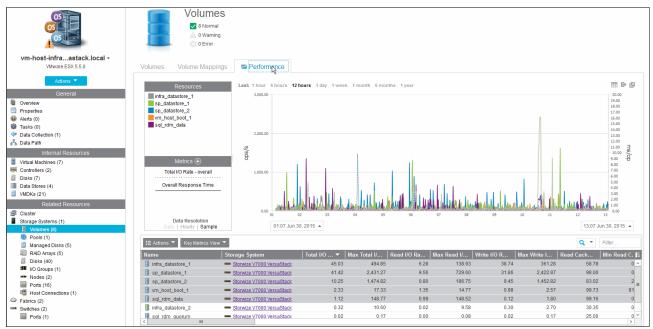


Figure 12-41 Hypervisor Volume Performance

The VSC selected the top five volumes grouped by Total I/O performance and shows the key metrics that are related to these volumes. You can customize this view and select the metric that you need for both the table view and for the performance graph independently, as shown in Figure 12-42.

Select Table Metrics				
Volume Metrics				
Overall I/O Rate (ops/s)	Read	Write	Total	^
Data Rate (MiB/s)	Read	Write	Total	
Response Time (ms/op)	Read	Write	Overall	=
Other (%)	Overall Host Attr	Volume Utilization	Write-cache Delay	
More				
I/O Rates				R
Transfer Rate (ops/s)	Disk-to-Cache	Cache-to-Disk		
Other (ops/s)	Write-cache Delay			
Cache Hits				
Overall I/O Cache Hits (%)	Read	Write	Total	
Response Times				
Peak Response Time (ms)	Read	Write		
Remote Mirror				
Global Mirror	Write I/O Rate (o	Overlapping Write	Overlapping Write	~
	OK	Cancel		

Figure 12-42 Hypervisor volume key metrics

We want to investigate the Data Rate Response Time for the volume hosting the Spectrum Protect Tivoli Storage Manager server and the data volume of the SQL cluster in our VersaStack environment and see how it evolved over the last month in the performance graph. Selecting 1 month and using the Metrics + button gives us the required information, as shown in Figure 12-43 on page 277.

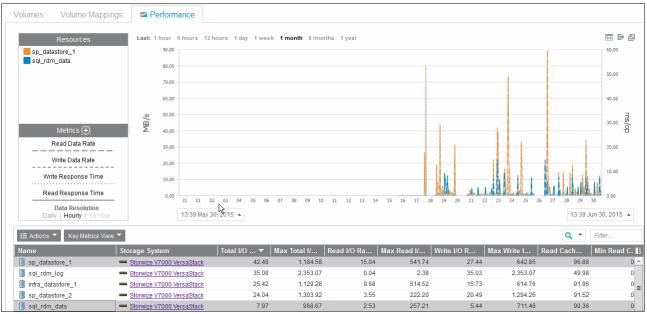


Figure 12-43 One-month volume performance

You can split this window to evaluate the performance of multiple sources one by one by using the open in a new window arrow button in the upper right corner of the graph. These resources can be dissimilar, showing, for example, volume performance, storage system FC port performance, and SAN fabric performance in separate windows with different metrics. After you find the specific spot that you want to investigate in more detail, you can synchronize all the windows by using the Synchronize Time clock icon, as shown in Figure 12-44.

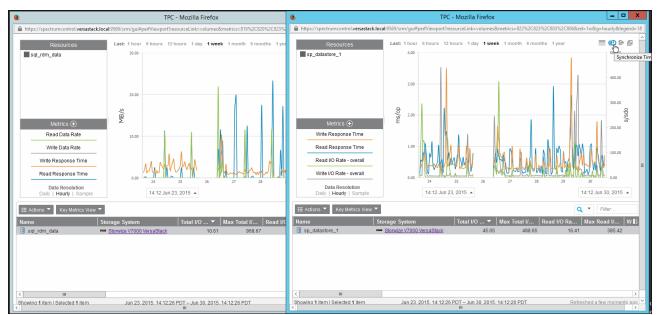


Figure 12-44 Time synchronized multiple performance windows

This completes the section about how to integrate the Storwize V7000 storage system with the Spectrum Control VSC. You explored the main VSC interfaces that are related to the Storwize V7000 storage system, defined and examined alerts, and viewed performance metrics on the Storwize V7000 resources.

In the next section, you add the hypervisors to the Spectrum Control VSC, register the vCenter Web Client extension, and explore the alerting and performance monitoring from within the VSC Web GUI and through the vSphere Web Client interface.

Integrating the VMware vCenter Hypervisor with Spectrum Control

Integrating the VMware vCenter and the ESXi Hypervisors that are used in the example VersaStack environment follows a similar approach as adding the Storwize V7000 storage system to the Tivoli Productivity Center SmartCloud Virtual Storage Edition.

Start the VSC Web GUI and click the Hypervisors section to start the registration process, as

No hypervisors are being monitored. To add a hypervisor or a virtual center, click the icon. Hypervisors (0) Switches (0) Servers (1) Fabrics (0)

Figure 12-45 Initiate Add Hypervisor wizard

shown in Figure 12-45.

Figure 12-46 shows the VSC Hypervisor Add VMware vCenter wizard.

Add Hypervis	sor		
Discover			
a 🕮 a	Туре:	ESX/ESXi	VMware vCenter
Host name or IP address: vcenter.versastack.local User name: administrator@vsphere.local			
	local		
1	Password:	•••••	
	Display name:		
	Description:		
	> Advanced		
0	 Back 	v Next ►	Cancel

Figure 12-46 Add Hypervisor

VSC now connects to the vCenter and obtains a list of registered clusters and hypervisors. After this task completes, you can deploy the vSphere Web Client extension, as shown in Figure 12-47.

Add Hyp	pervisor
Deploy vs	Sphere extension
	Sphere extension for Tivoli Storage Productivity Center to provision, view reports, and on storage that is monitored by Tivoli Storage Productivity Center directly in the Client.
Tivoli Storaç	ge Productivity Center
User name:	Administrator ?
Password:	•••••
	✓ Back Next ► Skip

Figure 12-47 Deploy vSphere extension

VSC uses a probing mechanism to check for configuration changes at regular intervals. After the Hypervisors are discovered, the system proposes the creation of a daily probe schedule, as shown in Figure 12-48.

Add Hypervisor				
Configure				
Hypervisors wm-host-infra-04.versastack wm-host-infra-01.versastack wm-host-infra-02.versastack wm-host-infra-03.versastack	Display name: Location: Data Collection Probe:	 San Jose 16:45 PDT V	Every day	
	Back	-	Cancel	

Figure 12-48 Hypervisor probe schedule

Back in the VSC Hypervisors section, you can immediately start the probe of the discovered hypervisors, as shown in Figure 12-49.

Tivoli Storage Productivity Center - Virtual Storage Center Edition	Home	Storage	Servers	Network	Groups	Advanced Analytics
OSOCIONAL O Normal M 4 Warning O Error						
Hypervisors Clusters Alerts Tas	sks Discove	ered Virtual Ma	chines			
+ Add Hypervisor 🗄 Actions 🔻						
Name Cluster	Sta	atus 🔻 🛛 Pi	robe Status	U	sed Space (%)	Total Disk Space (GiB)
Vm-host-infra-01.v	 Start Probe n 		Never Probed			3,681.00
Edit Alert Definitions	Schedule	Warning C	Never Probed			3,681.00
Edit Alert Notification Settings		Warning C	Never Probed			3,360.00
Provision Storage	<u>nent 2</u> 🔒	Warning 🧲	Never Probed			3,360.00
Analyze Tiering						
Add to Application						
Remove						
Acknowledge Status						

Figure 12-49 Start probe manually

After the probe is started, you can follow the progress by opening the probe logs, as shown in Figure 12-50.

05 05	Hype 0 Noi 4 Wa 0 Em	rning				
Hypervisor	rs Clusters	Alerts	Tasks Disc	overed Virtual N	lachines	
+ Add Hype	ervisor 泪 Action	ns 🔻				
Name		Cluster		Status 🔻	Probe Status	Used Spa
🔋 vm-host-i	infra-01.versast	I VersaStack	Management	🔥 Warning	Running	
📳 vm-host	View Properties		Management	🛕 Warning	Running	
📳 vm-host	View Details		management 2	🛕 Warning	Running	
📳 vm-host	View Data Path		management 2	💧 Warning	Running	
	Data Collection	+	Open Probe Logs			
	Edit Alert Definition	ons	Schedule			
	Edit Alert Notifica	tion Settings		4		
	Provision Storage	e				
	Analyze Tiering					
	Add to Application	n				
	Connections	•				
	Remove					
	Acknowledge Sta	atus				

Figure 12-50 Check probe logs

Depending on the resource on which the probe is run there are several stages of the probing to be run, as shown in Figure 12-51.

			bLogs.jsp?deviceId=13090&scheduIeId=14007&ijobRunNumber=13067	
ogs				
pe: Probe				
Run 1: Jun 30,	2015 16:33:33 PDT - Jun 30, 2015 16:	:39:35 PDT		
Show all 🔻				
atus	Date and Time	ID	Description	
Information	Jun 30, 2015 16:33:33.775 PDT	BTADS0000I	Starting Discover Process Front End , with Device Server RUN ID 8044 , and Job ID 13067 .	
Information	Jun 30, 2015 16:33:33.807 PDT	BTAVM0008	Probe of hypervisor vm-host-infra-01.versastack.local has started.	
Information	Jun 30, 2015 16:35:30.153 PDT	BTAVM0015	Collection of the physical storage configuration for hypervisor vm-host-infra-01.versastack.local has started.	
Information	Jun 30, 2015 16:35:30.153 PDT	BTAVM2258I	The probe of vm-host-infra-01.versastack.local found 2 controllers.	
Information	Jun 30, 2015 16:38:59.101 PDT	BTAVM0021	The probe of vm-host-infra-01.versastack.local found 7 physical disks.	
Information	Jun 30, 2015 16:38:59.554 PDT	BTAVM0016I	Collection of the physical storage configuration for hypervisor vm-host-infra-01.versastack.local completed successfully.	
Information	Jun 30, 2015 16:38:59.554 PDT	BTAVM0017I	Collection of the logical storage configuration for hypervisor vm-host-infra-01.versastack.local has started.	
Information	Jun 30, 2015 16:38:59.554 PDT	BTAVM22611	Collecting logical volumes for hypervisor vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:38:59.554 PDT	BTAVM00221	The probe of vm-host-infra-01.versastack.local found 4 logical volumes.	
Information	Jun 30, 2015 16:38:59.569 PDT	BTAVM22621	Collecting disk partition for hypervisor vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:38:59.632 PDT	BTAVM22591	Collecting file system details for hypervisor vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:38:59.632 PDT	BTAVM2264I	Files details for Infra_Datastore_1 were collected by 2,368 on 6/29/15 4:15 PM.	
Information	Jun 30, 2015 16:39:31.097 PDT	BTAVM22571	Found 16 files on Protect_Datastore_1 of vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:39:31.113 PDT	BTAVM2264I	Files details for Infra_Datastore_2 were collected by 2,368 on 6/29/15 4:15 PM.	
Information	Jun 30, 2015 16:39:35.184 PDT	BTAVM22571	Found 2 files on host-infra-01-boot-1 of vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:39:35.184 PDT	BTAVM2260I	Collecting list of files for hypervisor vm-host-infra-01.versastack.local.	
Information	Jun 30, 2015 16:39:35.216 PDT	BTAVM0018I	Collection of the logical storage configuration for hypervisor vm-host-infra-01.versastack.local completed successfully.	
Information	Jun 30, 2015 16:39:35.216 PDT	BTAVM0019I	Collection of the virtual machines configuration for hypervisor vm-host-infra-01.versastack.local has started.	
Information	Jun 30, 2015 16:39:35.216 PDT	BTAVM0023I	The probe of vm-host-infra-01.versastack.local found 7 virtual machines.	
Information	Jun 30, 2015 16:39:35.356 PDT	BTAVM0020I	Collection of the virtual machines configuration for hypervisor vm-host-infra-01.versastack.local completed successfully.	
Information	Jun 30, 2015 16:39:35.512 PDT	BTAVM0009I	Probe of hypervisor vm-host-infra-01.versastack.local completed successfully.	
Information	Jun 30, 2015 16:39:35.512 PDT	BTADS00011	Discover Process with Device Server RUN ID 8044 and Job ID 13067 is complete with Status= 1, Return Code= 0.	

Figure 12-51 Probe results

The ESXi hypervisors of the VersaStack infrastructure are now added to the VSC environment.

Spectrum Control hypervisor overview

Similar to the Storwize V7000 storage system that you registered before, you explore the different panes and information that VSC provides in the Web GUI. Start the VSC Web GUI and select **Servers/Hypervisors** from the main menu, as shown in Figure 12-52.

Tivoli Storage Productivity Center - Virtual Storage Center Edition	Home Storage	e Servers	Network Groups	Advanced Analytics	Cognos Settings	🧎 administrator 🕜 IEM.
OS O Normal ▲ 4 Vaming O Error						
Hypervisors Clusters Alerts Tasks	Discovered Virtual I	Vachines				
+ Add Hypervisor 🗄 E Actions 👻						Q 🔻
Name Cluster	Status 🔻	Probe Status	Used Space (%)	Total Disk Space (GiB)	Available Disk Space (GiB)	
III vm-host-infra-01.versast III VersaStack Manageme	nt 🛕 Warning	Successful	57%	3,681.00	0.00	
I vm-host-infra-02.versast I VersaStack Manageme	nt 🛕 Warning	Successful	56%	3,681.00	0.00	
I vm-host-infra-03.versast I VersaStack management	nt 2 🥼 Warning	Successful	27%	3,360.00	0.00	
III vm-host-infra-04.versast III VersaStack manageme	nt_2 🛕 Warning	 Successful 	27%	3,360.00	0.00	

Figure 12-52 Hypervisor overview

Throughout all the components in the Web GUI, a similar approach is taken to outline the information by using tabs. The tabs for the Hypervisor are grouped into the following categories:

- Hypervisors: Lists all the discovered hypervisors and allows you open the individual hypervisor's overview windows
- ► Clusters: Groups the hypervisor per cluster if deployed that way in the vCenter
 - Figure 12-53 shows the VSC Hypervisor overview of discovered clusters and associated resources.

voli Storage Productivity Center - Virtual Storage Cen	nter Edition HC	ome Storage	Servers	Network	Groups	Advanced Anal
Hypervisor O Normal A Warning	S					
O Error						
Hypervisors Clusters Alert	s Tasks E	Discovered Virtual Mac	chines			
	1	Discovered Virtual Mac	Hypervisors	Virtual	Machines	Data Stores

Figure 12-53 Hypervisor cluster overview

- Alerts: Filters all alerts that are related to the hypervisors
- ► Tasks: Shows tasks such as provisioning and storage tiering for the affected hypervisors
- Discovered Virtual Machines: Lists all virtual machines that were discovered since the last probe, which allows you to perform agentless registration of these VM for logical grouping and reporting purposes

Figure 12-54 shows that the VSC Hypervisor has discovered the virtual machines and sorted them by name.

ivoli Storage Productivity Center - Virtual S	Storage Center Edition	Home	Storage	Servers	Network	Groups	Adv
OS O Norm ▲ 4 Warni O Error	al						
Hypervisors Clusters	Alerts Tasks	Discovered	/irtual Machin	es			
+ Add Server I≡ Actions ▼							
Name 🔺	IP Address	OS Type	Hypervisor		Discovered Tim	е	
🗟 DCNM Virtual Appliance	fe80::250:56ff:feb4:	Other 2.6.x Linux (3	📳 <u>vm-host-inf</u> r	a-02.versastac	Jun 30, 2015 16:2	9:06 PDT	
Exchange2013	fe80::9075:3719:30	Microsoft Windows	📳 <u>vm-host-infr</u>	a-02.versastac	Jun 30, 2015 16:2	9:06 PDT	
🗟 SLES11SP3		SUSE Linux Enterpr	📳 <u>vm-host-infr</u>	a-02.versastac	Jun 30, 2015 16:2	9:06 PDT	
🗟 SpectrumAdmin	fe80::384c:a59f:378	Microsoft Windows	📳 vm-host-infr	a-04.versastac	Jun 30, 2015 16:2	9:41 PDT	
🗟 SpectrumDm	fe80::f45e:cb99:cf7	Microsoft Windows	📳 <u>vm-host-infr</u>	a-01.versastac	Jun 30, 2015 16:2	6:48 PDT	
🗟 SpectrumDm	fe80::f45e:cb99:cf7 fe80::698a:319b:8f	Microsoft Windows Microsoft Windows			Jun 30, 2015 16:2 Jun 30, 2015 16:2		
			wm-host-infr	a-01.versastac	,	6:48 PDT	
Spectrum/Storage	fe80::698a:319b:8f	Microsoft Windows	vm-host-infr	ra-01.versastac ra-03.versastac	Jun 30, 2015 16:2	6:48 PDT 9:23 PDT	
SpectrumVStorage	fe80::698a:319b:8f	Microsoft Windows SUSE Linux Enterpr	vm-host-infr vm-host-infr	r <u>a-01.versastac</u> r <u>a-03.versastac</u> r <u>a-01.versastac</u>	Jun 30, 2015 16:2 Jun 30, 2015 16:2	6:48 PDT 9:23 PDT 6:48 PDT	

Figure 12-54 Discovered virtual machines

The hypervisors in Figure 12-52 on page 282 are in a warning state. However, no alerts are triggered from the VSC perspective. Checking the properties from the General Resources menu indicates that the system was in a warning status. Connecting to the vCenter environment shows that the hypervisors are indeed in a warning state because the SSH services were enabled, as shown in Figure 12-55.

VCENTER.VersaStack.local	vm-host-infra-01.versastack.local VMware ESXi, 5.5.0, 2068190	
VersaStack_DC_1		
UrsaStack_Manageme	Summary Virtual Machines Performance Configuration Tasks	& Events Alarms Permissions Maps Storage Views Hardware Status
wm-host-infra-01.v		
vm-host-infra-02.v	Configuration Issues	
🚡 DCNM Virtual Appli	SSH for the host has been enabled	
Exchange2013		
FcmVE	General	Resources

Figure 12-55 ESX SSH warning

For a case like this one where system warnings are received for conditions that you are aware of and that you want to ignore, you can acknowledge the alerts for those specific resources. Here, acknowledge the ESXi warning state, as shown in Figure 12-56 on page 285.

05 05	Hypervisors © 0 Normal 4 Warning 0 Error				
Hypervisors	Clusters Alerts Ta	asks Dis	covered Virtual Mac	hines	
+ Add Hyperviso	r i∃ Actions ▼				
Name	Cluster	agament	Status	Probe Status Successful	Used Space (%) To
vm-host-infra-	Data Collection	agement	Warning	Successful	56%
vm-host-infra-	Edit Alert Definitions	agement 2	A Warning	Successful	27%
: vm-host-infra-	Edit Alert Notification Settings	agement 2	🔥 Warning	Successful	27%
	Provision Storage Analyze Tiering				
	Add to Application				
	Remove				
	Acknowledge Status]			

Figure 12-56 Acknowledge warning status

With the hypervisors correctly configured, open the overview of vm-host-infra-01 by double-clicking its entry from the Hypervisors overview, as shown in Figure 12-57.

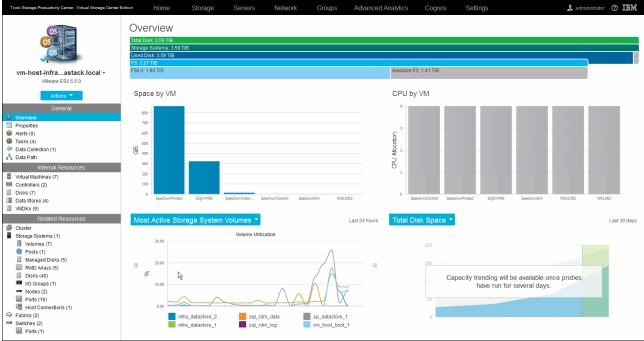


Figure 12-57 Hypervisor overview

Throughout the whole VSC GUI, a unified approach is used to chart graphical data and to group resources for the selected device into three categories: General, Internal Resources, and Related Resources. As we did for the Storwize V7000 storage system, we go over the sections individually and highlight some of them that are of interest for the current setup.

- ► General:
 - Overview: Brings you back to the graphical charts. These charts can be toggled and provide summarized data for the following categories:
 - Space by VM
 - CPU by VM
 - Most Active Storage System Volumes
 - Total Disk Space
 - Space from Storage Systems
 - Memory by VM
 - Most Active Switch Ports
 - Properties: Provides a summarized overview of the hypervisor, including details such as VMware ESX version, hardware serial number, and model and storage capacity.

Figure 12-58 shows the VSC Hypervisor overview showing the Cisco UCS B200-M4 serial information.

Tivoli Storage Productivity Center - Virtual Storage Center E	dition Home	Storage	Servers	Network	Groups	Advanced Analytics
	Properties	vare Sto	rage			
	Vendor	С	isco Systems Inc			
vm-host-infraastack.local -	Model	U	CSB-B200-M4			
VMware ESX 5.5.0	Serial Number	3	e62c583-2811-e511	-0000-0000000000	Df	
Actions 🔻	Processor Type	In	tel x86 compatible			
General	Processor Speed	2.	30 GHz			
Overview	Processor Count	20)			
Properties	Processor Architecture	IA	32			
 Alerts (0) Tasks (4) 	RAM	1:	27.74 GiB			
Data Collection (1)	Swap Space	0.	00 GiB			

Figure 12-58 Hypervisor hardware properties

- Alerts: Groups hypervisor-related alerts here for this specific hypervisor. For examples
 of configuring some sample alerts and general notifications overrides, see "Spectrum
 Control hypervisor monitoring and alerting" on page 294.
- Tasks: Shows provisioning tasks that are completed, are scheduled to be run, or are awaiting execution approval.

Figure 12-59 on page 287 shows the VSC Hypervisor overview of tasks for the selected hypervisor.

Tivoli Storage Productivity Center - Virtual Storage Center Edi	tion Home	Storage	Servers	Network	Groups	Advanced Analytics	Cognos
		Tasks ○ 0 Failed ○ 0 Warning ✓ 4 Successful ○ 0 Running	∑ 0 Pending				
vm-host-infraastack.local - VMware ESX 5.5.0							
Vivivale ESA 5.5.0	E Actions ▼						
Actions 🔻	Туре	Status	Re	lated Task		Schedule	
General	Provisioning	🗸 Successful				Run once on Jul 1, 2015 12:00:0	10 PDT
Overview	Provisioning	 Successful 				Disabled	
Properties	Provisioning	🗸 Successful				Disabled	
Alerts (0)	Provisioning	Successful				Disabled	
Tasks (4)							

Figure 12-59 Hypervisor tasks overview

 Data Collection: Allows you to verify and control the probe settings for this specific hypervisor. You can modify existing probe schedules or start an immediate probe.

Figure 12-60 shows the VSC Hypervisor data collection options.

Tivoli Storage Productivity Center - Virtual Storage Center E	dition Home	Storage	Servers	Network	Groups	Advanced Analytics	Cognos	Settings	🙏 administrator	?
05 06 06 06 06 06 06 06 06 06 06 06 06 06	100100 010011	Data Col	lection							
VMware ESX 5.5.0	Pr	obe							Actions 🔻 Start Probe	
General	Last Su	ccessful Probe		Jul 1	2015 16:49:01 PE	T			Schedule 🖓	
Overview	Schedul	e		Daily	Next run at Jul 2, 3	2015 16:45:00 PDT			Open Logs	
Properties	Average	Duration		6 mii	nutes					
 Alerts (0) Tasks (4) Data Collection (1) 										

Figure 12-60 Hypervisor data collection

- Data Path: Outlines the data path for all related resources to the hypervisor. For more information, see the bullet- on page 261.

Figure 12-61 shows the VSC Hypervisor data path overview for the selected system.

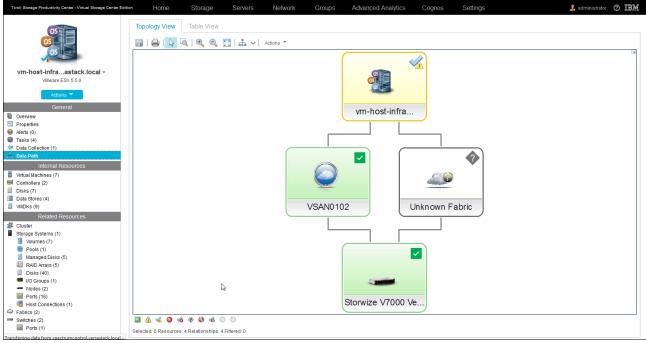


Figure 12-61 Hypervisor data path

- Internal Resources:
 - Virtual Machines: Lists all virtual machines for the selected hypervisor, including metrics that are retrieved from the vCenter/Hypervisor, such as configuration files, number of vCPUs, and assigned RAM.

Figure 12-62 shows the VSC Hypervisor virtual machines that are grouped for the selected system.

Tivoli Storage Productivity Center - Virtual Storage Center Editio	Home Stora	ige Server	s Net	work Group	s Advanced Analytics	Cognos Settings		🎍 administrator 🏼 🧿 🔢 🕅
	Virtua Virtua Virtua Virtua Violando Virtua Violando Violan	ming	es					
vm-host-infraastack.local -								
VMware ESX 5.5.0	E Actions ▼							Q 🔻 Filter
Actions 🔫	Name	Status 🔻	Agent S	Data Stores	Configuration File	OS Type	Processor Count	RAM (GiB) Capacity (
General	B SpectrumControl	Vormal	Normal	1	SpectrumControl.vmx	Microsoft Windows Server 2012		4 🔽 Name
General	SpectrumDm	Normal	-		SpectrumDm.vmx	Microsoft Windows Server 2012	(4 V Status
Properties	a spectrumprotect	Normal	Normal	Protect Datast	SpectrumProtect.vmx	SUSE Linux Enterprise 11 (64-b	it)	4 Acknowledged
Alerts (0)	Spectrum/Storage	Normal		E Protect Datast	Spectrum/VStorage.vmx	Microsoft Windows Server 2008		2 Agent Status
Tasks (4)	SQLVM01.VersaStack.local	Normal	Normal		SQLVM01.vmx	Microsoft Windows Server 2012	(4 Jata Stores
Data Collection (1)	🖏 W2K12R2	Normal			W2K12R2-Template.vmtx	Microsoft Windows Server 2012	(4
🖧 Data Path	💩 WK12R2	Normal			WK12R2.vmtx	Microsoft Windows Server 2012	(4 Configuration File
Internal Resources								 OS Type
Virtual Machines (7)								 Processor Count
Controllers (2)								 RAM (GiB)
Disks (7)								 Capacity (GiB)
Data Stores (4)								✓ VMDKs
VMDKs (9)								Show Select/Deselect All
Related Resources								
: Cluster								🧐 Restore Default View
Storage Systems (1)								
Volumes (7)								
Pools (1)								

Figure 12-62 Hypervisor virtual machines

The column view can be modified to display only a subset of data, as shown in Figure 12-62 on page 288.

Note: This view is updated every time the probe for the selected hypervisor is run. If you have an environment where the virtual machines migrate often between hosts of a DRS enabled cluster, as in our example setup, you might want to increase the frequency of the probing or run an *ad hoc* probe through the Data Collection entry in the General section.

 Controllers: Shows the internal storage controllers for the hypervisor and their data, such as the HBA WWN and associated disks.

Figure 12-63 shows the VSC Hypervisor controllers overview window, which lists the HBA WWNs.

Tivoli Storage Productivity Center - Virtual Storage Center Editi	ion Home	Storage Serve	rs Network	Groups	Advanced Analytics	Cognos	Settings	🌡 administrator 🕜 IBM.
COS COS COS COS COS COS COS COS COS COS		Controllers						
vm-host-infraastack.local - VMware ESX 5.5.0								
Actions 🔻	i≡ Actions ▼ Name	Description	Type	HBA WWN	Associated Disks			Q T Filter
General	with the second	Cisco VIC FCoE		20000025B500000E				∎¢
Overview Properties Alerts (0) W Tasks (4)	🛒 vmhba1	Cisco VIC FCoE	H FCAL	20000025B500000E	2 Z			
Data Collection (1)								
Virtual Machines (7) Controllers (2)								
 Disks⁴√) Data Stores (4) VMDKs (9) 								
Related Resources Cluster Storage Systems (1) Volumes (7)								
ter volumes (/) See Pools (1) Managed Disks (5) See RAID Arrays (5)								
Disks (40) Disks (40) Si // O Groups (1) Nodes (2)								
Ports (16) Host Connections (1)								
Fabrics (2) Switches (2)								
Ports (1)	Showing 2 items S	elected 0 items						Refreshed a few moments ago

Figure 12-63 Hypervisor controllers

Disks: Provides an overview of all physical disks being used by this hypervisor and the data paths towards them. The Storwize V7000 storage virtualization engine groups these disks within MDisk arrays, which are themselves grouped into pools. In these pools, volumes are created and mapped to hosts. From the Data Path tab, you can observe the correlation between the virtual volumes and the underlying physical disks and how they are shared across multiple volumes.

Figure 12-64 shows the VSC Hypervisor disk, data store, capacity, and other metrics.

Tivoli Storage Productivity Center - Virtual Storage Center Editio	Home	Storage	Servers	Network	Groups	Advanced Ana	lytics Cognos	Settings	2.	administrator 🕜 🎛
		Disks 7 Normal 0 Warning 0 Error								
vm-host-infraastack.local - VMware ESX 5.5.0	Disks Patr	IS								
Actions ▼ General	E Actions ▼								(Filter
Overview	Name 🔻	Status	Paths	Vendor Mo.	. Firmware	Serial Number	Capacity (GiB)	Available Disk Space (GiB)	Used Space (GiB)	Data Store
Properties	🛛 naa.6005076	Connected	V Z	IBM 2145	0000	00000000000007	2,048.00	0.00	2,048.00	Protect Data
Alerts (0)	anaa.6005076	Connected	🖉 Z	IBM 2145	0000	0000000000006	1.00	0.00	1.00	
Tasks (4)	aa.6005076	Connected	¥ 7	IBM 2145	0000	0000000000005	64.00	0.00	64.00	
Data Collection (1)	naa.6005076	. V Connected	¥ 7	IBM 2145	0000	00000000000004	256.00	0.00	256.00	
Data Path	aa.6005076	Connected	¥ 7	IBM 2145	0000	0000000000002	1,024.00	0.00	1.024.00	Infra Datasto
Internal Resources	aa.6005076		¥ 7	IBM 2145	0000	000000000000b	256.00	0.00		Infra Datasto
Virtual Machines (7)	0200000000			IBM 2145		00000000000000	32.00	0.00		host-infra-01
Controllers (2)										
Disks (7)										
Data Stores (4)										
VMDKs (9)										
Related Resources										
Cluster										
Storage Systems (1)										
Volumes (7)				R						
 Pools (1) 										
Managed Disks (5)										
RAID Arrays (5)										
Disks (40)										
I/O Groups (1)										
Modes (2)										
Ports (16)										
Host Connections (1)										
Fabrics (2)										
Switches (2)										
Ports (1)										

Figure 12-64 Hypervisor disks

- Data Stores: Lists the data stores for the hypervisor together with data such as Used Space %, Available data Store Space, and VMDKs. Double-clicking a data store brings you to the Properties notebook for that data store, where you can see more information about the VMDKs, such as Virtual Machine, Volume, and Hypervisor. This correlated click-through is consistent within the whole VSC Web GUI, allowing you to explore the data from your environment in an intuitive manner.

Figure 12-65 on page 291 shows the VSC Hypervisor Data Stores overview with thee available data set options.

Tivoli Storage Productivity Center - Virtual Storage Center Edit	ion Home Store	age Serve	ers Network G	Groups Advanced	Analytics Cognos	Settings		🗼 administrator 🕜 IBM.
	Data	Stores						
vm-host-infraastack.local - VMware ESX 5.5.0	i⊟ Actions ▼							Q - Filter
Actions 🔻	Name	▲ Type	File System	File System Type	Cluster	Data Store Cluster	Disks	Used Space (%) File Syste II
	host-infra-01-boot-1		hvmfs/volumes/5581ca5c-1.		VersaStack Ma		3 0200	✓ Name
General	Infra Datastore_1	Concatena	a /vmfs/volumes/5581ed95		VersaStack Ma			✓ Туре
Overview 0	Infra Datastore 2	Concatena	a /vmfs/volumes/55831adc	VMFS	VersaStack Ma			✓ File System
Properties	Protect Datastore 1	Concatena	a /vmfs/volumes/5581ede0	VMFS	VersaStack Ma			File System Type
 Alerts (0) Tasks (4) 								Cluster
Tasks (4) Data Collection (1)								
a Data Path								 Data Store Cluster
Internal Resources								 Disks
Virtual Machines (7)								✓ Used Space (%)
Controllers (2)								File System Capacity (GiB)
Disks (7)								✓ Used File System Space (GiB)
Data Stores (4)								 Available File System Space (GIB)
VMDKs (9)			N					 Data Store Capacity (GiB)
Related Resources			R					Available Data Store Space (GiB)
JE Cluster								Swap Space
Storage Systems (1)								
Volumes (7)								✓ Hosting Filer
Pools (1)								✓ VMDKs
Managed Disks (5)								😨 Show Select/Deselect All
RAID Arrays (5)								Sestore Default View
Disks (40)								
I/O Groups (1)								
Nodes (2)								
Host Connections (1)								
Fabrics (2)								
Switches (2)								
Ports (1)	<	ш						>
	Showing 4 items Selected 0 item	IS						Refreshed a few moments ago

Figure 12-65 Hypervisor Data Stores

- VMDKs: Lists the VMDKs for the virtual machines running at the specific hypervisor at the time of the data collection probe.
- ► Related Resources:
 - Cluster: Opens the cluster notebook with several tabs.
 - General: Name of cluster and last probe time stamp.

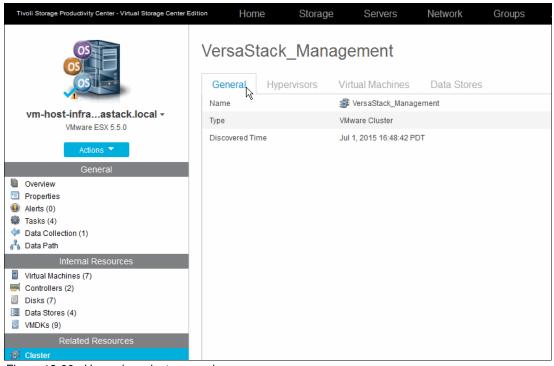


Figure 12-66 shows the VSC Hypervisor overview at a cluster level.

Figure 12-66 Hypervisor cluster overview

Figure 12-67 shows the VSC Hypervisor overview of members of the hypervisor cluster.

Tivoli Storage Productivity Center - Virtual Storage Center B	Edition Home	Storage	Servers	Network	Groups	Advanced Analytics
	VersaStad		Jement Virtual Machines	Data Store	25	
vm-host-infraastack.local - VMware ESX 5.5.0 Actions - General	E Actions ▼ Name I vm-host-infra- I vm-host-infra-	01.versast 02.versast	ersaStack Ma 🗸	🔏 Warning - A 📘	Probe Status Successful Successful	Q ▼ Filter Used Spa IJ 57% 56%
Overview Properties Alerts (0) Tasks (4) Data Collection (1) Data Path	L.					
Internal Resources Virtual Machines (7) Controllers (2) Disks (7) Data Stores (4) VMDKs (9)						
Related Resources						

Figure 12-67 Hypervisor cluster hypervisor members

Figure 12-68 shows the VSC Hypervisor overview of virtual machines that are associated with the cluster.

	e Servers	Netwo	ork Groups	Advanced Analytics
VersaStack_Man	-	es Data	Stores	
i≡ Actions ▼				Q ▼ Filter
Name	Status 🔻	Agent S	Data Stores	Configuration File
🗟 DCNM Virtual Appliance	Normal			DCNM Virtual Appliance.vmx
🖪 Exchange2013	Normal			Exchange2013.vmx
fcmve.versastack.local	Normal	Normal	Protect Datast	FcmVE.vmx
🖪 SLES11SP3	Normal		🔚 Protect Datast	spectrumprotect.vmtx
B SpectrumControl	Normal	Normal		SpectrumControl.vmx
🗟 SpectrumDm	Normal			SpectrumDm.vmx
B spectrumprotect	Normal	Normal	E Protect Datast	SpectrumProtect.vmx
🖥 spectrumrepmon	Normal	Normal	E Protect Datast	SpectrumRepmon.vmx
Spectrum/Storage	Normal		Protect Datast	Spectrum/VStorage.vmx
SQLVM01.VersaStack.local	Normal	Normal		SQLVM01.vmx
SQLVM02.VersaStack.local	Normal	Normal		SQLVM02.vmx
W2K12R2	Normal			W2K12R2-Template.vmtx
0 W2K8R2SP1	Normal			W2K8R2SP1.vmtx
W K12R2	Normal			WK12R2.vmtx
	General Hypervisors	Image: Status Image: Status Name Status DCNM Virtual Appliance Normal Exchange2013 Normal Exchange2013 Normal Exchange2013 Normal SESTISP3 Normal SpectrumControl Normal SpectrumDrotect Normal SpectrumVStorage Normal SQLVM01.VersaStack.local Normal SQLVM02.VersaStack.local Normal SQLVM02.VersaStack.local Normal W2K12R2 Normal W2K8R2SP1 Normal	General Hypervisors Virtual Machines Data Image: Actions Imag	General Hypervisors Virtual Machines Data Stores Image: Status Agent S Data Stores DCNM Virtual Appliance Normal Data Stores DCNM Virtual Appliance Normal Protect Datast Exchange2013 Normal Protect Datast SLES11SP3 Normal Protect Datast SpectrumControl Normal Protect Datast SpectrumDm Normal Protect Datast SpectrumProtect Normal Protect Datast SpectrumProtect Normal Protect Datast SpectrumVStorage Normal Protect Datast SQLVM01.VersaStack.local Normal Normal SQLVM02.VersaStack.local Normal Normal W2K12R2 Normal Normal W2K8R2SP1 Normal Normal

Figure 12-68 Hypervisor cluster VM overview

Figure 12-69 shows the VSC Hypervisor Cluster overview of data stores that are attached to the cluster.

Tivoli Storage Productivity Center - Virtual Storage Center E	dition Home Storag	e Servers Network	Groups	Advanced Analytics
OS OS	VersaStack_Man	agement Virtual Machines Data Sto	res	
vm-host-infraastack.local -	E Actions			Q Filter
Actions 🔽	host-infra-01-boot-1	 Type File System Concatena Concatena 	81ca5c-1 VMFS	ystem Type Clu IU <mark>∰ Ver</mark>
General	host-infra-02-boot-2 Infra_Datastore_1	Concatena Concatena	81ed95 VMFS	业 业 业
 Properties Alerts (0) 	 Infra_Datastore_2 Protect_Datastore_1 	Concatena Chi /vmfs/volumes/55 Concatena Chi /vmfs/volumes/55		业 业 业
 Tasks (4) Data Collection (1) 				
🚰 Data Path Internal Resources				
Virtual Machines (7) Controllers (2)				
 Disks (7) Data Stores (4) VMDKs (9) 				
Related Resources				

Figure 12-69 Hypervisor cluster data stores

- Storage Systems: Groups the storage resources for this hypervisor per storage system. For more information, see "Managing the storage infrastructure" on page 256.
- Fabrics: Shows the fabrics to which the hypervisor is connected.
- Switches: Shows the fabric member switches and the ports to which the hypervisor is connected.

Figure 12-70 shows the VSC Hypervisor switch port overview.

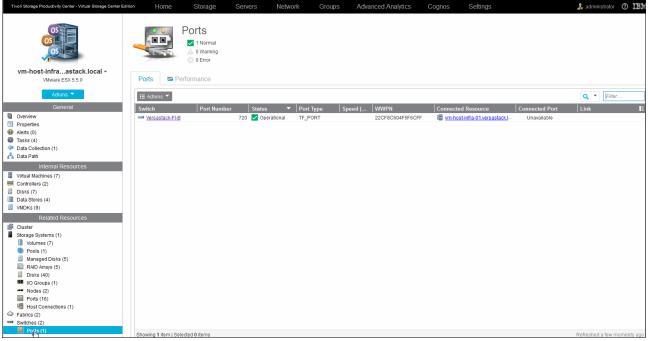


Figure 12-70 Hypervisor switch ports

Spectrum Control hypervisor monitoring and alerting

The Tivoli Storage Productivity Center Virtual Storage Edition Web GUI provides direct insights into the VMware Hypervisor environment that is deployed on the VersaStack infrastructure.

Through the screen captures that are shown in "Integrating the VMware vCenter Hypervisor with Spectrum Control" on page 278, the VSC shows you metrics such as the following ones:

- Storage capacity that is assigned to the hypervisors, and storage space that is used by the virtual machines
- Most active volumes and switch ports for these hypervisors
- Performance of the data store volumes on the Storwize V7000 storage system and the FC switch ports

This data is captured and stored in the underlying DB2 data warehouse that is integrated in the Spectrum Control VSC and used by the Cognos Business Intelligence Reporting engine. It can then be used for *ad hoc* or scheduled reporting, as described in 12.8.4, "Reporting for departments and applications" on page 327.

Monitoring performance

From within the VMware vCenter hypervisor management console, you will likely monitor performance and capacity aspects from a cluster, hypervisor, or single VM perspective. These performance metrics focus primarily on CPU, Memory, Network, and Disk.

At a disk level, you can review, for example, read/write rate and latency for the underlying physical disks for a specific hypervisor, or at physical disk, the data store or VDMK level for individual virtual machines.

However, you can have only the most detailed performance metrics in real time from within the VMware vCenter.

Figure 12-71 shows the VMware vCenter sample real-time performance chart for infra_datastore_1.

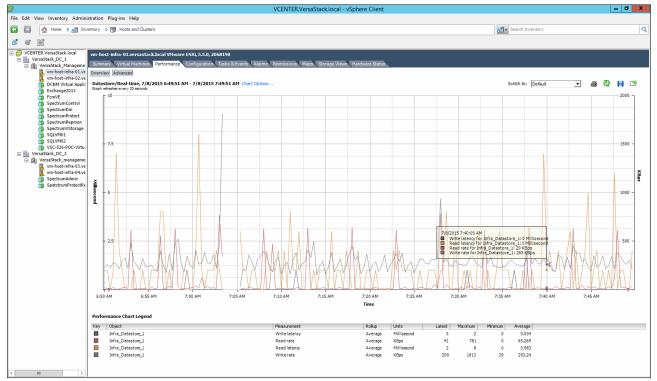


Figure 12-71 vCenter data store real-time performance

Within VSC, you can look at the same performance in a view that encompasses both real-time and historical data, as shown in Figure 12-72.

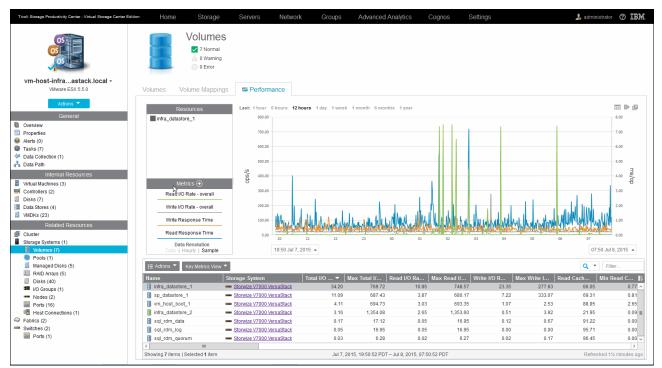


Figure 12-72 VSC data store real-time performance

You can dynamically narrow or expand the scope from one minute to up to the maximum period that you specified in the VSC retention settings. In this view, you can easily toggle between 1/6/12 hour periods or day/month/6 months/year.

You also have access to additional storage hardware-related metrics, such as Cache to Disk and Disk to Cache, and you can select multiple volumes to be overlaid in a single graph. In Figure 12-73 on page 297 is the same graph as in Figure 12-72, but with a second data store added and the scope expanded to 1 month.

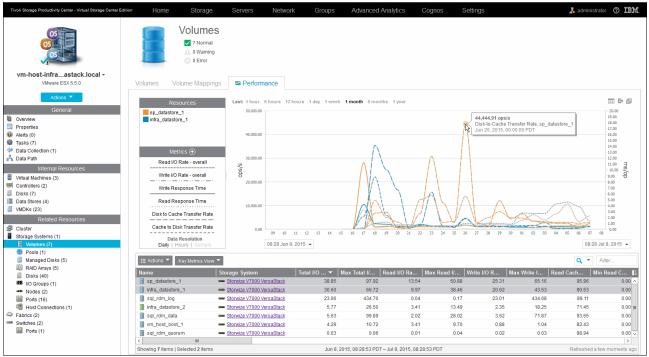


Figure 12-73 VSC multiple data stores 1-month overview

You can also use the vSphere Web Client extension to monitor performance by using storage system metrics, which gives the VMware administrator access to this information from a familiar working environment. However, the granularity is limited to a fixed 1-hour, 1-day, or 1-week interval when you access the information.

Figure 12-74 shows the VMware vSphere Web Client VASA that is provided by the Storage System Metrics performance chart.

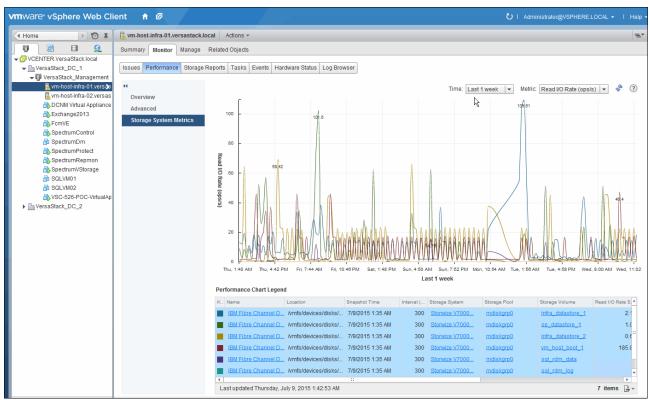


Figure 12-74 vSphere Web Client storage systems metrics performance

In addition to monitoring, you can also view reports that are customized to use information from Tivoli Storage Productivity Center. The reports include fabric connections, storage mapping information, and performance metrics for storage systems.

In our example, we registered the VSC as a VASA provider to the vSphere Web Client, which provides the following vSphere reports to view information about your virtual resources and the back-end storage systems:

Fabric Connections

This storage report displays fabric information that includes zone and switch details in the vSphere Web Client.

Storage Mapping

This Storage Mapping report displays end-to-end mappings between back-end storage that is monitored by Tivoli Storage Productivity Center and the virtual resources that are monitored by vSphere.

Storage System Metrics

This performance report displays performance metrics that include the total I/O rate and response time for the back-end storage systems that are monitored by Tivoli Storage Productivity Center, and that performance is running on the storage system.

SCSI Volumes (LUNs)

This volume report displays block storage information that is provided by Tivoli Storage Productivity Center. The information includes the following details:

- Space that is committed to the volume
- Thin-provisioning status
- System capability
- Storage array name
- Volume identifier on the array
- Namespace of the VASA provider
- Datastores

The Datastores report includes file system information that is provided by Tivoli Storage Productivity Center, including the system capability and the namespace of the VASA provider.

Capacity

The Hypervisor Overview pane in the VSC shows the capacity that is used by the VMs on the specific hypervisor.

Figure 12-75 shows the VSC Hypervisor Overview listing space by VM.

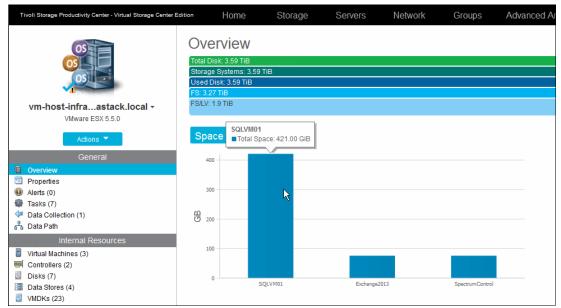


Figure 12-75 VSC Hypervisor Space by VM

Similarly, this information can be obtained through the VSC extension to the vSphere Web Client.

Figure 12-76 shows the VMware vSphere Web Client VASA-provided storage reports.

(Home) 🕲 I	VersaStack Management A	ctions 👻					-
							_
I 🔁 🖻 🧕	Getting Started Summary Moni	tor Manage Relate	d Objects				
VCENTER.VersaStack.local							
VersaStack_DC_1	Issues Performance Profile Cor	mpliance Tasks Even	ts Resource A	llocation vSphere DRS vSp	here HA Utilization Storag	ge Reports	
⇒ 🖞 VersaStack_Managemer♪							
vm-host-infra-01.versas	<u>@</u>				Report On: S	SCSI Volumes (LUNs)	
🗟 vm-host-infra-02.versas	SCSI ID	Datastore 1	Capacity	System Capability *	Storage Array *	Identifier on Array *	
DCNM Virtual Appliance	020004000060050764008180c	Protect_Datastore_1	2.00 TB	EasyTier,Replication	Storwize V7000 VersaSta	ack sp_datastore_1	
Exchange2013	020002000060050764008180c	Infra Datastore 2	256.00 GB	EasyTier,Thin,Replication	Storwize V7000 VersaSta	ack infra datastore 2	
FcmVE	020001000060050764008180c	Infra_Datastore_1	1.00 TB	EasyTier,Replication	Storwize V7000 VersaSta	ack infra_datastore_1	
SpectrumControl	02000000060050764008180c	host-infra-02-boot-2	32.00 GB	EasyTier,Replication	Storwize V7000 VersaSta		
SpectrumProtect	02000000060050764008180c	host-infra-01-boot-1	32.00 GB	EasyTier,Replication	Storwize V7000 VersaSta		
SpectrumRepmon		nost-inita-o 1-boot- i					
Spectrum/VStorage	020006000060050764008180c		1.00 GB	EasyTier,Replication	Storwize V7000 VersaSta		
SQLVM01	020003000060050764008180c		256.00 GB	EasyTier,Replication	Storwize V7000 VersaSta	ack sql_rdm_data	
SQLVM01	020005000060050764008180c		64.00 GB	EasyTier,Replication	Storwize V7000 VersaSta	ack sql_rdm_log	
VSC-526-POC-VirtualAp							
Up 100 320-1 00-VIIItuaiAp							

Figure 12-76 vSphere Web Client storage reports

Alert configuration

For the hypervisors, you can define the following alert triggers:

- Hypervisor
 - Server Status Change Offline
 - Server Status Change Online
 - Hypervisor Missing
 - Probe Failed
- ► File Systems
 - File System Discovered
 - File System Low on Free Space
- Disks
 - Disk Discovered
 - Disk Defect Discovered
 - Disk Failure Predicted

Figure 12-77 on page 301 shows the VSC Hypervisor where we define a File System Low on Free Space alert. It shows how to trigger an alert when the file system has 5% free space left. Instead of a percentage value, fixed data sizes can be used.

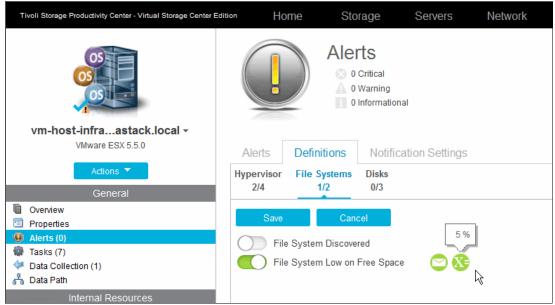


Figure 12-77 VSC Hypervisor alert definitions

12.8 Advanced Analytics

The Advanced Analytics feature that is built into Tivoli Productivity Center Virtual Storage Edition transforms the VersaStack environment on a cloud-enabled environment in the following ways:

- ► Defines service classes for the storage requirements
- Provides self-provisioning to servers and hypervisors
- Optimizes the placement of new volumes at volume creation and during the data lifecycle of that volume

12.8.1 Cloud Configuration

In the Cloud Configuration tab of the VSC Web GUI, you assign storage to tiers, define service classes, and create capacity pools. This section uses a *learn the concepts* overview within the GUI itself that you can use to become familiar with this function. The overview outlines the required steps.

Advanced Analytics Tivoli St rage Productivity Center - Virtual Storage Center Edition Home Storage Servers Network Groups Cognos Settings 00000 Assign storage pools to tiers by setting the tier level of each storage pool. The tier levels are number tags that can reflect any tier structure in the environment. You must assign storage pools to tiers to later provision volumes that Assign Storage to Tiers require a certain tier level and to optimize the placement of volumes. 2 Work With Service Classes Work With Capacity Pools

Figure 12-78 shows the VSC Advanced Analytics Learning the Concepts built-in tutorial.

Figure 12-78 VSC Advanced Analytics - Learning the Concepts

Storage tiers are defined at a Storwize V7000 pool level. In our example setup, we have SSD and SAS-based storage pools that are assigned to tier 1 and tier 2.

Figure 12-79 shows the VSC Advanced Analytics defined storage tiers in the VersaStack environment.

Tivoli St	torage Productivity Center - Virtual Storage	Center Edition	Home	Storage	Servers	Network	Groups	Advanced Analytics	Cogr
	Learn the Concepts			ign Stora	•		" action to assi	an a tier	
	Assign Storage to Tiers		Color		pools and use			k	
2	Work With Service Classes	I≣ Actions ▼	1						
	Work With Capacity Pools	Name Maiskgrp(Maiskgrp) Maiskgrp1		Storage System Storwize V70 Storwize V70	00 VersaStack	Tier Tier 2 Tier 1	RAID Level RAID 5 RAID 5	Solid State No Yes	

Figure 12-79 VSC Advanced Analytics - storage tiers

After you set the tiers, you can create service classes and define which tiers will be used for the specific service class, as shown in Figure 12-80 on page 303.

Create Serv	Create Service Class										
Define Proper	ties										
\mathbf{P}	Name: Description:	VersaStack_SQL									
	✔ Storage tier:	2 3 4 5 6 7 8 9 10 ?									
	RAID level:	Any ~									
	Virtualization:	On 🦳									
	VDisk mirroring:	Off									
	Thin provisioning:	Off									
	Redundant fabrics										
	Advanced										
	 Back 	Next ► Cancel									

Figure 12-80 VSC Advanced Analytics - SQL Service Class

Apart from the tier selection, you can define whether this volume must be mirrored to a auxiliary storage system, whether to use thin provisioning or to enforce redundant fabrics, as shown in Figure 12-81.

Tivoli Sto	orage Productivity Center - Virtual Storage	Center Edition	Home	Storage	Servers	Network	Groups	Advanced Analytics	Cognos Setting	5 Administrator (?) IBM.
60	Learn the Concepts		, P		Service	Classes				
	Assign Storage to Tiers	4	14	1	b.					
2	Work With Service Classes	+ Create Serv	vice Class	Actions 🔻						Q Filter
		Name	A	Туре	Used Space (%)	Total Capa	acity (GiB)	Available Space (GiB)	Unavailable Space (GiB)	Description
	Work With Capacity Pools	😤 Bronze		Block			0.00	0.00		0.00 Standard storage for non-mission-critical applications.
		P Enhancedis	solation	File			0.00	0.00		0.00 Enhanced isolated file storage.
		😍 Gold		Block	38%		1,186.00	738.00		0.00 Highest-performing storage for mission-critical applications.
		😤 Normalisola	ation	File			0.00	0.00		0.00 Normal isolated file storage.
		P Silver		Block	0%		12,044.00	12,044.00		0.00 High-performing storage for applications in production.
		🐶 VersaStack_	_SQL	Block	0%		12,782.00	12,782.00		0.00

Figure 12-81 VSC Advanced Analytics - Service Classes

As part of the service class creation, you can restrict the service class to specific capacity pools and define which users can provision from this service class. You can allow non-admin users to provision from these service classes without additional approval to run the provisioning request.

Figure 12-82 shows the VSC VersaStack and VersaStack_SSD capacity pools.

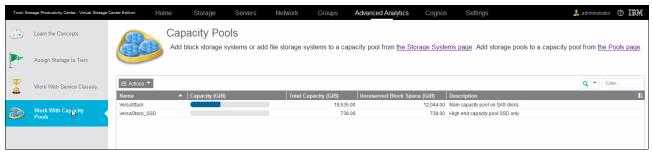


Figure 12-82 VSC Advanced Analytics - Capacity Pools

Similar to the Cisco UCS service profiles, you can use the VSC service classes to have a uniform deployment of your storage resources to the hypervisors or applications running on the hypervisors, such as this SQL cluster in this environment.

In the VersaStack_SQL service class that we created, we assigned both the Tier1 (SSD) and the Tier2 (SAS) tiers. When creating volumes based on this service class, the VSC analyzes the load on the pools that are associated with these tiers by using the historically captured performance data for optimal volume placement at the creation of the new volume.

12.8.2 Provisioning

With the service classes defined, you can now provision volumes. First, provision an additional data volume for the SQL Servers from within the VSC Web GUI, and then provision a new data store by using the vSphere Web Client VSC extensions.

Provisioning LUNs and volumes to the SQL cluster

To provision LUNs and volumes to the SQL cluster, complete the following steps:

1. Start the VSC Web GUI and navigate to the Servers section. Select the SQLVM01 and SQLVM02 servers, right-click them, and select **Provision Storage**.

Figure 12-83 on page 305 shows the VSC Provisioning starting the Provision Storage wizard to provision additional LUNs to the SQL Servers.

voli Storage Pro	Serve 8 Norm 0 Warr	nal hing achable		Storage		
Servers	Clusters	Alerts	Tasks Discover	ed Servers		
+ Add Sen	ver 🗄 Actions 🔻	1				
		Ctatur	- D k- Ct-t	A C4-4-		001/
Name	nrenmon	Status		Agent State	OS Type Windows	OS Version 6.1:Service Pack 1
-	13.VersaStack.local	Normal		V Up	Windows	6.2
	rsastack.local	Normal		V Up	Linux	3.0.76-0.11-defaul
InfraServ		Normal		V Up	Windows	6.2
B Spectrur		Normal		V Up	Windows	6.2
a spectrum	nprotect	Normal	Successful	V Up	Linux	3.0.76-0.11-default
B SQLVM0	1.VersaStack.local	🗸 Normal	Data Collection		Windows	6.2
B SQLVM0	2.VersaStack.local	Vormal	Edit Alert Definitions	•	Windows	6.2
PresaSta	ackDC.VersaStack	Normal	Edit Alert Notification Se	ottingo	Windows	6.2
			Provision Storage	eurrys		
			Analyze Tiering			
			Add to Application			
			Modify Agents			
			Remove	•		
			Remove			

Figure 12-83 VSC Provisioning - storage

2. Choose between block or file volume provisioning. Click **Block** and click **Next**.

Figure 12-84 shows the VSC Provisioning defining the required volumes and selecting the VersaStask_SQL service class.

Pr	ovision Storage							
	Define Volumes Specify the characteristics of the volume <u>i</u> <u>BPCUI01581</u> Volumes are assigned to the hypervisor		s. Volume	s are not assigned directly to virtual i	machine	S.		
	Name	Capacity		Service Class View		Capacity Pool View		
	1. sql_rdm_data_2	256 GiB	3 🗸	VersaStack_SQL	\sim	All available storage	\sim	×
1	2. sql_rdm_log_2	64 GiB	3 🗸	VersaStack_SQL	\sim	All available storage	\sim	×
	+ Add More 1 \$ Ticket:							
0			⊲ Back	Next ►				ancel

Figure 12-84 VSC Provisioning - Storage - Define Volumes

Note: The volumes that you want to use as raw device mapped volumes for the SQL Servers are created and assigned to the hypervisors and not to the SQL Servers directly. You must create the RDM-based disk later.

When you click **Next**, the built-in analytics engine determines the ideal storage pool placement for the volume based on the historical data that it captured from the storage environment.

Figure 12-85 shows the VSC Provisioning analytics engine calculating the ideal storage pool in which to place the volume.

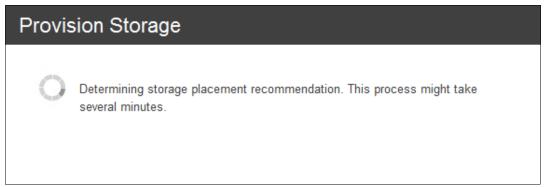


Figure 12-85 VSC Provisioning - storage placement

After the placement recommendation is defined, an overview window opens and shows the provisioning task with the option to either run it immediately or to schedule it for processing during your regular maintenance window.

Figure 12-86 shows the VSC Provisioning overview of the tasks to be run.

Provision S	Storage						
Service Class: 😲	VersaStack	SQL User: administrator					
Storage							
Status	Action	Volume Name	Pool	Storag	e System	Capacity (GiB)	
🔲 Not running	Create	🚦 sql_rdm_data_2	8 mdiskarp0	- Stor	wize V7000 Ver	256.00	
🔲 Not running	Create	🚦 sql_rdm_log_2	🛞 <u>mdiskqrp0</u>		wize V7000 Ver	64.00	
Host Connections Status	Action	Host Name	Host Type	Port	Volume		IJ
O Not running	Assign	wn-host-infra-02.versastack.lo	VMware ESX	20000025B501	🚦 sql_rdm_lo		
O Not running	Assign	vm-host-infra-01.versastack.lo	VMware ESX	20000025B501	🚦 sql_rdm_da.		
🔘 Not running	Assign	vm-host-infra-01.versastack.lo	VMware ESX	20000025B501	🚦 sql_rdm_lo		
🔘 Not running	Assign	vm-host-infra-02.versastack.lo	VMware ESX	20000025B501	🚦 sql_rdm_da		
		✓ Back	Execute	Schedule	Delete		Close

Figure 12-86 VSC Provision Storage Task Summary

3. Click **Execute** to start the job immediately and monitor the progress.

Figure 12-87 on page 307 shows that all jobs completed successfully.

Provisionin	g						
	rsaStack	_SQL_sql_rdm_data_2-201	Rename				s, 2015 09:31:19 PDT verage Duration: N/A <u>Open Logs</u> IP
Service Class: 🥐	VersaStack	SQL User: administrator					
Storage Status	0-11	Nolume Mana	Pool	64	- C	C	IJ
Status	Action Create	Volume Name	Pool		e System wize V7000 Ver	Capacity (GiB) 256.00	
Successful	Create	sql rdm log 2	mdiskqrp0		wize V7000 Ver	64.00	
Host Connections							
Status	Action	Host Name	Host Type	Port	Volume		
Successful	Assign	wm-host-infra-02.versastack.lo		20000025B501	sql rdm lo		
Successful	Assign	wn-host-infra-01.versastack.lo	VMware ESX	20000025B501	🗄 sql rdm da.		
 Successful 	Assign	wm-host-infra-01.versastack.lo	VMware ESX	20000025B501	🗄 <u>sql rdm lo</u>		
 Successful 	Assign	vm-host-infra-02.versastack.lo	VMware ESX	20000025B501	📱 <u>sql rdm da</u> .		
			$\widehat{\mathbf{A}}$				
Need Help		Execute	Schedule	Delete	Close		

Figure 12-87 VSC Provisioning - job results

- 4. To create the RDM mapping to the SQLVM01 and SQLVM02, complete the following steps:
 - a. Log in to the VMware vCenter.
 - b. Navigate to Hosts and Clusters.
 - c. Select vm-host-infra-01, select Configuration, and click Storage Adapters.
 - d. Click Rescan All.
 - e. Select vm-host-infra-02, select Configuration, and click Storage Adapters.
 - f. Click **Rescan All**. Two new devices (256 GB and 64 GB in size) show up in the devices list.
 - g. Navigate to VMs and Templates.
 - h. Select the SQLVM01 and Edit Settings.
 - i. Click $Add \rightarrow Hard Disk \rightarrow Raw Device Mappings$, and click Next.

-					Y			
9		SQLVM01 - Virtua	I Machine Properties		^			
Hardv	ware Options Resource	es Profiles VServices		tual Machine Version:	vmx-10			
		Add Remove	1011 GB Memory Size:	16 🕂 GB	-			
		Summary	512 GB - Maximum ros	ammandad far thia				
						1		x
			N AUC					
□ ⊘	VMCI device SCSI controller 0							
	Hard disk 1		Nar	ne, Identifier, Path ID	, LUN or C	apacity contains	s: •	Clear
	Hard disk 2	Select Target LUN	Name	Path ID	LUN	Capacity I	Hardware Acceleration	
	Hard disk 3	Select Datastore	IBM Fibre Channel Disk (naa.60050	vmhba0:C0:T0:L8	8	256.00	Supported	
	Hard disk 4		IBM Fibre Channel Disk (naa.60050	vmhba0:C0:T0:L7	7	64.00 GB	Supported	
8 <u>8</u>	Network adapter 1							
8 <u>9</u>		Ready to complete						
88) 1	Network adapter 3							
	Help							
			I					
		Help				< Bac	k Next >	Cancel
		Hardware Options Resource Show All Devices Hardware Memory CPUs Video card VMCI device SCSI controller 0 SCSI controller 1 CD/DVD drive 1 Hard disk 1 Hard disk 1 Hard disk 3 Hard disk 3 Hard disk 4 Network adapter 1 State Controller 1 Hard disk 4	Hardware Options Resources Profiles VServices Add Remove Add Remove Hardware Summary Memory Sources Video card VMCI device SSCSI controller 1 CD/DVD drive 1 Hard disk 1 Hard disk 2 Hard disk 3 Hard disk 3 Hard disk 4 Network adapter 1 Network adapter 3 Help	Hardware Options Resources Profiles VServices Vi Show All Devices Add Remove Configuration Hardware Summary Size: CPUS CPUS Video card Video card Video card Video card CD/DVD drive 1 Hard disk 1 Hard disk 2 Hard disk 3 Hard disk 4 Network adapter 1 Network adapter 2 Network adapter 3 Help	Hardware Options Resources Profiles VServices Virtual NoteLinite Properties Virtual Machine Version: Show All Devices Add Remove 1011 CB Memory Stee: 16 = GB Hardware Summary Add Hardware Size Add Hardware Size CB Memory Stee: 16 = GB Victo CPUs	Hardware Options Resources Profiles Vservices Victual Machine Version: vmx-10 Show All Devices Add Remove Memory Configuration Hardware Summary Add Remove Memory Size: 16 G Add Hardware Add Hardware Summary Add Hardware Commended for this Add Hardware Select and Configure a Raw LUN Which LUN would you like to use for this raw disk? Select Target LUN Remove Adapter 1 Network adapter 2 Network adapter 3 Network adapter 3 Network adapter 3 Help	Sciences Profiles Virtual Machine Properties Hardware Options Resources Profiles Virtual Machine Version: vmx-10 Show All Devices Add Remove If addition of the state of th	Bold Viriol - Viridal Machine Profiles Verbal Machine Version: vmx-10 Memory Show All Devices Add Remove Memory Memory Configuration Memory State Memory Configuration Memory State Memory Configuration Memory Memory Memory Memory Memory Configuration Memory Memory

Figure 12-88 shows VSC Provisioning adding the new LUNs as RDMs to the SQL VMs.

Figure 12-88 VSC Provisioning - add RDM

- j. Select the new data LUN and click Next.
- k. Store the LUN mapping with the virtual machine and click Next.
- I. Choose Physical compatibility for the LUN mapping and click Next.
- m. Choose the virtual device node and click Next and then Finish.

Repeat steps 4a on page 307 to 4m for the log LUN on SQLVM01 and for both the data and log LUN on the SQLVM02.

Provisioning a new data store to the hypervisor

You can provision a new volume to the hypervisors from within the VSC Web GUI and have a data store assigned to it. The same action can be performed from within the vSphere wEb Client.

This function gives VMware administrators the flexibility to foresee their own provisioning needs. Storage allocation is controlled by the use of service classes. The service class defines the target tier, the capacity pool, and whether the provisioning action can be carried out immediately or must be approved by the storage admin from within the VSC Web GUI first.

Figure 12-89 on page 309 shows the VSC vSphere Web Client extension connection status.

vmware: vSphere Web Cl	ient 🕇 🖉 🕴 U I Administrator@VSPHERELOCAL	✓ I Help
History	IBM Tivoli Storage Productivity Center	
🚮 Home		?
Image: Second	IBM Twoli Storage Productivity Center is software that centralizes, automates, and simplifies storage management. You can use this vSphere Web Client extension for Twoli Storage Productivity Center to: 1. Provision block and file storage and make the storage available as a datastore. 2. View details about your environment such as volume performance and fabrics 3. View end-to-end mappings between back-end storage and resources such as virtual machines, virtual machine file systems, hypervisors, and clusters. Enter and save credentials and connection information to connect to Tivoli Storage Productivity Center. Saving also registers Tivoli Storage Productivity Center as a VAS for the vCenter Server.	SA provider
😨 Tasks 🕞 Log Browser 🙀 Events	Host name: SpectrumControl VersaStack.local IBM Tivoli Storage Productivity Center	
🧳 Tags	Port: 9589 Extension version: 5.2.6.020150518	
New Search Saved Searches	User name: administrator Licensed Material - Property of IBM Corp. 5725-F92, 5725-F93, 5725-G33, 5725-P45, 5725-P92 (C) IBM Corp.oration and other(s) 2013, 2014. IBM, the IBM logo, and Twoli are trademarks of IBM Corp., registered in many jurisdictions worldwide.	
	Password: ******** For more information visit: http://pic.dhe.ibm.com/infocenter/livihelp/59/1/index.isp	
	Connected Version: 5.2.6.0 Build: 20150518-1239	•

Figure 12-89 VSC vSphere - Web Client Extension

To provision a new data store to the hypervisors, complete the following steps:

- 1. Log in to the vSphere Web Client.
- 2. Navigate to the **Hosts and Clusters**. Right-click vm-host-infra-01 and select **Provision Block Storage** from the **All TPC Actions** menu.

vCenter	k 🖟 vm-host-infra-01.versastack.local	Actions 👻
	Summary Monitor Manage Related	d Objects
The sector of th	t Processor Type: Actions - vm-host-infra-01.versastack.local essors: Actions: Actions - vm-host-infra-01.versastack.local essors: Actions: Ac	Cisco Systems Inc UCSB-B200-M Intel(R) Xeon(R) CPU E5-2650 v3
		d not reach isolation address:
Image: Book of the second	Settings JCSB-B2 Move To Assign Tag	stems Inc ESX 200-M4 Ima PUs x 2.29 GHz vMo 9 MB / 130,805 MB ▶ vSpt
	Alarms /M-Host- All vCenter Actions /M-Host- All TPC Actions Pro	B / 0.00 B Infra-01. ► Hos ► EVC Division Block Storage Division File Storage

Figure 12-90 shows the VSC vSphere Web Client provisioning of block storage.

Figure 12-90 VSC vSphere - Provision Block Storage

3. Set the size to 1 TiB, choose the **Silver** service class, select the **Create datastore** check box, name the data Infra_Datastore_3, and click **OK** to start the provisioning.

Figure 12-91 on page 311 shows the VSC vSphere Web Client defining of the block storage provisioning parameters.

VersaStack_Managemen	t:vm-host-infra-01.versastack.local Provision Block Storage ?	×
Size:	1 TiB 🔹	
Service class:	Silver	
Capacity pool:	Any available storage (🔻	
Create datastore	Infra_Datastore_3	
	OK Cancel	

Figure 12-91 VSC vSphere Block Storage Definition

The vSphere Web Client extension communicates with the VSC and runs a provisioning task that is similar to the task that was created for the SQL RAW device mapping provisioning.

Provisionin	g	\$					
	ver_V_15	0713_094238-20150713-09	Rename			Completed: Jul 1	3, 2015 09:41:41 PDT Duration: 1 minute <u>Open Logs</u>
Service Class: 🤨	Silver	User: administrator					
Storage							
Status	Action	Volume Name	Pool	Storag	e System	Capacity (GiB)	IJ
Successful	Create	<u>V 150713 094238</u>	8 mdiskarp0	Stor	wize V7000 Ver	1,024.00	
Host Connections							
Status	Action	Host Name	Host Type	Port	Volume		IJ
Successful	Assign	wn-host-infra-01.versastack.lo	VMware ESX	20000025B501	📳 <u>V 150713</u>		
Successful	Assign	wn-host-infra-02.versastack.lo	VMware ESX	20000025B501	📱 <u>V 150713</u>		
Multipath							
Status	Action	Host Name	Multipathing	Policy			
i Informational		wn-host-infra-01.versastack.lo	Default				
i Informational		vm-host-infra-02.versastack.lo	Default				
Need Help		Execute	Schedule	Delete	Close		

Figure 12-92 shows the task results.

Figure 12-92 VSC vSphere - Provisioning Task

With the vSphere Web Client itself, you can monitor the progress through the Tasks and Events subtabs from the vm-host-infra-01 monitor tab.

Figure 12-93 shows the results of data store provisioning.

🕯 vCenter 🗼 😨 耳	wm-host-infra-01.versastack.local Actions -					
	Summary Monitor Manage Related Objects					
 VCENTER.VersaStack.local WersaStack_DC_1 VersaStack_Management vm-host-infra-01.versas 	Issues Performance Storage Reports Tasks	Hardware Stat	us Log Browser			Q Filter
vm-host-infra-02.versas	Description	Туре	Date Time	Task	Target	User
DCNM Virtual Appliance	The creation of the VMFS completed.	Information	7/13/2015 9:43 AM		vm-host-infra-01	administrator
Exchange2013	Created VMFS datastore Infra_Datastore_3	Information	7/13/2015 9:43 AM		vm-host-infra-01	
FcmVE	Discovered datastore Infra_Datastore_3	Information	7/13/2015 9:43 AM		vm-host-infra-01	
SpectrumControl	File system [Infra_Datastore_3, 55a3ea5a-6b76	Information	7/13/2015 9:43 AM		vm-host-infra-01	
SpectrumDm	Task: Create VMFS datastore	Information	7/13/2015 9:43 AM	Create VMFS datastore	vm-host-infra-01	VSPHERE.LOCAL\Administrate
SpectrumRepmon	The rescan of the HBA completed.	Information	7/13/2015 9:43 AM		vm-host-infra-01	administrator
Spectrum/Storage	Task: Rescan HBA	Information	7/13/2015 9:43 AM	Rescan HBA	vm-host-infra-01	VSPHERE.LOCAL\Administrate
SQLVM01	Task: Rescan HBA	Information	7/13/2015 9:43 AM	Rescan HBA	vm-host-infra-01	VSPHERE.LOCAL\Administrate
SQLVM02	Task: Provision storage for LUN	Information	7/13/2015 9:42 AM	Provision storage for LUN	vm-host-infra-01	administrator

Figure 12-93 VSC vSphere - Provisioning Events

Optimization

VSC facilitates uniform business-aligned storage allocation. As outlined in 12.4.2, "Self-optimizing" on page 242, VSC can also analyze your storage environment either at scheduled intervals or when triggered by performance monitor events to perform storage optimization. Figure 12-94 shows the tiered storage optimization.

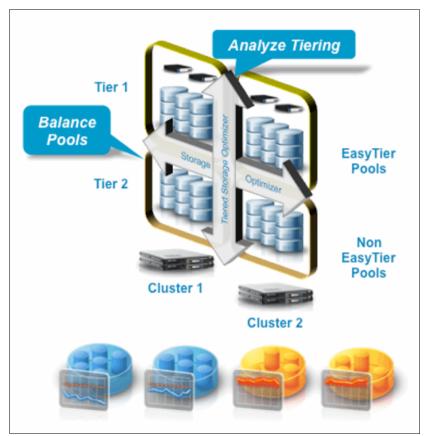


Figure 12-94 VSC tiered storage optimization

Storage optimization can consist of retiering a volume across tiers or balancing volumes within storage pools. This section outlines the logical flow for both actions.

Retiering optimizes storage performance by moving volumes to different storage tiers. You can choose the set of source volumes that you want to analyze for retiering. In this example, the volumes in a tier 2 pool are analyzed to see whether they require retiering to a set of three tier 1 pools, as shown in Figure 12-95.

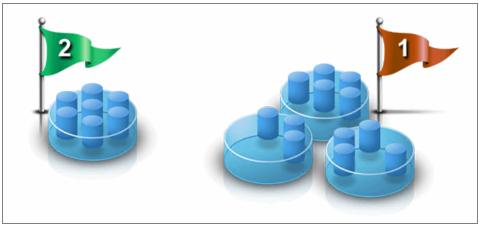


Figure 12-95 VSC Optimization

One of the volumes in the tier 2 pool is overutilized. If the overutilized volume is moved to a tier 1 pool with sufficient performance capacity, then the performance of the volume can be improved (Figure 12-96).

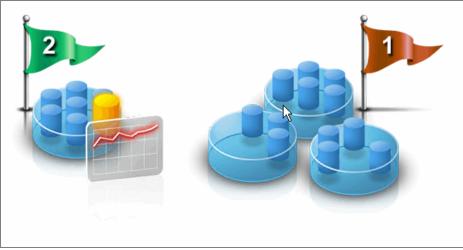


Figure 12-96 Volume should be moved to tier 1

The performance of the target pools on tier 1 is analyzed and recommendations are generated. The recommendations involve up-tiering the overutilized volume from the tier 2 pool to the tier 1 pool. You can review the recommendations and automatically move the volume to the tier 1 pool (Figure 12-97).

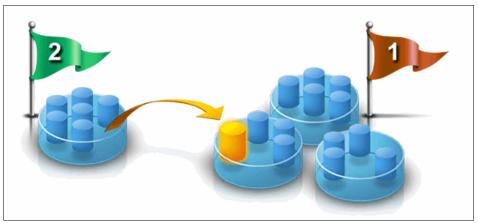


Figure 12-97 Volume moved to tier 1

You can also down-tier volumes. In this example, one of the volumes in the tier 1 pool is underutilized, which means that the volume is occupying more expensive storage than is necessary (Figure 12-98).

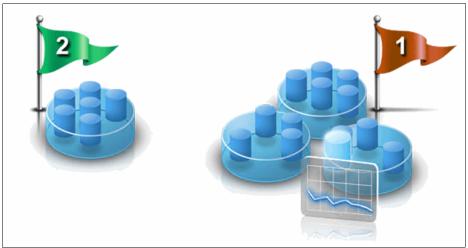


Figure 12-98 Volume that is identified to be down-tiered

By analyzing the performance of the tier 2 pool, a recommendation is generated to down-tier the volume (Figure 12-99 on page 315).

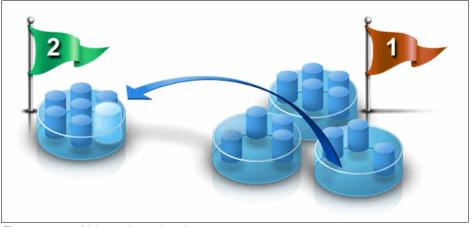


Figure 12-99 Volume down-tiered

A single tiering analysis can result in multiple volume movements in which volumes are moved to both lower and higher tiers of storage. You can schedule an analysis task to run at specified intervals for a selected set of source volumes and target pools so that you can regularly monitor opportunities to retier volumes (Figure 12-100).

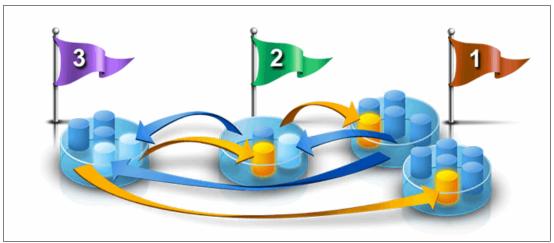


Figure 12-100 Multiple volume movements

Another form of optimization is balancing. An environment can contain pools with low and high activity levels. To identify pools that have high activity levels, look at the values that are shown in the Activity Deviation (%) column. The value in the Activity Deviation (%) column shows the difference between the activity level of the pool and other pools on the same tier and storage system. Pools with values greater than 10% are candidates for balancing (Figure 12-101).

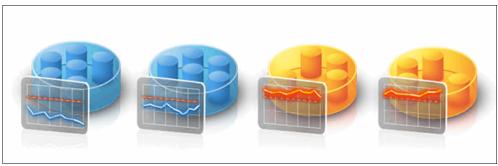


Figure 12-101 Balancing

Tivoli Storage Productivity Center can analyze pools on the same tier and identify opportunities to move volumes such that the activity deviation percentage of the pool falls below 10% (Figure 12-102).

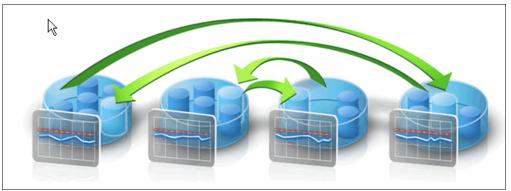


Figure 12-102 Deviation

The volumes with the most I/O activity in our VersaStack environment are the SQL clustered volumes and the data store hosting the Spectrum Protect server. Within the VersaStack capacity pool that we defined, we have two tiers of storage available: Tier 1 using SSDs and Tier 2 using SAS for back-end storage.

Use the Analyze Tiering function of the VSC to evaluate whether the SQL volumes require up-tiering to the SSD-based Tier 1 by completing the following steps:

- 1. Log on to the VSC Web GUI.
- 2. Navigate to Advanced Analytics \rightarrow Optimization \rightarrow Optimize Volumes.
- 3. Select the sql_rdm_data and sql_rdm_log volumes, right-click, and select **Analyze Tiering**, as shown in Figure 12-103 on page 317.

	Learn the Concepts Assign Storage to Tiers		mize Volumes	use the "Analyze Tiering" a	ction to look for ı
	Optimize Volumes	E Actions ▼			
49	Optimize Pools	Name sql_rdm_data sql_rdm_data_01 sql_rdm_data_2 sql_rdm view Performan sql_rdm Analyze Tiening sql_rdm Add to Applicatio sql_rdm_quorum_01	mdiskgrp0 mdiskgrp0	Storage System Storage System Storwize V7000 VersaStack	Status Online Online

Figure 12-103 VSC Optimize Volumes - Analyze Tiering

4. Select the VersaStack capacity pool and click Next (Figure 12-104).

Analyze Tiering			
Determining the Placement	t of Optimized V	olumes	
Choose a set of storage pools for volur are moved to the storage pool that bes the volumes.			
\bigcirc Select the storage pools from a list.			
\bigcirc Select a capacity pool from a list:			
Select the <u>VersaStack</u> capacity pool.			
0	Back	Next 🕨	Cancel

Figure 12-104 VSC Optimize Volumes - Select Capacity Pool

By default, VSC uses the data from the last seven days. You can either set the Volume I/O rate (I/O per second) or Volume I/O Density (I/O per second per GB). You can also define the maximum pool I/O rate for the available tiers to ensure that adding the volume does not cause the total amount of I/O for that pool to be exceeded (Figure 12-105).

Analyze Tiering		Q Name ▼ sql_rdm
Optimize the Placement of Volumes Analyze pool activity over the previous 7 \$ days Restrict Volume Placement Colocate volumes assigned to the same server or hypervisor. Yes	256.00 256.00 64.00 64.00	Physical Allocation (%) Fully Allocated
Threshold Above	Avoid ov for pools moved in the IO lin Specify t	D Fully Allocated Eulty Allocated er-saturating pools by specifying IO limits swithin each tier. Volumes will not be nto a pool if the movement would cause mit to be violated. the maximum non-cache I/O rate a pool in can sustain, after normalizing by pool
Below	~	
Analyze Cancel	1	

Figure 12-105 VSC Optimize Volumes - Define Thresholds

5. Click Analyze to start the process, as shown in Figure 12-106.

Tiering Analysis				
TieringAnalysis_20150714_045209883	Rename	idus internet a Taran dada analisi		ated: Jul 14, 2015 04:52:10 PDT Duration: 1 second <u>Open Logs</u>
Based on the analysis of the current performance data, none of analyze the source volumes or pools to run at regular intervals. Analysis Recommendations			onations for tering of balancing	poors, schedule the task to
i≣ Actions ▼ Pool Storage System Original Activ	vity Projected Activity Original A	ctivity Deviation (%) Projected Activity [llocated Sp │Recomi II
Image: mdiskgrp1 Storwize V7000-207 Image: mdiskgrp0 Storwize V7000-207	0.01 0.01	-100	-100	738.00 10.698.00
	ŀ\$			
Showing 2 items Selected 0 items				Refreshed a few moments ago
0	Execute Edit	Delete Close		9

Figure 12-106 Tiering Analysis results

The load over the past seven days on the SQL cluster in our VersaStack setup does not require the SQL clustered volumes to be moved into tier 1. We can now schedule this analysis to take place, for example, each week.

The results of the Analyze Tiering is grouped in the Tasks section of the VSC Web GUI. Recommendations for up- or down-tiering can be run after review by the storage administrator or set up for automated running as the tiering migration is transparent and has no impact on the host system.

12.8.3 Integrating servers and virtual machines

In "Integrating the VMware vCenter Hypervisor with Spectrum Control" on page 278, we added the VMware vCenter environment to the Tivoli Productivity Center VSC. As a result, all virtual machines running on the hypervisor are discovered at the time the scheduled resource probing of these systems takes place.

Within VSC, both physical and virtual systems are grouped in the Servers section.

Figure 12-107 shows the VSC Servers overview filtered by the Microsoft SQL virtual machines.

on only center - virtual o	torage Center Editio	home Home	Storage	Servers	Network	Groups	Advanced Analytics	Cognos	Setting
Server	S								
S Norma	al								
💧 🚺 🛆 0 Warnir	ng								
© Error									
🚸 1 Unkno	14/07								
	WII								
		asks Discov	vered Servers						
Servers Clusters		asks Discov	vered Servers						
Servers Clusters		asks Discov	vered Servers						
Servers Clusters		asks Discov	Agent State	OS Type	OS Version	Tota	Disk Space (GiB)		
Servers Clusters	Alerts Ta		1	OS Type Windows	OS Version 6.2	Tota	Disk Space (GiB) 421.00		

Figure 12-107 VSC Servers overview

Servers can be both physical or virtual systems. Virtual machines are added under the Discovered Servers tab.

On these servers, you can install Storage Resource agents to collect information about storage resources, such as servers, virtual machines, workstations, HBAs, and fabrics.

You must deploy Storage Resource agents on resources where you want to gather the following information:

- Asset information
- File and file system attributes
- Database application information
- Network-attached storage (NAS) device information
- Topology information
- Information about zoning and the fabrics that are visible to the server

You can also monitor servers without deploying a Storage Resource agent. When you add an agentless server, VSC correlates information about that server with the known host connections on monitored resources. If a match is made between the server and a monitored resource, you can view topology information and the capacity and performance of the storage that is assigned to that server.

We deployed a Storage Resource Agent on both members of the SQL clusters by completing the following steps:

- 1. Open the VSC Web GUI.
- 2. Navigate to Servers and click Add Server.

Figure 12-108 shows adding a server and deploying a Storage Resource Agent.

Add Server			
Select a Method to Add a Server			
Deploy an agent for full server monitoring	?		
		Ą	
Manually	From a File List		From Discovered Servers
0			Cancel

Figure 12-108 VSC Add Server

3. Select the **Deploy an agent for full server monitoring** and click **Manually**. You can also deploy multiple storage resource agents at a time by creating a file list containing the required information (Figure 12-109 on page 321).

Add Server			
Deploy Agent			
	Host name or IP address:	SQLVM01.VersaStack.local	
$\odot \rightarrow$ –	Installation path:	C:\Program Files\IBM\TPC	1
	Authentication:	User Name and Password	/
	User name:	administrator	
	Password:	•••••	
	🖌 Run in daemon mode		
	Port:	9510	
	Specify a user to run the se	rvice for Windows platforms:	
	User name:	administator	?
	Password:	•••••	
0	■ Back	Next ► Cano	el

Figure 12-109 VSC Add Server - Deploy Agent

4. Provide the required connectivity and login credentials and click Next (Figure 12-110).

Add Server						
Configure						
	Location:	San Jos	е			\sim
	Agent deployment:	Immedi	ate			\sim
	Schedule probe:	04:00	PDT	\sim	Every day	\sim
0	 Back 		Finish			Cancel

Figure 12-110 VSC Add Server - Schedule a probe

Similar to other resources, such as the Storwize V7000 storage systems a schedule is created to probe the newly added server at specified intervals (Figure 12-111).

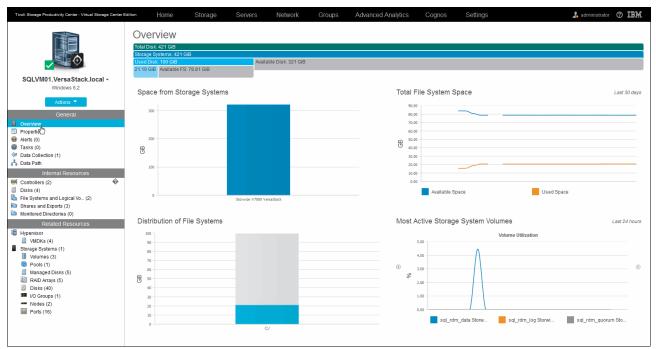


Figure 12-111 VSC Server - detailed overview

Within VSC, we take a uniform approach to group the information for the selected resource in three sections, as you can see in the left pane of Figure 12-111:

- General:
 - Overview: Gives a graphical representation of the following items:
 - Space from Storage Systems
 - Most Active Switch Ports
 - Most Active Storage Systems Volumes
 - Total File System Space
 - Distribution of File Systems
 - Properties: Displays General, Hardware, Storage, and Agent Related Information.

Figure 12-112 on page 323 shows the VSC Server General properties.

Tivoli Storage Productivity Center - Virtual Storage Center E	Edition Home Sto	rage Servers Network Groups Advanced Analytics C
	Properties	
	General Hardware	Storage Agent
	Name	SOLVM01.VersaStack.local
SQLVM01.VersaStack.local -	Status	Vormal
Windows 6.2	Acknowledged	No
Actions 🔻	OS Type	Windows
General	OS Version	6.2
Overview	IP Address	192.168.10.51
Properties	Domain Name	versastack.local
 Alerts (0) Tasks (0) 	Cluster	_
Data Collection (1)	Virtual Machine	Yes
🖞 Data Path	Hypervisor	International states and the states of the s
Internal Resources	Last Start Time	Jul 10, 2015 01:09:16 PDT
Disks (4)	Probe Status	Successful
File Systems and Logical Vo (2)	Probe Schedule	Daily. Next run at Jul 15, 2015 12:30:00 PDT
 Shares and Exports (3) Monitored Directories (0) 	Time Zone	GMT-07:00
Related Resources	Data Source Count	1
Hypervisor	Location	San Jose
 VMDKs (4) Storage Systems (1) 	Custom Tag 1	_
Volumes (3)	Custom Tag 2	_
 Pools (1) Managed Disks (5) RAID Arrays (5) Disks (40) 	Custom Tag 3	_
 I/O Groups (1) Nodes (2) 	L	Edit

Figure 12-112 VSC Server Properties

- Alerts: Shows the alerts that are filtered for the selected server. Within the Definitions tab, you can activate or customize the following alerts:
 - Server Status Change Offline
 - Server Status Change Online
 - HBA Driver Version Changed
 - HBA Firmware Version Changed
 - Probe Failed
 - File System Discovered?
 - File System Low on Free Space?
 - File System Missing
 - Disk Discovered
 - Disk Defect Discovered
 - Disk Failure Predicted
 - Disk Missing
 - Grown Disk Defects Threshold Exceeded

Figure 12-113 shows these alert definitions.

	Groups	Advanced Analytics	Cognos
tion Settings			
\sim			
\sim			

Figure 12-113 VSC Server - alert definitions

For each of these alerts, you can override the default notifications settings and have a script that is run through the Storage Resource Agent to take corrective actions automatically.

- ► Tasks: Groups tasks, such as provisioning jobs, for the specific server.
- Data Collection: Shows the status result of the latest probe and allows you to perform an Agent Upgrade (Figure 12-114).

Tivoli Storage Productivity Center - Virtual Storage Center Editio	m Home Storag	ge Servers	Network	Groups	Advanced Analytics	Cognos	Settings	🤰 administrator 🕜 🗓
	Data 0	Collection						
SQLVM01.VersaStack.local -	-							
Windows 6.2	Probe							Actions 🍷
Actions 🔻								
General	Last Successful Probe		Jul 1	4, 2015 12:29:14 F	PDT			
Overview	Schedule		Dail). Next run at Jul 15	2015 12:30:00 PDT			
Properties	Average Duration		1 se	cond				
 Alerts (0) Tasks (0) 								
Data Collection (1)								
🚰 Data Path	Agent Upgrad	e						Actions
Internal Resources	Agent Version		5.2.6	5.0				
Controllers (2)	Last Upgrade Status		Lina	vailable				
Disks (4)	Last Upgrade Time			vailable				
 File Systems and Logical Vo (2) Shares and Exports (3) 								
Monitored Directories (0)	Schedule			vailable				
Related Resources	Agent State		Up					
Hypervisor								

Figure 12-114 VSC Server - Data Collection

- Data Path: Shows the SAN data path.
- Internal Resources:
 - Controllers: Lists the internal controllers of the server, including information such as type, driver version, firmware, ROM version, HBA WWN, serial number, bus address, bus number, and associated disks.

- Disks
- File Systems and Logical Volumes
- Shares and Exports
- Monitored Directories
- Related Resources
 - Hypervisor: Lists the VMDKs that are associated with the server.

Figure 12-115 shows the VSC Server view of the SQL member and its associated VMDKs.

Tivoli Storage Productivity Center - Virtual Storage Center Edition	Home	Storage	Servers	Network	Groups A	Advanced Analytics	Cognos	Settings		💄 administrator 🕜 IBM.
		VMDKs								
SQLVM01.VersaStack.local -										
Windows 6.2	I≡ Actions ▼									Q - Filter
Actions 🔻	Path		Size (GiB)	Data Store	Virtual Machine	Hypervisor		Volume	Storage System	lk.
General	[Infra_Datastore_1]	SQLVM01/SQLVM01		Infra Datasto	a 2	VersaStack Ma	nagement	🗄 <u>sal rdm quorum</u>		Path 2
Overview	[Infra_Datastore_1]	SQLVM01/SQLVM01	256.00	Infra Datasto	2	VersaStack Ma		sql rdm data	Storwize V7000-2076	Size (GiB)
Properties	[Infra_Datastore_1]	SQLVM01/SQLVM01	64.00	Infra Datasto	2	VersaStack Ma		sql rdm log		Used Space (%)
Alerts (0)		SQLVM01/SQLVM01	100.00	Infra Datasto	B SOLVM01.VersaSta	ack.l I VersaStack Ma	nagement	infra datastore 1	Storwize V7000-2076	✓ Data Store
Tasks (0)										Virtual Machine
Data Collection (1)										
🖧 Data Path										
Internal Resources										File System
Controllers (2)										 Hypervisor
Disks (4)										Disk on Hypervisor
File Systems and Logical Vo (2)										✓ Volume
Shares and Exports (3)										Pool
Monitored Directories (0)										 Storage System
Related Resources										Share Path
Hypervisor										C Show Select/Deselect All
VMDKs (4)										
Storage Systems (1) Volumes (3)										Restore Default View
 Woldmes (3) Pools (1) 										
Managed Disks (5)										
RAID Arrays (5)										
Disks (40)										
I/O Groups (1)										
Nodes (2)										
Ports (16)										
	Showing 4 items S	elected 0 items								Refreshed a few moments ago

Figure 12-115 VSC Server VMDKs

- Storage Systems: Groups the storage resources that are related to the server.

By deploying Storage Resource Agents on to the SQL cluster member servers, VSC also can identify the MSCS cluster itself.

Figure 12-116 shows the Servers displaying the SQL cluster that is deployed in the VersaStack environment.

Tivoli Storage Productivi	ity Center - Virtual Storage C	enter Edition	Home	Storage	Servers	Network	Groups	Advanced Analytics
F	Servers Source Sourc							
Servers C	Clusters 🛕 Alert	s Tasks	Discove	red Servers				
E Actions ▼								
Name		Туре	Domain	IP Address	Discovered Tim	ne No	des Cluste	er Resource Groups
VMW_WSF	CLUS	MSCS	VERSASTA	192.168.10.53	Jun 20, 2015 12:1	18:23 PDT 👘 🖥	1 🗟 3	

Figure 12-116 VSC Server - Clusters

Within the cluster properties notebook are the following tabs:

- ► General: Cluster type, domain, IP address, and discovery time
- Nodes: Member nodes of the cluster
- ► Cluster Resource Groups: Resource groups that are defined on the cluster

Figure 12-117 shows the VSC Cluster Properties notebook showing the Cluster Resource Groups for the MSCS SQL cluster.

VMW_WSFC_	CLUS Properties	
	General Nodes Cluster Resource Groups	
	I≡ Actions ▼	Q ▼ Filter
	Cluster Resource Group 🔻 Hosting Node 🛛 Domain Name 🛛 Primary II	P Add Secondary IP A OS Type
Clusters	SQL Server (MSSQLSERV	0.54 🗹 Cluster Resource Group
	Cluster Group.VMW_WSF SQLVM02.VersaS VERSASTACK 192.168.10	0.53 🖌 Hosting Node
	🚯 Available Storage.VMW_W 🖥 <u>SQLVM02.VersaS</u> VERSASTACK	 Domain Name
		 Primary IP Address
		Secondary IP Address
		✓ OS Type
		✓ Used Space (%)
		✓ Total Disk Space (GiB)
		✓ Available Disk Space (GiB)
		✓ Owned Disk Space (GiB)
		 Owned Unallocated Disk Space (GiB)
		✓ Available File System Space (GiB)
		Show Select/Deselect All
	Showing 3 items Selected 0 items	Restore Default View Refreshed a few moments ago
	Showing 5 terms Selected 0 terms	Relieshed a lew moments ago
	Close	

Figure 12-117 VSC Cluster Resource Group

Provisioning

In the initial configuration of the MSCS SQL cluster, we used the Storwize V7000 GUI to provision the LUNs to the SQL cluster member servers. This step can also be performed through the VSC either at the cluster level by provisioning directly to the cluster or by selecting individual servers to which to provision. The section "Provisioning LUNs and volumes to the SQL cluster" on page 304 outlines how to provision additional data and log volumes to the SQL cluster.

Monitoring

VSC correlates the registered servers (agentless or servers with a Storage Resource Agent deployed) with the Storage Systems and Fabric resources that are used by these systems.

Figure 12-118 shows a one-month performance overview of the SQL cluster volumes.

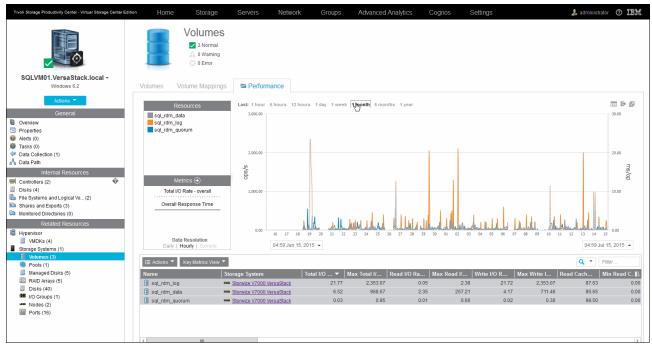


Figure 12-118 VSC Server Volume Performance

For more information about the performance monitoring and alerting capabilities of the Storwize V7000 storage system within the VSC environment, see 12.7.3, "Monitoring and alerting" on page 266.

Protection

For more information about protection, see Chapter 13, "IBM Spectrum Protect integration" on page 331.

12.8.4 Reporting for departments and applications

Environments that offer high levels of automation and flexibility, such as the VersaStack solution with the VMware hypervisor, often pose challenges for the storage administration teams in areas such as troubleshooting, accountability, and chargeback, especially when data is moved dynamically from less expensive SAS to more expensive SSD tiers by using the VSC built-in auto-tiering function.

To accommodate for these issues, you can use the concept of groups. Within the Groups section of the VSC Web GUI, you can define departments and applications.

You can use departments to group all resources for a specific geographical, organizational, or logical unit together to have a single pane overview. Figure 12-119 shown an overview of the Cisco department.

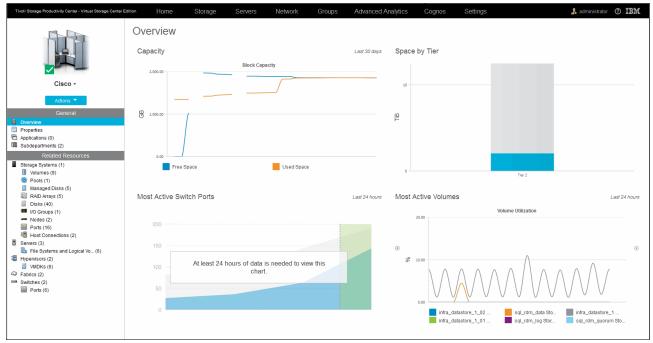


Figure 12-119 VSC Departments Overview

Within a department, you can create subdepartments. Each department or subdepartment can hold one or more applications.

An application is a logical grouping of one or more systems that in turn can be organized into subcomponents.

In the VersaStack setup example, we defined a Cisco UCS SQL cluster application by adding the two SQL member servers and added this application to the Cisco Labs subdepartment.

Figure 12-120 on page 329 shows the Cisco UCS SQL cluster application overview from the VSC Web GUI.

Tivoli Storage Productivity Center - Virtual Storage Center 6	Edition Home Storage	Servers Network	Groups Advanced	Analytics Cogno	s Settings		💄 administrator 🕜 IBM.
	Overview ﷺ Cisco > ﷺ Labs > ₪ Capacity ▼	UCS SQL Cluster	Last 30 days	Space by Tier			
UCS SQL Cluster - Microsoft Actions - General	2.000.00	Block Capacity		10			
Orkentew Properties Properties Filters (0) Subcomponents (0) Related Resources Storage Systems (1)	0.00			£ ⊢			
Image: Volumes (9) Image: Volumes (1) Imanged Disks (5) Image: RAID Arrays (5) Image: Disks (40) Image: Volume Volumes (1)	Free Space	Used Space	Last 24 hours	o Most Active Vo	umes	Tier 2	Last 24 hours
Nodes (2) Ports (16) Hyper Not Connections (2) Servers (2) Hyper Not Sort Logical Vo (4) HyperNots (2)	200			20.00		Volume Utilization	•
VMDKs (5) VMDKs (5) Stricts (2) Stricts (2) Ports (6)	100 At least 24 1	hours of data is needed to vie chart.	w this	0.00			$\mathbf{M}_{\mathbf{M}}$
	0				fra_datastore_1_02 fra_datastore_1_01	sql_rdm_data Sto sql_rdm_log Stor	infra_datastore_1 sql_rdm_quorum Sto

Figure 12-120 VSC Applications

Reporting interfaces

Tivoli Storage Productivity Center VSC provides multiple user interfaces for viewing reports about the storage infrastructure in an enterprise environment.

Cognos Business Intelligence Reporting interface

This interface runs in a web browser. Use this interface to view predefined reports and create custom reports about Tivoli Storage Productivity Center. You access reports from the web-based GUI, and work with the reports in the Cognos BI reporting tool.

To access these reports, select Cognos from the VSC Web GUI, as shown in Figure 12-121.



Figure 12-121 VSC Cognos reports

VSC includes several predefined reports and built-in templates to create your own capacity or performance reports with the built-in Report Studio. The following report packages are available when creating custom reports:

- Capacity and Relationships
- Historical Capacity
- ► Performance
- Storage Tiering

Both the predefined and your custom created reports can be scheduled to run at specific intervals and stored, exported, printed, or mailed in multiple formats, such as HTML, PDF, and XML.

For the example VersaStack SQL Cluster setup, three reports were of specific interest to us and scheduled to be mailed daily:

- Summarized Performance of Volumes by Server (for the SQL cluster servers)
- Performance of One Storage System (for the Storwize V7000 storage system)
- Summarized Performance of Volumes by Hypervisor

For more information about all the available reports, see the following website:

http://www.ibm.com/support/knowledgecenter/SSNE44_5.2.6/com.ibm.tpc_V526.doc/fqz0_ c_l1_ov_custom_and_predefined_rpts.html

vSphere Web Client extension interface

Use the vSphere Web Client extension for Tivoli Storage Productivity Center to view reports on your virtual environment and storage devices. You can view reports that are customized to use information from Tivoli Storage Productivity Center. The reports include fabric connections, storage mapping information, and performance metrics for storage systems. To view Tivoli Storage Productivity Center storage information in block and file storage reports, you must register Tivoli Storage Productivity Center as a VASA provider.

For more information, see "Spectrum Control hypervisor monitoring and alerting" on page 294.

Stand-alone GUI

You can view detailed information about the storage resources in your environment in the stand-alone GUI. These reports are organized into different types and categories and provide both summary and detailed information, depending on your needs. Many reports are also accessible through the topology viewer, which provides a visual representation of storage topology. To view information about reporting in the stand-alone GUI, go to the product documentation at the following website:

http://www.ibm.com/support/knowledgecenter/SSNE44_5.2.6/com.ibm.tpc_V526.doc/fqz0_ c_reporting.html

12.9 Resources

For more information about the topics in this chapter, see the following resources:

Tivoli Storage Productivity Center documentation:

http://www.ibm.com/support/knowledgecenter/SSNE44_5.2.6/com.ibm.tpc_V526.doc/tp c_kc_homepage.html

VSC wiki:

https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20Sm artCloud%20Virtual%20Storage%20Center/page/IBM%20SmartCloud%20Virtual%20Storage %20Center%20Wiki

► TPC 5.2.3 Field Level Install Guide for Windows, found at:

https://www.ibm.com/developerworks/community/wikis/form/anonymous/api/wiki/b6f0 fb06-4200-4f2f-9a10-382bddf87c6f/page/f84056cf-76e7-4389-8796-907d9231b2eb/atta chment/9d24b843-e00e-4790-b4b5-70e6469fedd0/media/TPC_523_Field_Install_Guide.p df

13

IBM Spectrum Protect integration

This chapter describes the implementation of a Spectrum Protect server into the VersaStack environment

13.1 Spectrum Protect Suite for Unified Recovery overview

The following sections highlight the features of the Spectrum Protect Suite.

13.1.1 IBM Spectrum Software Defined Storage Suite

New cloud environments and applications, such as analytics, mobile, and social applications, are driving a huge growth in data volumes, making data the new natural resource. But, cost-effectively optimizing your current storage environments while using new opportunities is straining storage budgets. IBM Spectrum Storage™ is a solution to this situation.

Spectrum Storage unlocks the potential of data and increases your business agility and efficiency in ways that were not possible previously. Spectrum Storage enhances the speed and efficiency of your storage and simplifies migration to new workloads by performing the following actions:

- Simplifying and integrating storage management and data protection across traditional and new applications
- Delivering elastic scalability with high performance for analytics, big data, social, and mobile
- ► Unifying silos to deliver data without borders with built-in hybrid cloud support
- Optimizing data economics with intelligent data tiering from flash storage to tape and cloud
- Building on open architectures that support industry standards, including OpenStack and Hadoop

Figure 13-1 shows Spectrum Protect as part of the IBM Spectrum Software Defined Storage Suite.

			Storage and Data	Control		
Storage Management	Policy Automation	Analytics & Optimization	Snapshot & Replication Management	Integration & API Services	Self Service Storage	Data Backup and Archive
2	80	(7			—	
			Im Control orage Center			Spectrum Protect Tivoli Storage Manager
			Data Access			
Traditional App	blications	New Genera	tion Applications			
Virtualized SAN	Block	Hypersc	ale Block	Global File	& Object	Active Data Retention
Spectrum Virt SAN Volume Co	tualize Introller	Spectrum Based on X	Accelerate IV Software	Spectr GPFS/Ela	rum Scale Istic Storage	Spectrum Archive
		Flexibility to use	e IBM and non-IBM Server	s & Storage or Cloud	Services	
				//		
IBM Storwize, X	KIV, DS8000, FlashSys	tem and Tape Sys	tems		and the second division of the local divisio	OFTLAY ER
Non-IBM stora	age, including commod	ity servers and me	dia			d non-IBM clouds
					#ibmintero	connect

Figure 13-1 IBM Spectrum Software Defined Storage Suite

The VersaStack with SQL Solution uses the capabilities of three of the IBM Spectrum Software Defined Storage components to complement the functions of the Cisco UCS, IBM Storwize V7000 storage system, and VMware vCenter:

- ► IBM Spectrum Virtualize[™]
- IBM Spectrum Control
- IBM Spectrum Protect

Here is an overview of all of the components of the Spectrum SDS suite with links to more information:

► IBM Spectrum Accelerate[™]

Spectrum Accelerate offers grid-scale block storage with rapid deployment that helps speed delivery of data across an enterprise and adds flexibility to cloud deployments. For more information about this component, see the following website:

http://www.ibm.com/systems/storage/spectrum/accelerate/index.html

► IBM Spectrum Scale[™]

Spectrum Scale is flash-accelerated, industrial-strength, highly scalable software-defined storage that enables global shared access to data with extreme scalability and agility for cloud and analytics. For more information about this component, see the following website:

http://www.ibm.com/systems/storage/spectrum/scale/index.html

IBM Spectrum Virtualize

Spectrum Virtualize is at the heart of IBM SAN Volume Controller and IBM Storwize family. It enables these systems to deliver industry-leading virtualization that enhances storage to improve resource utilization and productivity, and streamlines deployment for a simpler, more responsive, scalable, and cost-efficient IT infrastructure. For more information about this component, see the following websites:

- http://www.ibm.com/systems/storage/software/virtualization/svc
- http://www.ibm.com/systems/storage/storwize
- IBM Spectrum Control

Spectrum Control provides efficient infrastructure management for virtualized, cloud, and software-defined storage to simplify and automate storage provisioning, capacity management, availability monitoring, and reporting. For more information about this component, see the following website:

http://www.ibm.com/software/tivoli/csi/cloud-storage/

► IBM Spectrum Protect

Spectrum Protect enables reliable, efficient data protection and resiliency for software-defined, virtual, physical, and cloud environments. For more information about this component, see the following website:

http://www.ibm.com/software/tivoli/csi/backup-recovery/

► IBM Spectrum Archive[™]

Spectrum Archive enables you to move automatically infrequently accessed data from disk to tape to lower costs while retaining ease of use and without the need for proprietary tape applications. For more information about this component, see the following website:

http://www.ibm.com/systems/storage/tape/ltfs/index.html

13.1.2 IBM Spectrum Protect Suite for Unified Recovery

IBM Spectrum Protect (formerly known as Tivoli Storage Manager) Suite for Unified Recovery includes the following components:

Backup Server

IBM Spectrum Protect (Tivoli Storage Manager) Extended Edition. Includes Operations Center (OC) for simplified administration, built-in efficiency features, and advanced disaster recovery.

- Snapshot Management
 - Manages application-aware snapshots on EMC, Hitachi, NetApp, IBM, and VSS-compatible Windows storage.¹
 - Enables fast, simple recovery of individual files and volumes.
 - Enables "instant" restore for VMware data stores.
- Advanced Agent for Virtual Environments

Incremental "forever" backup for VMware and Hyper-V. Enables flexible, near-instant recovery.

- Advanced Agents for Core Applications
 - Online, application-aware multi-threaded backups and restores.
 - Mail agents support Microsoft Exchange and IBM Lotus® Domino®.
 - Database agents support Oracle and Microsoft SQL. IBM DB2 and Informix® are supported in the base backup server.
 - Enterprise Resource Planning agent supports SAP and SAP HANA environments.
- ► Space Management

Policy-based hierarchical space management for Linux and AIX systems.

Figure 13-2 on page 335 shows data protection with Spectrum Protect Suite for Unified Recovery.

¹ EMC and Hitachi UNIX support requires Device Agents, which are available separately.

TSM Suite for Unified Recovery

Protection	on For		Protected Using
9	Applications * Databases (DB2, Oracle, SQL,) * Mail (Exchange, Domino) * SAP, SAP HANA	Protected By	On-Prem * Disk & SSD * Tape * Redundant Copies * In-device snapshots
	Infrastructure * Hypervisors (vmWare, Hyper-V) * Systems (AIX, Windows, Linux, OSX,) * Filers (NAS, NDMP,) * Big data (Elastic Storage,)	* Backup * Archive * Space Management	Off-Prem * Replication * Tape Rotation * DB2 HADR with device replication
	Data * Filesystems (Files, directories, ACL's,) * "My Documents" * Encryption * Compression	* Incremental Forever * Deduplication * Compression * Snapshots * LAN, WAN, SAN	Flexibility * Device transitions * Storage hierarchy * Operations Center * Integrates to (TWS, TSA Ornbus, PowertA)

Figure 13-2 Spectrum Protect Suite for Unified Recovery

The following components were deployed in the VersaStack with SQL environment:

- Tivoli Storage Manager Server
- ► Tivoli Storage Manager Operations Center
- ► Tivoli Storage Manager/FlashCopy Manager for Virtual Environments
- Tivoli Storage Manager for Databases
- ► Tivoli Storage Manager Backup/Archive Client
- ► IBM Tivoli Monitoring for Spectrum Protect

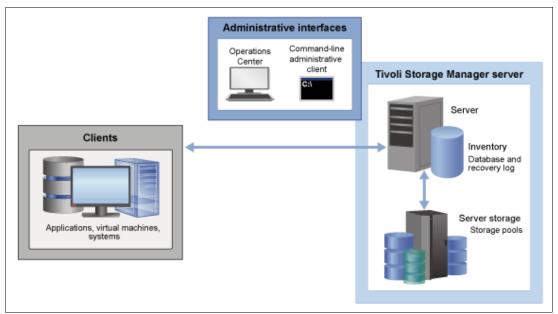


Figure 13-3 shows the Tivoli Storage Manager overview.

Figure 13-3 Tivoli Storage Manager overview

Server

The Tivoli Storage Manager server stores client data to storage media. The server includes an inventory in which Tivoli Storage Manager stores information about the client data that it is protecting.

Administrative interfaces for the server include a web-based interface that is called the Operations Center, and a command-line administrative client. The Tivoli Storage Manager server inventory includes the following components, which can be monitored from the OC:

- Database
- Recovery log
- Active log
- Archive log
- Storage

Database

Tivoli Storage Manager saves information about each file, logical volume, or database that it backs up, archives, or migrates. This inventory data is stored in the server database. The server database also includes information about the policy and schedules for data protection services. Client data is stored in a storage pool.

Recovery log

The recovery log consists of the active and archive logs, and other optional logs. These logs are records of database transactions, which can be used for database recovery. If a failure occurs, such as a power outage or application error, the changes that were made but not committed are rolled back. Then, all committed transactions, which might not yet be written to disk, are redone.

Active log

The active log is a record of the most recent database transactions that are not yet committed.

Archive log

The archive log is a record of the most recent database transactions that are committed but not yet included in a database backup.

Storage

The Tivoli Storage Manager server can write data to hard disk drives (HDDs), disk arrays and subsystems, stand-alone tape drives, tape libraries, and other forms of random-access and sequential-access storage. The media that the server uses are grouped into storage pools.

Storage devices can be connected directly to the server, or connected through a local area network (LAN) or a storage area network (SAN).

Storage pools

Storage pools are a central Tivoli Storage Manager concept. Understanding them is key to managing effectively your Tivoli Storage Manager server environment. Storage pools connect the Tivoli Storage Manager policy hierarchy to the storage devices where client data is stored. A storage pool represents a set of volumes of the same media type, for example, disk or tape volumes.

Tivoli Storage Manager stores all managed data objects in storage pools. You can organize storage pools into one or more hierarchical structures, and each storage hierarchy can span multiple Tivoli Storage Manager server instances.

To obtain the best value from your storage investment, you must store data correctly in the storage pool hierarchy. A disk pool is often first in the hierarchy and can be followed by a tape pool. Tivoli Storage Manager supports many device and media types for sequential access storage.

Figure 13-4 shows how Spectrum Protect automatically places data on the most cost-appropriate tier of storage.

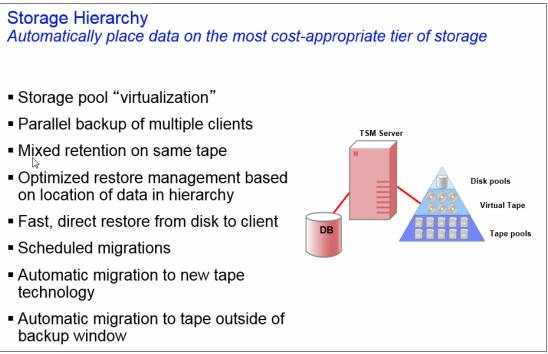


Figure 13-4 Spectrum Protect Storage Hierarchy

Clients

Tivoli Storage Manager clients or client nodes protect data by sending it to a Tivoli Storage Manager server. Client software must be installed on the client system, and the client must be registered with the server.

A client node is equivalent to a computer, such as a backup-archive client that is installed on a workstation for file system backups. A file space is a group of client files that are stored as a logical unit in server storage.

Multiple nodes can be installed on a single computer, as in the case of a Microsoft SQL Server that contains both an application client for SQL database backups and a backup-archive client for file system backups.

You can define the following clients for use with Tivoli Storage Manager:

- Applications
- Virtual machines
- Systems

Applications

The following clients are application clients. Data that is being protected for these clients is structured data that requires interaction with backup interfaces specific to the application.

- ► Tivoli Storage Manager for Enterprise Resource Planning
- Tivoli Storage FlashCopy Manager
- Tivoli Storage Manager for Databases
- Tivoli Storage Manager for Mail
- Tivoli Storage Manager for Virtual Environments

This list excludes VMware vSphere clients, which are classified as system clients.

A virtual machine (VM) that is backed up by using application client software that is installed on the VM is also classified as an application client.

Virtual machines

A VM is an individual guest that is hosted within a hypervisor. Each VM is represented as a Tivoli Storage Manager file space. Backups for multiple VMs are consolidated together under a common node. Each VM is stored under a separate file space for this common node.

A client is considered a VM when it is protected by either Data Protection for VMware or Data Protection for Microsoft Hyper-V.

Systems

All other clients, for example, backup-archive and API clients, are classified as system clients. These clients back up unstructured data that is contained within files and directories.

System clients also include the following items:

- A Tivoli Storage Manager source server in a server-to-server virtual volume configuration
- A VM that is backed up using backup-archive client software that is installed on the VM

Tivoli Storage Manager Operations Center

The OC provides web and mobile access to status information about the Tivoli Storage Manager environment. You can use the OC to monitor multiple servers and to complete some administrative tasks. The OC also provides web access to the Tivoli Storage Manager command line.

Figure 13-5 shows the Tivoli Storage Manager OC as deployed in VersaStack and the SQL environment.

TSM Clients 63	Alerts 0	TSM Servers 2
35 • Atrisk 2	° ** 8 8 🖛 8 4 * 1	All available
	Services	Inventory Database space 163 GB free out of 180 GB
Applications 29	Policies	Databases Z Normal Active logs Z Normal
	Backup & Restore	Archive log space 353 GB free out of 378 GB
	Migrate & Recall	Archive logs 🖾 Normal
Virtual Machines 20	Expiration	Storage Primary on Disk 302 GB free out of 866 GB Pools
	Activity	Pools (1) Warning Devices 🖾 Normal
	Tasks 🖾 Processes 2 📑 Sessions 0	Primary on Tape 0 bytes free out of 0 bytes
Systems 14	Traffic 😥 - Current Previous	Storage Devices Normal
7%) 🛛 📕	52 06	Copy Storage 0 bytes free out of 0 bytes
Ŧ	24 18 12 6 Now	Pools Normal Devices Normal

Figure 13-5 Tivoli Storage Manager Operations Center overview

From the OC, you can complete daily monitoring tasks to ensure that the Tivoli Storage Manager system is functioning correctly.

You can explore the Tivoli Storage Manager OC yourself by exploring the live demonstration environment at IBM Service Engage, found at the following website:

https://demo.tsm.ibmserviceengage.com:11090/TSMLiveDemo

For more information, see 13.6, "Monitoring and managing the Spectrum Protect environment" on page 419.

Tivoli Storage Manager / FlashCopy Manager for Virtual Environments

IBM Tivoli Storage Manager for Virtual Environments (referred to as Data Protection for VMware) provides a comprehensive solution for protecting VMs.

Data Protection for VMware eliminates the impact of running backups on a VM by offloading backup workloads from a VMware ESX or ESXi-based host to a vStorage Backup server. Data Protection for VMware works with the Tivoli Storage Manager backup-archive client (installed on the vStorage Backup server) to complete full and incremental backups of VMs. The client node that is installed on the vStorage Backup server is called the data mover node. This node moves the data to the Tivoli Storage Manager server for storage, and for VM image-level restore later. Instant restore is available at the disk volume level and full VM level. In addition, protection of vApps and organization vDCs in a vCloud Director environment is also available.

Figure 13-6 shows an overview of Tivoli Storage Manager for Virtual Environments and FlashCopy Manager for Virtual Environments

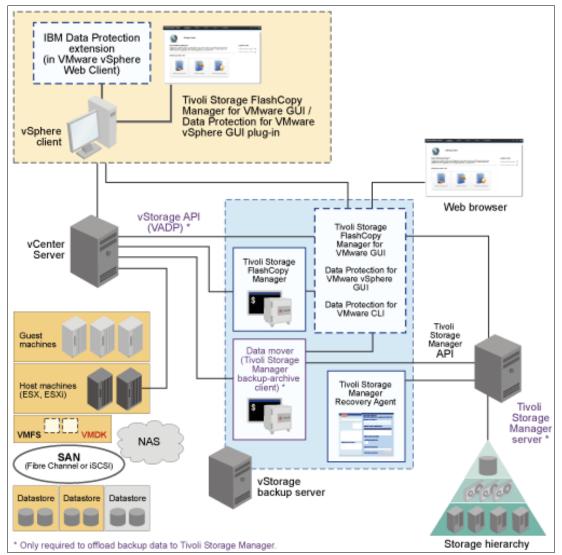


Figure 13-6 Tivoli Storage Manager for Virtual Environments / FlashCopy Manager for Virtual Environments overview

Backup operations in virtualized environments can be separated into in-guest backup, on-host backup, and off-host backup types. Tivoli Storage FlashCopy Manager for VMware uses the off-host backup approach to protect your environment.

Tivoli Storage FlashCopy Manager for VMware supports data protection of virtualized environments by providing off-host storage hardware snapshot backups for VMware VMs. You can install Tivoli Storage FlashCopy Manager for VMware on a physical system or on a VM that has network access to the vCenter Server. The physical or VM where Tivoli Storage FlashCopy Manager for VMware is installed is referred to as the vStorage backup server. Unlike the in-guest backup approach, backup agents are not required to run in each VM. This off-host approach facilitates faster backup operations and is nondisruptive to production applications.

The following list includes the major features when off-host backups are started on a dedicated vStorage backup server or VM:

- File-level and guest-level image backups can be created and recovered.
- Centralized management of backup data is provided.
- ► Backups are offloaded to free up production server resources.
- File system consistent backups can be created by using snapshots.
- Tivoli Storage FlashCopy Manager for VMware and Tivoli Storage Manager for Virtual Environments backups use the VMware vStorage API for Data Protection.

For more information, see 13.3, "Protecting the VMware infrastructure" on page 357.

Tivoli Storage Manager for Databases

Figure 13-7 shows the MMC Snap-In for the Tivoli Data Protection / FlashCopy Manager for SQL application.

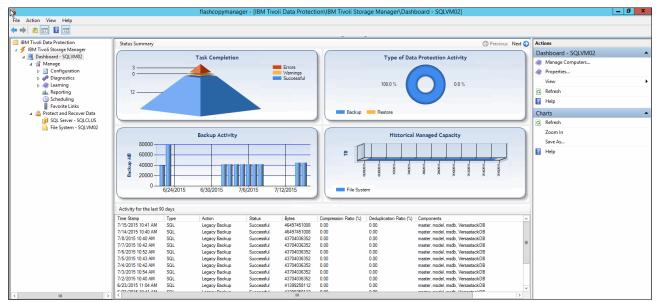


Figure 13-7 Tivoli Data Protection for SQL / FlashCopy Manager for SQL

With Tivoli Storage Manager for Databases: Data Protection for Microsoft SQL Server software, you can back up and restore Microsoft SQL Server databases to Tivoli Storage Manager storage or local shadow volumes. A local shadow volume contains data that is stored on shadow volumes, which are local to a disk storage subsystem.

Data Protection for SQL Server provides a connection between an SQL Server and a Tivoli Storage Manager, which allows SQL Server data to be protected and managed by Tivoli Storage Manager. Data Protection for SQL Server protects SQL Server data and improves the availability of SQL Server databases. You can continue to run primary applications on your database servers while data is backed up and restored.

You can use a command-line interface (CLI) or graphical user interface (GUI) to back up and restore SQL Server databases. For more information about backing up and restoring SQL Server databases, see your SQL Server documentation.

Microsoft supports the Microsoft Legacy application programming interface (API) for streaming backup and restore operations. Microsoft also supports the use of Volume Shadow Copy Service (VSS) technology for backup and restore operations.

Data Protection for SQL Server uses the Tivoli Storage Manager API to communicate with the Tivoli Storage Manager, and the SQL Server API to communicate with SQL Server.

In addition to these APIs, Data Protection for SQL Server VSS operations require the Tivoli Storage Manager backup-archive client (VSS Requester) and Microsoft VSS to produce an online snapshot (point-in-time consistent copy) of SQL Server data.

For more information, see 13.4, "Protecting the SQL cluster" on page 368.

Tivoli Storage Manager Backup/Archive client

The backup/archive client program enables users to back up and archive files from their workstations or file servers to storage, and restore and retrieve backup versions and archived copies of files to their local workstations. It includes the following components:

- An administrative client program that you can access from a web browser or from the command line. The program enables a Tivoli Storage Manager administrator to control and monitor server activities, define storage management policies for backup, archive, and space management services, and set up schedules to perform those services at regular intervals.
- An application programming interface (API) that you can use to enhance an existing application with storage management services. When an application is registered with a server as a client node, the application can back up, restore, archive, and retrieve objects from storage.
- A web backup-archive client that enables an authorized administrator, help desk person, or other users to perform backup, restore, archive, and retrieve services by using a web browser on a remote system.

Tivoli Storage Manager uses VSS to back up all system state components as a single object to provide a consistent point-in-time snapshot of the system state. The system state consists of all bootable system state and system services components.

Tivoli Storage Manager supports Microsoft VSS on the supported Windows clients.

In our example, we deployed the Tivoli Storage Manager Backup/Archive clients on the SQL Server node to back up the operating system component, including the system state. In the VMware environment, you use the Tivoli Storage Manager for Virtual Environments to back up the VMDK hosting the operating system, but this specific SQL cluster deployment is configured to disallow taking snapshots of the SQL VM themselves, which means that you need an in-guest operating system backup.

IBM Tivoli Monitoring for Spectrum Protect

Tivoli Monitoring for Spectrum Protect brings together multiple components to provide real-time monitoring and historical reporting for your Tivoli Storage Manager servers.

Figure 13-8 shows a schematic flow of Tivoli Monitoring for Spectrum Protect.

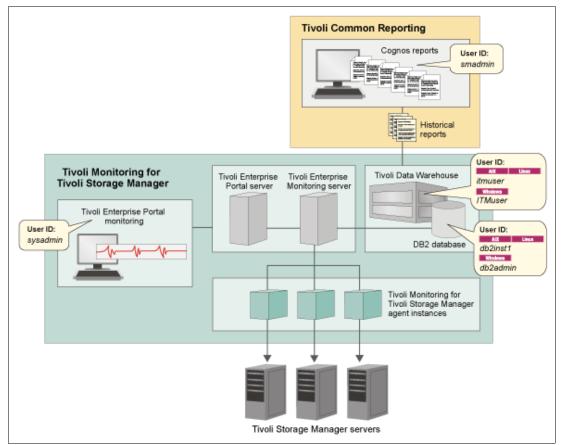


Figure 13-8 IBM Tivoli Monitoring overview

IBM Tivoli Monitoring acts as a monitoring application that provides workspaces for you to monitor real-time information. You can monitor the Tivoli Storage Manager server status, database size, agent status, client node status, scheduled events, server IDs, and so on, by using the monitoring workspaces.

Tivoli Monitoring for Spectrum Protect also provides reports that are based on the historical data that is retrieved. You can use the existing historical reports that are provided, or you can create your own custom reports.

For more information, see 13.6, "Monitoring and managing the Spectrum Protect environment" on page 419.

13.1.3 Licensing metrics

IBM Spectrum Protect Suite for Unified Recovery provides a comprehensive set of data protection capabilities with simplified licensing on a tiered per-terabyte (TB) metric.

The suite features capacity-based licensing, advanced agents for virtual environments and core applications, snapshot management, and hierarchical space management. It lets you get started quickly to gain the benefits of IBM data protection software.

You can use IBM Spectrum Protect Suite for Unified Recovery to more easily modernize data protection. It enables the following capabilities with simple pay as you grow licensing:

- Protect data with confidence with policy-based management, visual administration, and a scalable IBM platform.
- Reduce costs for backup infrastructure and administration so that you can invest more on innovation.
- Add advanced capabilities that your organization needs to deliver maximum data availability and mitigate the risk of data loss. Application aware backup agents and hardware-assisted snapshot management capabilities are included.

Tivoli Storage Manager Solution bundles at-a-glance		New	
	Per component per server	Capacity	Capacity
	IBM Tivoli Storage Manager Entry	IBM TSM Suite for Unified Recovery - Front End	IBM Tivoli Storage Manager Suite for Unified Recovery
Available Components			
IBM Tivoli Storage Manager	Standard Edition	Extended Edition	Extended Edition
IBM Tivoli Storage Manager for Virtual Environments	√	✓	√
IBM Tivoli Storage Manager for Mail	✓	✓	√
IBM Tivoli Storage Manager for Databases	√	✓	√
IBM Tivoli Storage Manager for Enterprise Resource Planning	✓	✓	✓
IBM Tivoli Storage Manager backup-archive client for file systems	✓	✓	√
IBM Tivoli Storage Manager for Storage Area Networks	✓	✓	✓
IBM Tivoli Storage Manager for Space Management		✓	✓
IBM Tivoli Storage Manager FastBack®		✓	✓
IBM Tivoli Storage Manager Fastback for Microsoft Exchange		✓	4
IBM Tivoli Storage Manager Fastback for Bare Machine Recovery		✓	√

Figure 13-9 shows the Spectrum Protect license bundles (per server or per capacity).

Figure 13-9 Spectrum Protect Solution bundles

Choose from flexible licensing options to get the most favorable plan for your organization:

- Front End: Capacity is licensed the same way users see it, which simplifies show-back and charge-back auditing:
 - A tiered per-terabyte (TB) license metric with built-in discounts as data grows.
 - Entry: Save up to 55%. Entry versions are limited to 100 TB of managed backup data, and two Tivoli Storage Manager servers per enterprise.

- Back End: Capacity is measured at the backup servers after efficiency features are used.
 - A tiered per-terabyte (TB) license metric with built-in discounts as data grows.
 - Entry: Save up to 55%. Entry versions are limited to 100 TB of managed backup data, and two Tivoli Storage Manager servers per enterprise.
 - Archive: Save up to 80%. The Archive option applies to data ingested through an archive operation and backed up to Tivoli Storage Manager VTL or tape archive pools. Data that is backed up to other storage pools is supported fully and charged at the standard IBM Spectrum Protect Suite for Unified Recovery capacity rate.
 - IBM ProtecTIER® Option: Save up to 75%. The ProtecTIER Option measures capacity after IBM ProtecTIER data deduplication is used. Assuming 4:1 data deduplication, capacity-based licensing for data that is stored with ProtecTIER would be 75% less than the top tier rate.

For more information, see the following website:

http://www.ibm.com/software/products/en/tsm-suite-for-unified-recovery

13.2 Spectrum Protect implementation

The following sections describe the components that we deployed for our example Spectrum Protect implementation.

13.2.1 Architectural overview

This section outlines which Spectrum Protect server components are deployed in the SQL on VersaStack environment.

Spectrum Protect components

Here are the Spectrum Protect core components:

- Spectrum Protect backup server
- Spectrum Operations Center
- IBM Tivoli Monitoring for Spectrum Protect Reporting and Monitoring Server

Spectrum Protect backup server

Spectrum Protect is a highly scalable backup solution that can be deployed on multiple hardware- and software-platforms. For a list of supported operating system, got to the following website:

http://www.ibm.com/support/docview.wss?uid=swg21243309#Server%20Table

Within the SQL on VersaStack example setup, we deployed Spectrum Protect V7.1.1.300 on SUSE Linux Enterprise Server 11 SP3 running in a VM on the second hypervisor of the SQL on VersaStack setup, that is, vm-host-infra-02.versastack.local.

The minimum requirements for running Spectrum Protect on Linux x86_64 can be found at the following website:

http://www.ibm.com/support/docview.wss?rs=663&context=SSGSG7&q1=ServerRequirements
&uid=swg21204361&loc=en US&cs=utf-8&lang=en

As an alternative, Microsoft Windows or another supported guest OS running on the VMware ESXi hypervisor might be chosen for deployment. For more information, see 13.2.2, "Guest support for virtual machines and virtualization" on page 347.

Given the limited size of the SQL on VersaStack lab setup and the expected payload, we assigned the following resources to the Spectrum Protect VM:

- VM Version: 8
- ► CPU: Four vCPUs
- Memory: 32 GB
- VNIC0: VM-Production 1 GbE for the management interfaces
- ► VNIC1: VM-Backup 1 GbE for the backup data transport
- VM virtual disks:
 - Hard disk 1: 64 GB, operating system
 - Hard disk 2: 32 GB, DB2 database
 - Hard disk 3: 64 GB, DB2 log files
 - Hard disk 4: 192 GB, DB2 archive log files
 - Hard disk 5: 512 GB, data deduplication enabled storage pool

All disks are thick provisioned and lazy zeroed and hosted on a dedicated data store on the Storwize V7000 storage system called Protect_Datastore_1.

Note: In this lab setup, both the primary production and the secondary backup environment are hosted on the same VersaStack physical infrastructure. In a real-world scenario, it is a preferred practice to use dedicated storage for the backup environment in combination with the Spectrum Protect Node-Replication towards a secondary backup or server, or to invest in dedicated backup hardware.

A secondary Spectrum Protect server to act as the replication target server is deployed with the same specifications as the primary server, but hosted on a separate Cisco UCS blade (vm-host-infra-03.versastack.local) on the Protect_Datastore_2 in the VersaStack_DC_2 data center. This is a logical separation because the same underlying hardware is being used in our lab setup.

Spectrum Protect Operations Center

The Spectrum Protect Operations Center (OC) is a light-weight management application that offers the daily dashboard and management interface for the Spectrum Protect servers. It can be deployed on the same system hosting the primary Spectrum Protect server or on, for example, the VM that also hosts the IBM Tivoli Monitoring for Spectrum Protect server.

The OC hardware and software requirements can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg21653418

The OC follows a hub-spoke model with the first Spectrum Protect server connected to it acting as the hub server. This system in turn connects to the spoke servers to query information and run commands.

There is a co-relation between the version of the OC and the version of the hub server as new functions are introduced over time, requiring updates on the Spectrum Protect Servers themselves. For more information, see the following website:

http://www.ibm.com/support/docview.wss?uid=swg21640917

Figure 13-10 on page 347 shows the OC hub-spoke model running on a hub server or separate computer.

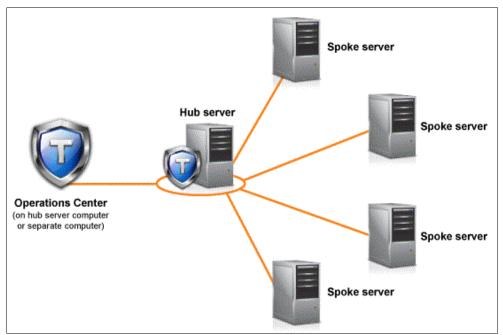


Figure 13-10 Operations Center hub-spoke model

In the lab setup that we deployed, the Linux version of the OC on the primary Spectrum Protect server itself acts as the hub server with the Spectrum Replica server being the monitored spoke.

For larger environments with multiple Spectrum Protect servers, it is a preferred practice to use dedicated Spectrum Protect server instances running in a virtual environment to be the hub server. You can use this setup to upgrade the OC and the hub server to new code levels and plan for upgrades to the production spoke servers later.

Spectrum Protect Reporting and Monitoring Server

In the SQL on VersaStack lab setup, we deployed the IBM Tivoli Monitoring Server for Spectrum Protect on a Windows 2008R2 server running in a VM with the following specifications:

- VM Version: 8
- CPU: Four vCPUs
- Memory: 16 GB
- VNIC0: VM-Production 1 GbE for the management interfaces
- ► VM Virtual Disks: Hard disk 1: 80 GB, operating system and application, thin provisioned

You can also deploy the Reporting and Monitoring Server on AIX and Linux operating systems. The list of hardware and software requirements can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg21678084

On this system, we configured two Spectrum Protect Monitoring Agents that perform an hourly agentless query towards the Spectrum Protect servers.

13.2.2 Guest support for virtual machines and virtualization

VM and virtualization guest support for Spectrum Protect products is subject to the following supported configurations and limitations.

Note the following items for all virtualization technologies:

- The guest must be running an operating system that is supported by the Tivoli Storage Manager product.
- Tivoli Storage Manager products and components that rely on other IBM and third-party products are supported only if the prerequisite IBM and third-party components are also supported by the virtualized environment. Examples of these dependencies are listed but not limited to the following ones:
 - For the Tivoli Storage Manager Server product, IBM DB2 must also support running within the virtualized environment.
 - For the Data Protection products, the application being protected must also support running on that operating system inside a guest.
- The performance of Tivoli Storage Manager applications, especially the Tivoli Storage Manager server, ultimately depends on the resources that are available to the application, whether it is deployed in a physical or virtual environment. For more information about resource considerations for the Tivoli Storage Manager server, see 13.2.3, "Blueprints" on page 349.

VMware ESX and ESXi guest

The support position for the following Tivoli Storage Manager products and components is for backup and recovery within the VMware ESX virtual guest, which includes all versions of ESX and ESXi supported by VMware.

Figure 13-11shows an overview of Spectrum Protect components that are supported to run as a guest on ESX.

TSM PRODUCT/COMPONENT	SUPPORT?	ADDITIONAL SUPPORT INFORMATION
TSM Server TSM Operations Center TSM Reporting and Monitoring	Yes	 IBM can make no guarantees with respect to the performance and scalability in a virtualized environment No support for attached tape drivers or tape libraries, either virtual or
		physically attached . No support for LAN-Free data movement to tape or disk
TSM Backup-Archive and API clients	Yes	 No support for LAN-Free data movement No support for backupset restore from tape
TSM Storage Agent	No	- No support
TSM UNIX HSM (Space Management) clients	Yes	 No support for LAN-Free data movement
TSM HSM for Windows clients	Yes	- No known restrictions
TSM for Mail (DP for Domino, DP for Exchange)	Yes	- No support for LAN-Free data movement
TSM for Databases (DP for Oracle, DP for SQL)	Yes	- No support for LAN-Free data movement
TSM for Enterprise Resource Planning	Yes	- No support for LAN-Free data movement
TSM FastBack for Workstations / CDP for Files	Yes	- No known restrictions
TSM FastBack	Yes	- No known restrictions
TSM for SysBack	Not applicable	- Not applicable

Figure 13-11 Spectrum Protect supported components on ESX

As you can see, almost all Spectrum Protect components are supported in a virtual environment except for the Spectrum Protect Storage Agent, LAN-free, and Tape Library support. A complete list of all virtual environments and the supported Spectrum Protect components can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg21239546

13.2.3 Blueprints

In our SQL on VersaStack lab setup, we deployed the Spectrum Protect servers manually within the Linux VMs by completing the following steps:

- 1. Deployed SUSE Linux Enterprise Server 11 in the VM and configure the core networking through YaST.
- 2. Created a user to host the Spectrum Protect server instance that is named spadmin.
- 3. Created a group for the spadmin user named tivoli.
- 4. Formatted the VM hard disks for the database, log, archive log, and data by using YaST and mounted them under the following directories:
 - /tsmdb
 - /tsmlog
 - /tsmarchlog
 - /tsmdedupe
- 5. Created the /tsminst1 directory to hold the Spectrum Protect instance configuration files and assigned spadmin:tivoli ownership to all the directories above.
- 6. Copied the TSM_7111_LIN86_AGT_ML.bin file to the VM, extracted it, and started the IBM Installation Manager through install.sh. We selected the Spectrum Protect Extended Edition, License and OC components to be deployed.
- Ran the Spectrum Protect Instance configuration wizard (/opt/tivoli/tsm/server/bin/dsmicfgx) and used the above directories and user settings.
- Started the Spectrum Protect OC from https://spectrumprotect.versastack.local:11090/oc and followed the initial configuration wizard.
- 9. Used the built-in CLI from the OC to delete the three default storage pools (backuppool, archivepool, and spacemgpool)
- 10.Used the built-in CLI from the OC to create the data deduplication enabled storage pool and define a domain for the backup data that uses this pool.

Example 13-1 shows the sample commands to define a data deduplication enabled storage pool and a VersaStack logical domain, and to assign the storage pool to the default domain.

Example 13-1 Spectrum Protect commands

define devc dedup devtype=file mountl=100 maxcap=10G dir=/tsmdedupe
define stgpool spectrumdedupe dedup maxscr=51 deduplicate=yes identifyprocess=0

```
def domain VersaStack descript="VersaStack Domain"
def policyset VersaStack PS_VersaStack
def mgmt VersaStack PS_VersaStack MC_VersaStack
def copyg VersaStack PS_VersaStack MC_VersaStack dest=spectrumdedupe
assign defmgmt VersaStack PS_VersaStack MC_VersaStack
validate policyset VersaStack PS_VersaStack
activate policyset VersaStack PS_VersaStack
```

```
update copygroup STANDARD STANDARD STANDARD STANDARD destination=spectrumdedupe
update copygroup STANDARD STANDARD STANDARD type=archive
destination=spectrumdedupe
```

validate policyset STANDARD STANDARD activate policyset STANDARD STANDARD

11.Disabled the deduperquiresbackup and set registration to open through the server properties in the OC.

For more information, see the following website:

http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.1/com.ibm.itsm.srv.install.d oc/t srv install luw-linux.html

Spectrum Protect Blueprints

IBM released installation instructions and an automation tool to perform these tasks, which are called Spectrum Protect Blueprints.

The Tivoli Storage Manager Blueprint improves time-to-value for Tivoli Storage Manager deployments by providing a set of hardware blueprints for small, medium, and large Tivoli Storage Manager Server architectures. These reference architectures are based on hardware running AIX, Linux, or Windows, and are optimized as disk-only storage by using a Storwize storage system or IBM Elastic Storage[™] Server (based on IBM Spectrum Scale technology) and Tivoli Storage Manager data deduplication. The architectures were tested to determine the optimal workloads and limits for each size. The value proposition is to speed up the sales cycle by matching customer workload requirements to one of the three predefined sizes.

The blueprint consists of a document, or "cookbook", that describes the three reference architectures in detail, including IBM hardware model numbers and configuration requirements. It also includes scripts to speed up the installation and configuration, increasing time-to-value. The storage preparation script automates preparation of the file systems that will be used by the Tivoli Storage Manager server. The blueprint configuration script does a configuration check to verify that the hardware configuration meets the blueprint specifications, validates kernel settings on Linux systems, and verifies the configuration of required file systems before running the standard Tivoli Storage Manager server installation. The script also configures the Tivoli Storage Manager server by using preferred practices and performs the following actions:

- Creates a DB2 instance.
- Defines data deduplication storage pools with optimal performance settings.
- Defines administrative maintenance tasks that are optimized for data deduplication scalability.
- Defines a Tivoli Storage Manager database backup to disk.
- Creates a dsmserv.opt file with preferred practice option overrides.
- Creates policy domains for database, mail, and file servers with management classes for 30, 60, and 120-day retention.
- Defines backup schedules for all client types that can be easily selected when deploying the wanted client workloads.

The workload simulation script runs simulated Tivoli Storage Manager database and storage pool workloads and provides performance measurements that can be used as a reference against those measurements on the blueprint configuration.

When deploying Spectrum Protect in your VersaStack environment, follow the instructions that are outlined for the Small configuration when running Spectrum Protect in a virtual environment on one of the Cisco UCS blades.

Figure 13-12 shows a small Storwize V7000 storage system Spectrum Protect blueprint configuration overview.

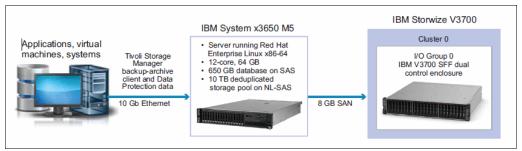


Figure 13-12 Spectrum Protect Blueprint

For proof of concept purposes, IBM developed a Spectrum Protect Virtual Appliance that hosts the following items:

- Spectrum Protect Server
- Spectrum Protect Operations Center
- Spectrum Protect for Virtual Environments

This POC Spectrum Protect VM is based on the small system version in the Spectrum Protect Blueprints, which are published at the following website:

https://ibm.biz/TivoliStorageManagerBlueprints

Plans to release Spectrum Protect as a virtual appliance are being investigated. For more information about the Spectrum Protect POC Appliance, contact your IBM representative or IBM Business Partner.

13.2.4 Multi-site setup

Deploying a Spectrum Protect server as VM by using shared resources on your primary environment gives you the benefit of advanced data and application protection technologies while maximizing your investment in the VersaStack environment.

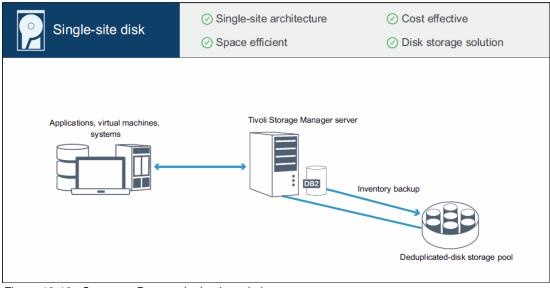


Figure 13-13 shows Spectrum Protect running, virtualized, in the primary environment.

Figure 13-13 Spectrum Protect single-site solution

However, having both your primary data and backup data on the same environment without a secondary copy is not recommended (remember this is just our lab setup and not a production environment).

Spectrum Protect has multiple high-availability and disaster recovery solutions that are built in, depending on the storage hardware that is used and the specific requirements:

- Backup of the Spectrum Protect configuration files, database, and a secondary copy of your primary storagepool to a copypool on tape that is externalized through tape-vaulting
- Cross-site backup with primary data from site 1 being backed up to site 2 and a copy being sent back to site 1 outside the backup window with cross-site server configuration backup
- DB2-HA mirroring the Spectrum Protect database and instance in combination with storage mirroring and cross-site copypools to have automated failover between two sites
- Per client (node) replication between two (cross-site) or multiple (many-to-one) Spectrum Protect servers

Figure 13-14 on page 353 shows Spectrum Protect servers on the primary and secondary site that use node replication.

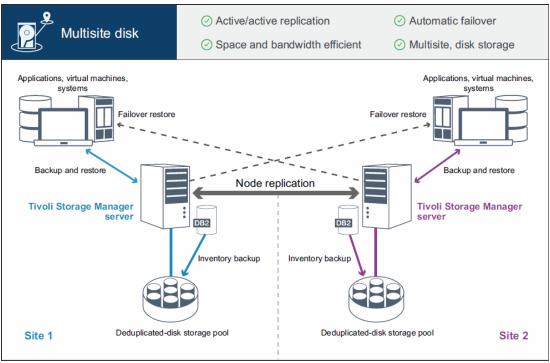


Figure 13-14 Spectrum Protect multisite solution

In the SQL on VersaStack lab setup, we deployed a secondary Spectrum Protect server that is similar to the primary server deployment that is outlined in 13.2.3, "Blueprints" on page 349. After the initial configuration, we started the Spectrum Protect OC and used the built-in CLI to define a server-to-server connection from the primary to the secondary server over the backup VLAN. Example 13-2 shows how to define the server to server communication.

Example 13-2 Define server-to-server communication

```
define server spectrumprotectreplica serverpassword=Object00
hladdress=192.168.60.11 lladdress=1500
```

ANR1660I Server SPECTRUMPROTECTREPLICA defined successfully.

We then used the Monitor Spoke wizard to register the secondary server as a spoke server and defined the primary server on the secondary server.

Figure 13-15 shows the Spectrum Protect servers that are configured in the OC.

Tivoli Storage Manager	Overviews	Clients	Services	Servers	Storage Pools	Storage Devices				🌺 adm	in 🔇 🖡	0 13)
	TSM	Servers	2									
	Alerts	4	\bigcirc	All available								
Spoke	Quick Look 🔄 D	etails 📔 🗄 Mo	nitor Spoke 🕢 Bac	sk Up Q	Filter							
Name	Sta	tus 🔺	Clients Al	lerts I	Database	Active Log		Archive Log	Last Database Backup	Uptime	1	
SPECTRUMPROTE	ст 🛛	Normal	32	3	22.0 GB		58.2 GB	178.1 GB	1 day	2 weeks	~	
SPECTRUMPROTE	CTREP 🖬	Normal	31	3	24.0 GB		58.4 GB	177.0 GB	1 day	3 weeks	×	

Figure 13-15 Spectrum Protect OC servers overview

Within the OC, select the primary server spectrumprotect, click **Details**, and then click **Details** in the left pane.

Scroll down to Replication, set outbound replication to **Enabled**, and select spectrumprotectreplica as the peer replication server.

Tivoli Storage Manager	Overviews Clie	nts Services	Servers	Storage	Pools	Storage Devices
	SPECTRU	MPROTECT				
	Normal					
Summary	Central sched	uling		ACTIVE		
Properties	Poll by client o	r prompt by server		ANY	-	
	Duration for or	ne-time actions		5	days	Indefinite
Alerts 3	Schedule rand	Iomization		25	%	All schedules run at beginning of startup
Active Tasks	Client-polling	interval			hours	 Determined by client
Completed Tasks	Retain schedu	ile events		14	days	Today only
12	Inbound sess	ions disabled		_		
	Outbound ses	sions disabled		_		
	 History and Le 	ogs				
	Retain activity	log data		30	days 👻	Do not retain
	Retain activity	summary data		30	days	Do not retain
2000	Create accour	ting records		OFF	•	
Related resources Clients						
Maintenance	Outbound rep	ication		ENABLE	D 👻	
Schedules Services	Peer server			SPECTR	UMPROTEC	TREPLICA -
Storage Pools	Default archiv	e rule		ALL_DAT	Ά τ	
	Default backu	o rule		ALL_DAT	- A	
	Default space	-management rule		ALL_DAT	- A	
	Retain replica	tion history		30	days	Do not retain

Figure 13-16 shows setting the replication target server through the Spectrum Protect OC.

Figure 13-16 Spectrum Protect OC server details

Perform the same action on the secondary server (spectrumprotectreplica) to enable cross-site replication. Both servers are now enabled for node replication.

Node replication

Node replication is the process of incrementally copying, or replicating, data that belongs to backup-archive client nodes. Data is replicated from one Tivoli Storage Manager server to another Tivoli Storage Manager server.

The server from which client node data is replicated is called a *source replication server*. The server to which client node data is replicated is called a *target replication server*. A replication server can function as either a source server, a target server, or both.

Use replication processing to maintain the same level of files on the source and the target servers. When client node data is replicated, only the data that is not on the target server is copied. As part of replication processing, client node data that was deleted from the source server is also deleted from the target server. Client node data is marked for deletion during replication processing, but it is not deleted until expiration processing runs on the target server.

You can maintain different versions of files on the source and target servers or you can maintain files for more or less time on the target server than they are being maintained on the source server. To do this task, you must configure the source and target servers to allow the target server manage replicated files by using the target server policies.

If a disaster occurs and the source server is temporarily unavailable, client nodes can recover their data from the target server. If the source server cannot be recovered, you can convert client nodes to store data on the target server. When there is an outage, the source server can automatically fail over to a target server for data recovery.

You can use replication processing to recover damaged files. You must replicate the node to the target server before the file damage occurs. Subsequent replication processes detect damaged files on the source server and replace them with undamaged files from the target server.

Figure 13-17 shows automated recovery from the replication server if there are damaged volumes or files on the source server.

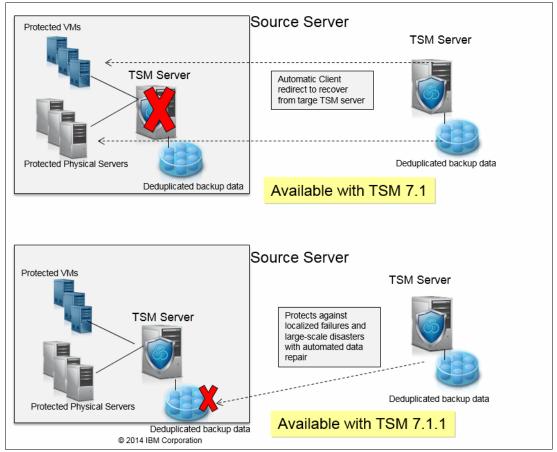


Figure 13-17 Spectrum Protect Node Replication V7.1.1. enhancements

You can replicate the following types of client node data:

- Active and inactive backup data together, or only active backup data
- Archive data
- Data that was migrated to a source server by Tivoli Storage Manager for Space Management clients

Use node replication for data recovery at a disaster recovery site and to maintain the same level of files on the source and target servers. Node replication is used for the following objectives:

- Controlling network throughput by scheduling node replication at specific times
- Recovering data from a large-scale site loss
- Recovering damaged files on the source server

Automatic failover for data recovery overview

Automatic failover for data recovery occurs if the source replication server is unavailable because of a disaster or a system outage.

During normal operations, when the Tivoli Storage Manager Version 7.1 client logs in to a source replication server, it receives connection information for the target failover server. The client node stores the failover connection information in the client options file. During client restore operations, the Tivoli Storage Manager server automatically changes clients to the target replication server and back again. Only one failover server can exist per node at any time. The server information is stored in the options file. The failover server can be modified only if the default replication server is modified and another replication is completed for the node.

If the client cannot connect to the source replication server, it uses the failover connection information and attempts to log on to the target failover server. The client logs on to the target replication server and is allowed only to recover data. The client cannot store data during failover processing.

When a new client operation is started, the client attempts to connect to the source replication server. The client resumes operations on the source server if the source replication server is available.

13.2.5 Summary

This section reviewed the following information:

- Spectrum Protect components
- Spectrum Protect core architecture
- Spectrum Protect deployment by using blueprints
- Spectrum Protect high availability setup by using node replication

This completes the base overview of the Spectrum Protect server. The next section covers the backup of the VMware environment on the SQL on VersaStack setup by deploying the Spectrum Protect for Virtual Environments application module.

13.3 Protecting the VMware infrastructure

This section describes how we used Spectrum Protect in our example VMware environment.

13.3.1 Deploying Spectrum Protect for Virtual Environments

Spectrum Protect for Virtual Environments is an add-on that runs on a separate system that is called the vStorage backup server, as shown in Figure 13-6 on page 340.

vStorage backup server

This vStorage backup server can either be virtual or physical (when SAN-based data movement towards physical or virtual tape library is a requirement) and hosts the following components:

- ► Spectrum Protect / FlashCopy Manager for Virtual Environments stand-alone GUI
- Spectrum Protect / FlashCopy Manager for Virtual Environments vSphere GUI plug-in
- Spectrum Protect / FlashCopy Manager for Virtual Environments Command Line Interface
- Spectrum Protect for Virtual Environments Datamover
- Spectrum Protect for Virtual Environments Recovery Agent

Both Windows x64 and Linux x86_64 are supported operating systems for Spectrum Protect for Virtual Environments. Spectrum Protect FlashCopy Manager for Virtual Environments, however, requires a Linux x86_64 operating system. Therefore, we deploy two vStorage backup servers in the SQL on VersaStack setup.

Figure 13-18 shows the welcome page of the Spectrum Protect / FlashCopy Manager for VMware vSphere GUI.

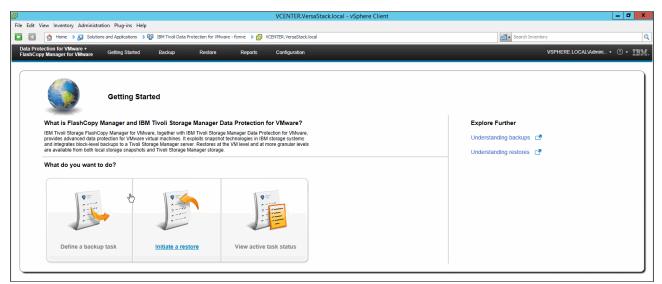


Figure 13-18 Spectrum Protect / FlashCopy Manager for Virtual Environments vSphere GUI

SpectrumvStorage

For the SpectrumvStorage server, we use a SUSE Linux Enterprise Server 11 SP3 VM with the following specifications:

- VM Version: 8
- ► CPU: Two vCPUs
- Memory: 4 GB

- VNIC0: VM-Production 1 GbE for the management interfaces
- ► VNIC1: VM-Backup 1 GbE for the backup data transport
- VM Virtual Disks: Hard disk 1: 64 GB, operating system, Spectrum Protect for Virtual Environments GUI, vSphere GUI, CLI, Datamover, and Recovery Agent

SpectrumDm

For the SpectrumDm server, we use a Windows 2012 VM with the following specifications:

- VM Version: 8
- ► CPU: Two vCPUs
- Memory: 4 GB
- VNIC0: VM-Production 1 GbE for the management interfaces
- ► VNIC1: VM-Backup 1 GbE for the backup data transport
- VM Virtual Disks: Hard disk 1: 64 GB, operating system, Spectrum Protect for Virtual Environments Datamover, and Recovery Agent

The hardware and software requirements for Spectrum Protect for Virtual Environments can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg21697958

The hardware and software requirements for Spectrum Protect / FlashCopy Manager for Virtual Environments can be found at:

http://www.ibm.com/support/docview.wss?uid=swg21701160

To complete the installation, complete the following steps:

- 1. Deploy SUSE Linux Enterprise server on the SpectrumvStorage VM.
- 2. Deploy Windows 2012 on the SpectrumDm VM.
- Deploy Spectrum Protect for Virtual Environments on the SpectrumVStorage VM, selecting all components.
- 4. Deploy Spectrum Protect for Virtual Environments on the SpectrumDm VM, selecting the Datamover and Recovery Agent components.
- 5. Start the Spectrum Protect for Virtual Environments GUI and complete the initial configuration wizard to register the application onto the Spectrum Protect server.
- Deploy Spectrum Protect / FlashCopy Manager for Virtual Environments on the SpectrumVStorage VM.
- 7. Prepare the target FlashCopy volumes on the Storwize V7000 storage system.
- 8. Start the Spectrum Protect / FlashCopy Manager for Virtual Environments GUI and complete the initial configuration wizard.

This process is outlined in more detail in the *FlashCopy Manager 4.1.1 for VMware and Tivoli* Storage Manager for Virtual Environments (Data Protection for VMware 7.1.1) Integrated Installation Cookbook, found at:

https://www.ibm.com/developerworks/community/groups/service/html/communityview?com munityUuid=869bac74-5fc2-4b94-81a2-6153890e029a#fullpageWidgetId=W1420ccd1a64d_45f 8_8f76_fdbd1fa5cb3e&file=e4f9e51d-32cf-4942-8e00-1f51fa1f5476

This process also can be found on IBM Tivoli Storage Manager for Virtual Environments community wiki on IBM developerWorks at the following website:

https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/Tivoli%20St
orage%20Manager/page/Data%20Protection%20for%20VMware

In the SQL on VersaStack setup, we deployed versions 4.1.2 and 7.1.2 respectively, but the same installation instructions apply.

13.3.2 Storwize V7000 FlashCopy mapping

Spectrum Protect / FlashCopy Manager for VMware 4.1.2 requires the target volumes to be created and mapped on the Storwize V7000 storage system.

Similar to the instructions that are outlined in *FlashCopy Manager 4.1.1 for VMware and Tivoli Storage Manager for Virtual Environments (Data Protection for VMware 7.1.1) Integrated Installation Cookbook*, in our example environment, we create two thin-provisioned target volumes for the infra_datastore_1 and infra_datastore_2 volumes that host the VMware data stores.

We then use the Create FlashCopy Manager from within the FlashCopy Mappings section of the Storwize V7000 GUI to create a FlashCopy consistency group and map the source and target volumes.

Figure 13-19 shows using the V7000 Create FlashCopy Mappings wizard to link the source and target volumes.

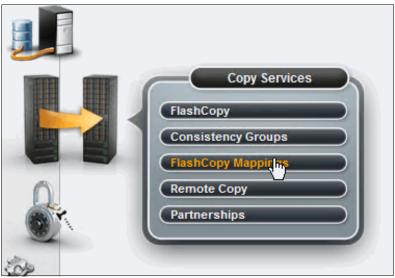


Figure 13-19 Storwize V7000 FlashCopy Mappings

In the lab setup, we define two target volumes. The number of target volumes determines the number of FlashCopy based backups that you can make if you surpass is overwritten. So, with two target volumes, only two restore points are available. Adjust the number of target volumes to your requirements.

Figure 13-20 shows the status of the FlashCopy mappings on the Storwize V7000 GUI.

🏦 versastackv7000 > Copy S	ervices > FlashCopy Mapp	ings	IBM Storwize V7000			
+ Create FlashCopy	Mapping E Actions ⊂	Filter				
Mapping Name	Status	Source Vol 🔺	Target Volume	Progress	Group	Flash Time
fcmap4	Copying	infra_datastore_1	infra_datastore_1_02	10%	fccstgrp1	Jun 19, 2015, 7:31:30 PM
fcmap1	Copying	infra_datastore_1	infra_datastore_1_01	9%	fccstgrp0	Jun 23, 2015, 11:12:18 AM
fcmap0	Copying	infra_datastore_2	infra_datastore_2_01	0%	fccstgrp0	Jun 23, 2015, 11:12:18 AM
fcmap2	Copying	infra_datastore_2	infra_datastore_2_02	39%	fccstgrp1	Jun 19, 2015, 7:31:30 PM

Figure 13-20 Storwize V7000 FlashCopy mappings overview

As you can see, the status of our mappings is Copying because we selected a thin-provisioned volume as the FlashCopy Manager targets to reduce the space that is required for the FlashCopy copies.

You also must specify the **NOCOPY** configuration parameter, as described in *FlashCopy Manager 4.1.1 for VMware and Tivoli Storage Manager for Virtual Environments (Data Protection for VMware 7.1.1) Integrated Installation Cookbook* or by editing the /opt/tivoli/tsm/tdpvmware/common/scripts/vmcliprofile file directly.

Example 13-3 show the vmcliprofile file.

Example 13-3 Spectrum Protect / FlashCopy Manager for Virtual Environments vmcliprofile file

```
>>> GLOBAL
ACS DIR /home/tdpvmware/tdpvmware/config
ACSD fcmve 57328
# ENFORCE_TLS12 NO
# TRACE NO
<<<
>>> ACSD
ACS REPOSITORY /home/tdpvmware/tdpvmware/config/repo
# REPOSITORY_LABEL TSM
# SYNCHRONOUS RECONCILE RESTORE AND DELETE
<<<
>>> VMWARE
VCENTER_SERVER vcenter
AUXILIARY ESX HOST vm-host-infra-02.versastack.local
# VCENTER SERVER VM NAME
VCENTER SERVER USER administrator@vsphere.local
# FCM VM NAME
# VM BACKUP MODE SNAPSHOT EXCL MEM
# NUMBER_CONCURRENT_VM_TASKS 1
MAX VERSIONS ADAPTIVE
# HOST NAME MAPPING
# TIMEOUT PARTITION 3600
# TIMEOUT_PREPARE 3600
# TIMEOUT_FLASH 300
# TIMEOUT VERIFY 3600
# TIMEOUT CLOSE 3600
# TIMEOUT FLASHRESTORE 3600
# TIMEOUT_COMPLETERESTORE 3600
<<<
```

```
>>> VMCLI
VE TSM SERVER NAME
                         spectrumprotect
VE TSM SERVER PORT
                       1500
VE TSMCLI NODE NAME
                      fcmtsmve vmcli
VE VCENTER NODE NAME
                       fcmtsmve vcvcenter
DERBY HOME /home/tdpvmware/tdpvmware
VE DATACENTER NAME VersaStack DC 1::FCMTSMVE VERSASTACK DC 1
VMCLI TRACE NO
VMCLI SCHEDULER_INTERVAL 60
VMCLI TASK EXPIRATION TIME 864000
VMCLI RESTORE TASK EXPIRATION TIME 2592000
VMCLI GRACE PERIOD 2592000
VMCLI RECON INTERVAL FCM 600
VMCLI RECON INTERVAL TSM 1200
VMCLI DB BACKUP AT 00:00
VMCLI DB BACKUP VERSIONS 3
VMCLI LOG DIR logs
VMCLI DB HOST localhost
VMCLI DB PORT 1527
VMCLI CACHE EXPIRATION TIME 600
VMCLI DB NAME VMCLIDB
VE DATACENTER NAME
                         VersaStack DC 2::VERSASTACK DC 2
<<<
>>> DEVICE CLASS V7000
COPYSERVICES HARDWARE TYPE SVC
COPYSERVICES PRIMARY SERVERNAME v7000
COPYSERVICES USERNAME superuser
# SVC COPY RATE 80
# SVC CLEAN RATE 50
# SVC GRAIN SIZE 256
COPYSERVICES REMOTE NO
# COPYSERVICES COMMPROTOCOL HTTPS
# COPYSERVICES CERTIFICATEFILE NO CERTIFICATE
# COPYSERVICES SERVERPORT 5989
FLASHCOPY TYPE NOCOPY
# COPYSERVICES TIMEOUT 6
# RECON INTERVAL 12
TARGET SETS 1 2
TARGET NAMING %SOURCE_0%TARGETSET
```

13.3.3 Protecting VMware data

<<<

With both Spectrum Protect for Virtual Environments and Spectrum Protect FlashCopy Manager for Virtual Environments, you can perform the following tasks:

- Hardware-assisted FlashCopy snapshot-based backups:
 - Near-instantaneous backups by using hardware snapshots.
 - The backups are on the Storwize V7000 storage system itself, and require capacity on the primary storage system.

- Low RTO and RPO possibilities (less than one hour) for all the VMs that are hosted on the VMware environment.
- The primary (storage) environment must be operational in case a restore is needed.
- The recovery can be either at the VM or at data store level.
- Recovery granularity is at the VM level (same or alternative location) or file level by attaching the VMDK to the source or an alternative target VM.

Figure 13-21 shows selecting a FlashCopy based restore point to attach a backed-up VMDK to a VM.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started Ba	ickup	Restore	Reports	Configuration				
2	Restore Points Insta	nt Access/Rest	tore Status	Mount Status					
Virtual Machines	Restore Points	8	Restore N	Iount List All Attac	ched Attach	Detach	🔍 Filter 🔚		
			Restore Po	pint			Template	Backup Type	Location
VersaStack_DC_1			July 27, 2015	6:59:03 AM PDT			No	IFINCREMENTAL	SPECTRUMPROTECT
vm-host-infra-01.versastad	ck.local		July 27, 2015	5 6:54:30 AM PDT (Atta	ichable)		No	FCM	DEVICE_CLASS:V7000
Exchange2013			July 22, 2015	6:04:22 PM PDT			No	IFINCREMENTAL	SPECTRUMPROTECT
SpectrumControl			July 21, 2015	6:21:04 PM PDT			No	IFINCREMENTAL	SPECTRUMPROTECT

Figure 13-21 Spectrum Protect / FlashCopy Manager for Virtual Environments restore points

Software-based backups towards the Spectrum Protect server

Software-based backups towards the Spectrum Protect server have the following features:

- These backups can use data reduction technologies such as client-side data deduplication and compression and incremental forever backups to perform bandwidth and storage usage optimized backups.
- ► Independent backup and long-term copies are stored on the Spectrum Protect server.
- RPO in general is 24 hours, with RTOs depending on the chosen back-end infrastructure. The Instant-Restore function can provide low RTOs for individual VMs or individual VMDKs.
- Recovery is at the VM level.
- Recovery granularity is at the VM (same or alternative location), VMDK (full VMDK or instant VMDK restore or file level by either attaching the backup copy as a virtual mount point within the source or alternative VM or exposing this virtual mount point as a network share to the user).

Figure 13-22 on page 363 shows selecting a Tivoli Storage Manager based restore point to expose a backed-up VMDK over the network.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started	Backup	Restore	Reports	Configuration			
	Restore Points	Instant Access	s/Restore Status	Mount Status				
	Restore Poir		Restore	Mount List All A	Attached Attach	Detach 🔍 Fitter 🔀		
Virtual Machines De	select all	2	Restore I	Point		Template	Backup Type	Location
VersaStack_DC_1			July 27, 20	15 6:59:03 AM PDT		No	IFINCREMENTAL	SPECTRUMPROTECT
vm-host-infra-01.versastacl	k.local		July 27, 20	15 6:54:30 AM PDT ((Attachable)	No	FCM	DEVICE_CLASS:V7000
Exchange2013			July 22, 20	15 6:04:22 PM PDT		No	IFINCREMENTAL	SPECTRUMPROTECT
SpectrumControl			July 21, 20	15 6:21:04 PM PDT		No	IFINCREMENTAL	SPECTRUMPROTECT

Figure 13-22 Spectrum Protect for Virtual Environments Restore Points

Both the FlashCopy and Spectrum Protect based backups and restores are managed from the same GUI.

Spectrum Protect for Virtual Environments GUI

This GUI can be accessed directly through a web URL or a vSphere client plug-in, as shown in Figure 13-18 on page 357.

The interface is divided into five sections for easy access to the main functions:

- Getting Started: Provides information about the available backup and restore functions and links to perform the following functions:
 - Define a backup task.
 - Initiate a restore.
 - View the active task status.
- Backup

Figure 13-23 shows an overview of Spectrum Protect for Virtual Environment backup schedules.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started	Backup	Restore	Reports	Configuration			VSPHERE.LOCALVAdmini + (?) + TEHA
<u> 16</u>	Backup Sche	edules						
Create Schedule Delete	Show all VMs 🥰 Filte	er 🔛						Showing 2 items Selected 0 items
Schedule		Туре	Datacenter		Last Run	Start Method	Status	IJ
Versastack_Protect_Manual (3166)		TSM_IFINCR	VersaStack_DC_	,1	July 27, 2015 6:58:35 AM PDT	Run now	🔒 Warning	
Versastack_Manual (5)		FCM	VersaStack_DC_	1	July 27, 2015 6:54:30 AM PDT	Run now	Success	
L ₆								

Figure 13-23 Spectrum Protect for Virtual Environments GUI Backup overview

From within this section, you can use the Create Schedule wizard to define a backup schedule that performs FlashCopy based backups, Spectrum Protect based backups, or combined backups. You can also define manual *ad hoc* based backups to be run immediately.

A single Datamover instance in the vStorage backup server can back up multiple VMs in parallel (up to 50). This function, which is combined with the incremental forever backup technology, greatly reduces the scheduling complexity and the number of schedules that are required.

VMs can be selected at the cluster, host, folder, or VM level with the option to include automatically newly created VMs. Likewise, VMs or VMDKs can be excluded from backup by using wildcards with Spectrum Protect for Virtual Environments.

For FlashCopy Manager for Virtual Environments clusters, hosts or VMs can be selected for backup by either selecting the cluster, host, or data store (to have newly created VMs automatically be incorporated into the backup) or individual VMs within specific data stores.

Restore

Figure 13-24 shows an overview of Spectrum Protect for Virtual Environments data store restore points.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started	Backup	Restore	Reports	Configuration				VSPHERE.LC	OCAL\Admini • 🕐	• IBM	•
	Restore Points In	nstant Access	ss/Restore Status	Mount Status								^
♥ • • • • • • • • • • • • • • • • • • •	Restore Points	ts										
Datastores 💌 De	eselect all	8	Restore Restore P		ttached Attach Deta	ch 🤍 Filter 📓 Destructable	Backup Type	Location	Showin	og 2 items Selected 1	Item	
VersaStack_DC_1				15 6:54:30 AM PDT		Yes	Баскор туре FCM	DEVICE_CLASS:V7000				
✓ Versastack_DC_1			July 27, 2015			Yes	FCM	DEVICE_CLASS:V7000				
								<u></u>				
								1				
Backup Type: FCM Backup ID: A0ICLZ7K08 Task ID: 5 Datacenter: VersaStack_DC_1 Total VM count: 1 Datastore Urt: ds:///vmfs/volumes/55	581ed95-7fbb07c5-b688-	-0025b5070a11	11/			Status: Success		I PDT				~
Recent Tasks									Name, Target or Status contains: -	,	Clear	×
Name Target	Sta	tatus	Details					Initiated by	vCenter Server	Requested Start Ti	🗢 Start T	ſim
<					ш							>

Figure 13-24 Spectrum Protect for Virtual Environments GUI restore overview

From this pane, you switch between data store- or VMs-based restore points:

- Virtual Machines Restore Points:
 - You can select (multiple) VMs to be restored to their original or alternative location.
 - You can select a VMDK of a VM to be mounted onto the vStorage backup server or to be exposed through a network (CIFS/NFS) share for specific users.
 - You can perform an instant restore of a VM or instant access to a VM where the Spectrum Protect server is used as a temporary data store in the VMware environment with the backup VM booted from this data store for restore consistency verification (instant access) or booted from and moved onto the production data stores with vMotion.
 - You can attach a VMDK from a FlashCopy backup to the source or an alternative VM.
- Datastore Restore Points:

You can select the data stores and VMs of those data stores at the time of the FlashCopy backup to perform an instant restore at the data store level and have the selected VMs registered in the VMware environment.

Note: All VMs in the selected data stores are overwritten by the instant restore process. Do not use the instant restore process if you have VMs that are not backed up in the selected restore point.

Next to the Restore Points section, you also have two overview panes that show you the Instant Access/Restore Status and the Mount Status operations that are in progress.

Reports

Figure 13-25 shows the Backup Status in the Spectrum Protect for Virtual Environments Reports overview.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started Backup	Restore	Reports	Configuration				VSPHERE.LOCALVAdmini • ③ • IRM.
	Recent Tasks Backup Status	Events Applica	tion Protection	Managed Capacity	Datacenter Occupan	cy		Summary Log View
	Backup Status							
Select a datacenter:	elect a report:							
VersaStack_DC_1	Coverage status for all VMs 👻 🧧	Generate Report						
	Backup Coverage Reports							
Show backup history Sho	Coverage status for all VMs							Showing 0 items Selected 0 items
VM Name	/Ms with a backup			TSM Copy	Backup Duration	Backup Currency	Last Node Replication End	L .
	/Ms without backups							
	/Ms with a completion date more that							
	/Ms with a coverage status other tha							
	/Ms that have backups but the VM do		enter					
	/Ms without a TSM copy of the backu							
N N	/Ms that have a TSM backup but not	a FCM hardware snap	shot					
-	Backup Failure Reports							
	Show failures from the most recent b	ackup						
	Show all backup failures							

Figure 13-25 Spectrum Protect for Virtual Environments GUI Reports overview

This pane hosts the following subsections:

- Recent Tasks: Gives an overview of the tasks recently run from within the GUI
- Backup Status: Allows you to determine which VMs have a backup (either on Spectrum Protect or on FlashCopy), the most recent backup failures, the VM coverage status, and so on.
- Events: Shows an overview of all events, and completed events with the option to see all or failed VMs that are related to the corresponding event.
- Application Protection: Spectrum Protect for Virtual Environment can scan Windows based VMs to determine which applications that run in these VMs are supported by its agentless application protection capability. You can see the following statuses:
 - Application Configuration Status: Shows you which supported applications run in the VM and what kind of Spectrum Protect client or application is deployed in the VM.
 - Unified Component Backup Status: Shows the backup status for both the agentless VM backup as the in-guest Spectrum Protect client or application backup status.
 - Backup Activity Status: Consolidates the view of all backups (agentless and in-guest) for the VMs in the selected virtual data center.
- Managed Capacity: The capacity of the data stores that are protected through FlashCopy Manager for Virtual Environments.

 Datacenter Occupancy: The number of VMs in the protected virtual data centers with the number of VMs being backed up and the occupancy on the Spectrum Protect Server.

Configuration

Figure 13-26 shows the Spectrum Protect for the Virtual Environment nodes' relationship.

Data Protection for VMware + FlashCopy Manager for VMware	Getting Started Backup	Restore	Reports	Configuration	VSPHERE.LOCAL\Admini • ③ • IBM.
×	Configuration Status				
Show all available datacenters		Т	his VMware vCent	er has the following Tivoli Storage Manager Nodes relationship:	
VCENTER			Tivoli Storage N	lanager Node Name	Description
+ VersaStack_DC_1			FCMTSMVE_	VCVCENTER	vCenter Node
VersaStack_DC_2			FCMTSM		VMCLI Node
			FCMTSM	/E_VERSASTACK_DC_1	DataCenter Node
			🍫 ЕСМТ	SMVE_REMOTE_MP_WIN / FCMTSMVE_REMOTE_MP_LNX	Mount Proxy Node Pairs
				SMVE_VERSASTACK_DC_1_DM	DataMover Node
			FCMT	SMVE_VERSASTACK_DC_1_DM1	DataMover Node

Figure 13-26 Spectrum Protect for Virtual Environments GUI Configuration overview

The vCenter and its virtual data centers are mapped to specific virtual nodes on the Spectrum Protect server. VMs are stored on a common virtual data center node so that they can be backed up or restored by any datamover. An overview of the Spectrum Protect to VMware node relationship can be seen in this pane. You can also query the connectivity towards the datamovers, run the Spectrum Protect or FlashCopy Configuration wizards or edit the Tivoli Storage Manager configuration from the Tasks drop-down box.

Spectrum Protect for Virtual Environments vSphere Web Client extension

Within the Spectrum Protect family, there is a dual approach to backup management. One approach is for the central backup administrators to manage all backups and restores centrally either through the legacy Spectrum Protect Administration Center, the OC, or through the administrative client by using the command-line interface (CLI).

The other approach is for the backup consumer to run the restore in their familiar working environment. For this approach, you can use the Spectrum Protect / FlashCopy Manager for Virtual Environments vSphere Web Client extension.

Figure 13-27 on page 367 shows vSphere Web Client extension tasks overview.

vmware [®] vSphere Web Cl	ent 🕇 🖉 🛛 🖸 Administrator@VSPHERE.LOCAL = Help -
🕢 History 🕞 🕑 🖡	IBM Data Protection: Getting Started and Connections
🚮 Home	Getting Started Connections
Ø vCenter > Rules and Profiles > Hybrid Cloud Senices > Vcenter Orchestrator > Im IBM Data Protection & Administration > Tasks	Overview Use this web client extension to quickly restore virtual machines from IBM Tivoli Storage FlashCopy Manager for VMware or IBM Tivoli Storage Manager Data Protection for VMware.
Log Browser	Tasks
Events Tags Q New Search Saved Searches	Restore an existing virtual machine: Select a virtual machine Restore a deleted virtual machine: Select a datacenter Manage tab IBM Data Protection tab Select a virtual machine Click Restore Complete additional tasks by using the IBM Data Protection for VMware Web GUI: IBM Data Protection Connections tab Select a vicenter Select a vicenter Complete additional tasks by using the IBM Data Protection for VMware Web GUI: IBM Data Protection Connections tab Select a vicenter Click Open
	For more information, see IBM Knowledge Center: IBM Twoli Storage, Manager Data Protection for VMware IBM Tivoli Storage FlashCopy Manager for VMware About this product

Figure 13-27 Spectrum Protect for Virtual Environments vSphere Web Client extension

You can use this extension to do the following tasks:

- Restore a full VM to its original or alternative location (Spectrum Protect / FlashCopy Manager for Virtual Environments).
- ► Restore a VMDK to its original location (FlashCopy Manager for Virtual Environments).

13.3.4 Summary

This section reviewed the deployment of Spectrum Protect for Virtual Environments and FlashCopy Manager for Virtual Environments and described which functions these products deliver to protect the VMware environment on which the SQL on VersaStack systems are running.

We used these functions to back up the Spectrum Control and other auxiliary VMs in the test setup, such as the Exchange 2013 mail server to which the Spectrum Control and Spectrum Protect automated reports and alert emails are sent.

The application protection that is integrated in Spectrum Protect for Virtual Environments can be used to perform agentless backups of Microsoft SQL Servers within the VMs. As part of the backup process, the SQL Server is notified of the backup, quiesces its database, and has the SQL log files committed.

This backup methodology is not suited for all SQL Server instances. SQL Servers that are deployed in a clustered setup or use physical raw device mappings for its data disks, such as the SQL on VersaStack, cannot be backed up this way because VMware snapshots are disabled on the OS VMDKs and are skipped on physical raw device mapping-based VMDKs.

For this kind of deployment, a traditional deployment of a base Spectrum Protect Backup/Archive client in combination with the Spectrum Protect for Databases application is recommended, as described in 13.4, "Protecting the SQL cluster" on page 368.

13.4 Protecting the SQL cluster

This section describes the following topics:

- Backup models to protect application and data in a VMware vSphere environment
- ► How to protect Microsoft SQL databases in a cooperative hybrid approach
- The deployment of Spectrum Protect for Databases on the SQL cluster

13.4.1 Application and Data Protection in vSphere Environments

The Application and Data Protection in vSphere Environments document on IBM developerWorks provides high-level recommendations for using the appropriate Spectrum Protect and Spectrum Protect / FlashCopy Manager solutions to protect VMs that are deployed in a VMware vSphere environment. This document focuses specifically on data protection for database and application products that are typically hosted in VMware virtual server environments and gives guidance about choosing between three generic types of data protection:

- Off-host data protection solutions that feature a backup/recovery agent that can be hosted on a machine other than the hypervisor host, for example, Spectrum Protect for Virtual Environments and Spectrum Protect FlashCopy Manager for VMware
- In-guest data protection solutions that require the deployment of a backup/recovery agent in the guest machine, for example, Spectrum Protect for Databases - Data Protection for Microsoft SQL Server
- Hybrid solutions that use elements of both off-host data protection and in-guest data protection solutions.

There are several considerations that must be accounted for when choosing the appropriate data protection solution, for example:

- Recovery time objectives (RTO): Block-level recovery from an off-host backup might provide a shorter recovery time compared to recovery from an in-guest backup.
- Recovery point objectives (RPO): Recovery of transaction logs that are produced by in-guest backup might minimize data loss in a recovery scenario.
- Type of storage: Raw device mapping disks in physical compatibility mode cannot be the target of a VMware snapshot operation and are better suited for in-guest solutions.
- Other considerations, including storage vendor, data layout, Tivoli Storage Manager server configuration, long-term recovery requirements, and so on.

Although this document does not intend to provide exhaustive details about all of these factors, it is meant as a starting point for evaluating the different options that are available.

Hybrid solutions

Off-host data protection and in-guest data protection techniques are not mutually exclusive. In many cases, especially for faster recovery of an entire VM including the hosted database or application, it might be desirable to combine both techniques. This combination can be done by using the in-guest data protection agent to protect the database or application-specific data and off-host data protection for the VM's operating system, configuration, and installed applications.

There are two generic types of hybrid solutions:

- "Partitioned" hybrid solution: In this type of solution, the data protection is divided (or partitioned) between the off-host data protection solution and the in-guest data protection solution. In general, each solution provides protection for a part of the VM and the two solutions do not interact with each other. Take an example of a Microsoft SQL Server deployment in a VM that has the database and log files that are stored on raw device mapped volumes. Because off-host data protection solutions cannot take snapshots of these types of disks, an in-guest agent (Data Protection for Microsoft SQL Server) is required to protect the Microsoft SQL Server databases. An off-host solution (Data Protection for VMware) can be used to protect the other virtual disks on the VM, such as the operating system disk and application binary files. To avoid redundancy in these situations, Data Protection for VMware can be configured to bypass the disks already being protected by the in-guest agent when moving the VM information to the Spectrum Protect server.
- "Cooperative" hybrid solution: In this type of solution, the data protection is also divided between the off-host data protection solution and the in-guest data protection solution, but the two solutions have explicit knowledge of each other and can cooperate to provide higher levels of data protection. Take an example of a Microsoft SQL Server deployment in a VM that has the database and log files that are stored on a virtual disk. An off-host solution (Data Protection for VMware) can be used to protect the entire VM, including the disks belonging to Microsoft SQL Server, and provide full backup and recovery of the VM. If the database administrator must recover an individual Microsoft SQL Server database without disrupting other databases on the same server, you can use an in-guest solution (Data Protection for Microsoft SQL Server) to provide this level of recovery. This is possible because the in-guest solution and the off-host solution are configured in a manner that allows them to cooperatively provide data protection, specifically the in-guest solution (Data Protection for Microsoft SQL Server) can read backup data that created by the off-host solution (Data Protection for Microsoft SQL Server).

For more information about how to select the most appropriate method to protect a SQL Server in a partitioned or cooperative hybrid method, see *Application and Data Protection in vSphere Environments*, found at:

https://ibm.biz/BdFdjN

The SQL on VersaStack deployment requires an in-guest backup approach, as described in 13.4.3, "Spectrum Protect for Databases" on page 370.

13.4.2 Protecting Microsoft SQL Database in VMware

As many workloads are being virtualized, the methods that are deployed to protect those applications are evolving to take advantage of the virtualized infrastructure. Take the example of Microsoft SQL Servers that are deployed in VMware ESXi virtual guest machines. Data protection products today can take application consistent backups of VMs hosting Microsoft SQL databases and recover individual Microsoft SQL databases from the backup of the VM image.

One of the key requirements that must be considered for any data protection solution is the recovery point objectives (RPO), that is, the time granularity to which you can recover a Microsoft SQL database. One potential solution is to take VM backups on a frequent basis so that the data protection product can provide the necessary recovery points (because the recovery point of a VM level backup is at the point of the backup). Even with the efficiencies of change block tracking and data deduplication, this approach can become prohibitive if only in the cost of creating and deleting VM snapshots.

However, most traditional in-guest data protection methods can provide the appropriate RPOs, but these in-guest methods lose the efficiencies that are introduced by backup at the VM level.

The *Protecting Microsoft SQL Database in VMware* paper provides guidance about how to deploy Spectrum Protect for Virtual Environments (Data Protection for VMware) and Spectrum Protect for Databases (Data Protection for Microsoft SQL) in a manner that preserves the backup efficiencies that are offered by backing up data at a VM level, but also provides more granular recovery points by deploying complementary in-guest backup methods. Specifically, the goals of this paper are to demonstrate how Spectrum Protect can be used to accomplish the following tasks:

- Provides optimized backups of the VM by using VMware vStorage APIs for Data
- Provides protection and changed block tracking technologies
- Provides the Microsoft SQL database administrator (DBA) the appropriate tools to augment the VM backups with SQL log backups
- Provides the Microsoft SQL DBA the appropriate tools to recover a Microsoft SQL database to a wanted recovery point by using the VM backups with the log backups

Protecting Microsoft SQL Database in VMware can be downloaded from the following website:

https://ibm.biz/BdRWXx

As mentioned, the SQL on VersaStack deployment requires an in-guest backup approach, as outlined in 13.4.3, "Spectrum Protect for Databases" on page 370.

13.4.3 Spectrum Protect for Databases

You can install Data Protection for SQL Server in a Windows failover cluster environment, and protect clustered SQL Server 2008 databases and later versions.

The hardware and software requirements for the Data Protection for SQL Server / FlashCopy Manager for SQL Server can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=swg21882505

Data Protection for SQL Server must be installed on all nodes of your cluster where you intend to perform backups and restore operations. Table 13-1 shows our example system overview.

System name	IP address	Function
spectrumprotect	192.168.10.30	Spectrum Protect backup server
versastackdc	192.168.10.25	Microsoft Active Directory Server
SQLVM01	192.168.10.51	SQL Node 1
SQLVM02	192.168.10.52	SQL Node 2
VMW_WSFC_CLUS	192.168.10.53	Virtual IP of cluster manager
SQLCLUS	192.168.10.54	Virtual IP of the SQL Server instance

Table 13-1 SQL on VersaStack IP and system overview

Deploying on a Microsoft SQL cluster

To install Spectrum Protect for Databases on a Microsoft SQL cluster, complete the following steps:

- 1. Install and configure the Spectrum Protect Backup/Archive client and API on both SQL nodes.
- 2. Install and configure the Spectrum Protect for Databases on both SQL nodes.
- 3. Create a scheduling cluster service.
- 4. Define the backup schedule on the Spectrum Protect server.

These steps are outlined in more detail in the following sections.

Installing the Spectrum Protect Backup/Archive client

To install the Spectrum Protect Backup/Archive (B/A) client, complete the following steps:

1. Log on to SQLVM01 as an administrator and run 7.1.2.2-TIV-TSMBAC-WinX64.exe.

Figure 13-28 shows the B/A client extraction directory.

🛃 IBM Tivoli Storage Manager Backup-Archive Client - InstallShield 🗙
Location to Save Files Where would you like to save your files?
Please enter the folder where you want these files saved. If the folder does not exist, it will be created for you. To continue, click Next.
Save files in folder: c:\tsm_images\TSM_BA_Client
Change
InstallShield < Back Next > Cancel

Figure 13-28 Spectrum Protect Backup/Archive - client installation

2. Accept the default path for the extraction of the installation executable files and click **Next**. The installation wizard starts after the extraction is complete, as shown in Figure 13-29.



Figure 13-29 Spectrum Protect Backup/Archive - client installation wizard

3. Start the wizard by clicking Next. The window that is shown in Figure 13-30 opens.

閿	IBM Tivoli Storage Manager Client - InstallShield Wizard
	ion Folder xt to install to this folder, or dick Change to install to a different folder.
	Install IBM Tivoli Storage Manager Client to: c:\Program Files\Tivoli\TSM\ Change
InstallShield -	< Back Next Cancel

Figure 13-30 Spectrum Protect Backup/Archive - client installation location

4. Keep the default installation location and click **Next** to continue the installation. The window that is shown in Figure 13-31 on page 373 opens.

b	IBM Tivoli Storage Manager Client - InstallShield Wizard	
Preparing SAN Environment settings The Installer will configure the following DISKPART settings		
Click on an icon i	in the list below to change how a feature is installed.	
Administrative Client Command Backup-Archive Client GUI Files Backup-Archive Client Web Files Client API (64-bit) Runtime Files Client API (32-bit) Runtime Files		
	X Client API SDK Files This feature requires 0KB on your hard drive.	
i	This feature will be installed on local hard drive.	
	This feature, and all subfeatures, will be installed on local hard drive.	
Install to:	This feature will be installed when required.	
InstallShield	X This feature will not be available.	
Help	Space < Back Next > Cancel	

Figure 13-31 Spectrum Protect Backup/Archive - client deployment administrative CLI

5. Activate the Administrative Client Command Line Interface for installation and click **Next**. The window that is shown in Figure 13-32 opens.

😼 IBM Tivoli Storage Manager Client - InstallShield Wizard 🗙
Ready to Install the Program The wizard is ready to begin installation.
Click Install to begin the installation. If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield

Figure 13-32 Spectrum Protect Backup/Archive - client installation start

6. Click **Install** to start the installation and confirm the installation of any subcomponents or runtime libraries during this process. The window that is shown in Figure 13-33 opens.



Figure 13-33 Spectrum Protect Backup/Archive - client exit installation wizard

- 7. Click **Finish** to complete the installation wizard.
- Repeat these steps for the SQLVM02 cluster node. After the Backup/Archive client installation completes on both nodes, proceed to the installation of the Spectrum Protect Data Protection for SQL Server application.

Installing Data Protection for SQL Server

To install Data Protection for SQL Server, complete the following steps:

 Log on to SQLVM01 as an administrator and run TSM_DB_712_DP_MS_SQL_SVR_MP_ML.exe. You are prompted to extract the installation packages in TSMSQL_WIN in to a subdirectory of your current working directory. The window that is shown in Figure 13-34 on page 375 opens.

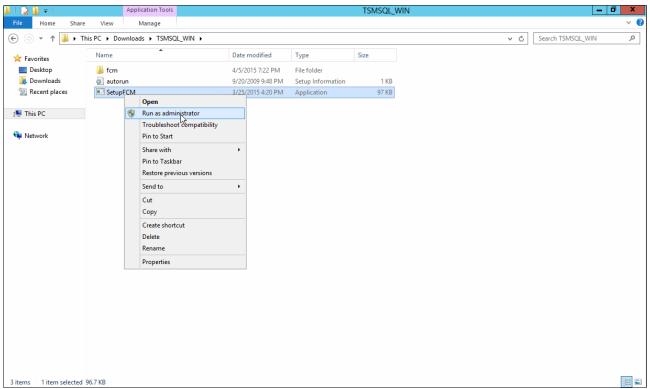


Figure 13-34 Data Protection for SQL - start SetupFCM

2. Go to the TSMSQL_WIN directory and run SetupFCM by using **Run as Administrator**. The window that is shown in Figure 13-35 opens.

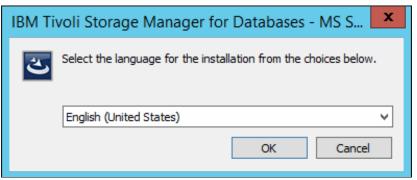


Figure 13-35 Data Protection for SQL - language selection

3. Confirm the default language by clicking **OK**. The window that is shown in Figure 13-36 opens.

IBM Tivoli Storage Manager for Databases - MS SQL - Management Cons	
<u>ا</u> ک	BM Tivoli Storage Manager for Databases - MS SQL - Management Console requires the ollowing items to be installed on your computer. Click Install to begin installing these equirements.
Status	Requirement
Pending	Microsoft SQL Server 2012 System CLR Types 11.0.2100.60 (x64)
Pending	Microsoft ReportViewer 2012
	R
	Install Cancel

Figure 13-36 Data Protection for SQL - install application dependencies

 Some Microsoft components might need to be installed before you install Data Protection for SQL. Confirm the installation of these packages by clicking **Install**. The window that is shown in Figure 13-37 opens.



Figure 13-37 Data Protection for SQL - installation wizard

5. The InstallShield Wizard starts. Click **Next** to continue. The window that is shown in Figure 13-38 opens.

🗒 IBM Tivoli Storage Manager for Databases - MS SQL 💻 🗖 🗙
Software License Agreement Please read the following license agreement carefully.
International Program License Agreement
Part 1 - General Terms
BY DOWNLOADING, INSTALLING, COPYING, ACCESSING, CLICKING ON AN "ACCEPT" BUTTON, OR OTHERWISE USING THE PROGRAM, LICENSEE AGREES TO THE TERMS OF THIS AGREEMENT. IF YOU ARE ACCEPTING THESE TERMS ON BEHALF OF LICENSEE, YOU REPRESENT AND WARRANT THAT YOU HAVE FULL AUTHORITY TO BIND LICENSEE TO THESE TERMS. IF YOU DO NOT AGREE TO THESE TERMS,
* DO NOT DOWNLOAD. INSTALL. COPY. ACCESS. CLICK ON AN
 I accept the terms in the license agreement. I do not accept the terms in the license agreement. InstallShield
Print < Back Next > Cancel

Figure 13-38 Data Protection for SQL - accept license agreement

6. Accept the International Program License Agreement and click **Next**. The window that is shown in Figure 13-39 opens.

👹 IBM Tiv	voli Storage Manager for Databases - MS SQL - Managem 💌	
	tion Folder ext to install to this folder, or click Change to install to a different folder.	
	Install IBM Tivoli Storage Manager for Databases - MS SQL - Management Con C:\Program Files\Tivoli\ Change	
InstallShield -	< Back Next > Cancel	_

Figure 13-39 Data Protection for SQL - installation location

7. Keep the default installation location and click **Next**. The window that is shown in Figure 13-40 opens.

😸 IBM Tivoli Storage Manager for Databases - MS SQL - Managem 💌	
Ready to Install the Program The wizard is ready to begin installation.	
Click Install to begin the installation.	
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.	
InstallShield	-
< Back Install Cancel	

Figure 13-40 Data Protection for SQL - start the installation

8. Click **Install** to start the installation. The window that is shown in Figure 13-41 opens.

岁 IBM Tivoli Storage Manager for Databases - MS SQL 💻 🗖 🗙	
Installing IBM Tivoli Storage Manager for Databases - MS SQL - Management Console The program features you selected are being installed.	
1	Please wait while the InstallShield Wizard installs IBM Tivoli Storage Manager for Databases - MS SQL - Management Console. This may take several minutes. Status:
InstallShield —	< Back Next Cancel

Figure 13-41 Data Protection for SQL - installation progress

9. Monitor the installation progress until the InstallShield Wizard completes the installation. The window that is shown in Figure 13-42 opens.



Figure 13-42 Data Protection for SQL - InstallShield Wizard completed

10.Click **Finish** to complete the installation. This step completes the base installation of the Data Protection for SQL application.

11.Go to **Programs** and start the DP for SQL Management Console. Upon first start, the Tivoli Storage Manager Configuration wizard starts. The window that is shown in Figure 13-43 opens.

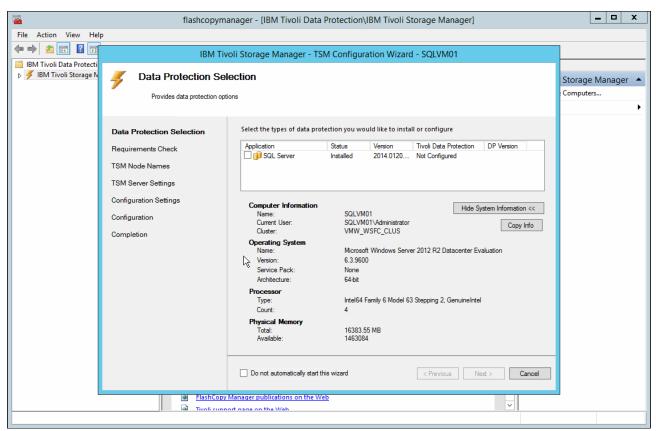
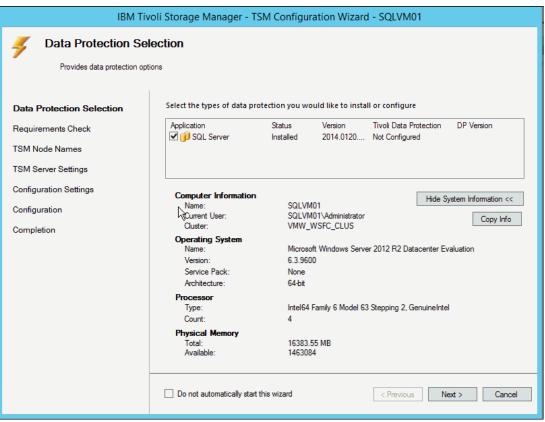


Figure 13-43 Data Protection for SQL configuration - installation wizard



12. Select **SQL Server**. The window that is shown in Figure 13-44 opens.

Figure 13-44 Data Protection for SQL configuration - Data Protection Selection

13. Review the information and click **Next**. The window that is shown in Figure 13-45 opens.

	IBM Tiv	voli Storage Manager - TSM Configuration Wizard - SQLVM02	
/	irements Cheo ures that the environment	CK ent supports requirements	
Data Protection Requirements TSM Node Nam TSM Server Se	Check	Operation Pending: 0, In Progress: 0, Passed: 11, Failed: 0, Warnings: 1, Skipped: 0 Resun Issue Resolution	e Details <<
Configuration S Configuration Completion	a shared disk or a CS	TAGINGDIR value. If this cluster uses shared disk or cluster shared volume (CSV), enter a path on SV accessible by all nodes in the cluster.	
		Image: Second	
		< Previous Next >	Cancel

Figure 13-45 Data Protection for SQL configuration - Requirements Check issue resolution

14. As part of the requirements check, you are prompted to provide the path to a shared disk or CSV. In our example, we use C:\ClusterStorage\Volume1 CSV. Click **OK** to continue. The window that is shown in Figure 13-46 opens.

Frequirements Check Data Protection Selection Requirements Check TSM Node Names TSM Server Settings Configuration Settings Configuration Completion Pequire Hotikues Passed ProverShell Check Passed Operation Required Passed ProverShell Check ProverShell Chec	IBM Tiv	oli Storage Manager - TSM Configuration W	/izard - SQLVM01
Requirements Check Iminum VSS Requestor Level Hide Detail TSM Node Names Re-run Hide Detail TSM Server Settings Rule Status Configuration Settings Iminum OS Level Passed Completion Iminum OS Level Passed Iminum OS Level Passed Iminum OS Level Iminum VSS Providers Passed Iminum VSS Requestor Level Iminum VSS Requestor Level Passed Iminum VSS Requestor Level Iminum VSS Requestor Level Passed Iminum VSS Requestor Level Iminum VSS Requestor Level Passed Iminum VSS Requestor Level Iminum VSS Requestor Level Passed Iminum VSS Requestor Level Iminum VSS Requestor Level Passed Iminum VSS Requestor Level Iminum VSS Requestor Level			
Configuration Settings Ø Minimum OS Level Passed Configuration Ø Restart Required Passed © Required Hotfixes Passed © WMI Service Check Passed © Duster check Passed © VowerShell Check Passed © VSS Providers Passed © Minimum VSS Requestor Level Passed Ø Minimum SQL Server level Passed Ø License Check for Data Protection for SQL Passed	Requirements Check		: 0, Wamings: 1, Skipped: 0 Hide Details <<
	Configuration Settings Configuration	 Minimum OS Level Restart Required Required Hotfixes WMI Service Check Cluster check Cluster check PowerShell Check VSS Providers Media Check Minimum VSS Requestor Level Minimum SQL Server level License Check for Data Protection for SQL 	Passed Passed Passed Passed Passed Passed Passed Passed Passed Passed Passed

Figure 13-46 Data Protection for SQL configuration - Requirements Check completed

15.All requirements should have passed, so click **Next** to specify the Spectrum Protect Node Names. The window that is shown in Figure 13-47 opens.

IBM Tiv	oli Storage Manager - TSM Configuration Wizard - SQLVM01
Jetermine the TSM node na	imes to use
Data Protection Selection Requirements Check TSM Node Names TSM Server Settings Configuration Settings Configuration Completion	Which TSM node names would you like to use? VSS Requestor SQLVM01 Data Protection for SQL SQLVM01_SQL QAWaysOn Node VMW_WSFC_CLUS Data Protection for Exchange DAG Node File System and Custom Application
	< Previous Nex> Cancel

Figure 13-47 Data Protection for SQL configuration - Tivoli Storage Manager node configuration

The wizard identified the node name for the system itself that is used as part of the B/A client installation (SQLVM01). The wizard proposes two additional node names to be registered on the Spectrum Protect server: SQLVM01_SQL to run the SQL backups and VMW_WSFC_CLUS to hold the SQL backup data for both the SQLVM01_SQL and SQLVM02 cluster nodes. Backups are run on the SQL cluster node that is holding the SQL database resources at the time of the backup.

16. Click Next to continue. The window that is shown in Figure 13-48 on page 385 opens.

IBM Tiv	oli Storage Manager - TSM Configuration Wizard - SQLVM01
JETERM Server Setting	
Determines the TSM server Data Protection Selection Requirements Check TSM Node Names TSM Server Settings Configuration Settings Configuration Completion	Which TSM server would you like to use? TSM Server Address: 192.168.10.30 TSM Server Port: 1500 Would you like this wizard to configure your TSM server? No Yes TSM Server Administrator Account admin TSM Server Administrator Password Onfiguration Macro: FemTsmConfig.mac Review / Edit

Figure 13-48 Data Protection for SQL configuration - Tivoli Storage Manager server settings

17. Specify the Spectrum Protect Server Address and the Tivoli Storage Manager Server Administrator account to be used to configure the server. The wizard uses the FcmTsmConfig.mac macro to automate the registration actions. This macro creates a domain on the Spectrum Protect server and registers a new disk-based storage pool. In our example, we want to use the data deduplication-enabled storage pool as the target for the SQL backups, so click **Review/Edit** to modify the macro. The window that is shown in Figure 13-49 opens.

Text Editor	_ 0 ×
<pre>/**/ /* This macro is generated as part of the TSM configuration wizard. */ /* A TSM administrator can use this information as an example of one way to */ /* to configure TSM to support application data protection. */ /**/</pre>	
/**/ /* If needed, define a stgpool and volume for sql */ /**/	
<pre>/*define stgpool fcm_spsql disk /*define spacetrigger stg stgpool=fcm_spsql /*define volume fcm_spsql fcm_volsql1.dsm formatsize=100 /*</pre>	
define domain fcm_pdsql define policy fcm_pdsql standard define mgmt fcm_pdsql standard standard define mgmt fcm_pdsql standard standard define copygr fcm_pdsql standard standard dest=spectrumdedupe verexists=2 verdeleted=1 retextra=30 retonly=60 validate policy fcm_pdsql standard activate policy fcm_pdsql standard	
<pre>/*</pre>	
<pre>/*update node SQLVMOI T_3_m_p_P_w backdelete=yes forcep=yes /**/ /* If needed, register a sql node</pre>	

Figure 13-49 Data Protection for SQL configuration - modify the configuration macro

18.Comment out the storage pool definition by putting /* at the beginning of each line in the corresponding section. Change the destination in the 'define copygroup' line to specify dest=spectrumprotectdedupe and close the editing window to go back to the Tivoli Storage Manager Server Settings window. Click Next to continue. The window that is shown in Figure 13-50 opens.

IBM Tiv	oli Storage Manager - TSM Configuration Wizard - SQLVM01
Helps to configure VSS Req	
Data Protection Selection Requirements Check TSM Node Names TSM Server Settings Configuration Settings Configuration Completion	Which type of service configuration would you like? Default (Recommended for most environments) Custom (Helps avoid service name conflicts when a TSM BA client is already installed)
	< Previous Next > Cancel

Figure 13-50 Data Protection for SQL configuration - VSS Requester Services

19.Keep the default service configuration. The Spectrum Protect Client-Acceptor Daemon and Scheduling services for the base Backup/Archive client deploys because we did not perform this step as part of the B/A client installation. In cases where these services are already installed, use the Custom option to define additional services for the Data Protection for SQL specifically. Click **Next** to continue. The window that is shown in Figure 13-51 opens.

Requirements Check Renum TSM Node Names Renum TSM Server Settings Rule Configuration Settings © Confi Comfiguration © Provi Completion © Regist Configuration © Regist Completion © Regist	snapshots using a TSM server Pending: 0, In Progress: 0, Passed: 7, Faile	d: 0, Wamings: 1, Skipped: 0
Requirements Check TSM Node Names TSM Server Settings Configuration Settings Configuration Completion © Regist Image: Configuration Settings	Pending: 0, In Progress: 0, Passed: 7, Faile	d: 0, Warnings: 1, Skipped: 0
Configuration Settings @ Confi Configuration @ Provi @ Confi Completion @ Regis @ Regis 1 Confi @ Confi	7	Hide Details <<
	iguring VSS Requestor isioning Data Protection for SQL Server iguring Data Protection for SQL Server stering client service stering agent service igure TSM Server iguring Services art Required	Status Passed Passed Passed Passed Wamings Passed Passed Passed

Figure 13-51 Data Protection for SQL configuration - status

20. You see a warning that the SQLVM01 node already is defined on the Tivoli Storage Manager Server. You can review the warnings by clicking the corresponding hyper link. Then, click **Next** to continue. The window that is shown in Figure 13-52 on page 389 opens.

IBM Tiv	oli Storage Manager -	TSM Configu	ration Wizar	d - SQLVM01	
Frovides status information					
Data Protection Selection	Congratulations! Tivoli Storage Mar	nager is readv	/ to use		
Requirements Check TSM Node Names TSM Server Settings Configuration Settings	Application	Status Installed	Version 2014.0120	Tivoli Data Protection Configured	DP Version 7.1.2.0
Configuration Completion	A best practice is to run V	stics when this wiza	-	torage Manager	
				< Previous F	nish Cancel

Figure 13-52 Data Protection for SQL - configuration complete

21. The Data Protection for SQL application is now configured to back up the SQL data to the Spectrum Protect server. Repeat these steps on the second node of the cluster (SQLVM02).

On a single-server setup, this setup is sufficient to run backups manually by using the Data Protection for SQL Management interface, and to automate backups by defining local or Spectrum Protect initiated schedules. In a clustered setup, you must take an additional step to create a SQL backup cluster service to permit the cluster to run the backups on the active SQL node.

Configuring the SQL Scheduler Service

To configure the SQL Scheduler Service, complete the following steps:

1. Log in to SQLVM01 as an administrator, open a command window, and deploy the scheduler service, as shown in Example 13-4.

Example 13-4 Install the Data Protection for SQL Server Scheduler on SQLVM01

```
C:\Program Files\Tivoli\TSM\baclient>dsmcutil inst sched /name:"Data Protection
for SQL Server" /node:VMW_WSFC_CLUS /password:T_3_m_p_P_w /autostart:no
/cluster
name:VMW_WSFC_CLUS /clientdir:"C:\Program Files\Tivoli\TSM\baclient"
/optfile:"C
:\Program Files\Tivoli\TSM\TDPSql\dsm.opt" /startnow:no
TSM Windows NT Client Service Configuration Utility
Command Line Interface - Version 7, Release 1, Level 2.1
(C) Copyright IBM Corporation, 1990, 2015, All Rights Reserved.
```

```
Last Updated May 7 2015
TSM Api Version 7.1.2
Command: Install TSM Client Service
Machine: SQLVM01(Local Machine)
Installing TSM Client Service:
      Machine
                       : SQLVM01
      Service Name : Data Protection for SQL Server
      Client Directory : C:\Program Files\Tivoli\TSM\baclient
      Automatic Start : no
      Logon Account : LocalSystem
The service was successfully installed.
Creating Registry Keys ...
Updated registry value 'ImagePath' .
Updated registry value 'EventMessageFile' .
Updated registry value 'TypesSupported' .
Updated registry value 'Data Protection for SQL Server' .
Updated registry value 'ADSMClientKey' .
Updated registry value 'OptionsFile' .
Updated registry value 'ClientNodeName' .
Updated registry value 'EventLogging' .
Generating registry password ...
Authenticating TSM password for node VMW WSFC CLUS ...
Connecting to TSM Server via client options file 'C:\Program
Files\Tivoli\TSM\TD
PSql\dsm.opt' ...
Password authentication successful.
The registry password for TSM node VMW WSFC CLUS has been updated.
```

 Log in to SQLVM02 as an administrator, open a command window, and deploy the scheduler service, as shown in Example 13-5.

Example 13-5 Install the Data Protection for SQL Server Scheduler on SQLVM02

C:\Program Files\Tivoli\TSM\baclient>dsmcutil inst sched /name:"Data Protection for SQL Server" /node:VMW_WSFC_CLUS /password:T_3_m_p_P_w /autostart:no /cluste name:VMW_WSFC_CLUS /clientdir:"C:\Program Files\Tivoli\TSM\baclient" /optfile:" :\Program Files\Tivoli\TSM\TDPSql\dsm.opt" /startnow:no

TSM Windows NT Client Service Configuration Utility Command Line Interface - Version 7, Release 1, Level 2.1 (C) Copyright IBM Corporation, 1990, 2015, All Rights Reserved. Last Updated May 7 2015 TSM Api Version 7.1.2

Command: Install TSM Client Service Machine: SQLVM02(Local Machine) Installing TSM Client Service:

Machine : SQLVMO2 Service Name : Data Protection for SQL Server Client Directory : C:\Program Files\Tivoli\TSM\baclient Automatic Start : no Logon Account : LocalSystem The service was successfully installed. Creating Registry Keys ... Updated registry value 'ImagePath' . Updated registry value 'Image

Generating registry password ... Authenticating TSM password for node VMW_WSFC_CLUS ...

Connecting to TSM Server via client options file 'C:\Program Files\Tivoli\TSM\T PSql\dsm.opt' ...

Password authentication successful.

The registry password for TSM node VMW_WSFC_CLUS has been updated.

The window that is shown in Figure 13-53 opens.

朝 儘				Failover Cluster Mana	ger			_ 0 ×
File Action View Help								
				_				
📲 Failover Cluster Manager	Roles (1)							Actions
✓ WMW_WSFC_CLUS.VersaSta Roles	Search						🔎 Queries 🔻 🔛 👻	Roles 🔺
Nodes	Name	Status	Type	Owner Node	Priority	Information		🧑 Configure Role
þ 📇 Storage	SQL Sen		er er	SQLVM01	Medium			Virtual Machines
Networks		G Start Role						📸 Create Empty Role
E Cluster Events		🐻 Stop Role						View
		Move Nove	•					Refresh
		Change Startup Priority	•					Help
		Information Details						SQL Server (MSSQLSERVER)
		B Show Critical Events						SQL Server (WISSQLSERVER) -
		Add Storage			1			C Stop Role
		Add Resource	•	Client Access Point				Move
		More Actions	•	Generic Application				
	>	🗙 Remove		Generic Script				S Change Startup Priority ►
		Properties	Ľ	Generic Service More Resources				Information Details
	<						>	Show Critical Events
								Add Storage
	🚩 🖓 SQI	QL Server (MSSQLSERVER)					Preferred Owners: Any node	Add Resource
		_						More Actions
	Status: Priority:	Running Medium						🗙 Remove
	Owner Node							Properties
	Client Acces	ss Name: SQLCLUS						P Help
	IP Addresse	es: 192.168.10.54						
< III >	Summary Res	esources						
Roles: SQL Server (MSSQLSERVER)								

Figure 13-53 Failover Cluster Manager - add generic service

3. Start the Failover Cluster Manager, select **Roles/SQL Server (MSSQLSERVER)**, right-click, and select **Add Resource/Generic Service**. The window that is shown in Figure 13-54 on page 393 opens.

	New Resour	ce Wizard X
Select Se	ervice	
Select Service	Select the service you want to use from the	list:
Configure Generic	Name	Description
Service	CNG Key Isolation	The CNG key isolation service is hosted in the
Summary	COM+ Event System	Supports System Event Notification Service (S
Juninary	COM+ System Application	Manages the configuration and tracking of Com
	Computer Browser	Maintains an updated list of computers on the n
	Credential Manager	Provides secure storage and retrieval of creden
	Cryptographic Services	Provides three management services: Catalog
	Data Protection for SQL Server	
	DCOM Server Process Launcher	The DCOMLAUNCH service launches COM an
	Device Association Service	Enables pairing between the system and wired \checkmark
	R	
		Next > Cancel

Figure 13-54 Failover Cluster Manager - New Resource Wizard

4. Select the Data Protection for SQL Server from the list and click **Next**. The window that is shown in Figure 13-55 opens.

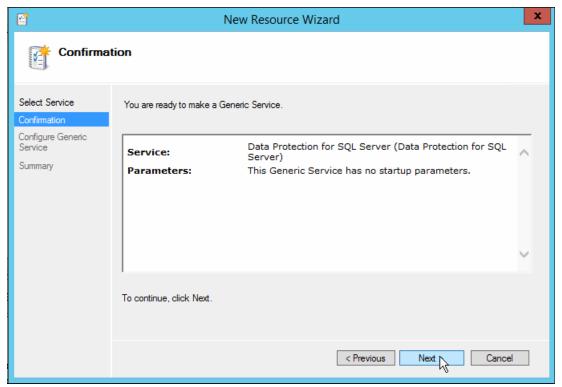


Figure 13-55 Failover Cluster Manager - New Resource Wizard - confirm generic service

5. Click **Next** to confirm the selection of the Data Protection for SQL Server Generic Service and confirm the subsequent windows to complete the resource creation. The window that is shown in Figure 13-56 opens.

- 43		Fail	over Cluster	Manager			_ 🗆 X
File Action View Help							
🗢 🔿 🖄 📰 🚺							
📲 Failover Cluster Manager	Roles (1)					Actions	
∠ WMW_WSFC_CLUS.VersaSta Roles	Search			<i>۾</i>	Queries 🔻 🕁 🔻	 Roles 	•
Nodes	Name	Status	Туре	Owner Node	Priority Infon	matio 🌸 Configu	ure Role
🔺 Ӓ Storage	SQL Server (MSSQLSE	Running	Other	SQLVM02	Medium		Machines 🕨
Disks Pools						Create I	Empty Role
Networks						View	•
📓 Cluster Events						Q Refresh	
						🛛 Help	
						Data Prot	ection for SQ 🔺
						😪 Bring O	nline
						🙀 🛛 Take Of	ffline
						🚯 Informa	ation Details
						B Show C	Critical Events
						📑 More A	ctions 🕨
						🔀 Remove	e
						Propert	ies
						🛛 🛛 Help	
	<	Ш				>	
	SQL Server (M	SSQLSERVER)		P	Preferred Owners: Any no	ode	
	Name			Status	Information		
	Roles						
	Data Protoction for O	COL Sonror		🕥 Online			
	Server Name	Online Offline					
	H Name:			(r) Online			
	Other nesourc	mation Details v Critical Events		-			
	BORL SI CO			Online			
		Actions	•	(r) Online		>	
< III >	Summary Res	ove					
	Prop	ertier					

Figure 13-56 Failover Cluster Manager - modify the Data Protection for SQL Server role

 From within the Failover Cluster Manager, go to the SQL Server Role, select Resources, right-click the newly created Data Protection for SQL Server Resource, and select Properties. The window that is shown in Figure 13-57 on page 395 opens.

Data Prot	ection for S	QL Server	Properties	X
General	Depend	dencies	Policies	
Advanced Pol			stry Replication	
Programs or services important to have this running. Specify the r should be replicated t	data available egistry keys belo	on the node on ow HKEY_LOC	which they are	at
Root Registry Key				
SOFTWARE\IBM\/	DSM\CurrentV	ersion\Nodes\	VMW_WSFC	
	Add	Edit	Remov	e
	ОК	Ca	ancel Ap	ply

Figure 13-57 Failover Cluster Data Protection for SQL Server - add registry replication

7. Click Registry Replication/Add and enter the following string:

SOFTWARE\IBM\ADSM\CurrentVersion\Nodes\VMW_WSFC_CLUS\SPECTRUMPROTECT

 This string replicates the Spectrum Protect password that is used by Data Protection for SQL between the cluster nodes. Click **OK** twice, bring the Data Protection for SQL Server Resource online, and close the Failover Cluster Manager.

Spectrum Protect uses the Password Access Generate feature to rotate the passwords for these nodes based on the server password retention policies. This feature also allows remote execution of the Spectrum Protect B/A CLI and Data Protection for SQL CLI interfaces without requiring password prompt interventions. The initial password must be used once to establish the communication with the Spectrum Protect server and to store this password locally.

Log on to the SQLVM01 and run the command that is shown in Example 13-6 from a CLI.

Example 13-6 Data Protection for SQL Password Access Generate on SQLVM01

```
C:\Program Files\Tivoli\TSM\TDPSql>tdpsqlc.exe query tsm
/tsmpassword=T_3_m_p_P_
```

```
W
```

```
IBM Tivoli Storage Manager for Databases:
Data Protection for Microsoft SQL Server
Version 7, Release 1, Level 2.0
(C) Copyright IBM Corporation 1997, 2015. All rights reserved.
Tivoli Storage Manager Server Connection Information
_____
Nodename ..... SQLVM01 SQL
NetWork Host Name of Server ..... 192.168.10.30
TSM API Version ..... Version 7, Release 1, Level 2.1
TSM Server Name ..... SPECTRUMPROTECT
TSM Server Type ..... Linux/x86 64
TSM Server Version ..... Version 7, Release 1, Level 1.300
Compression Mode ..... Client Determined
Domain Name ..... FCM PDSQL
Active Policy Set ..... STANDARD
Default Management Class ..... STANDARD
The operation completed successfully. (rc = 0)
Log on to the SQLVM02 and run the command that is shown in Example 13-7 from a CLI.
Example 13-7 Data Protection for SQL Password Access Generate on SQLVM02
C:\Program Files\Tivoli\TSM\TDPSql>tdpsqlc.exe query tsm
/tsmpassword=T 3 m p P
w
IBM Tivoli Storage Manager for Databases:
Data Protection for Microsoft SQL Server
Version 7, Release 1, Level 2.0
(C) Copyright IBM Corporation 1997, 2015. All rights reserved.
Tivoli Storage Manager Server Connection Information
   _____
Nodename ..... SQLVM02 SQL
NetWork Host Name of Server ..... 192.168.10.30
TSM API Version ..... Version 7, Release 1, Level 2.1
```

```
TSM Server Name ..... SPECTRUMPROTECT
TSM Server Type ..... Linux/x86_64
TSM Server Version ..... Version 7, Release 1, Level 1.300
Compression Mode ..... Client Determined
Domain Name ..... FCM_PDSQL
Active Policy Set ..... STANDARD
Default Management Class ..... STANDARD
```

 Change the Log On for the Data Protection for SQL Server Service on both SQLVM01 and SQLVM02 from the Local System Account to an account that is authorized to access the SQL Server. In the example lab setup, we use the domain administrator account. The window that is shown in Figure 13-58 on page 397 opens.

Data Protection for S	SQL Server Properties (Local Comp 🗴
General Log On Reco	very Dependencies
Log on as:	
Local System account Allow service to in	nt iteract with desktop
This account:	Administrator@VersaStack.loca
Password:	•••••
Confirm password:	•••••
	<i>₽</i>
	OK Cancel Apply

Figure 13-58 Data Protection for SQL Server - Service Change Log on settings

10. Centralized backups are scheduled and run by using local commands or Powershell cmdlets. In the SQL on VersaStack example setup, we create the tsmsql.cmd file and placed it in C:\ClusterStorage\Volume1, as shown in Example 13-8.

Example 13-8 tsmsql.cmd

```
@ECHO OFF
rem
     sqlfull.smp sample command file
rem
     Sample command file containing commands to do a scheduled full
rem
    backup of all SQL databases to an IBM Object00 Storage Manager
rem
rem
     server.
rem
    This file is meant to be executed by the IBM ObjectOO Storage
rem
    Manager central scheduler in response to a defined schedule on
rem
rem
     the IBM Object00 Storage Manager server.
rem
rem
rem
    Replace "C:" with the drive where Data Protection for SQL
rem
rem
     is installed. Update the directory to match the installation
     directory that you chose when you installed the product.
rem
```

```
rem
   _____
set sql dir=C:\Progra~1\Tivoli\TSM\TDPSql
C:
cd %sql dir%
rem
         The two lines below put a date/time stamp in a log file for you.
rem
    Note: You can change "sqlsched.log" to whatever you prefer in
rem
rem
    lines below.
   _____
rem
date /t < NUL >> %sql dir%\sqlsched.log
time /t < NUL >> %sql dir%\sqlsched.log
    _____
rem
    Now call the command-line interface to do the backup:
rem
rem
    Replace "srvrname" with the name of the options file name you
rem
rem
    plan to use.
rem
rem
    If SQL authentication is being used and the SQL login settings have
    not been stored via the GUI, you must also specify the /sqluser and
rem
    /sqlpassword options on the command below.
rem
rem
    In this example, we use the '*' to back up all of the databases
rem
rem
    on the SQL Server. Note that database 'tempdb' will not
    be backed up.
rem
rem
    Note: You can change "sglsched.log" and "sglfull.log" to
rem
rem
         whatever you prefer.
rem
   _____
%sql dir%\tdpsqlc backup * full /sqlserver=SQLCLUS /backupmethod=legacy
/tsmoptfile=%sql dir%\dsm.opt /logfile=%sql dir%\sqlfull.log >>
%sql dir%\sqlsched.log
set RC=%ERRORLEVEL%
echo ----- >> %sql dir%\sqlsched.log
echo Return code was %RC% >> %sql dir%\sqlsched.log
echo ========= >> %sql dir%\sqlsched.log
exit %RC%
```

11.Log on to the active SQL node, open a CLI, and verify the backup by manually running a full backup, as shown in Example 13-9.

Example 13-9 Verify the SQL node backup manually

C:\Program Files\Tivoli\TSM\TDPSql>tdpsqlc backup * full /sqlserver=SQLCLUS /bac kupmethod=legacy

IBM Tivoli Storage Manager for Databases: Data Protection for Microsoft SQL Server Version 7, Release 1, Level 2.0 (C) Copyright IBM Corporation 1997, 2015. All rights reserved. Connecting to SQL Server, please wait... Starting SQL database backup... Connecting to TSM Server as node 'VMW WSFC CLUS'... Using backup node 'VMW WSFC CLUS'... Beginning full backup for database master, 1 of 4. Full: 0 Read: 4290304 Written: 4290304 Rate: 507.30 Kb/Sec Database Object Name: 20150728044933\00001E90 Backup of master completed successfully. Beginning full backup for database model, 2 of 4. Full: 0 Read: 3237632 Written: 3237632 Rate: 1,770.30 Kb/Sec Database Object Name: 20150728044941\00001E90 Backup of model completed successfully. Beginning full backup for database msdb, 3 of 4. Full: 0 Read: 14769920 Written: 14769920 Rate: 13,442.45 Kb/Sec Database Object Name: 20150728044945\00001E90 Backup of msdb completed successfully. Beginning full backup for database VersaStackDB, 4 of 4. Full: 0 Read: 189322597120 Written: 189322597120 Rate: 49,625.27 Kb/Sec Database Object Name: 20150728044948\00001E90 Backup of VersaStackDB completed successfully. Total SQL backups selected: 4 Total SQL backups attempted: 4 Total SQL backups completed: 4 Total SQL backups excluded: 0 Total SQL backups inactivated: 0 Total SQL backups deduplicated: 0 Throughput rate: 49,483.14 Kb/Sec Total bytes inspected: 189,344,894,976 Total bytes transferred: 189,344,894,976 Total LanFree bytes transferred: 0 Total bytes before deduplication: 0 Total bytes after deduplication: 0 Data compressed by: 0% 0.00% Deduplication reduction: Total data reduction ratio: 0.00%

Elapsed processing time: 3,736.77 Secs

```
The operation completed successfully. (rc = 0)
```

12. Move the SQL resources to the other SQL node and repeat steps 1 on page 389 to 11 on page 398.

Setting up the SQL backup schedule

You can define a backup schedule either through an administrative CLI session towards the Spectrum Protect server or through the Spectrum Protect OC.

To define a schedule through the CLI, start the Spectrum Protect Administrative Command Line from within Programs on the SQLVM01 or through a command window, as shown in Example 13-10.

Example 13-10 Define the SQL backup schedule through a CLI

```
C:\Program Files\Tivoli\TSM\baclient>dsmadmc
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 7, Release 1, Level 2.1
(c) Copyright by IBM Corporation and other(s) 1990, 2015. All Rights Reserved.
Enter your user id: admin
Enter your password: *******
Session established with server SPECTRUMPROTECT: Linux/x86_64
Server Version 7, Release 1, Level 1.300
Server date/time: 06/22/2015 05:23:53 Last access: 06/22/2015 05:17:02
```

tsm: SPECTRUMPROTECT>def sched FCM_PDSQL SQL_CLUSTER_FULL desc="SQL Daily Full Backup" action=command object="C:\ClusterStorage\Volume1\tsmsql.cmd" priority=2 starttime=21:00 duration=15 duru=minutes period=1 perunits=day dayofweek=any ANR2500I Schedule SQL_CLUSTER_FULL defined in policy domain FCM_PDSQL.

tsm: SPECTRUMPROTECT>define association FCM_PDSQL SQL_CLUSTER_FULL VMW_WSFC_CLUS ANR2510I Node VMW_WSFC_CLUS associated with schedule SQL_CLUSTER_FULL in policy domain FCM_PDSQL.

To define a schedule through the Spectrum Protect OC, complete the following steps:

1. Log on to the OC and click **Client/Schedules**. The window that is shown in Figure 13-59 opens.

Tivoli Storage Manager	Overviews	Clients	Services	Servers	Storage Pools	Storage Devices
		Clients				
	TSM Clients	Schedules			Alerts	
		÷.			10	

Figure 13-59 Data Protection for SQL Spectrum Protect Operations Center - define schedules

Create Schedule			
🕑 Name	Name		
Service	June	Contract of the second s	
Time	C-		
Summary	Name	Service	Time
	Create a new schedule to	o automate client protection tasks. Learn more →	
	Server	3 SPECTRUMPROTECT	•
	Domain	FCM_PDSQL	•
	Туре	Application	-
	Subtype	Microsoft SQL Server	•
	Name	SQL_CLUSTER_FULL	
	Description		
		Next ►	Cancel

2. Click the **Create Schedule** icon. The window that is shown in Figure 13-60 opens.

Figure 13-60 Data Protection for SQL Spectrum Protect Operations Center - schedule name

- 3. In this window, complete the following steps:
 - a. Select the Spectrum Protect server on which the schedule must be defined.
 - b. Choose the FCM_PDSQL domain.
 - c. Set the type to Application.
 - d. Set the subtype to Microsoft SQL Server.
 - e. Define SQL_CLUSTER_FULL as the name.

Create Schedule	
⊘ Name	Service
Service	
Time	
Summary	Name Service Time
	Select the type of service to schedule. The script files that you specify must exist on the client systems. Learn more →
	Weekly full and daily incremental backup A full backup one day and incremental backups on all other days
	Script files Full sqlfull.cmd
	Incremental sqlincr.cmd
	Daily full backup
	Script file C:\ClusterStorage\Volume1\tsmsql.cmd
	Back Next Cancel

Click Next. The window that is shown in Figure 13-61 opens.

Figure 13-61 Data Protection for SQL Spectrum Protect Operations Center - schedule service

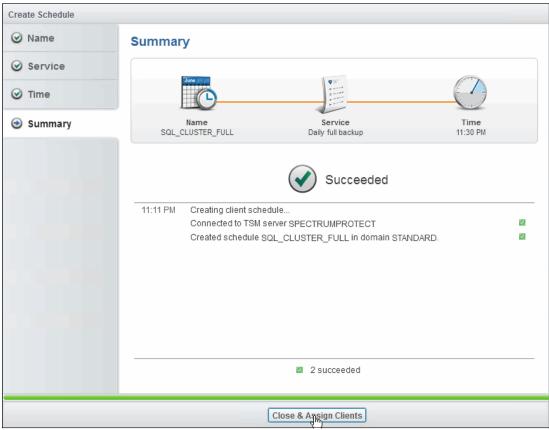
4. In this use case, we want to run a daily full backup. In the script file location, specify C:\ClusterStorage\Volume1\tsmsql.cmd and click **Next**. The window that is shown in Figure 13-62 on page 403 opens.

Orente Orbedule	
Create Schedule	
⊘ Name	Time
Service	June
🕑 Time	
Summary	Name Service Time SQL_CLUSTER_FULL Daily full backup
	The start time specifies when the schedule can begin. Learn more $ ightarrow$
	Repeats To Every day

Figure 13-62 Data Protection for SQL Spectrum Protect Operations Center - schedule time

5. Select the start time for the schedule. Optionally, you can define a runtime alert to receive a notification if the schedule exceeds the expected duration. For example, if the daily backup run takes on average 1 hour, you can set the runtime alert to two hours.

The number of Anticipated clients determines the schedule randomization that is used by the Spectrum Protect server to spread the scheduling load.



Click **Create** to start the schedule creation. The window that is shown in Figure 13-63 opens.

Figure 13-63 Data Protection for SQL Spectrum Protect Operations Center - schedule creation successful

6. Click **Close & Assign Clients** to associate the SQL cluster node with this newly created schedule. The window that is shown in Figure 13-64 opens.

	8	VERSASTACK_DC_2_[🕁 Back Up					
	8		🚫 Set At Risk					
	8	VMCLI	More •	Schedule Associatio				
	—	VMW_WSFC_CLUS						
<								
	Showing 26 Selected 1							

Figure 13-64 Data Protection for SQL Spectrum Protect Operations Center - associate schedule

 The Clients section in the Spectrum Protect OC opens. Select VMW_WSFC_CLUS, right-click, and select More/Schedule Association. The window that is shown in Figure 13-65 on page 405 opens.

Schedule Association							
Client VMW_WS	FC_CLUS selected on SPECTRUMPROTECT (UTC-7:00))		Showing schedule SQL_CLUSTER_FULL in FCM_PDSQL			
Assign 🔻	Name	Start	Repeats	Clients			
•	SQL_CLUSTER_FULL	(Every day				
	Start time 11:30 PM	*					
	k						
		Save	Cancel				

Figure 13-65 Data Protection for SQL Spectrum Protect Operations Center - associate client to schedule

8. Select the Assign check box next to SQL_CLUSTER_FULL and click Save.

By default, the Client Acceptor Daemon and Scheduler service on a Spectrum Protect B/A client polls the Spectrum Protect server every 12 hours. For a client or the Data Protection for SQL Server Cluster Resource Service to pick up a newly created schedule immediately, the corresponding service must be restarted or brought offline/online, after which the window that is shown in Figure 13-66 opens. The scheduler log file shows the next scheduled operation.

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File	Edit	Format	View	Help			
2 - C						1	^
				SCHEDULEREC QUERY			
				SCHEDULEREC QUERY			
				No schedule returned f			
· ·				Schedule will be refre			
					ent Version 7, Release 1, Level 2.1		
				Querying server for ne			
				Node Name: VMW_WSFC_CL			
06/	22/2	015 23	:21:40	Session established wi	th server SPECTRUMPROTECT: Linux/x86_64		
				Server Version 7, Re			
06/	22/2	015 23	:21:40	Server date/time: 06	/22/2015 23:19:55 Last access: 06/22/2015 22:51:47		
· ·				SCHEDULEREC QUERY			
				SCHEDULEREC QUERY			
				Next operation schedul		:	=
				Schedule Name:			
					Command		
					C:\ClusterStorage\Volume1\tsmsql.cmd		
				Options:			
					23:30:00 on 06/22/2015		
06/	22/2	ð15 23	:21:40	Command will be execute	ed in 11 minutes.		
							× .
						/ ,	ill.

Figure 13-66 Data Protection for SQL schedule log

The interval in which a client polls the Spectrum Protect Server can be lowered. Alternatively, the Spectrum Protect server can be configured for prompted mode where the server reaches out to the client at the time the schedule must be run.

Protecting SQL databases

In "Configuring the SQL Scheduler Service" on page 389, we manually started a full backup of the SQL databases and defined a command script for use with the daily backup schedule.

As stated earlier in 13.3, "Protecting the VMware infrastructure" on page 357, you can use Spectrum Protect to have a centralized approach to back up and restore operations through the legacy Spectrum Protect Administration Center, the OC, or a CLI.

For each Spectrum Protect Application, we integrate as closely as possible into the daily working environment for the specific protected application. For the Data Protection for SQL application, this means having an MMC-based GUI and a rich set of Powershell based cmdlets.

- 0 ×

Exploring the Data Protection for SQL Server MMC Interface

er - [IBM Tivoli Data Pro n\IBM Tivoli St File Action View Help 🗢 🔿 🞽 📰 🚺 🗊

Figure 13-67 shows the Data Protection for SQL Server MMC interface.

IBM Tivoli Storage Manager IBM Tivoli Storage Manager Ibm Tivoli Storage Manager Immediate Manager Ibm Tivoli Storage Manager Immediate Manager Ibm Tivoli Storage Manager Immediate Manager	IBM Tivoli Data Protection	IBM Tivoli Storage Manager		Actions					
Deshboard - SQLVM01 Manage Manage (omputetion by Configuration by Configuration by Contained and information needed to create and manage volume-level snapshots. Water and Record Data Standarding Standar		ibin mon storage manager		IBM Tivoli Storage Manager	•				
 Manage Manage									
 Disgnostics Charming Reporting Scheduling Solvere Data Solvere Data<td></td><td>Overview</td><td></td><td>View</td><td>+</td>		Overview		View	+				
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Scheduling Frontet and Recover Date SolLVM02 Management SolLVM01 Dashboard - SQLVM02 Management SolLVM02 Dashboard - SQLVM02 Pathboard - SQLVM02 Management SolLVM02 Pathboard - SQLVM02 Pathboard - SQLVM02 More Data Recover Data Recover Data SolL of Performing SolL data protection tasks Pathboard - SQLVM02 Pathboard - SQLVM02 More Information More Information on the Web FlashCopy Manager publications on the Web									
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Dashboard - SQLVM02 Image: Dashb									
Protect Data Recover Data Sol. If Performing Sol. data protection tasks IP Protect Data Recover Data File System If Performing Sol. data protection tasks IP Configuration IP Performing Sol. data protection tasks IP Performing Sol. data protection tasks IP Configuration IP Performing Sol. data protection tasks IP Learning IP Performing Sol. data protection tasks IP Learning IP Performing Sol. data protection tasks IP Dependencia IP Performing Sol. data Part Converting Tasks IP Dependencia IP Performing Sol. data Part Converting Tasks IP Solution IP Performing Solution tasks IP Experiment IP Performing Solution tasks <td< td=""><td></td><td></td><td>Indextee day to the end information</td><td></td><td></td></td<>			Indextee day to the end information						
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		Tivoli support page on the Web							

Figure 13-67 Data Protection for SQL MMC overview

Figure 13-67 shows the default welcome window for the Data Protection for SQL application. From within one central console, you can create groups of systems on which the Data Protection for SQL, Exchange, or file systems are deployed.

In the SQL on VersaStack environment, we create a group that is called SQL Cluster with SQLVM01 and SQLVM02 as member servers.

The dashboard for SQLVM01 is expanded and shows the two main sections:

- Manage
- Protect and Recover Data

From within the Protect and Recover Data section, you can select the applications that are being configured, as shown in Figure 13-68 on page 407.

a flashcopyman	ager - [IBM Ti	voli Data Protectior	I\IBM Tivoli Storage	Manager\Group -	SQL Cluster\Dashboard - SQLVM01\Protect and	Recover Data\SQL S	erver - SQLCLU] 📃 🗖 🗙
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⊿ ■ Dashboard - SQLVM01			esh 👔 Standard Databa				Properties
🕟 🎁 Manage	DB Name	Space Used (MB)	Log Used (MB)	Compatibility	Attributes		Hide Activity
Protect and Recover Data SQL Server - SQLCLUS	master	3.44	0.71	120	System database, Truncate log on checkpoint		View
File System - SQLVM01	model	2.19	1.21	120	System database		G Refresh
⊿ 📕 Dashboard - SQLVM02	msdb	13.81	0.48	120	System database, Truncate log on checkpoint		Help
Manage Protect and Recover Data	Versa Stack DB	180419.06	1335.22	120	Truncate log on checkpoint		VersaStackDB
Protect and Recover Data							Backup Method: Legacy
							Backup Destination: TSM
							-
							Full Backup
							Copy-Only Full Backup
				Differential Backup to TSM			
				Log Backup to TSM			
				R			👔 Help
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	Task List T						
			ove 📄 Remove Comple				
	Computer SQLVM01		State Result Completed Succeeded	Start Time 7/28/2015 7:06 AM	Duration Messages 00:00:05		
	SQLVM01		Completed Succeeded	7/28/2015 7:08 AM			
	SQLVM01		Completed Succeeded	7/28/2015 7:09 AM			
	JOGLYMUT	Gel-Sqibackup	completed Succeeded	772072013 7.03 AM	00.00.00		
< III >							

Figure 13-68 Data Protection for SQL MMC - SQL Server - Protect overview

If you select the SQL Server SQLCLUS, you have the following subpanes on the right side:

- Protect: In this pane, you can run manual backups by using local snapshots, backups towards the Spectrum Protect server, or a combination of both. Depending on the backup method you choose (Legacy or VSS), you can choose between the different backup possibilities:
 - Full Backup
 - Copy Only Full Backup
 - Differential Backup to Tivoli Storage Manager
 - Log Backup to Tivoli Storage Manager

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File Action View Help	-										
🗢 🔿 🙍 🖬 🛿 🖬											
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A 📕 Dashboard - SQLVM01	Select All	🕝 Clear All 🛛 😽 F	Refresh 🗈 Active	Backups 🗈 Alway	sOn Node Backups	Show Refresh	Options Search:			Properties	
⊿ Manage ▷ III Configuration	Database		Backup	Secondary	Backup		Management	_		Hide Activity	
Diagnostics	Name	Backup Type	Method	Replica	Location	Mounted As	Class	Backup State	Backup Date	View	•
Learning	master	Full	Legacy	No	TSM		DEFAULT	Active	7/28/2015 4:49	Refresh	
Reporting Scheduling	model	Full	Legacy	No	TSM		DEFAULT	Active	7/28/2015 4:49	🛛 🛛 Help	
Favorite Links	msdb	Full	Legacy	No	TSM		DEFAULT	Active	7/28/2015 4:49	master	
Protect and Recover Data SQL Server - SQLCLUS	VersaStackDB	Full	Legacy	No	TSM		DEFAULT	Active	7/28/2015 4:49	Restore	
File System - SQLVM01										Restore to Point-in-Time	
Dashboard - SQLVM02										Restore to Alternate Location	
										Inactivate	
										Delete Backup	
										Mount Backup	
										Unmount Backup	
										Explore	
	<								>	Help	
	4 of 4 displayed	, 1 selected									
	Task List Task	Details									
	i ♠ Up ↓ Do	wn 🗉 Stop 🏹 F	lemove Remov	re Completed 🛛 🖷	Q 🗐 🏚						
	Computer	Name	State Resu	lt Start	Time	Duration Mes	sages				
< III >											

Figure 13-69 shows the Recover overview.

Figure 13-69 Data Protection for SQL MMC SQL Server - Recover overview

- ► Recover: In this pane, you work with the database backups to do the following functions:
 - Restore
 - Restore to Point-in-Time
 - Restore to Alternate Location
 - Inactivate
 - Delete Backup
 - Mount Backup
 - Unmount Backup
 - Explore

You can toggle between the Active Backup (latest backup) or All Backups, and also switch to a Files based view, where you can choose Restore, Restore to Alternate Location, or Inactivate the backups by working with the backed up database files themselves.

Figure 13-70 on page 409 shows the Automate overview.

a flashcopyman	ager - [IBM Tivoli Data Protection\IBM Tivoli Storage Manager\Group - SQL Cluster\Dashboard - SQLVM01\Protect and Recover Data\SQL	Server - SQLCLU] – 🗇 🗙
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IBM Tivoli Data Protection	Protect Recover Automate	Actions
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⊿ Group - SQL Cluster ⊿ A Dashboard - SQLVM01		Properties
🔟 🧃 Manage		Show Activity
 Configuration Ø Diagnostics 		View
Learning		G Refresh
IL Reporting		👔 Help
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Protect and Recover Data		G Refresh
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Dashboard - SQLVM02		
	1	
	PowerShell - 👔 🗋 🎽 🐘 🎇 🔝 🗸 🖄 Tips	
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	Crodet ^	
	Add-DpSqPolicy	
	Backup-DpSqlComponent Cory-DpSqlPolicy	
	Copy-UpSqiPolicy Dismount-DpSqlBackup	
	Get-DpSqlBackup	
	Get-DpSqlComponent V	
< III >		

Figure 13-70 Data Protection for SQL MMC SQL Server Automate Overview

Automate: In this pane, you can work with the built-in Powershell cmdlets or run the Data Protection for SQL command-line commands to create advanced automation tasks for your SQL databases. These functions can be run live from within the MMC, saved, and scheduled for execution.

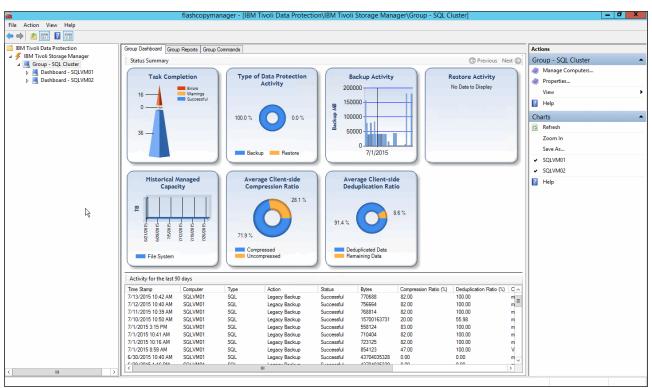


Figure 13-71 shows the Dashboard.

Figure 13-71 Data Protection for SQL MMC - Group Dashboard

The Dashboard has a graphical overview of the Data Protection for SQL activities, including charts for the following items:

- Task Completion
- Activity Type
- Backup Activity
- Restore Activity
- Historical Managed Capacity
- Average Client-Side Compression Ratio
- Average Client-Side Deduplication Ratio

The Group Reports tab in this pane consolidates the built-in reports at a group level where the Group Commands let you run and automate commands towards the member servers by using Powershell cmdlets.

Legacy and VSS Backup and Restore Options

With Data Protection for SQL Server, you can use the common interface in the Volume Shadow Copy Service (VSS) framework to create database backups.

VSS backups are at the volume and file levels. Legacy backups are a stream of bytes that Data Protection for SQL Server stores on the Spectrum Protect server.

You can back up Data Protection for SQL Server data by using the following methods:

- Full database backup (Legacy and VSS): With this method, Data Protection for SQL Server backs up an SQL Server database and the portion of the transaction log that is necessary to provide a consistent database state. With this backup type, the copy includes enough information from any associated transaction log to create a backup that is consistent with itself. The portion of the log that is included contains only the transactions that occur from the beginning of the backup until its completion.
- Copy-only full backup (Legacy and VSS): With this method, Data Protection for SQL Server creates data backups that do not affect existing backup and restore processes and can be retained in the longer term. For example, you can use this type to back up a log before an online file restore operation. In this example, the copy-only full backup is used once. After the backup is restored, it is deleted.
- Differential backup (only Legacy): With this method, Data Protection for SQL Server backs up only the data pages in an SQL Server database instance that changed after the last full backup. A portion of the transaction log is also backed up.

Differential backup is associated with the last full backup that was run. The last full backup might be completed by Data Protection for SQL Server or another application. For example, if you run a full SQL Server-to-disk backup, and run a differential backup, the differential backup is associated with the SQL Server disk backup.

You cannot use differential backup for databases on the secondary replica in Microsoft SQL Server 2012.

Log backup (only Legacy): With this method, Data Protection for SQL Server backs up only the contents of an SQL Server database transaction log since the last successful log backup. This type of backup is preceded by a full backup or an equivalent type of backup.

Log backups normally follow full backups. The portion of the log that is included in full and differential backups is not equivalent to a log backup. Additionally, in full and differential backups, the log is not truncated as it is during a log backup. However, a log backup that follows a full or differential backup includes the same transactions as a full or differential backup. Log backups are not cumulative like differential ones; they must be applied against a base backup and in the correct order.

- File backup (only Legacy): With this method, Data Protection for SQL Server backs up only the contents of a specified SQL Server logical file. This type of backup can ease the scheduling conflicts if you must back up large databases. You can back up different sets of files during different scheduled backups. File, group, and set backups must be followed by a log backup, but a full backup is not required.
- Group backup (only Legacy): With this method, Data Protection for SQL Server backs up only the contents of a specified SQL Server file group. You can back up the set of database tables and indexes within a specific group of files.

The group is specified as part of the setup within SQL Server when you define the database files. If no group is specified and all the database files are part of the primary group, you cannot partially back up or partially restore the database by using the group.

Set backup (only Legacy): With this method, Data Protection for SQL Server backs up the contents of specified SQL Server file groups and files as a unit.

13.4.4 Summary

In this section, we deployed Data Protection for SQL on the SQL on VersaStack SQL nodes and configured those backups towards the Spectrum Protect server by using an in-guest backup approach. As you can see from Figure 13-71 on page 410, we achieved an average of 71.9% compression and 91.4% client-side data deduplication ratio on the test database backups.

Client-side data deduplication is one of the Advanced Protection technologies that you can use to reduce both the amount of backup data to be transferred and stored on the Spectrum Protect server, which is described in 13.5, "Using Spectrum Protect advanced protection and recovery technologies" on page 412.

13.5 Using Spectrum Protect advanced protection and recovery technologies

This section briefly describes some of the key Spectrum Protect advanced protection and recovery technologies:

- Progressive incremental backups
- Client- and server-side data deduplication
- Spectrum Protect server high availability

13.5.1 Progressive incremental backups

Figure 13-72 shows how much storage you can potentially save.

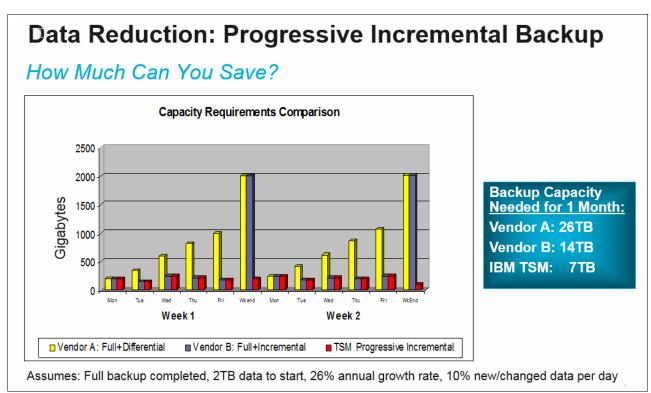


Figure 13-72 Spectrum Protect progressive incremental backups

One of the core technologies for file-based backups within Spectrum Protect is *progressive incremental backup*. After the first full backup, only incremental backups are made, which has the following effects:

- A progressive incremental backup lowers the backup window by eliminating regular full backups.
- It reduces the back-end storage that is required to hold the backup data.
- It eliminates and reduces the restore complexity as a single pass restore versus full+differential or full+incremental restores being run.
- It performs a true progressive incremental backup at backup time with no resources consuming post-backup synthetic full backup reconsolidation.

With the shift towards virtualized server environments, this technology is incorporated into the Spectrum Protect for Virtual Environments application as Incremental Forever, as shown in Figure 13-73.

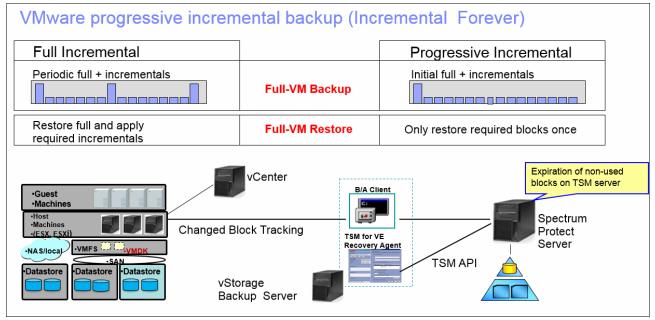


Figure 13-73 Spectrum Protect for Virtual Environments Incremental Forever

Data that is backed up by using progressive incremental backups can be stored on any supported storage medium and does not suffer from over time tape scattering because Spectrum Protect has a built-in collocation mechanism that stores and groups backup data sets (at the file-system or VM level) and the least amount of tapes, ensuring adequate restore times and eliminating time-consuming redundant tape mounts.

The following URL is a link to an ESG Lab Review: Tivoli Storage Manager for Virtual Environments, which describes in detail the potential savings in network and backup infrastructure resources by using both the Progressive incremental and data deduplication technologies, achieving 95% data reduction over just 11 days of backups:

https://ibm.biz/BdXuvj

13.5.2 Data deduplication

Data deduplication is a method of reducing storage needs by eliminating redundant data.

Two types of data deduplication are available on Spectrum Protect:

- Client-side data deduplication
- Server-side data deduplication

Client-side data deduplication is a data deduplication technique that is used on the backup-archive client to remove redundant data during backup and archive processing before the data is transferred to the Tivoli Storage Manager server. Using client-side data deduplication can reduce the amount of data that is sent over a local area network (LAN).

Figure 13-74 shows the process of Spectrum Protect client-side data deduplication.

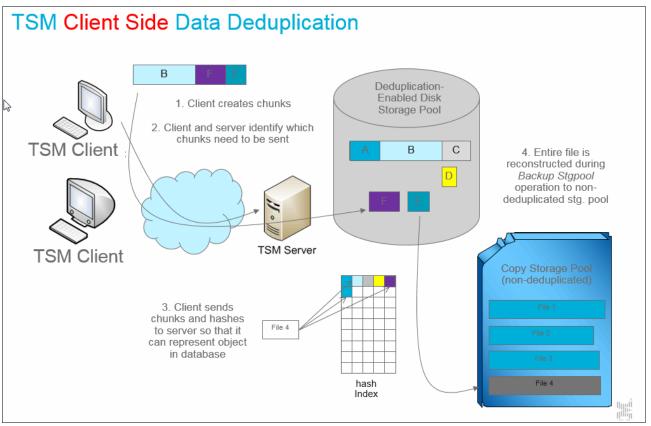


Figure 13-74 Spectrum Protect client-side data deduplication

Server-side data deduplication is a data deduplication technique that is done by the server.

Figure 13-75 on page 415 shows the process of Spectrum Protect server-side data deduplication.

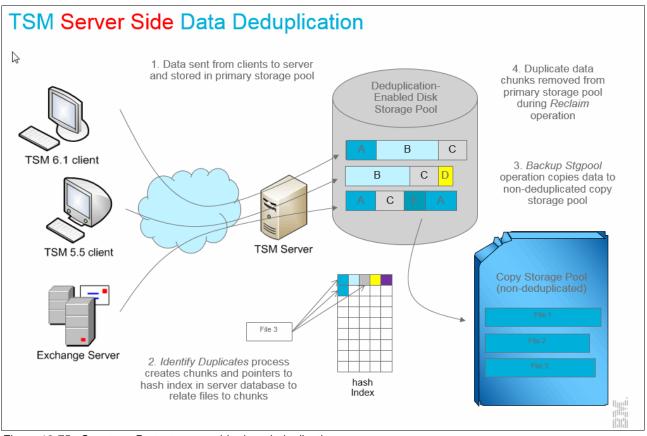


Figure 13-75 Spectrum Protect server-side data deduplication

The Tivoli Storage Manager administrator can specify the data deduplication location (client or server) to use with the **DEDUP** parameter on the **REGISTER NODE** or **UPDATE NODE** server command.

With client-side data deduplication, you can perform the following functions:

- ► Exclude specific files on a client from data deduplication.
- Enable a data deduplication cache that reduces network traffic between the client and the server. The cache contains extents that were sent to the server in previous incremental backup operations. Instead of querying the server for the existence of an extent, the client queries its cache.
- Enable both client-side data deduplication and compression to reduce the amount of data that is stored by the server. Each extent is compressed before it is sent to the server. The trade-off is between storage savings and the processing power that is required to compress client data. In general, if you compress and de-duplicate data on the client system, you are using approximately twice as much processing power as data deduplication alone.

Client-side data deduplication uses the following process:

- The client creates extents. Extents are parts of files that are compared with other file extents to identify duplicates.
- The client and server work together to identify duplicate extents. The client sends non-duplicate extents to the server.
- Subsequent client data deduplication operations create extents. Some or all of those extents might match the extents that were created in previous data deduplication operations and sent to the server. Matching extents are not sent to the server again.

Client-side data deduplication provides several advantages:

- It can reduce the amount of data that is sent over the LAN.
- The processing power that is required to identify duplicate data is offloaded from the server to client nodes. Server-side data deduplication is always enabled for data deduplication-enabled storage pools. However, files that are in the data deduplication-enabled storage pools and that were de-duplicated by the client do not require additional processing.
- The processing power that is required to remove duplicate data on the server is eliminated, allowing space savings on the server to occur immediately.

For further data reduction, you can enable client-side data deduplication and compression together. Each extent is compressed before it is sent to the server. Compression saves space, but it might increase the processing time on the client workstation.

With client-side data deduplication, the server does not have whole copies of client files until you back up the primary storage pools that contain client extents to a non-deduplicated copy storage pool (extents are parts of a file that are created during the data deduplication process). During storage pool backup to a non-deduplicated storage pool, client extents are reassembled into contiguous files.

By default, primary sequential-access storage pools that are set up for data deduplication must be backed up to non-deduplicated copy storage pools before they can be reclaimed and before duplicate data can be removed. The default ensures that the server has copies of whole files at all times, in either a primary storage pool or a copy storage pool.

For more information about IBM data deduplication solutions, see *Implementing IBM Storage Data Deduplication Solutions*, SG24-7888.

In the SQL on VersaStack deployment, we used Spectrum Protect Node-Replication rather than working with a copy storage pool.

13.5.3 Node replication with automated failover

Node replication is the process of incrementally copying or replicating client node data from one Spectrum Protect server to another Spectrum Protect server for the purpose of disaster recovery.

The server from which client node data is replicated is called a *source replication server*. The server to which client node data is replicated is called a *target replication server*.

Node replication avoids the logistics and security exposure of physically moving tape media to a remote location. If a disaster occurs and the source replication server is unavailable, backup-archive clients of Tivoli Storage Manager can recover their data from the target replication server. If you cannot recover the source replication server, you can convert client nodes to non-replicating nodes for store operations on the target replication server.

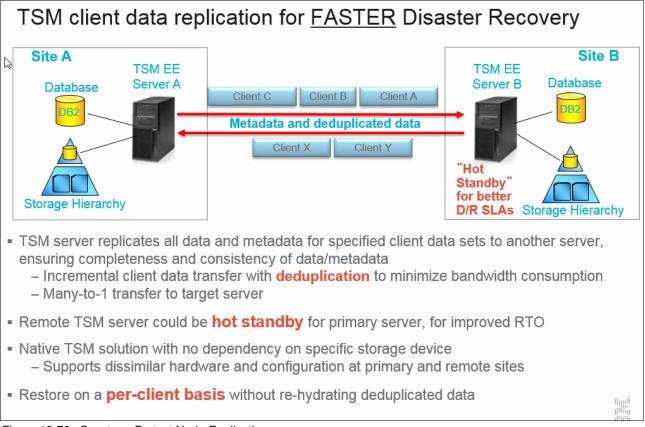
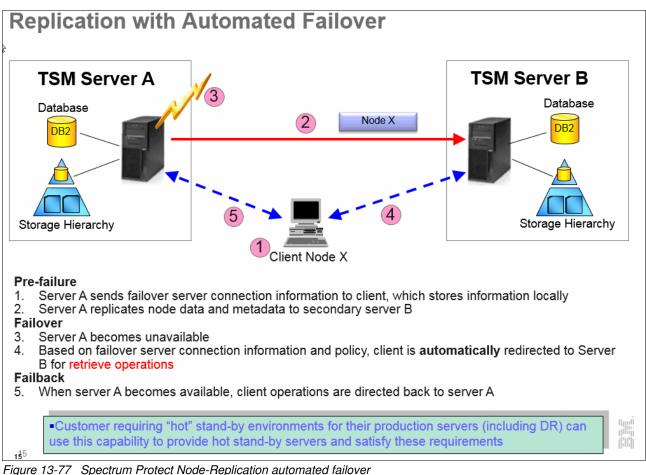


Figure 13-76 shows the benefits of data replication for recovery.

Figure 13-76 Spectrum Protect Node-Replication

As of Version 7.1, Spectrum Protect Node-Replication is enhanced to offer automated failover. When a Backup/Archive client or a Data Protection application starts, it attempts to open a session to its primary backup server. If this task fails, a connection to the secondary replication server is established, which allows for restores without requiring backup operator intervention.

Figure 13-77 shows the process of replication with automated failover.



Policy Driver Remote Replication was introduced in Spectrum Protect Version 7.1.1. You can use this feature to have dissimilar versions or retention times on the source and target servers. A typical use case is to have a limited number of versions in a branch office for fast local restore with more versions in the central data center, or more versions on the primary production server and a limited longer term subset on the secondary server.

Figure 13-78 on page 419 shows Policy Driven Remote Replication.

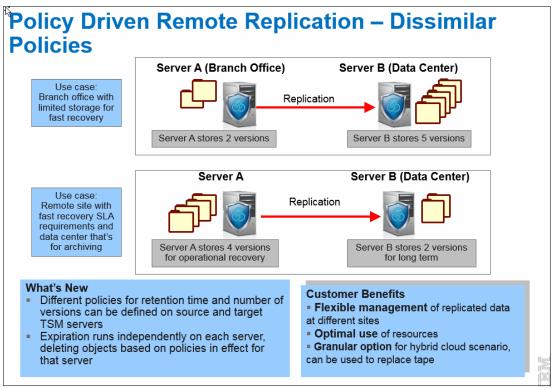


Figure 13-78 Spectrum Protect Node-Replication - dissimilar policies

When using Node-Replication, you can also configure the Spectrum Protect servers to recover automatically damaged data on the primary server by retrieving it from the secondary replication server, as shown in Figure 13-17 on page 355.

13.6 Monitoring and managing the Spectrum Protect environment

Within the Spectrum Protect product range, there is a dual approach to monitoring and managing the backup environment. On one side, the backups can be centrally managed, monitored, and reported upon, while on the other side, the GUIs, backup and restore processes, and local reporting are integrated closely with the native environment that the user uses for the application by using, for example, the Spectrum Protect Data Protection for SQL or Data Protection for VMware application modules.

This section describes the following features:

- Data Protection for SQL monitoring and reporting from within the MMC snap-in
- Data Protection for VMware monitoring and reporting through the GUI
- How you can use the OC as a central operational management dashboard
- Have long-term statistical data and reports generated and automatically distributed through the Reporting and Monitoring component.

13.6.1 Data Protection for SQL



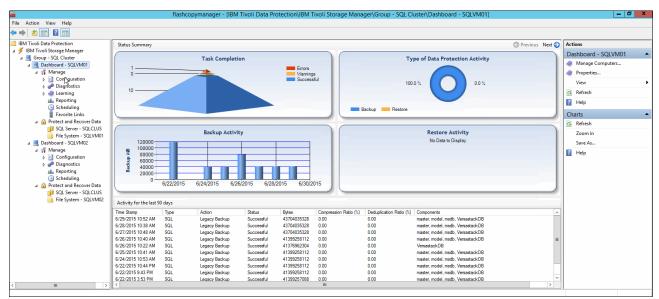


Figure 13-79 Data Protection for SQL - dashboard

The Status Summary shows you the following features:

- Task Completion
- Type of Data Protection Activity
- Backup Activity
- Restore Activity

These charts can be configured to show data for up to 90 days and can be viewed for individual servers or grouped, as we did for the SQL cluster in our example.

Figure 13-80 shows the activity report.

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	Data Protection Activity Report							Help				
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	SQLVM01	6/29/2015 1:16:47 PM	SqlServer	Legacy Backup	Successful	43704035328	-	-	master, model, msdb, VersastackDB			
	SQLVM01	6/29/2015 10:52:50 AM	SqlServer	Legacy Backup	Successful	43704035328	-	-	master, model, msdb, VersastackDB			
	SQLVM01	6/28/2015 10:38:19 AM	SqlServer	Legacy Backup	Successful	43704035328	-	-	master, model, msdb, VersastackDB			
	SQLVM01	6/27/2015 10:48:46 AM	SqlServer	Legacy Backup	Successful	43704035328	-	-	master, model, msdb, VersastackDB			
	SQLVM01	6/26/2015 10:40:29 AM	SqlServer	Legacy Backup	Successful	41399258112	-	-	master, model, msdb, VersastackDB			
	SQLVM01	6/26/2015 10:22:47 AM	SqlServer	Legacy Backup	Successful	41376962304	-		VersastackDB			
	SQLVM01	6/25/2015 10:41:09 AM	SqlServer	Legacy Backup	Successful	41399258112			master, model, msdb, VersastackDB	~		
	<				ш					>		

Figure 13-80 Data Protection for SQL - activity report

The SQL DBA can use the built-in Data Protection Activity Summary and Activity reports to create *ad hoc* reports that are specific to their environment without requiring intervention from the central backup admin team.

For a complete overview of the Data Protection for SQL interface and functions, see the following website:

http://www.ibm.com/support/knowledgecenter/SSTFZR_7.1.2/com.ibm.itsm.db.sql.doc/t_
protect dpdbsql.html

13.6.2 Data Protection for VMware

The VMware administrator can use the Data Protection for VMware vSphere plug-in or web GUI to monitor the backup activities that are related to their VMware environment.

Figure 13-81 shows the Data Protection for VMware Recent Tasks section.

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ta Protection for VMware + ashCopy Manager for VMware	Getting Started	Backup Restore	Reports	Configuration			VSPHERE.LOCAL	dmini • 🥐 • ፲
	Recent Tasks Back	kup Status Events /	Application Protection	on Managed Capacity	Datacenter Occupancy			Summary Log
	Recent Tasks							
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lame	Progress	Details			Start Time	End Time		
ersastack_Protect_Manual (3166)	Processed: 141.14 MB	Processing virtual ma	chine: 1 / 1		July 27, 2015 6:58:35 AM PDT			
ersastack_Manual (5)	Success				July 27, 2015 6:54:30 AM PDT	July 27, 2015 6:54:54 AM PDT		
ersastack_Manual (5)	Success				July 27, 2015 6:50:37 AM PDT	July 27, 2015 6:50:57 AM PDT		
		ŀ\$						
Task Details								
Task Name: Versastack_Protect_ Task Type: Backup Back End Type: TSM Status: Running Data Mover Node: FCMTSMVE_V Bytes Processed: 141.14 MB Virtual Machines Processed: 1 Virtual Machines Failed: 0					Task ID: 3166 Backup Type: TSM_IFINCR Task Creation Time: July 27, 201 Datacenter Node: FCMTSMVE_V Server: SPECTRUMROTECT Details: Processing snapshot dis to Send: 3,113,680,896 Transpor Virtual Machines Backed Up: 0		trumControl vmdk (Hard Disk 1) Capacity: {	0,532,733,952 Date

Figure 13-81 Data Protection for VMware Recent Tasks

For some applications, in-guest backup clients and applications must be deployed as they are in the SQL on VersaStack environment. The VMware administrator can see the status of the agentless VM backups, and retrieve information about the backups that are run with the specific VMs from the administrator's familiar VMware interface.

13.6.3 Spectrum Protect Operations Center

The OC provides web and mobile access to status information about the Spectrum Protect environment. You can use the OC to monitor multiple servers and to complete some administrative tasks. The OC also provides web access to the Spectrum Protect CLI.

From the OC, you can complete daily monitoring tasks to ensure that the Spectrum Protect system is functioning correctly.

Figure 13-82 shows the Overview window of the OC.

TSM Clients 60	Alerts 3	TSM Servers 2	
25 • Atrisk 1		A	available
	Services	Inventory Database space	164 GB free out of 180 GB
Applications 29	Policies	Databases	Normal
	Backup & Restore	082 Archive log space	357 GB free out of 378 GB
	Archive & Retrieve	Archive logs	Normal
Virtual Machines 18	Expiration	Storage Primary on Disk	408 GB free out of 840 GB
6% • 1	Expiration	Pools Pools	Normal
	Activity	Devices	Normal
	Tasks 🖾 Processes 2 📑 Sessions 0	Primary on Tape	0 bytes free out of 0 bytes
Systems 13	Traffic 🐺 - Current Previous	Storage Pools Devices	Normal
	49 GB	Devices	0 bytes free out of 0 bytes

Figure 13-82 Operations Center Overview window

Tivoli Storage Manager Clients

With this function, you can determine whether any clients are at risk of being unprotected because of failed or missed backups. You can click the Tivoli Storage Manager Clients area to view details for the following items:

- Applications: Groups applications that are protected by the Spectrum Protect Data Protection modules.
- Virtual Machines: Shows the VMs that are protected through the Data Protection for VMware module and the results of the latest backup that is run for these VMs.
- Systems: Lists the physical systems or VMs that have a Spectrum Protect Backup/Archive client that is installed.

Figure 13-83 on page 423 shows an overview of the Tivoli Storage Manager clients from within the OC.

	TSM Clients 60								
	Alerts 3 B /	Applications 29	\frown	vystems 13					
		Back Up			Peer Server	Next Schedule	Next Octor day	1017	1
Гуре	DCNM Virtual Appliance	At Risk Policy	Server	Replication	Peer Server SPECTRUMPROTECTREPLICA	Next Schedule	Next Schedul	VM Type	Last Access 5 days
	Exchange2013	Policy	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA			VMware	13 hours
	FCMTSMVE_REMOTE_MP_LNX		SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA			viiware	1 week
	FCMTSMVE_REMOTE_MP_LNA	-	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				1 hour
	FCMTSMVE_RENOTE_MP_VNIV	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				1 week
	FCMTSMVE_VERSASTACK_DC_1	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA			VMware	10 minute
3	FCMTSMVE_VERSASTACK_DC_1_DM1	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA	VERSASTACK PROTE	6:00 F		1 hour
8	FCMTSMVE_VERSASTACK_DC_1_DM	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA	TENONOTAGI, PROTE	0.001	VMware	9 hours
	FCMTSMVE_VERGASHOR_DO_1_DM	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA	FCMTSMVE_VMCLI_SC	7:00 F		10 minut
2	FcmVE		SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA	TOMTOMTE_VMOD_00	0 1.001	VMware	14 hours
, 1	LOCAL_MP_LNX	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA			viiware	14 Hours
	LOCAL_MP_WIN	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				1 week
	SLES11SP3		SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA			VMware	14 hours
1	SQLVM01	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				2 days
	SQLVM01 FS	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				2 days
	SQLVM01_P3	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				21 hours
	SQLVM01_SQL SQLVM02	_	SPECTRUMPROTECT	Send	SPECTRUMPROTECTREPLICA				2 days
	Califina.		of Lottom NotLot	Sella	or consolif Roleonkerelok				2 uays

Figure 13-83 Operations Center - Tivoli Storage Manager Clients

The Tivoli Storage Manager clients show all the registered clients for both the source and replication Spectrum Protect servers. Within each pane, the information that is displayed can be toggled, and you can set advanced filters to display only the systems that you want to review, as shown in Figure 13-84.

▼	Q -	Advanced Filter ON		Reset			
	AND	Type Name		is 🔹	Application	• + = • + =	TREPLI
	OR	Name	•	contains 👻	VMW_WSFC_CLUS	- +-	TREPLI
				Apply	L.		TREPLI
	SPEC	TRUMPROTECT		Send		SPECTRUMPROTE	CTREPLI

Figure 13-84 Operations Center - Advanced Filter

In this example, we define a filter to show both the SQL VMs and the logical cluster nodes on the Spectrum Protect Servers.

Backup schedules for physical systems or VMs that have a Backup/Archive client that is deployed can be triggered from within this section of the OC.

Figure 13-85 shows the SQLVM02 OC client summary showing the activity for the last two weeks.

Storage Manager Overviews Clients Ser	ices Servers Storage Po	ols Storage Devic	es.							🕹 admin 🤝 📕 🕐 ፲
SQLVM02_SQL										SPECTRUMPROTECT
Activity over 24 Hours		ver 2 Weeks								
roperties Client Files		40								
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	GB	20								
Current Sessions										
There are no active sessions for the	lient.									
		10								
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	Scheduled			× ×						
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Email										
IP address 192 168 10 52										

Figure 13-85 Operations Center - Client Summary

Double-clicking a Tivoli Storage Manager client or selecting the **Client Details** shows the activities that are related to that client for the last two weeks.

From within this window, you can also change the client properties on the Spectrum Protect server, start the remote web client through Client Access, and retrieve diagnostic information for the backups that is related to that client.

Alerts

With this function, you can determine whether any client-related or server-related errors require attention.

Click the Alerts area to view details. Activity log messages are available in the Alerts window.

Activity

With this function, you can verify that the amount of data that was recently sent to and from the Tivoli Storage Manager servers is within the expected range.

Tivoli Storage Manager Servers

With this function, you can verify that the Tivoli Storage Manager servers that are managed by the OC are available to provide data protection services to clients.

Click the Tivoli Storage Manager Servers area to view details and to go to more details for a specific server, for example:

- In the Servers window, select a server, and click **Details**.
- ► See the Summary, Active Tasks, and Completed Tasks tabs.

In the Active Tasks view, you can view or cancel the sessions that are in progress. You can also view activity log messages.

In the Completed Tasks view, you can view the sessions and processes that succeeded or failed. You can also view activity log messages.

From the Summary and Completed Tasks tabs, you can view information about the following processes:

- Database backups
- Scheduled server maintenance processes, such as reclamation, storage pool backups, and storage pool migrations

Inventory

If problems are indicated for the server database and associated logs, click **Inventory** to view details, for example:

- Check the amount of used and free space for the database, the active log, and the archive log.
- Verify that database backups are running as expected.

Storage Pools

If problems are indicated for primary or copy storage pools, click **Storage Pools** to view details.

For example, verify that the storage pools have enough free space.

If data deduplication is enabled, see the Completed Tasks view for the respective server to ensure that processes are completing successfully.

Storage Devices

If problems are indicated for devices, click **Storage Devices** to view details. Check for the following problems that can affect the status:

- ► For DISK device classes, volumes might be offline or have a read-only access state.
- ► For tape or shared FILE device classes, libraries, paths, or drives might be offline.
- For FILE device classes that are not shared, directories might be offline. Also, adequate free space might not be available for allocating scratch volumes.

Command Line

From the OC command line, you can issue commands to manage Tivoli Storage Manager servers that are configured as hub or spoke servers.

The Spectrum Protect OC provides you with a management interface and a dashboard that holds up to 14 days of data that is related to the Spectrum Protect environment. This short-term data is stored on the Spectrum Protect Server that acts as the OC Hub server.

Longer term data is collected separately and stored in a Tivoli Monitoring for Spectrum Protect data warehouse outside of the Spectrum Protect servers databases. This data warehouse is queried by the supplied Cognos Business Intelligence Report creation tool to offer automated reports, historical trending, audit logs, and so on.

13.6.4 Reporting and monitoring for Spectrum Protect

This section describes the reporting and monitoring components.

IBM Tivoli Monitoring for Spectrum Protect

Tivoli Monitoring for Spectrum Protect brings together multiple components to provide Tivoli Storage Manager data collection, real-time monitoring of that data, and historical reports.

Tivoli Monitoring acts as a monitoring application that provides workspaces for you to monitor real-time information. You can monitor the Tivoli Storage Manager server status, database size, agent status, client node status, scheduled events, server IDs, and so on, by using the monitoring workspaces.

Tivoli Monitoring for Spectrum Protect also provides reports that are based on the historical data that is retrieved. You can use the existing historical reports that are provided, or you can create your own custom reports.

Tivoli Monitoring for Spectrum Protect consists of the following components:

- IBM DB2: Stores historical data that is obtained from Tivoli Storage Manager servers that are monitored by IBM Tivoli Monitoring.
- IBM Tivoli Monitoring: Consists of a number of components that accumulate and monitor historical data for reporting:
 - Tivoli Enterprise Portal Server
 - Tivoli Data Warehouse
 - Tivoli Enterprise Monitoring Server
 - Summarization Pruning agent
 - Warehouse Proxy agent
 - Tivoli Monitoring for Spectrum Protect agent

The Tivoli Monitoring for Spectrum Protect agent queries and formats data to be presented to you in the following ways:

- ► As workspaces from the Tivoli Enterprise Portal
- As reports that use the Tivoli Data Warehouse and the reporting portion of Tivoli Monitoring for Spectrum Protect

Figure 13-86 on page 427 shows the Protect Servers overview.

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Ø SPECTRU						07/01/15 07:22:23		Informatic		ANR0407I Session 19518 started for administrator ADMIN (DSMAPI) (Tcp/lp 192.168.10.33(63686)). (SE					3686)). (SESSI
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Figure 13-86 Tivoli Enterprise Portal Spectrum Protect Servers overview

Tivoli Enterprise Portal for Spectrum Protect

You can monitor your Tivoli Storage Manager server in real time by using the workspaces that are provided in the Tivoli Enterprise Portal. Client and server activities are monitored by the monitoring agent, and are displayed in workspace views.

When you open the Tivoli Enterprise Portal and go to the Tivoli Storage Manager view, a dashboard workspace shows commonly viewed information in a single location.

The dashboard workspace can be customized to suit your monitoring needs, but the default settings show the following information:

- Storage space that is used for each node that is defined on the server
- Storage pool summary details
- Unsuccessful client and server schedules, including all missed or failed schedules
- Client node activity for all nodes on the server
- Activity log errors, including all severe error messages

These workspaces are provided as part of the Tivoli Enterprise Portal:

- Activity log: This workspace provides information about activity log messages that are based on the parameters that are selected. The data can be used to generate aggregated reports that are grouped by server, and subgrouped by client. By default, only error messages are displayed. To display warning and informational messages, you can update the agent environment file to update the KSK_QUERYWARN and KSK_QUERYINF environment variables.
- Activity summary: This workspace provides summarized activity log information about virtual environments.
- Agent log: This workspace provides trace file information that is produced by the agent without having to enable tracing. It provides messages information, such as login successes and failures, and agent processes.
- Availability: This workspace provides the status and the performance of the agent that is running for each of the different workspaces that are listed under the Tivoli Storage Manager agent. It can help to identify problems with the gathering of historical data.

Client node storage: The main workspace displays information about client node storage, disk, and tape usage data. This data can help you identify the clients that are using the most resources on the server. Disk and tape usage information is displayed in graph format.

The subworkspaces display data in a tabular format and a graph format. To display the subworkspaces, select the **Client Node Storage** workspace, right-click, select **Workspace**, and click the subworkspace that you want to view. Additional subworkspaces include the following ones:

- File space usage
- Tape usage
- Total storage space used
- Storage pool media
- Client missed files: This workspace provides the status of missing files that are reported during client backups. It displays the client node name, the name of the server, the missing file name, and the full path to the missing file. This workspace can help to identify clients with many missing files.
- Client node status: This workspace provides the date of the last successful backup, successful backup dates, with warnings, and dates of any failed backups, for the client node. You can click the chain-link icon for more details about each node. Click the green back arrow to return to the main workspace view.
- Database: This workspace provides information about the status of database backups, including the last full backup and the last incremental backup. This information can be used to determine when all of the allocated database space is used. If all the allocated space is used, expansion operations must be taken to ensure that the database continues to operate. As a Tivoli Storage Manager server processes client requests for backup-archive operations, the Tivoli Storage Manager database is updated with current and historical types of data. The total capacity and total space used data is displayed in a bar chart format, and database details such as percentage of space that is used and total space that is used is displayed in a tabular format.
- Drives: This workspace provides status about the drives, including drive name, library name, device type, drive status (such as loaded or empty), the volume name, and whether the drive is online.

An additional subworkspace drills down to the drives.

- Libraries: This workspace provides the status about libraries, such as the library name, type, if it is shared or not, LAN-free, auto label, number of available scratch volumes, whether the path is online, and the serial number.
- Node activity: This workspace provides activity metrics for a specific node over a 24-hour period, for example, activity metrics include the amount of data that is backed up, the number of objects that are inspected, and the number of processed objects.

The subworkspaces display data in a tabular format and a graph format. To display the subworkspaces, select the Node Activity workspace, right-click, select **Workspace**, and click the subworkspace that you want to view. Additional subworkspaces include the following ones:

- Client activity backup
- Client activity restore
- Client activity archive
- Client activity retrieve
- NAS activity

- Server activity DB backup
- Server activity file expiration
- Occupancy: This workspace provides tabular and graphical information about where backup and archive data is stored on the server and how much data is stored. For example, number of files, physical MB, and logical MB, by node name. Click the chain-link icon to see more details. Bar graph details show the space that is used, in MB, by the storage pool and the number of files that are used by the storage pool.

The subworkspace displays data in a tabular format and a graph format. To display the subworkspaces, select the Occupancy workspace, right-click, select **Workspace**, and click the subworkspace that you want to view. An additional subworkspace drills down to the drives.

- Processor Value Unit (PVU) details: This workspace provides PVU details by product, and PVU details by node. It includes information such as node name, product, license name, last used date, try buy, release, and level. If the Tivoli Storage Manager server is not a Version 6.3 server or later, the workspace is blank.
- Replication details: This workspace provides byte by byte replication details. It describes all of the replication details, such as node name, file space ID, version, start and end times, status, complete status, incomplete reason, estimated percentage of completion, estimated time remaining, and estimated time to completion.
- Replication status: This workspace provides the replication status for a node without all of the details that the replication details workspace provides. It displays node name, server, file space type, name and ID, target server, and the number of files on the source and target servers.
- Schedule: This workspace provides details about client and server schedules. You can group the data by node name, schedule name, or status to identify any potential problems. It displays information, such as schedule name, node name, server name, scheduled start, actual start, and the status of the schedule, which can be success, missed, or failed, including any error or warning text.
- Sessions: This workspace provides a view of all the client sessions that are running on the specified server. This workspace is useful for determining which clients are connected to the Tivoli Storage Manager server and how much data was sent or received. The workspace also shows tape mount information that indicates library and tape usage.
- Storage pool: This workspace provides you with detailed information about your storage pools. Tivoli Storage Manager can contain multiple storage pools. These storage pools define the methods and resources that are used to store the data that is backed up or archived to the Tivoli Storage Manager server. The data that is displayed in this workspace includes storage pool names, server name, device classes, total space, utilized space, total volumes used, percentage of space used, disk space used, and data deduplication savings. It also displays a graph with the total space, total usage, and total volumes used.
- Server: This workspace provides the operational status of the Tivoli Storage Manager server. These operations are measured in megabytes per operation. After the operational status is reported, the values are reset to zero. The numbers that are reported for each operation are not cumulative over time.
 - You can view the following activities or status:
 - Length of time it takes activities to complete.
 - Any problems that occur after activities complete.
 - The status of server-only activities.

- The data that is displayed includes information such as server name, disk storage pool space, tape usage count, current database size, information for client operations from a previous day, object count reclamation by byte and duration, migration by byte and duration, and backup by byte and duration.
- Bar graphs are also provided to display server operation duration and server operation byte counts.

Figure 13-87 shows the Server Operation Duration and Byte Count as seen in the Enterprise Portal.

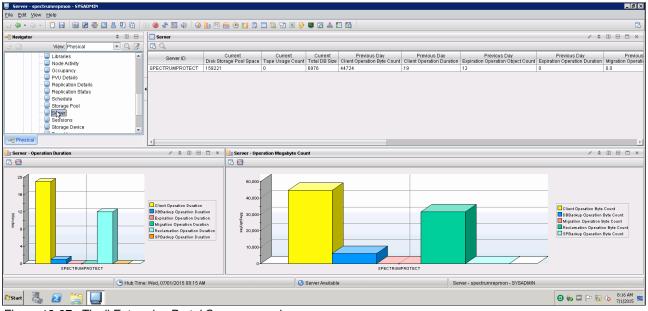


Figure 13-87 Tivoli Enterprise Portal Servers overview

- Storage device: This workspace provides you with the read and write error status of the storage devices. This status helps you identify possible problems with any of your storage devices. Bar chart graphs also display the read and write error count.
- ► Tape usage: This workspace provides you with tape usage data for each client.
- Tape volume: This workspace provides the status of all tape storage devices. This information can help you identify any storage devices that are near full capacity.

Daily monitoring with the Enterprise Portal

You can use Tivoli Monitoring for Spectrum Protect to monitor many daily operations to ensure that your system is running in good condition. To do so, complete the following steps:

1. Start the Tivoli Enterprise Portal, log on with your sysadmin ID and password, and go to Tivoli Storage Manager.

Many of the items that you can check daily are displayed in the dashboard view when it opens. The dashboard displays a grouping of commonly viewed items in a single view. Examine items and look for any values that might indicate a potential problem:

- Node storage space used: Check this graph for disk, storage, and tape space that is used.
- Storage Pool: Click the chain link icon to drill down for additional details.
- Unsuccessful server schedules: Review this table for any missed or failed server schedules. Click the chain link icon for additional details.

- Unsuccessful client schedules: Review this table for any missed or failed client schedules. Click the chain link icon for additional details.
- Drive Status
- Review this table to ensure that all drives are online.
- Activity log errors: Review this table to check for error, warning, and severe messages. Click the chain link icon for additional details.
- 2. In the navigation pane, select the Database workspace. Examine the Percent Space Used value to ensure that the database file system has enough available space. You can also check the Backup Status field to ensure that the database backups completed successfully.
- 3. Go to the Storage Pool workspace and review the total space that is used to ensure that there is enough space available to manage the anticipated workload.
- 4. Go to the Activity Log workspace and review the information in the table for any error messages that might indicate a problem that must be resolved.
- 5. Go to the Drives workspace and check to ensure that all drives are online.
- 6. Go to the Libraries workspace and check to ensure that the path to the library is online. Click the chain-link icon for additional details.
- 7. Go to the Tape Volume workspace to view the status and identify devices that are near full.
- 8. Go to the Server or Activity Log workspace to review operational statuses, such as what activities are taking too much time to complete, statuses of activities, messages about the activities, and other details that help to identify potential problems.

Cognos reports

IBM Cognos 8 Business Intelligence is an integrated business intelligence suite that is provided as part of Tivoli Common Reporting. You can use Cognos to view and create business reports, analyze data, and monitor events and metrics.

The Cognos reports include status and trending data about your Tivoli Storage Manager server and clients.

These Cognos reports are available in HTML, PDF, Microsoft Excel, XML, and CSV (delimited text) formats.

Figure 13-88 shows an overview of the available Status and Trending reports for Spectrum Protect.

Status reports	Trending reports
Client activity status Client backup currency Client backup status Client schedule status Client storage pool usage summary Client storage soummary and details Current client occupancy summary Current storage pool summary Highest storage space usage Node replication details Node replication details Node replication summary Server activity log details Server activity log details Storage pool deduplication savings VE activity status VE backup type summary VE current occupancy summary Yesterday's missed and failed client schedules	<u>Client activity success rate</u> <u>Client schedule success rate</u> <u>Client storage usage trends</u> <u>Disk utilization trends</u> <u>Node replication growth</u> <u>Server database growth trends</u> <u>Server storage growth trends</u> <u>Server throughput trends</u>

Figure 13-88 Spectrum Protect Cognos Reports

A detailed description for these reports can be found at the following website:

http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.1/com.ibm.itsm.srv.doc/r_rpt _cognos_rpts.html?lang=en-us#r_rpt_cognos_rpts__crpts

You can use Report Studio to create your own customized Cognos reports.

Report Studio is a product for creating Cognos reports that analyzes corporate data according to specific information needs. In Report Studio, you can accomplish the following tasks:

- Create a Cognos report by developing a query to fetch data from the WAREHOUSE database.
- Modify an existing Cognos report to change its appearance.
- View data from a Cognos report to test your new query.

For more information about creating customized reports, see the following website:

https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/Tivoli%20St
orage%20Manager/page/Creating%20Customized%20Reports

14

General performance

This chapter describes some of the tools that are available to analyze VersaStack performance.

14.1 IBM Easy Tier

Easy Tier is a performance function that automatically and nondisruptively migrates frequently accessed data from magnetic media to solid-state drives (SSDs). In that way, the most frequently accessed data is stored on the fastest storage tier, and the overall performance is improved.

The first generation of Easy Tier introduced automated storage performance management by efficiently boosting enterprise-class performance with SSDs, and automating storage tiering from enterprise-class drives to SSDs. These changes optimized flash deployments with minimal costs. Easy Tier also introduced dynamic volume relocation and dynamic extent pool merge.

The third generation of Easy Tier introduces further enhancements that provide automated storage performance and storage economics management across all three drive tiers (flash, enterprise, and nearline storage tiers). You can use it to consolidate and manage efficiently more workloads on a single IBM Storwize V7000 Gen2 storage system. It also introduces support for storage pool balancing in homogeneous pools. It is based on performance, not capacity.

IBM has a tool to analyze the movements of extents by EasyTier that is called the IBM Storage Tier Advisor Tool, which can be found at the following website:

http://www.ibm.com/support/docview.wss?uid=ssg1S4000935

Using the tool with the dpa_heat file that is generated on our example Storwize V7000 storage system shows which volumes have hot data. VDisk 4 was receiving much I/O, so EasyTier has migrated extents onto the SSD tier. The distribution of extents can be shown by running **lsvdiskextent**.

Figure 14-1 shows the Volume Heat Distribution by using the STAT tool, The hot data is in red, warm data in orange, and cold in blue.

	Recomm	ended NL Confid	juration							
THEFT	Volume H	leat Distribution	1							
						Volume H	leat Distribution			
		Vdisk ID *7	Copy ID *8	Configured Size *9	IO Percentage of Extent Pool	Tier	Capacity on Tier *10		Heat Distribution *11	
		0	0	32.00 GiB	0.05%	SSD Tier	2.00 GiB		2.00 GiB	
		-	-			Enterprise Tier	30.00 GiB		29.00 GiB	1.00
		1	0	32.00 GiB	0.06%	SSD Tier	2.00 GiB		2.00 GiB	
		-				Enterprise Tier	30.00 GiB		27.00 GiB	3.00
		2	0	1024.00 GiB	1.25%	SSD Tier	101.00 GiB	25.00 GiB	76.00 G	B
		- -	·	102.000 0.0	112070	Enterprise Tier	923.00 GiB		880.00 GiB	43.00
		11	0	6.00 GiB	0.02%	SSD Tier	0.00 GiB			
		**	•	0.00 010	0.02 /0	Enterprise Tier	6.00 GiB		5.00 GiB	1.00 G
			0	256.00 GiB	54.97%	SSD Tier	32.00 GiB	16.00 GiB		16.00 GiB
		*	0	250.00 GIB	34.37 %	Enterprise Tier	224.00 GiB		212.00 GiB	5.00 GiB 7.0
nmary Report		5	0	64.00 GiB	1.64%	SSD Tier	0.00 GiB			
initially kepolit		5	0	04.00 GID	1.04 /8	Enterprise Tier	64.00 GiB		2.00 GiB	11.00 GiB 1.0
stemwide		6	0	1.00 GiB	0.00%	SSD Tier	0.00 GiB			
ommendation		•		1.00 0.0	0.00 %	Enterprise Tier	1.00 GiB		1.00 GiB	
		7	0	2048.00 GiB	22.80%	SSD Tier	53.00 GiB	8.00 GiB	44.00 GiB	1.0
		·	0	2040.00 GID	22.00%	Enterprise Tier	1995.00 GiB		1789.00 GiB	206.0
		15	0	209.00 GiB	0.00%	SSD Tier	0.00 GiB			
		15	0	209.00 GIB	0.00%	Enterprise Tier	209.00 GiB		208.00 GiB	1.0
		0	0	121.00 GiB	0.04%	SSD Tier	4.00 GiB		4.00 GiB	
		2	0	121.00 GIB	0.0476	Enterprise Tier	117.00 GiB		106.00 GiB	11.0

Figure 14-1 The Volume Heat Distribution that is found by using the STAT tool

14.2 Autotier

Spectrum Control features the Analyze Tiering wizard that can tier volumes automatically or based on the criteria that you set in your tiering policies. For example, you can tier volumes based on the volume workload, on file usage, or both. Depending on the conditions that are set in the tiering policy, recommendations are generated. For example, you can reduce storage costs by moving volumes with low workloads to lower or less expensive tiers. You can also improve performance and use storage more efficiently by moving volumes with heavy workloads to the tiers that best meet their workload requirements.

Volumes can be moved to tiered storage pools on the same storage virtualizer, but volumes cannot be moved from one storage virtualizer pool to another storage virtualizer pool.

A customer can select the resources that they want to analyze. The source storage pools that are related to the resources that you selected are analyzed to determine whether they meet the workload requirements of the volumes. If the workload requirements of the volume in its current tier are not met, the volume is a candidate for relocation. You can perform the following actions:

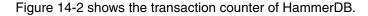
- Specify the target storage pools for the volumes.
- Include or exclude volumes in mirrored volume relationships from the analysis.
- Optionally, provide more information about storage pools on back-end storage systems. Tivoli Storage Productivity Center might require more information to estimate the workload capability of the source and target storage pools.

To ensure that the performance of the target pools is not degraded when volumes are added, you specify a maximum utilization percentage for the pools. The performance data that is collected on the previous day is used to estimate the average daily utilization of the physical resources, such as controllers, nodes, and disks, that are associated with a pool. The physical resources that are associated with a pool vary depending on the type of storage system.

Note: In our example setup, we put our SSDs in the control enclosure. This is a preferred practice because of our SAS topology; the Storwize V7000 SPCve chip has 16 PHYs, eight of which go to the internal SAS expanders, and the expansions chains receive four each. This means that placing our SSDs on the control enclosure allows us to receive the maximum bandwidth benefit.

To demonstrate the increased performance on SSDs and autotiering, use the HammerDB tool and Spectrum Control to measure the performance and complete the following steps:

- 1. Place the sql_rdm_data VDisk on Enterprise SAS-only mdiskgrps. Then, create a 250 GB database on this volume.
- 2. After the database creation finishes, run the HammerDB I/O tool. Create 21 virtual users, with a user delay and repeat delay of 500 ms.



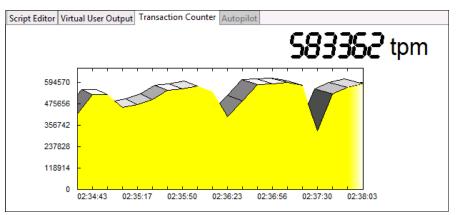


Figure 14-2 The transaction counter of HammerDB while creating 21 virtual user on 10 K SAS drives

3. The transactions max out at 594570. Then, migrate the sql_rdm_data volume to SSD storage by using Spectrum Control. To do so, go to the sql_rdm_data volume in Spectrum Control, right-click it, and select **Transform Storage**, which starts a wizard. In the wizard, select the mdiskgrp with only SSDs (in our example, mdiskgrp2), as shown in Figure 14-3 and Figure 14-4 on page 437.

Storwize V7000 VersaStack IBM Storwize V7000 - 2076	Volumes 23 Normal M 0 Warning © 0 Error	
General	Volumes 🔤 Performance	
Overview Properties	2 Refresh	
Alerts (338)	Name 🔺 Pool	Status
Threshold Violations (123)	📳 infra_datastore_1 🛛 🚷 <u>mdiskqrp0</u>	🗸 Online
······································	🚪 infra_datastore_1_01 🛛 🛞 <u>mdiskqrp0</u>	🗸 Online
🗇 Data Collection (2) 🖧 Data Path	📲 infra_datastore_1_02 🛛 🎯 mdiskqrp0	🗸 Online
	📳 infra_datastore_2 🛛 🛞 <u>mdiskqrp0</u>	🗸 Online
Internal Resources	🚪 infra_datastore_2_01 🛛 🍪 mdiskgrp0	🗸 Online
Volumes (23)	📳 infra_datastore_2_02 🛛 🛞 mdiskgrp0	Online
8 Pools (2)	infra_datastore_3 🛞 mdiskgrp0	Online
 Managed Disks (6) RAID Arrays (6) 	R infra datastore 4 8 mdiskgrp0	Online
Disks (48)	sp_datastore_1	Online
# I/O Groups (1)	sp_datastore_2	Online
	sal rdm data	Online
Bill Ports (16)	sql_rdm_data_01	Online
4 Host Connections (4)	sql_rdm_data_2	Online
Related Resources	Analyze Tiering	Online
Servers (2)	Add to Application	Online
Hypervisors (4)	sql_rdm_log_2	Online

Figure 14-3 The Storwize V7000 volumes window on Spectrum Control

Transform Stor	age					
Select one or more target p	pools.					
E Actions ▼					Q ▼ Filter	
Name	Status 🔹	🗸 🛛 Capacity (G	iB)	Tier	Available Space	IJ
🛞 mdiskgrp0	🗸 Online		19,535.00	Tier 2		10,69
🛞 mdiskgrp2	🔽 Online		738.00	Tier 1		73
<						>
Showing 2 items Selecte	ed 1 item			F	efreshed a few moment	ts ago
		 ■ Back 	Recommend		Cance	

Figure 14-4 Using Spectrum Control to move the volume to a different tier

4. Rerun HammerDB by using the same input as before, as shown in Figure 14-5.

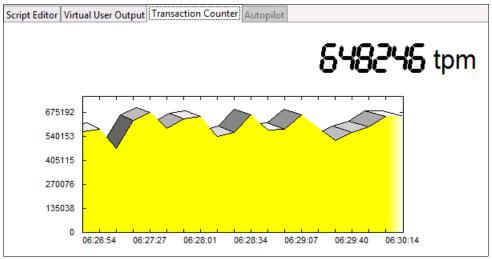


Figure 14-5 The transaction counter of HammerDB while creating 21 virtual user on SSDs

You can see that there is an increase to a maximum transactions per minute (TPM) of 675192.

You can use the automation layer in Spectrum Control to perform the autotiering analysis at scheduled intervals and have the volumes uptiered or downtiered automatically depending on the actual, historical, or expected workload.

14.3 General performance metrics

The HammerDB tool shows an increase in performance when migrating the SQL data volumes from SAS-based disks to SSD-based disks.

Gauging system performance by using a tool such as HammerDB is an intensive process requiring multiple reruns. Moreover, it is difficult to evaluate the results in case where the general performance and capabilities of the environment supersede the load being put on the system by the benchmarking tool.

For the VersaStack environment, three components determine the general performance (abstracting the impact that is introduced by the OS and hypervisors):

- Computing blade (B200 M4)
- ► I/O backplane (VIC 1340)
- Storage system (Storwize V7000 storage system)

14.3.1 B200 M4

The CPU performance of the host on which the SQL virtual machines (VMs) are running also determines the processing performance of the database. The results are shown in Figure 14-6.

spec*	SPEC [®] CINT2 Copyright 2006-2015 Standard Performance	006 Result
Cisco S	Systems	SPECint [®] _rate2006 = 848
Cisco UCS B2 3.00GHz)	200 M4 (Intel Xeon E5-2650 v3 @	SPECint_rate_base2006 = 821
CPU2006 licens	e: 9019	Test date: Feb-2015
Test sponsor:	Cisco Systems	Hardware Availability: Sep-2014
Tested by:	Cisco Systems	Software Availability: Nov-2013
400.perlbench	Copies 0 300 600 900 1200 1600 2000 2400 2800 3200 3600 40	4000 4400 4800 5200 5600 6000 6400 6800 7200 7600 8400
401.bzip2	40 40	
403.gcc	400 - 619 - 623	
429.mcf	40 1130	
445.gobmk	40 552 40 539 1190	
456.hmmer	40 1170	
458.sjeng	40 591 40 572	
462.libquantum	40	8320
464.h264ref	40 972 40 953	
471.omnetpp		
473.astar	40 448	
483.xalancbmk	40 913	
	SPECint_rate_base2006 = 821	
	SPECint_rate2006 = 848	

Figure 14-6 Cisco UCS B200 SPEC CINT2006 results

The B200 M4 that we use in our example SQL on VersaStack environment has a SPECINT rate of 848, as shown in Figure 14-6 on page 438.

14.3.2 VIC 1340

The main component determining the I/O backplane performance capability is the Cisco UCS Virtual Interface Card 1340. The VIC 1340 has the following features:

- ► Sixteen PCIe Gen3 interfaces.
- Two 40-Gbps Unified I/O ports or two sets of four 10-Gbps Unified I/O ports.
- It delivers 80 Gbps to the server.
- It helps reduce total cost of operation (TCO) by consolidating the overall number of NICs, HBAs, cables, and switches. LAN and SAN traffic runs over the same mezzanine card and fabric.
- ► It adapts to either 10-Gbps or 40-Gbps fabric connections.
- ► It has more than 900,000 I/O operations per second (IOPS).

For more information about the VIC 1340, see the following website:

http://www.cisco.com/c/en/us/products/interfaces-modules/ucs-virtual-interface-car d-1340/index.html

14.3.3 Storwize V7000 storage system

Workload simulation and performance metrics for the Storwize V7000 Gen 2 storage system can be modeled by using the IntelliMagic Disk Magic tool.

The IBM Disk Magic for Windows modeling tool helps estimate IBM disk subsystem performance. The IBM disk controllers that are supported are XIV, DS8000, IBM DS6000[™], DS5000, DS4000, SAN Volume Controller, Storwize V3500, V3700, V5000, V7000, and V7000U.

It is beyond the intended scope of this book to go into details of Disk Magic. There is a comprehensive amount of information available at the following websites:

► For IBM employees:

https://ibm.biz/BdX7ca

► For IBM Business Partners (you will need your IBM ID to sign in):

https://ibm.biz/BdX7cb

440 VersaStack Solution by Cisco and IBM with SQL, Spectrum Control, and Spectrum Protect

15

General validation

Performing validation testing is important for quality control and to demonstrate that the product performs as expected. This chapter description the validation testing that we performed for our example VersaStack solution.

15.1 Validation scenarios

These are the scenarios that we validated on our example VersaStack solution:

- Storwize V7000 storage system:
 - Unexpected Fibre Channel cable failure
 - Unexpected node failure
- ► Microsoft WSFC and SQL Server FCI: Active cluster node failure
- Cisco Nexus Switches: vPC peer switch failure
- ► Cisco UCS Service Profile: Service profile migration

15.2 Storwize V7000 failover validation

The pair of nodes within a single Storwize V7000 enclosure is known as an *I/O group*.

When an application server processes I/O to a volume, it can access the volume with either of the nodes in the I/O group. When you create a volume, you can specify a preferred node. Many of the multipathing driver implementations that the system supports use this information to direct I/O to the preferred node. The other node in the I/O group is used only if the preferred node is not accessible.

If you do not specify a preferred node for a volume, the system selects the node in the I/O group that has the fewest volumes to be the preferred node.

An I/O group consists of two nodes. When a write operation is performed to a volume, the node that processes the I/O duplicates the data onto the partner node that is in the I/O group. After the data is protected on the partner node, the write operation to the host application is completed. The data is physically written to disk later.

Read I/O is processed by referencing the cache in the node that receives the I/O. If the data is not found, it is read from the disk into the cache. The read cache can provide better performance if the same node is chosen to service I/O for a particular volume.

I/O traffic for a particular volume is, at any one time, managed exclusively by the nodes in a single I/O group. Thus, although a clustered system can have multiple nodes within it, the nodes manage I/O in independent pairs, which means that the I/O capability of the Storwize V7000 storage system scales well because additional throughput can be obtained by adding additional I/O groups.

When a node fails within an I/O group, the other node in the I/O group assumes the I/O responsibilities of the failed node. Data loss during a node failure is prevented by mirroring the I/O read and write data cache between the two nodes in an I/O group.

If only one node is assigned to an I/O group or if a node fails in an I/O group, the cache is flushed to the disk and then goes into write-through mode. Therefore, any writes for the volumes that are assigned to this I/O group are not cached; they are sent directly to the storage device. If both nodes in an I/O group go offline, the volumes that are assigned to the I/O group cannot be accessed.

15.2.1 Unexpected Fibre Channel cable failure

Removing the Fibre Channel (FC) cables from one node in the Storwize V7000 storage system causes all the I/O traffic to go through the Host Interface Card (HIC) on the other node, but I/O continues and both nodes are still used.

This scenario can be used as a good example of the redundancy of the Storwize V7000 and to show how the Storwize V7000 storage system and Spectrum Control handle errors.

Example 15-1 shows the output of the **lsportfc** command, where you can see that all eight FC ports are active.

[09:30:26] mcr-v7000-canister-02:~ # lsportfc							
-	o port id			•	peed node id	node name	WWPN
nportid		• _	• •		cluster use		
adapter	_port_id				_		-
0 1		1	fc	8Gb	4	node1	500507680B214FF4
0C0160	active			switch	local_partn	er 2	1
12		2	fc	8Gb	4	node1	500507680B224FF4
0C0020	active			switch	local_partn	er 2	2
23		3	fc	8Gb	4	node1	500507680B234FF4
A90160	active			switch	local_partn	er 2	3
34		4	fc	8Gb	4	node1	500507680B244FF4
A90020	active			switch	local_partn	er 2	4
45		4		rnet N/A	4	node1	500507680B314FF4
000000	inactive	_unconfig			local_partn		1
56		5		rnet N/A	4	node1	500507680B324FF4
000000	inactive	_unconfig	-		local_partn		2
67		6		rnet N/A	4	node1	500507680B334FF4
000000	inactive	_unconfig	gured	none	local_partn	er 3	3
78		7		rnet N/A	4	node1	500507680B344FF4
000000	inactive	_unconfig	-		local_partn	er 3	4
14 1		1	fc	8Gb	2	node2	500507680B214FF5
000000	active			switch	local_partn		1
15 2		2	fc	8Gb	2	node2	500507680B224FF5
0C0040	active			switch	local_partn		2
16 3		3	fc	8Gb	2	node2	500507680B234FF5
A90000	active			switch	local_partn		3
17 4		4	fc	8Gb	2	node2	500507680B244FF5
A90040	active			switch	local_partn		4
18 5		4		rnet N/A	2	node2	500507680B314FF5
000000	inactive	_	-		local_partn		1
19 6		5		rnet N/A	2	node2	500507680B324FF5
000000	inactive	_	-		local_partn		2
20 7		6		rnet N/A	2	node2	500507680B334FF5
000000	inactive	_unconfig	-		local_partn		3
21 8		7		rnet N/A	2	node2	500507680B344FF5
000000	inactive	_unconfig	gured	none	local_partn	er 3	4

Example 15-1 List the FC ports by running lsportfc

To simulate this validation scenario, complete the following steps:

1. Remove the four FC cables from node 2 (the control node at this time). This action creates an error message on the Storwize V7000 CLI and GUI. Accessing the event menu by using the GUI shows more information.

2. To access the event log, click the **Events** tab, as shown in Figure 15-1.



Figure 15-1 The Events tab

3. Figure 15-2 shows two errors inside the event log. A Directed Maintenance Procedure (DMP) can be run by clicking the event in question and then clicking **Run Fix**. Click **Run Fix** for the top error to start a DMP for that error.

Recommended Action: Sector 1061 : Fibre Channel ports not operational									
3 Refresh	🚱 Refresh │ ≔ Actions │ Recommended Actions │ 🔍 Filter │ 🔣								
Error Code	Last Time Stamp	Status	Description	Obje	ct Type 🛛 🕻	Object ID	Object Name		
1061	6/26/15 10:17:17 AM	😵 Alert	Fibre Channel ports not operational	node	2	2	node2		
1450	6/26/15 10:17:17 AM	🐼 Alert	Fibre Channel I/O ports not operational	node	2	2	node2		

Figure 15-2 Event log in the GUI

You are asked if the change is on purpose and, if not, what you want like to do to fix it.

Figure 15-3 shows the window that explains the error. In this case, four FC ports are inactive.

<u> </u>											
Fi	Fibre Channel ports not operational										
	Fibre Channel ports status changed										
1	There has been a change of status on the Fibre Channel ports.										
	The Fibre Chann										
	Machine Type ar	nd Model	Node Identifier	Node Nam	e Enclosu	re Identifier End	closure Serial Number	Panel Name	Canister Position In Enclosure		
	2076-524		2	node2	2	782	219KH	02-2	Right		
	The current state	us of the	Fibre Channel p	orts							
	Adapter slot ID	Port ID	Port WWPN	Curre	ent status	Expected status					
	2	1	500507680B21	4FF5 Inact	ive	Active					
	2	2	500507680B22	4FF5 Inact	ive	Active					
	2	3	500507680B23	4FF5 Inact	ive	Active					
	2	4	500507680B24	4FF5 Inact	ive	Active					
	2 4 500507680B244FF5 Inactive Active If this change is intentional due to administration or maintenance, dick this box: In the dick Next. Note: this event could also be caused by a hardware change on this node that has not yet been accepted into configuration. Click Cancel to exit this fix procedure and check if any unfixed event with error code 1198 or 1199 is logged against this node, and run fix procedure for that event first. If there is no such event or it has already been fixed, dick Next to proceed.								2		
	Cancel									4	lext

Figure 15-3 DMP showing the four inactive FC ports

4. Click Next. The DMP shows you possible ways to fix the issue.

Figure 15-4 shows how the DMP directs you to fix the error by checking the FC connections.

Fibre Channel ports not operational									
Check the Fibre Channel cabling									
For the ports that currently have inactive status and are not expected to be, check the Fibre Channel cable.									
Ensure the correct type of cable is being used.									
If the cable appears damaged, replace it.									
 If there are any sharp bends in the cable, re-route or replace it. Reseat the cable connector by unplugging the cable for two seconds, and then reconnecting it. 									
After performing this service action, click Next to check the port status.									
Select one of these options before dicking Next:									
🗢 Fibre Channel status is incorrect, try next service action									
Fibre Channel status is correct, mark as fixed									
The Fibre Channel ports are located on this node Machine Type and Model Node Identifier Node Name Enclosure Identifier Enclosure Serial Number Panel Name Canister Position In Enclosure									
Machine type and Model Node Calentitier Node Name Enclosure Identitier Enclosure serial Number Panel Name Canister Position in Enclosure 2076-524 2 node2 2 78219KH 02-2 Right	Ξ								
The current status of the Fibre Channel ports									
Adapter slot ID Port WWPN Current status Expected status									
2 1 500507680B214FF5 Inactive Active									
2 2 S00507680B224FF5 Inactive Active									
2 3 500507680B234F5 Inactive Active									
2 4 5005076808244FF5 Inactive Active									
Refresh port status table									
Elbe-channel ports									
Cancel Back Next									

Figure 15-4 DMP prompt to check the cables

5. If you plug in the FC cables that were removed from node 2 and refresh this window, you see the status of the ports go to Active and the event is marked as fixed.

Figure 15-5 shows that the problem is solved and the event is marked as fixed.

Fibre Channel ports not operational	
Error is marked as fixed	
The event is marked as fixed.	
Click Close to exit.	
	Close

Figure 15-5 Final window of the DMP

6. Go to Spectrum Control and click **Storage** → **V7000 VersaStack** → **Nodes**. When you look at this period, you see that I/O continued, even when the cables were unplugged.

Figure 15-6 shows Spectrum Control showing the total I/O rate and overall response time. The FC cables were removed from 10:30 - 10:45, and you can see that I/O continued throughout this period and response time stayed constant.

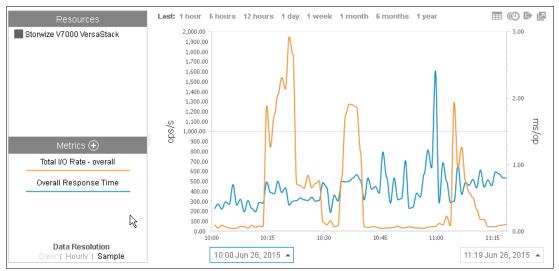


Figure 15-6 Spectrum Control chart showing total I/O and overall response time

15.2.2 Unexpected node failure

A Storwize V7000 storage system is an active/active storage controller that seamlessly allows for the failure of one node.

To simulate this failure, complete the following steps:

1. Physically remove one of the nodes from the enclosure. This is not a recommended action in an actual production environment, but is done to demonstrate various features only.

Figure 15-7 shows the performance window on the Storwize V7000 GUI. I/O is running and the health status is green. The Storwize V7000 performance window shows only 5 minutes of data.

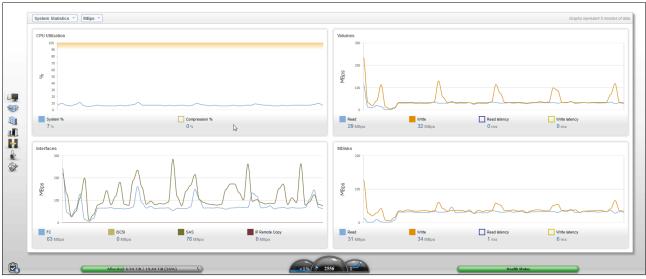


Figure 15-7 The performance window of the Storwize V7000 GUI

2. Remove the control node (node 2 in this case), which causes the cluster IP to fail over from node 2 to node 1. You briefly lose access to the GUI.

Figure 15-8 shows that removing the control node takes the GUI offline, as shown in the upper right of the window.



Figure 15-8 The GUI is offline

3. Access the GUI again by refreshing the GUI after a few minutes. There are errors in the event log. For more information, go to the System tab in Monitoring.

Figure 15-9 shows the System window, which shows both enclosures with an error within the control enclosure, that is, enclosure 1.

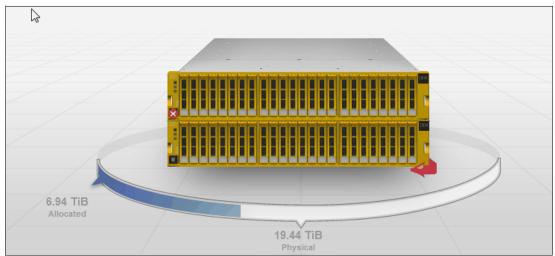


Figure 15-9 System tab showing an error in the control enclosure

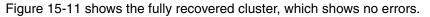
4. Rotate the enclosure by using the red arrow, and hover your cursor over the canister to see more information.

Figure 15-10 shows you hovering the cursor over the canister, which shows its ID, state, configuration node, WWNN, and service IP.

	Can	ister	
ID: State:	•	2 (Righ Offline	
Configura WWNN: Service IP		No 500507(173.36.)	680B004FF5 252.194

Figure 15-10 The canister is offline in the GUI

5. Reinsert node 2. When it starts, it seamlessly joins the cluster, and the systems window updates to show that it joined the cluster.



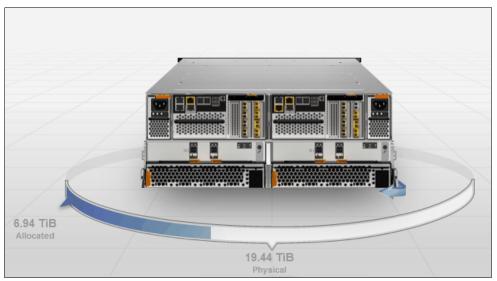


Figure 15-11 The systems window after reinserting the node

 We can confirm on Spectrum Control that I/O continued throughout by clicking Storage → V7000 VersaStack → Nodes and selecting the period that the node was removed. The node was removed between 15:15 and 15:30. Figure 15-12 shows Spectrum Control displaying the read and write I/O during the time when a node was removed from the cluster.



Figure 15-12 Show read and write I/O on spectrum control.

As previously explained, with only one node active, the cache is immediately flushed to disk, so the host does not write over data on cache that has yet to be destaged. This means that you have a write cache hit of 0% when a node is removed, which can be shown with the analytics available to you through Spectrum Control.

To view the write cache hit percent, press the + next to Metrics.

Figure 15-13 shows the Spectrum Control window for the Storwize V7000 storage system; the + expands the metrics that are available to view.

Storwize V7000 VersaStack IBM Storwize V7000 - 2076	Resources Last
Actions 🔻	
Overview	, o
Properties	s/sdo
Alerts (57)	Metrics 🛖
🚟 Threshold Violations (19)	Read I/O Rate - Select Chart Metrics
🎲 Tasks (0)	
🗇 Data Collection (2)	Write I/O Rate - overall
🖧 Data Path	
Internal Resources	
🚦 Volumes (17)	
🛞 Pools (2)	Data Resolution
Managed Disks (7)	Daily Hourly Sample
😡 RAID Arrays (7)	
🗵 Disks (48)	≣ Actions ▼ Key Metrics View ▼
📽 I/O Groups (1)	Name Total I/O .
🚥 Nodes (2)	

Figure 15-13 The Spectrum Control view of the Storwize V7000 storage system

You can change the metrics that you want to display. In our example, we display Cache Write Delay and Cache Hit Percent.

Figure 15-14 on page 451 shows the different metrics that are available, Cache Write Delay and Cache Hit Percent are selected and everything else is clear.

Select Chart Metric	s		(2 Selected
Volume Metrics (2)	- Disk Metrics	🐻 Port Metrics 🛛 🛥 N	ode Metrics	
Overall I/O Rate (ops/s)	Read		Total	^
Data Rate (MiB/s)	Read	Write	Total	
Response Time (ms/op)	Read	Write	Overall	=
Other (%)	Overall Host Attr	Write-cache Delay		
√ More				
I/O Rates				
Transfer Rate (ops/s)	Disk-to-Cache	Cache-to-Disk		
Other (ops/s)	✓Write-cache Delay			
Cache Hits				
Overall I/O Cache Hits (%)	Read	✓Write	Total	
Response Times				
Peak Response Time (ms)	Read	Write		
Remote Mirror				
Global Mirror	Write I/O Rate (o	Overlapping Write	Overlapping Writ	e 🗸
	ОК	Cancel		

Figure 15-14 The different Spectrum Control metrics that are available

Selecting the period that we are interested in shows the cache hits dropping from 100% to 0% when one canister is removed and then returning to 100% when the canister is returned.

Figure 15-15 shows the Write Delay and Cache Hit Percent, and the node was removed between 10:15 and 10:30.

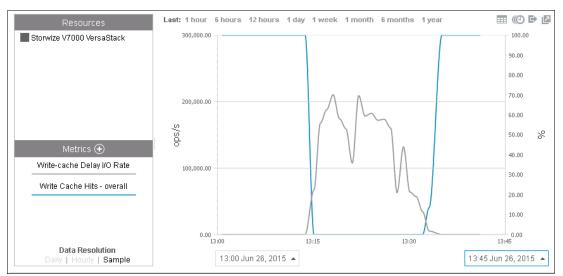


Figure 15-15 Use Spectrum Control to show the behavior of a cache with one node and with two nodes

15.3 Microsoft Windows Server Failover Clustering and SQL Server Failover Cluster Instance overview

A Windows Server Failover Clustering (WSFC) cluster is a group of independent servers that work together to increase the availability of applications and services, such as File and Print Services and SQL Server Failover Cluster Instances.

An AlwaysOn Failover Cluster Instance (FCI) is a SQL Server instance that is installed across nodes in a WSFC cluster. If there is a failover, the WSFC service transfers ownership of resources to another available designated node in the cluster. The SQL Server instance is then restarted on the failover node, and databases are recovered as usual.

15.3.1 Active cluster node failure

This validation scenario describes the impact of a manual failure of the WSFC active node and the SQL Server FCI. This scenario highlights the high availability for the SQL Server database instance.

Test procedure

The virtual machine hosting the primary instance of the SQL Server FCI is identified.

ਥ Failover Cluster Manager File Action View Help 🗢 🔿 🙎 🖬 🚺 🖬 📲 Failover Cluster Manager Roles (1) ▲ 📳 VMW_WSFC_CLUS.Versa 🔎 Queries 🔻 🔚 Search Roles Nodes Information Status Туре Owner Node Priority Name ... a 📙 Storage SQL Server (MSSQLSERVER) (Running SQLVM01 Other Medium 📇 Disks Pools 🗧 Networks ш Cluster Events SQL Server (MSSQLSERVER) Preferred Owners Status: Running Priority: Medium Owner Node: SQLVM01 Client Access Name: SQLCLUS IP Addresses: 192.168.10.54

Figure 15-16 shows the Failover Cluster Manager with the owner node.

Figure 15-16 Failover Cluster Manager

Complete the following steps:

1. Start an OLTP workload from a machine outside the VersaStack environment. The tool to generate an OLTP workload is called HammerDB.

Figure 15-17 shows the HammerDB OLTP workload running on the SQL Server FCI.

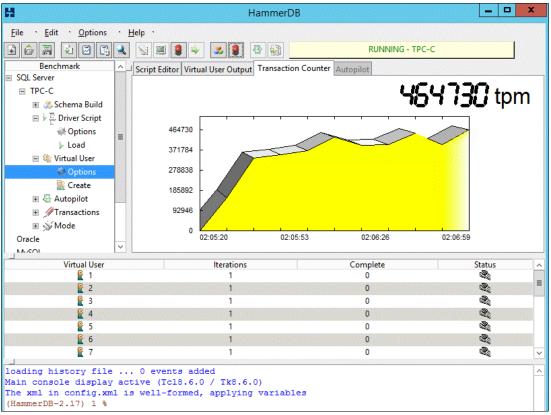


Figure 15-17 HammerDB OLTP workload tool

2. From the Failover Cluster Manager window, right-click the virtual machine that is an owner node and stop the cluster service.

Figure 15-18 shows stopping the cluster service on a node by using Failover Cluster Manager.

巷			Failover C	Cluste	er Ma	nager		
File Action View Help								
🗢 🄿 🖄 🖬								
📲 Failover Cluster Manager	Nodes (2)						1	
▲ 📲 VMW_WSFC_CLUS.Versa	Search						P	Queries
Roles								Lister State
Nodes	Name			Stat		Assigned Vote		rent Vote
⊿ 📇 Storage ﷺ Disks	SQLVM01		Pause •) Up	1	1	
	SQLVM02		Resume) Up	1	1	
Networks			Resume •					
B Cluster Events	<	•	Remote Desktop					
		-	Information Details	-				WENE AND
	SQLVI		Show Critical Events					
	Status:		More Actions		Start	Cluster Service		
	Node ID:		2		Stop	Cluster Service		
	Uptime:		4 Days 0:53:43		Stop	Cluster Service		
	Memory:		1.27 GB Available, 16.0 GB Total		Evict			
	Processors:		(4) Intel(R) Xeon(R) CPU E5-2650 v	3@2	.30GHz	!		
	CPU Usage:		1%					
	Operating Syste	em:	Microsoft Windows Server 2012 R2	Datad	center E	Evaluation		
	Version:		6.3.9600					
	Service Pack:		No Service Pack Installed					
	System Type:		x64-based PC					
	Manufacturer:		VMware, Inc.					
	Model:		VMware Virtual Platform					

Figure 15-18 Failover Cluster Manager window

Test observations

The status of the node whose cluster service was stopped is Down after moving the roles to the other node.

Figure 15-19 shows the node's cluster service as Down.

趨			Failover Cluste	er Manager
File Action View Help				
🗢 🄿 🙍 🖬				
📲 Failover Cluster Manager	Nodes (2)			
⊿ WWW_WSFC_CLUS.Versa	Search			
Roles	In the second se	inserition and the series of the		osaniineaniineaniineann
Nodes	Name	Status	Assigned Vote	Current Vote
⊿ 📇 Storage	SQLVM01	🔳 Down	1	1
📇 Disks	SQLVM02	🕥 Up	1	1
Pools				
Networks	<			
B Cluster Events				

Figure 15-19 Failover Cluster Manager window

The client machine from where the OLTP workload was started loses connectivity during the failover.

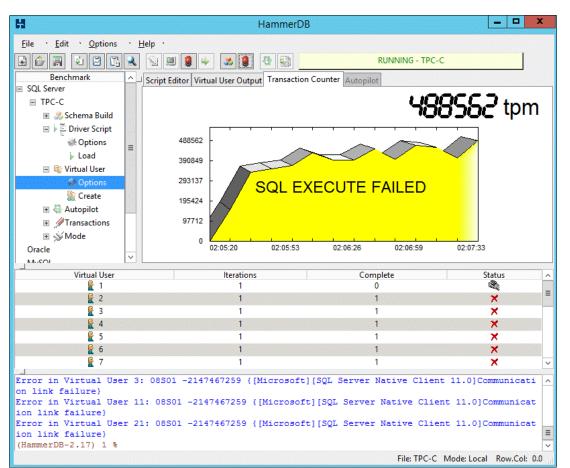


Figure 15-20 shows the client losing connectivity when the owner node cluster service is down.

Figure 15-20 HammerDB OLTP workload tool

The cluster service and the SQL Server FCI came online quickly on the other node and were able to reconnect the clients successfully. During this exercise, all the instance-level entities of the SQL Server, including the security objects, are made to fail over to the passive virtual machine. After the manual failover, the standby instance of the failover cluster instance is made the active instance that hosts the FCI. After the test is complete, the cluster service of the node 8is restarted to put all the cluster nodes online.

Figure 15-21 shows the failover cluster manager after the resources are moved from the failed cluster node to the available cluster node.

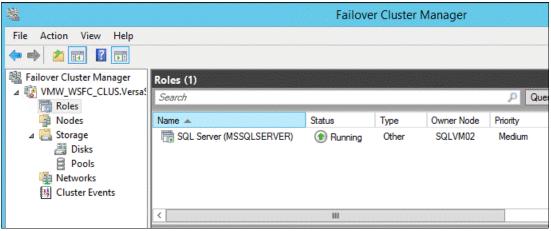


Figure 15-21 Failover Cluster Manager window

15.4 Cisco Nexus devices

A virtual PortChannel (vPC) allows links that are physically connected to two different Cisco Nexus 9000 Series devices to appear as a single PortChannel to a third device. The third device can be a Cisco Nexus 2000 Series Fabric Extender or a switch, server, or any other networking device. A vPC can provide Layer 2 multipathing, which allows you to create redundancy by increasing bandwidth, enabling multiple parallel paths between nodes, and load-balancing traffic where alternative paths exist.

Figure 15-22 shows the Cisco Nexus vPC physical and logical topology.

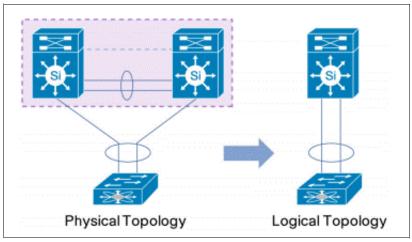


Figure 15-22 Cisco Nexus vPC topology

A vPC provides the following benefits:

- Allows a single device to use a PortChannel across two upstream devices
- Eliminates Spanning Tree Protocol blocked ports
- Provides a loop-free topology

- ► Uses all available uplink bandwidth
- Provides fast convergence if either the link or a device fails
- Provides link-level resiliency
- ► Helps ensure high availability

15.4.1 vPC peer switch failure validation

This validation scenario describes a vPC peer switch failure by bringing down one of the Nexus 9372 PX switches. This scenario highlights the high availability and redundancy of Nexus switches in the VersStack environment.

Test procedure

Figure 15-23 shows the status of vPC configuration when both Nexus 9372 peer switches are up and running.

Figure 15-23 showing the Cisco Nexus vPC status.

N9K-A# sh vpc brief Legend: (*) - local vPC is down, forwarding	via vPC peer-link	N9K-E Leger		pc brief (*)		is down, forw	warding via vPC p	eer-link
<pre>vPC domain id : 101 Peer status : peer adjacency : yPC keep-alive status : peer is alive Configuration consistency status : success Per-vlan consistency reason : consistency Con</pre>	ok Not Performed	Peer vPC & Confi Per-v Type- vPC r Numbe Peer Dual- Grace	iguration -2 incom- cole er of v: Gateway -active eful Com-	ive stat on consi nsistenc nsistenc PCs conf Y exclude nsistenc	y status y reason igured d VLANs y Check	: peer is a s success : consister : secondary : 2 : Enabled : - : Enabled	ncy Check Not Per	
vPC Peer-link status	·			nk statu				
id Port Status Active vlans			Port		Active vlans			
1 Pol0 up 1,30,40,50,60					1,30,40,50,6			
vPC status		vPC s	status					
id Port Status Consistency Reason	Active vlans		Port		Consistency			ive vlans
13 Pol3 up success success	1,30,40,50, 60	13	Po13	up	success	success	1,3 60	0,40,50,
14 Pol4 up success success N9K-A#	1,30,40,50, 60	14 × N9K-E	_	up	success	success	1,3 60	0,40,50,

Figure 15-23 Cisco Nexus vPC Status

Complete the following steps:

 Before reloading the Nexus switch with the primary role, initiate an OLTP workload on the SQL clustered instance from outside the VersaStack environment. The tool that is used in this example for generating a workload is HammerDB.

Figure 15-24 shows the HammerDB OLTP workload running on SQL Server FCI.

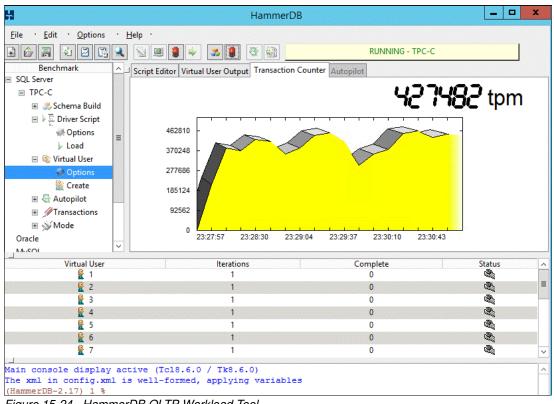


Figure 15-24 HammerDB OLTP Workload Tool

2. Connect to the Nexus 9372 switch with the vPC role as the primary through Secure Shell and run reload.

Figure 15-25 shows the **reload** command that is run on the primary switch.

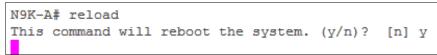


Figure 15-25 Cisco Nexus Command Prompt

Test observation

When the primary Nexus peer switch was reloading, the secondary peer switch that is up and running assumes the vPC role of operational primary.

The peer status and vPC keep-alive status are seen as Down and in a suspended state, as shown in Figure 15-26 on page 459.

During the reload of the primary switch, half of the network bandwidth is lost and the remaining vPC switch maintains the network connectivity. There is no impact to the vPC operation or data forwarding.

Figure 15-26 shows the vPC peer status as Down, but the data and control planes are still operational with the OLTP workload also running in the background.

H		HammerDB		_ 🗆 🗙
<u>F</u> ile <u>Edit</u> <u>Options</u> <u>H</u> e	elp ·			
	🛐 🔳 🗿 🌳 🗾 🗿	8	RUNNING - TPC-C	
Benchmark	Script Editor Virtual User Out	put Transaction C	ounter Autopilot	
SQL Server			and a second	
E TPC-C				255 tpm
🗉 🚚 Schema Build				
🖃 🕨 🗒 Driver Script				
🕷 Options 📃	489114		\sim	> -
} Load	391291			
🖃 🍋 Virtual User				
🍪 Options	293468 -			
Create	P	1	92.168.10.32 - PuTTY	_ _ ×
🗉 🎡 Autopilot				60
	14 Po14 up	success	success	1,30,40,50,
🗉 🐝 Mode		-		60
Oracle	N9K-B# sh vpc brie Legend:	Í		
) - local vP	C is down, forwarding via v	PC peer-link
Virtual User	200 E			
📱 1	vPC domain id		: 101	
2	Peer status vPC keep-alive sta		: peer link is down : Suspended (Destination	. TD not worshable
8 3)	LUS	: Suspended (Destination	n if not reachable
4	Configuration cons	istency statu	18 : SUCCESS	
5	Per-vlan consisten		: success	
6	Type-2 inconsisten	cy reason	: Consistency Check Not	
7	vPC role Number of vPCs con	figured	: secondary, operational : 2	I primary
Main console display act:			: Enabled	
The xml in config.xml is			: -	
(HammerDB-2.17) 1 %	Graceful Consisten		: Enabled	
	Auto-recovery stat	us	: Enabled (timeout = 24	0 seconds)
	vPC Peer-link stat	us		
	id Port Status	Active vlan	3	
	1 Po10 down	_		
	vPC status			
		Consistency		Active vlans
	13 Po13 up	success	success	1,30,40,50, 60
	14 Po14 up	success	success	1,30,40,50,
				60

Figure 15-26 Cisco Nexus vPC Peer Status down

After the reloaded switch comes back up, the vPC status is back to normal, as shown in Figure 15-27. Network bandwidth is restored to full capacity.

Figure 15-27 shows the Cisco Nexus vPC status restored to normal state after the failed switch successfully came back up.

\$	19	2.168.10.31 - PuTTY		x 🛃				192.168.10.32 - PuTTY	
19K-A# sh vpc brief				^					
egend:				13	Po13	up	success	success	1,30,40,50,
(*)	- local vPC	is down, forwarding via	vPC peer-link						60
				14	Po14	up	success	success	1,30,40,50,
vPC domain id		: 101							60
Peer status		: peer adjacency form	ed ok	N9K	-B# sh	vpc brie	f		
vPC keep-alive stat	us	: peer is alive		Leg	end:	-			
Configuration consi	stency statu	is : success				(*) - local vE	C is down, forward:	ing via vPC peer-link
Per-vlan consistenc	y status	: success							
Type-2 inconsistenc	y reason	: Consistency Check N	ot Performed	VPC	domain	id		: 101	
vPC role		: primary, operationa	1 secondary	Pee	r statu	3		: peer adjacend	cy formed ok
Number of vPCs conf	igured	: 2		VPC	keep-a	live sta	tus	: peer is alive	
Peer Gateway		: Enabled		Con	figurat	ion cons	istency stat	us : success	
Dual-active exclude	d VLANs	: -		Per	-vlan c	onsisten	cy status	: success	
Graceful Consistenc	y Check	: Enabled		Typ	e-2 inc	onsisten	cy reason	: Consistency (Check Not Performed
Auto-recovery statu	3	: Enabled (timeout =	240 seconds)	VPC	role			: secondary, op	perational primary
				Num	ber of	vPCs con	figured	: 2	
vPC Peer-link statu	3			Pee	r Gatew	ay		: Enabled	
				Dua	1-activ	e exclud	led VLANs	: -	
id Port Status .	Active vlans			Gra	ceful C	onsisten	cy Check	: Enabled	
				Aut	o-recov	ery stat	us	: Enabled (time	eout = 240 seconds)
l Pol0 up	1,30,40,50,6	0							
				VPC	Peer-1	ink stat	us		
vPC status				id	Port	Status	Active vlar	13	
id Port Status	Consistency	Reason	Active vlans	1	Po10	up	1,30,40,50,	60	
13 Po13 down* :	Not	Consistency Check Not		VPC	status				
	Applicable	Performed		- id	Port	Status	Consistency	Reason	Active vlans
14 Po14 down*	Not	Consistency Check Not	-	_ 13	Po13	up	success	success	1,30,40,50,
				=					60
	Applicable	Performed		14	Po14	up	success	success	1,30,40,50,
									60
V9K-A#				VNOR	-B#				

Figure 15-27 Cisco Nexus Switch vPC Status as Normal

15.5 Cisco UCS service profile

Conceptually, a *service profile* is an extension of the VM abstraction that is applied to physical servers. The definition is expanded to include elements of the environment that span the entire data center, encapsulating the server identity (LAN and SAN addressing, I/O configurations, firmware versions, boot order, network VLAN, physical port, and quality of service (QoS) policies) in logical "service profiles" that can be dynamically created and associated with any physical server in the system within minutes rather than hours or days. The association of service profiles with physical servers is performed as a simple, single operation. It enables migration of identities between servers in the environment without requiring any physical configuration changes, and facilitates rapid bare-metal provisioning of replacements for failed servers.

Service profiles also include operational policy information, such as information about firmware versions.

This highly dynamic environment can be adapted to meet rapidly changing needs in today's data centers with just-in-time deployment of new computing resources and reliable movement of traditional and virtual workloads. Data center administrators can now focus on addressing business policies and data access on the basis of application and service requirements, rather than physical server connectivity and configurations.

Service profiles can be abstracted from the specifics of a given server to create a service profile template, which defines policies that can be applied any number of times to provision any number of servers. Service profile templates help enable large-scale operations in which many servers are provisioned as easily as a single server.

In addition, by using service profiles, Cisco UCS Manager provides logical grouping capabilities for both physical servers and service profiles and their associated templates. This pooling or grouping, combined with fine-grained role-based access, allows businesses to treat a farm of compute blades as a flexible resource pool that can be reallocated in real time to meet their changing needs, while maintaining any organizational overlay on the environment that they want.

Figure 15-28 shows the Cisco UCS service profile incorporating a complete metadata description of the information that is required to provision a server in a data center, including storage, network, and operational policies.

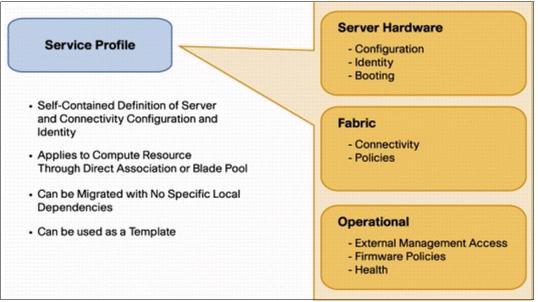


Figure 15-28 Cisco UCS service profile

15.5.1 Service profile migration validation

This validation scenario describes a use case of a Cisco UCS service profile migration in case there is an unplanned Cisco UCS B200 M4 hardware failure. This scenario is tested on a server that boots from SAN and needs spare hardware to replace the failed one.

Test procedure

Complete the following steps:

1. Power off the Cisco UCS B200 M4 server in slot 1 to simulate the hardware failure scenario.

Figure 15-29 shows a decommissioned server in Cisco UCS Manager.

Δ	Cisco Unified Computing S	ystem Manager - Versastack-Fl
Fault Summary	3 🏐 🕒 New 🚽 🛃 Options 🛛 🕢 🚺 📥 Pending Activities	O Exit
1 4 1	>> 🛱 Equipment + 🥡 Chassis + 🗊 Chassis 1 + 🥪 Servers	> ⇔ Server 1
Equipment Servers LAN SAN VM Admin	General Faults Events FSM	
Filter: All	Fault Summary	Physical Display
		Hends Resulting
Equipment	Status	
E B B Fans	Current Task: identifying a server in 1/1 via	
IO Modules PSUs	CIMC(FSM-STAGE:sam:dme:Fabric ComputeSlotEpIdentify:ExecuteLo	
Servers	cal)	
🗄 🥁 Server 2	Actions	
in	Re-acknowledge Slot	
Rack-Mounts	Remove Server	
Servers	Decommission Server	Properties
For Eabric Interconnect A (subordinate		Slot ID: 1 Chassis ID: 1
		Product Name: PID:
		Part Details 😵
		Connection Details 😵
		Boot Order Details 😵
		boot order Details

Figure 15-29 Cisco UCS Manager showing a decommissioned blade

- 2. Disassociated the service profile from the failed blade server.
- 3. Decommission the blade and swap it with a new blade with an equal configuration.
- 4. Reacknowledge the slot. The new blade is discovered by the UCSM.

Figure 15-30 on page 463 shows a new blade being discovered in Cisco UCS Manager.

🗄 Equipment + 🥡 Chassis + 📦 Chassis 1 + 🥪 Servers + 🥪	Server 1
	ions SEL Logs VIF Paths Faults Events FSM Statistics Temperatures Power
Fault Summary	Physical Display
Status	
Overall Status: 🔀 Discovery	Constant
Status Details 🔗	
Current Task: getting inventory of server 1/1 via	
CIMC(FSM-STAGE:sam:dme:Compu	
teBladeDiscover:BmcInventory)	
teBladeDiscover:BmcInventory) Admin State: 1 In Service	
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: C In Progress	
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: 1 In Progress Avail State: 1 Unavailable	
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: 1 In Progress Avail State: 1 Unavailable Assoc State: 1 None	
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: In Progress Avail State: Unavailable Assoc State: None Power State: N/A	
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: I In Progress Avail State: I Unavailable Assoc State: I None Power State: N/A Slot Status: 1 Equipped	Properties
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: In Progress Avail State: Unavailable Assoc State: None Power State: N/A	Properties Slot ID: 1 Chassis ID: 1
teBladeDiscover:BmcInventory) Admin State: In Service Discovery State: In Progress Avail In Progress	Properties Slot ID: 1 Chassis ID: 1 Product Name: Cisco UCS B200 M4
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: In Progress Avail State: Unavailable Assoc State: None Power State: N/A Slot Status: 1 Equipped Check Point: Deep Checkpoint	Properties Slot ID: 1 Chassis ID: 1 Product Name: Cisco UCS B200 M4 Vendor: Cisco Systems Inc PID: UCSB-B200-M4
teBladeDiscover:BmcInventory) Admin State: 1 In Service Discovery State: In Progress Avail State: Unavailable Assoc State: None Power State: N/A Slot Status: 1 Equipped Check Point: Deep Checkpoint	Properties Slot ID: 1 Chassis ID: 1 Product Name: Cisco UCS B200 M4 Vendor: Cisco Systems Inc Revision: 0 FID: UCSB-B200-M4 Serial: FLM191159JP
teBladeDiscover:BmcInventory) Admin State: In Service Discovery State: In Progress Avail In Progress	Properties Slot ID: 1 Chassis ID: 1 Product Name: Cisco UCS B200 M4 Vendor: Cisco Systems Inc Revision: 0 Erial: FLM191159JP Name:

Figure 15-30 Cisco UCS Manager new blade discovery

5. Power off the B200 M4 server in slot 1 to simulate the hardware failure scenario.

6. Reassociate the service profile to the new hardware. Figure 15-31 shows the service profile association in Cisco UCS Manager.

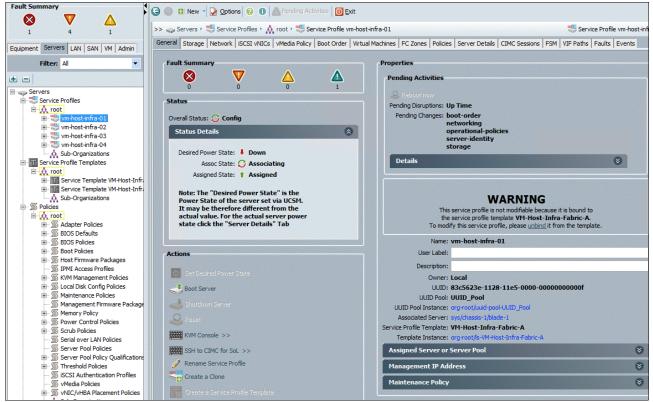


Figure 15-31 Service profile association in Cisco UCS Manager

Test observations

The service profile migration from the failed hardware to the new hardware was successful and the new server booted from SAN successfully.

Figure 15-32 on page 465 shows the vSphere ESXi booting after the successful migration of the Cisco UCS service profile.

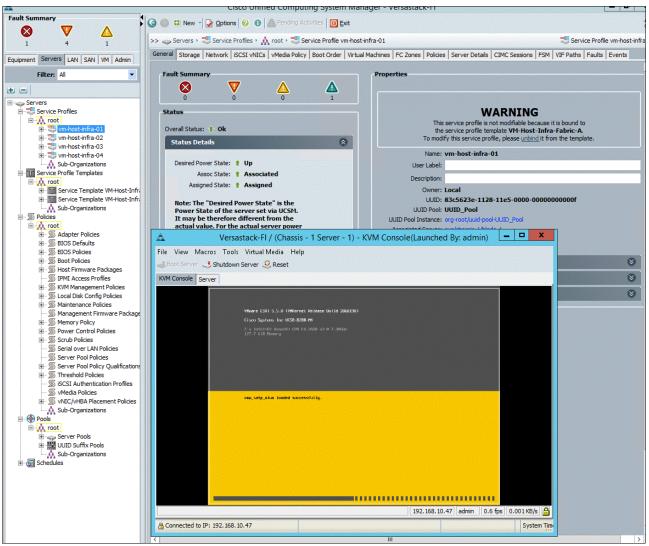


Figure 15-32 ESXi booting

The WSFC active node running on the failed ESXi host did not migrate to the second ESXi host because the vSphere HA/DRS anti-affinity rule is configured.

The WSFC and SQL Server FCI active node failed over successfully to the second virtual machine node running on the other ESXi host.

A couple of other VMs with a default vSphere HA/DRS configuration migrated and restarted on the second ESXi host successfully.

All the above outcomes were the expected behavior, and the services recovered quickly with a minimum of downtime.

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Α

Windows Active Directory and running configurations

This appendix shows how to build Windows Active Directory Server virtual machines (VMs), and the running configurations for the Nexus-A and Nexus-B switches.

Building Windows Active Directory Server virtual machines

To build an Active Directory Server virtual machine (VM) for the vm-host-infra-01 ESXi host, complete the following steps:

- 1. Log in to the host by using the VMware vSphere Client.
- 2. In the vSphere Client, select the host in the inventory pane.
- 3. Right-click the host and select New Virtual Machine.
- 4. Select Custom and click Next.
- 5. Enter a name for the VM. Click Next.
- 6. Select infra_datastore_1. Click Next.
- 7. Select Virtual Machine Version: 10. Click Next.
- Verify that the Windows option and the Microsoft Windows Server 2012 R2 (64-bit) version are selected. Click Next.
- 9. Select two virtual sockets and one core per virtual socket. Click Next.
- 10. Select 4 GB of memory. Click Next.
- 11.Select one network interface card (NIC).
- 12. For NIC 1, select the MGMT Network option and the VMXNET 3 adapter. Click Next.
- 13.Keep the LSI Logic SAS option for the SCSI controller selected. Click Next.
- 14. Keep the Create a New Virtual Disk option selected. Click Next.
- 15. Make the disk size at least 60 GB. Click Next.
- 16.Click Next.
- 17.Select the Edit the Virtual Machine Settings Before Completion check box. Click Continue.
- 18. Click the **Options** tab.
- 19. Select Boot Options.
- 20. Select the Force BIOS Setup check box.
- 21.Click Finish.
- 22. From the left pane, expand the host field by clicking the plus sign (+).
- 23. Right-click the newly created AD Server VM and click **Open Console**.
- 24. Click the third button (green right arrow) to power on the VM.
- 25.Click the ninth button (CD with a wrench) to map the Windows Server 2012 R2 ISO, and then select **Connect to ISO Image on Local Disk**.
- 26.Go to the Windows Server 2008 R2 SP1 ISO, select it, and click Open.
- 27. Click in the BIOS Setup Utility window and use the right arrow key to go to the Boot menu. Use the down arrow key to select CD-ROM Drive. Press the plus (+) key twice to move CD-ROM Drive to the top of the list. Press F10 and Enter to save the selection and exit the BIOS Setup Utility.
- 28. The Windows Installer boots. Select the appropriate language, time and currency format, and keyboard. Click **Next**.
- 29. Click Install now.
- Make sure that the Windows Server 2012 R2 Standard (Full Installation) option is selected. Click Next.

- 31.Read and accept the license terms and click Next.
- 32.Select Custom (Advanced). Make sure that Disk 0 Unallocated Space is selected. Click Next to allow the Windows installation to complete.
- 33.After the Windows installation is complete and the VM restarts, click OK to set the Administrator password.
- Enter and confirm the Administrator password and click the blue arrow to log in. Click OK to confirm the password change.
- 35. After logging in to the VM desktop, from the VM console window, select the VM menu. Under Guest, select Install/Upgrade VMware Tools. Click OK.
- 36. If prompted to eject the Windows installation media before running the setup for the VMware tools, click **OK**, then click **OK** again.
- 37. In the dialog box, select Run setup64.exe.
- 38. In the VMware Tools installer window, click Next.
- 39. Make sure that **Typical** is selected and click **Next**.
- 40.Click Install.
- 41.Click Finish.
- 42.Click Yes to restart the VM.
- 43. After the restart is complete, select the VM menu. Under Guest, select Send Ctrl+Alt+Del. Then, enter the password to log in to the VM.
- 44.Set the time zone for the VM, IP address, gateway, and host name.

Note: A restart is required.

- 45. If necessary, activate Windows.
- 46.Download and install all the required Windows updates.

Note: This process requires several restarts.

- 47.Open Server Manager.
- 48.On the left pane, click Roles, the select Add Roles on the right.
- 49.Click Next.
- 50. In the list, select the Active Directory Domain Services check box.
- 51. In the dialog box that opens, click Add Required Features to add .NET Framework 3.5.1.
- 52.Click Next.
- 53.Click Next.
- 54.Click Install.
- 55. In the middle of the window, click Close this wizard and launch the Active Directory Domain Services Installation Wizard (dcpromo.exe).
- 56. In the Active Directory Domain Services Installation wizard, click Next.
- 57.Click Next.
- 58. Select Create a new domain in a new forest and click Next.
- 59. Type the FQDN of the Windows domain for this VersaStack environment and click Next.

- 60. Select the appropriate forest functional level and click Next
- 61.Keep DNS server selected and click Next.
- 62. If one or more DNS servers exist that this domain can resolve from, select **Yes** to create a DNS delegation. If this AD server is being created on an isolated network, select **No** to not create a DNS delegation. The remaining steps in this procedure assume that a DNS delegation is not created. Click **Next**.
- 63. Click **Next** to accept the default locations for database and log files.
- 64.Enter and confirm <<*var_password>>* for the Directory Services Restore Mode Administrator Password. Click **Next**.
- 65. Review the Summary information and click **Next**. Active Directory Domain Services installs.
- 66.Click Finish.
- 67. Click Restart Now to restart the AD Server.
- 68. After the machine restarts, log in as the domain administrator.
- 69. Open the DNS Manager by clicking Start \rightarrow Administrative Tools \rightarrow DNS.
- 70. Optional: Add Reverse Lookup Zones for your IP address ranges.
- 71.Expand the Server and Forward Lookup Zones. Select the zone for the domain. Right-click and select New Host (A or AAAA). Populate the DNS Server with Host Records for all components in the VersaStack environment.
- 72. Optional: Build a second AD server VM. Add this server to the newly created Windows Domain and activate Windows. Install Active Directory Domain Services on this machine. Start dcpromo.exe at the end of this installation. Choose to add a domain controller to a domain in an existing forest. Add this domain controller to the domain created earlier. Complete the installation of this second domain controller. After vCenter Server is installed, affinity rules can be created to keep the two AD servers running on different hosts.

Nexus 9000 running configuration

This section shows the running config information for Nexus-A and Nexus-B.

These configurations are generated by running running-config, as shown in Example A-1.

Example A-1 The running-config command

N9K-A# sh running-config

Nexus 9000 A running configuration

Here is the content of the Nexus 9000 A running configuration:

```
!version 6.1(2)I3(3a)
switchname N9K-A
vdc N9K-A id 1
  allocate interface Ethernet1/1-54
  limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 512
  limit-resource u4route-mem minimum 248 maximum 248
```

```
limit-resource u6route-mem minimum 96 maximum 96
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8
cfs eth distribute
feature udld
feature lacp
feature vpc
username admin password 5 $1$vFdUE8vJ$CDbxkfFaGGQjCaxM6JKsz. role network-admin
ip domain-lookup
copp profile strict
snmp-server user admin network-admin auth md5 0x546a7b8b3b91374ff18cdc3997e0d17
2 priv 0x546a7b8b3b91374ff18cdc3997e0d172 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING
rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
vlan 1,30,40,50,60
vlan 30
  name vMotion
vlan 40
  name WinClus
vlan 50
  name WinCSV
vlan 60
  name Backup
spanning-tree port type edge bpduguard default
spanning-tree port type edge bpdufilter default
spanning-tree port type network default
vrf context management
  ip route 0.0.0.0/0 192.168.10.1
vpc domain 101
  peer-switch
  role priority 10
  peer-keepalive destination 192.168.10.32 source 192.168.10.31
  delay restore 150
  peer-gateway
  auto-recovery
  ip arp synchronize
interface port-channel10
  description vPC peer-link
  switchport mode trunk
  spanning-tree port type network
  vpc peer-link
interface port-channel13
  description to FI-A
  switchport mode trunk
  spanning-tree port type edge trunk
 mtu 9216
  vpc 13
interface port-channel14
  description to FI-B
  switchport mode trunk
  spanning-tree port type edge trunk
  mtu 9216
```

vpc 14 interface Ethernet1/1 interface Ethernet1/2 interface Ethernet1/3 interface Ethernet1/4 interface Ethernet1/5 interface Ethernet1/6 interface Ethernet1/7 interface Ethernet1/8 interface Ethernet1/9 interface Ethernet1/10 interface Ethernet1/11 interface Ethernet1/12 interface Ethernet1/13 interface Ethernet1/14 interface Ethernet1/15 interface Ethernet1/16 interface Ethernet1/17 interface Ethernet1/18 interface Ethernet1/19 interface Ethernet1/20 interface Ethernet1/21 interface Ethernet1/22 interface Ethernet1/23 interface Ethernet1/24 interface Ethernet1/25 description FI-A:1/25 switchport mode trunk mtu 9216 channel-group 13 mode active interface Ethernet1/26 description FI-B:1/26 switchport mode trunk mtu 9216 channel-group 14 mode active interface Ethernet1/27 interface Ethernet1/28 interface Ethernet1/29 interface Ethernet1/30 interface Ethernet1/31 interface Ethernet1/32 interface Ethernet1/33 interface Ethernet1/34 interface Ethernet1/35 interface Ethernet1/36 interface Ethernet1/37 interface Ethernet1/38 interface Ethernet1/39 interface Ethernet1/40 interface Ethernet1/41 interface Ethernet1/42 interface Ethernet1/43 interface Ethernet1/44 interface Ethernet1/45 interface Ethernet1/46

```
interface Ethernet1/47
  description vPC Peer N9K-B:1/47
  switchport mode trunk
  channel-group 10 mode active
interface Ethernet1/48
  description vPC Peer N9K-B:1/48
  switchport mode trunk
  channel-group 10 mode active
interface Ethernet1/49
interface Ethernet1/50
interface Ethernet1/51
interface Ethernet1/52
interface Ethernet1/53
interface Ethernet1/54
interface mgmt0
 vrf member management
  ip address 192.168.10.31/24
line console
line vty
boot nxos bootflash:/n9000-dk9.6.1.2.I3.3a.bin
N9K-A#
```

Nexus 9000 B running configuration

Here is the content of the Nexus 9000 B running configuration:

```
version 7.0(3)I1(1a)
switchname N9K-B
vdc N9K-B id 1
 limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 511
  limit-resource u4route-mem minimum 248 maximum 248
  limit-resource u6route-mem minimum 96 maximum 96
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8
cfs eth distribute
feature udld
feature lacp
feature vpc
username admin password 5 $1$h0zBLP15$ZFoDle1seUIJ3gX6ugx54. role network-admin
ip domain-lookup
copp profile strict
snmp-server user admin network-admin auth md5 0x672fc1ebf92b0e84c5443ce2f1c34b69
priv
0x672fc1ebf92b0e84c5443ce2f1c34b69 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING
rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
vlan 1,30,40,50,60
vlan 30
 name vMotion
vlan 40
```

```
name WinClus
vlan 50
  name WinCSV
vlan 60
  name Backup
spanning-tree port type edge bpduguard default
spanning-tree port type edge bpdufilter default
spanning-tree port type network default
vrf context management
  ip route 0.0.0.0/0 192.168.10.1
vpc domain 101
  peer-switch
  role priority 20
  peer-keepalive destination 192.168.10.31 source 192.168.10.32
  delay restore 150
  peer-gateway
  auto-recovery
  ip arp synchronize
interface port-channel10
  description vPC peer-link
  switchport mode trunk
  spanning-tree port type network
  vpc peer-link
interface port-channel13
  description FI-A
  switchport mode trunk
  spanning-tree port type edge trunk
  mtu 9216
  vpc 13
interface port-channel14
  description to FI-B
  switchport mode trunk
  spanning-tree port type edge trunk
  mtu 9216
  vpc 14
interface Ethernet1/1
interface Ethernet1/2
interface Ethernet1/3
interface Ethernet1/4
interface Ethernet1/5
interface Ethernet1/6
interface Ethernet1/7
interface Ethernet1/8
interface Ethernet1/9
interface Ethernet1/10
interface Ethernet1/11
interface Ethernet1/12
interface Ethernet1/13
interface Ethernet1/14
interface Ethernet1/15
interface Ethernet1/16
interface Ethernet1/17
interface Ethernet1/18
interface Ethernet1/19
interface Ethernet1/20
```

```
interface Ethernet1/21
interface Ethernet1/22
interface Ethernet1/23
interface Ethernet1/24
interface Ethernet1/25
  description FI-B:1/25
  switchport mode trunk
  mtu 9216
  channel-group 14 mode active
interface Ethernet1/26
  description FI-A:1/26
  switchport mode trunk
  mtu 9216
  channel-group 13 mode active
interface Ethernet1/27
interface Ethernet1/28
interface Ethernet1/29
interface Ethernet1/30
interface Ethernet1/31
interface Ethernet1/32
interface Ethernet1/33
interface Ethernet1/34
interface Ethernet1/35
interface Ethernet1/36
interface Ethernet1/37
interface Ethernet1/38
interface Ethernet1/39
interface Ethernet1/40
interface Ethernet1/41
interface Ethernet1/42
interface Ethernet1/43
interface Ethernet1/44
interface Ethernet1/45
interface Ethernet1/46
interface Ethernet1/47
  description vPC Peer N9K-A:1/47
  switchport mode trunk
  channel-group 10 mode active
interface Ethernet1/48
  description vPC Peer N9K-A:1/48
  switchport mode trunk
  channel-group 10 mode active
interface Ethernet1/49
interface Ethernet1/50
interface Ethernet1/51
interface Ethernet1/52
interface Ethernet1/53
interface Ethernet1/54
interface mgmt0
  vrf member management
  ip address 192.168.10.32/24
line console
line vty
boot nxos bootflash:/n9000-dk9.7.0.3.I1.1a.bin
```

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Related publications

The publications that are listed in this section are considered suitable for a more detailed description of the topics that are covered in this book.

IBM Redbooks

The following IBM Redbooks publications provide additional information about the topic in this document. Some publications that are referenced in this list might be available in softcopy only.

- Implementing the IBM System Storage SAN Volume Controller V7.4, SG24-7933
- ► Implementing the IBM Storwize V7000 V7.4, SG24-7938
- Introducing and Implementing IBM FlashSystem V9000, SG24-8273
- IBM Real-time Compression in IBM SAN Volume Controller and IBM Storwize V7000, REDP-4859

You can search for, view, download, or order these documents and other Redbooks, Redpapers, Web Docs, draft and additional materials, at the following website:

ibm.com/redbooks

Other resources

These publications are also relevant as further information sources:

- IBM System Storage Open Software Family SAN Volume Controller: CIM Agent Developers Reference, SC26-7545
- IBM System Storage Open Software Family SAN Volume Controller: Command-Line Interface User's Guide, SC26-7544
- IBM System Storage Open Software Family SAN Volume Controller: Configuration Guide, SC26-7543
- IBM System Storage Open Software Family SAN Volume Controller: Host Attachment Guide, SC26-7563
- IBM System Storage Open Software Family SAN Volume Controller: Installation Guide, SC26-7541
- IBM System Storage Open Software Family SAN Volume Controller: Planning Guide, GA22-1052
- IBM System Storage Open Software Family SAN Volume Controller: Service Guide, SC26-7542
- IBM System Storage SAN Volume Controller Software Installation and Configuration Guide, SC23-6628
- IBM System Storage SAN Volume Controller V6.2.0 Software Installation and Configuration Guide, GC27-2286

Online resources

These websites are also relevant as further information sources:

VersaStack Designs (links to PDF download page)

http://www.cisco.com/c/en/us/solutions/enterprise/data-center-designs-cloud-com
puting/versastack-designs.html

VersaStack Solution - Cisco

http://www.cisco.com/c/en/us/solutions/data-center-virtualization/versastack-so lution-cisco-ibm/index.html

VersaStack Solution by Cisco and IBM

http://www.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=SP&htmlfid=T SS03159USEN&appname=TAB_2_1_Appname

- Video: Client value of VersaStack https://www.youtube.com/watch?v=dvDG6UHMEuQ
- Video: Growth Opportunities with VersaStack Solution

https://www.youtube.com/watch?v=h32TsA2smLk

- Video: High-Level Business Value of VersaStack from IBM and CISCO https://www.youtube.com/watch?v=E0W4ggyN99o
- Video: IBM and Cisco VersaStack Compression https://www.youtube.com/watch?v=xDbk4ddXzL0
- Video: IBM and Cisco VersaStack Data Virtualization https://www.youtube.com/watch?v=N-rNcokXzf0
- Video: IBM and Cisco VersaStack Flash Optimization and IBM Easy Tier https://www.youtube.com/watch?v=J7Rr13fEv0U
- Video: IBM and Cisco VersaStack Introduction https://www.youtube.com/watch?v=mkg1fkpAKII
- Video: IBM and Cisco VersaStack Turbo Compression https://www.youtube.com/watch?v=PR_Uir1mxXE
- Video: New VersaStack Solution by Cisco and IBM https://www.youtube.com/watch?v=HHtgEABDYts
- Video: Take 5 VersaStack by Cisco and IBM https://www.youtube.com/watch?v=18mKR0sKQ30
- Video: Talking VersaStack with Your Customers https://www.youtube.com/watch?v=UHANwo51ie0

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Spectrum Control, and Spectrum Protect VersaStack Solution by Cisco and IBM with SQL, ISBN 0738441074 SG24-8301-00

(1.0" spine) 0.875"<->1.498" 460 <-> 788 pages



SG24-8301-00

ISBN 0738441074

Printed in U.S.A.



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