THE LENOVO THINKSERVER – EMC VSPEX PRIVATE CLOUD VALIDATED REFERENCE ARCHITECTURE DEPLOYMENT GUIDE

Scalable VMware® vSphere™ 5.1 for Up To 100 Virtual Machines

EMC VSPEX powered by Lenovo ThinkServer

Abstract

The Lenovo ThinkServer - EMC VSPEX Private Cloud solution for VMware vSphere 5.1 supports up to 100 virtual machines with redundant server/network topology and highly available storage. This validated and modular reference architecture built with proven best-of-breed technologies is a complete virtualization solution for Private Cloud deployments.

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Chapter 1 Introduction

This chapter presents the following topics:

Purpose of this guide

The Lenovo ThinkServer - EMC VSPEX Private Cloud solution for VMware vSphere 5.1 provides a system architecture capable of supporting up to 100 virtual machines with a redundant server/network topology and highly available storage. This validated and modular reference architecture built with proven best-of-breed technologies is a complete virtualization solution enabling informed hypervisor, compute, and networking layer decisions for Private Cloud deployments. When embarking on server virtualization, the Lenovo ThinkServer - EMC VSPEX Private Cloud Solution accelerates your IT transformation by enabling faster deployments, greater efficiency, and lower risk.

This document describes the key components, logical design and deployment instructions for this highly available virtualized converged solution for business applications.

Business value

Business applications are moving into virtualized and consolidated compute, network, and storage environments. The choices available to build such an environment are vast and often lacking proven guidelines at every stage of the design:

- Vendor and component selection
- Component interoperability
- Solution Scalability
- Solution Performance
- Solution Robustness and Availability
- Physical and Logical System Design and Configuration

The Lenovo ThinkServer - EMC VSPEX Private Cloud solution using VMware eliminates the complexity of designing and building virtualized converged infrastructure solutions by providing a proven and documented reference architecture:

- Trusted component vendors
- Interoperability testing already done
- Assured performance and high availability
- Reliable, flexible, and scalable reference design
- Virtualization planning and configuration burdens reduced
- Physical cable connectivity guidelines

Scope

This document contains the key design principles and deployment instructions required to build a highly available virtualized converged Lenovo ThinkServer - EMC VSPEX solution for business applications. The document provides:

- a base understanding of the design principles applied to the Lenovo ThinkServer - EMC VSPEX solution
- deployment instructions to build the Lenovo ThinkServer – EMC VSPEX solution

This document does not provide the guiding principles to size and match an internal or external customer's business need to a Lenovo ThinkServer - EMC VSPEX platform. It assumes that this has been completed prior to deployment as per the Lenovo ThinkServer – EMC VSPEX Solution Architecture Guide.

Audience

This document is intended for channel partner professional services teams who will be deploying the Lenovo ThinkServer – EMC VSPEX platform.

Expected Level of Technical Knowledge: High for devices and technologies described in this document.

Terminology

The abbreviations used in this document are summarized in the table below.

Table 1. Abbreviations

Abbreviation	Description
ACL	Access Control List
CNA	Converged Network Adapter
DRS	Distributed Resource Scheduling within VMware
HA	High Availability
iBMC	Integrated Baseboard Management Controller
iKVM	Integrated Keyboard, Video and Mouse Remote Control
IOPs	Performance metric for number of inputs or outputs per second
iSCSI	Internet Small Computer Systems Interface
LACP	Link Aggregation Control Protocol

Abbreviation	Description
LUN	Logical Unit Number
PCIe	Peripheral Component Interconnect Express
PDU	Power Distribution Unit
QoS	Quality of Service
SAN	Storage Area Network
SAS	Serial Attached SCSI
SP	Service Processor
vCPU	Virtual CPU
VLAN	Virtual LAN
VM	Virtual Machine

Solution Tested

The Lenovo ThinkServer - EMC VSPEX Private Cloud solution core elements organized by virtualization, compute, networking and storage layers are:

Virtualization

- VMware vSphere 5.1 ESXi Hypervisor and
- VMware vCenter Server
- VMware vSphere High Availability

Compute

- Lenovo ThinkServer RD630
- Lenovo ThinkServer RD330 (Management)
- QLogic 8300 Series Converged Network Adapters

Networking

- Extreme Networks Summit Series x670 with ExtremeXOS TM

Storage

- EMC VNXe Series Storage

The table below provides a summary of the hardware and its configuration.

Table 2. Hardware Summary

Hardware	Configuration	Notes
Compute: Lenovo ThinkServer	3 ThinkServer RD630 CPU: 2 x socket 8 cores each One vCPU per virtual machine Four vCPUs per physical core Memory: 2 GB RAM per virtual machine 256 GB RAM across all servers 2GB Ram reservation per vSphere host Network: Two QLogic 8362 CNA	Configured as a single vSphere cluster
Network infrastructure: Extreme Summit Series	2 Extreme Summit x670 48-port Four 10GbE ports used per vSphere Server Four 10Gbe ports used for VNXe	Redundant LAN configuration
Storage: VNXe Series	VNXe 3300 Chassis 3U Two storage processors (active/active) Five 12 Slot 3.5" 2U Disk-Array Enclosures Eighty-Five (total) 300GB 15KRPM 3.5" SAS Drives	iSCSI Storage
Management Platform: Lenovo ThinkServer	ThinkServer RD330 CPU: 2 x socket > 4 cores each Two vCPU per virtual machine Memory: 64 GB RAM 8GB Ram reservation per vSphere host Network: Motherboard GbE interface	Configured as a single ESX host to run the following Infrastructure VM's Vcenter, SQL server, Active Directory, Lenovo Management software
Virtualization Vmware	• VMware vSphere 5.1 ESXi Hypervisor and • VMware vCenter Server • VMware vSphere High Availability	VMware vSphere 5 Enterprise recommended

The guiding principles for the solution design are:

- Function

  General purpose business applications that run in a virtual environment.

- Usability

  Simplified debug, maintenance, upgrade and monitoring with pre-determined network, storage and compute configurations, all validated and documented with procedures.

- Performance

  Targets a general-purpose workload of up to 100 virtual machines with a typical workload. Example workloads would be medium-to-light database, web application or mail server processing.

- Resilience / Reliability

  This design is intended to provide N+1 redundancy throughout the system to recover from typical single points of failure at each layer of the system. Compute, network and storage all provide fail over and fail back of services without impacting business applications.

- Ease of Deployment

  Channel partners trained on the platform can deploy a system ready for business application service enablement in days versus weeks or months for a similar solutions that are not pre-engineered

- Scalability

  Designed from the ground up to enable pay as you grow scaling. Compute and storage layers have assigned ratios that allow customers to incrementally grow each tier to match new business demands. For example, a pre-engineered server to disk ratio is designed into the architecture.

- Manageability / Maintainability

  The best practices to configure each component in the system are documented to maximize the value of the tools used to manage a converged Infrastructure platform. Some examples are: BIOS settings, MTU size, onboard IPMI capabilities, power consumption and rack design.

- Economic and technical constraints, and tradeoffs

  N+1 design requires powered and connected compute, storage and network infrastructure to be lightly loaded during normal business production hours. This architecture includes an optional server to enable high availability at the compute layer, so if a server fails, the system has enough resources to maintain business operations. The

design is an active/passive design aimed at availability and reduced complexity.

Chapter 2 Solution Architecture

This chapter presents the following topics:

Architecture Overview

The Lenovo ThinkServer – EMC VSPEX Validated Private Cloud Solution offers a scalable solution for up to 100 VMware based virtual machines with full hardware and software redundancy.

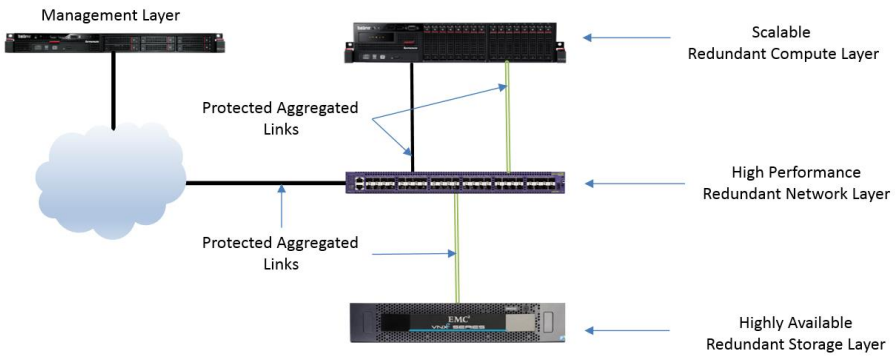


Figure 1. Solution Architecture Logical View

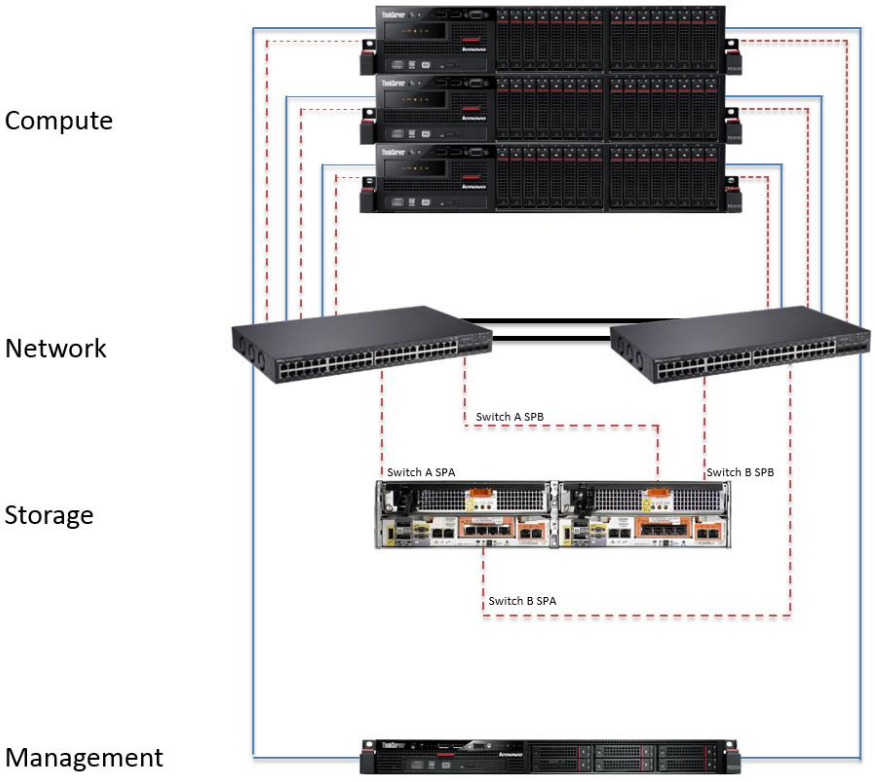


Figure 2. Solution Architecture Physical View

The solution architecture was designed and tested based on the goals below to enable a robust compute platform for typical business applications without sacrificing performance or availability:

- Matched Compute Cores and Memory to disk spindles for typical business work loads
- Converged network adaptors equipped with hardware offload for storage processing, allowing more CPU cycles for business applications
- Simple HA design (Active/Passive) N+1
- Simple growth rules to increase capacity
- In band VMware ESX management path over redundant interfaces; other components are managed out of band (network, storage, compute hardware)
- Reduced cabling requirements
- Converged layer 2 Ethernet fabric all storage, network and high availability traffic.

Both of the storage and network communications fabrics have at least two physical ten-gigabit Ethernet paths with one active and one passive path. Network traffic is segregated on these physical links into at least five virtual LANs (VLANs):

- Compute

  iSCSI and TCP processing off loaded to QLogic 8300 Converged Network Adapters with hardware ASIC's to reduce CPU utilization and maximize compute layer CPU for business applications

- Management

  Management path QOS to ensure reachability of all devices under all network conditions.

- Storage

  Dedicated high bandwidth/low latency physical links exclusively for Ethernet based iSCSI storage traffic. Storage network traffic is designed to provide access to storage at less than 3ms latency.

- vMotion

  High-bandwidth links for migrating and live migrating virtual machines from one physical server to another

- User Access

  Bandwidth dedicated to application communication networks for user to machine and machine to machine designated traffics. Many User Access VLANs are typically provisioned.

- Fault Tolerance

  Low latency/low bandwidth/high quality network utilized for hypervisor to hypervisor health checks and resource scheduling. This is used with the optional VMware Fault Tolerance host to host replication of storage and state to a 2nd physical host.

Quality of Service (QoS) is applied to each shared VLAN to predictably manage the behavior of these networks and to ensure shared links prioritize application and storage traffic as needed.

With this VMware based solution, common infrastructure components are virtualized and hosted on a separate dedicated management server: VMware vSphere management server, Microsoft Windows 2012 Active Directory, DHCP server, DNS server and Microsoft Windows SQL Server 2008R2 Standard.

Lenovo RD630 enterprise class servers are deployed in an N+1 configuration to provide full failover capabilities for all hosted virtual application servers. A minimum of one physical core is allocated for every four virtual CPUs (vCPU), with one vCPU to each virtualized application server. This gives a final ratio of no more than four virtualized application servers for each physical CPU core. At least two gigabytes of Physical RAM is reserved for each virtual application.

Overall the solution is designed to be resilient to multiple simultaneous failures at the network, computing, storage and power layer.

Best practices are documented throughout this document. However, advanced design elements are highlighted but not described in detail, as the goal for the solution is reduced complexity for install, support and management of the system.

Logical Design View

Once a system is physically connected, it is often difficult to predict how or where data will go without a logical component layer view to highlight the relevant design elements. The Lenovo ThinkServer – EMC VSPEX Validated Private Cloud Solution is designed to use an active/passive failure plane to simplify the configuration, debugging, deployment and dependencies.

This logical view of the design is an important tool to simplify solution debugging and for reliably predicting impacts of typical maintenance activities. For example, the effect of rebooting an Ethernet switch must be understood in advance to avoid any disruption to business applications that are running in a live environment. The logical view for Customer access, Management access, Storage access and Cluster/HA design are provided below for reference.

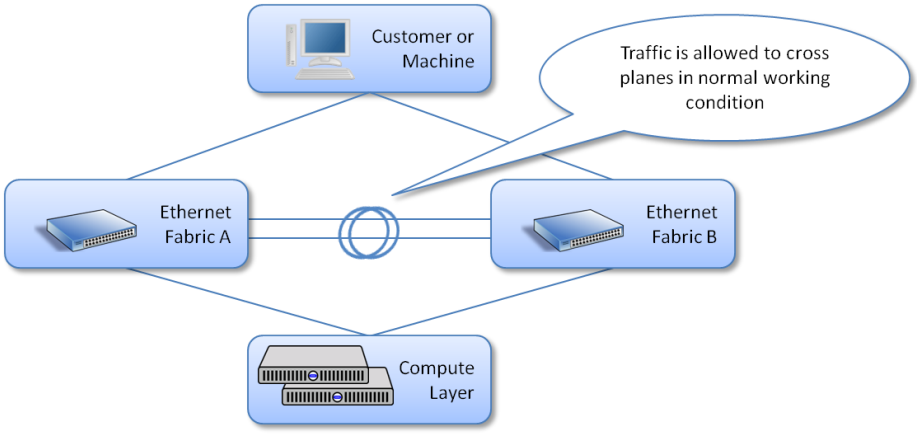


Figure 3. Customer Logical View

Customer Basic Design:

- Active Path and Passive Path

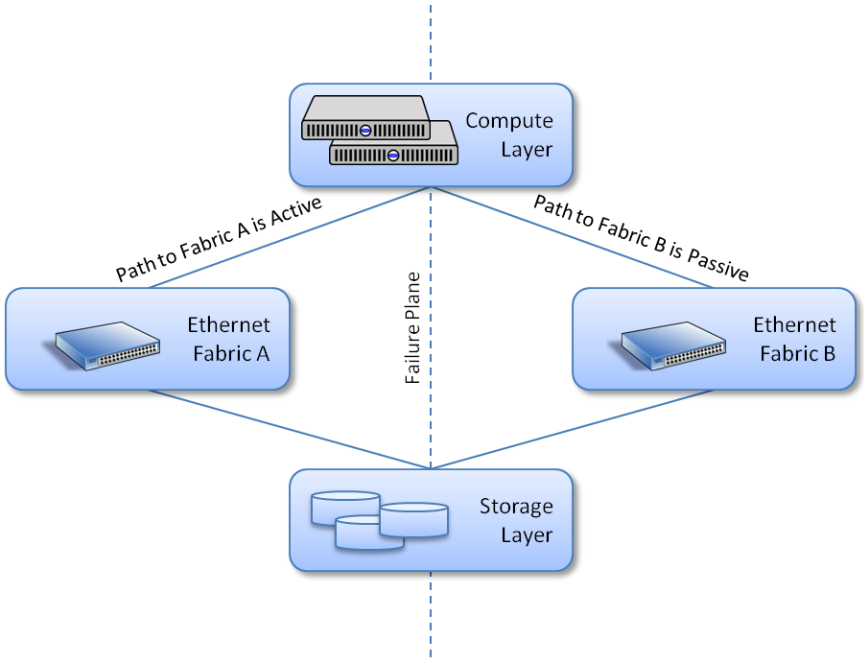


Figure 4. Storage Logical View

Storage Basic Design:

- Active Path and Passive Path based on Hypervisor Multi-Pathing

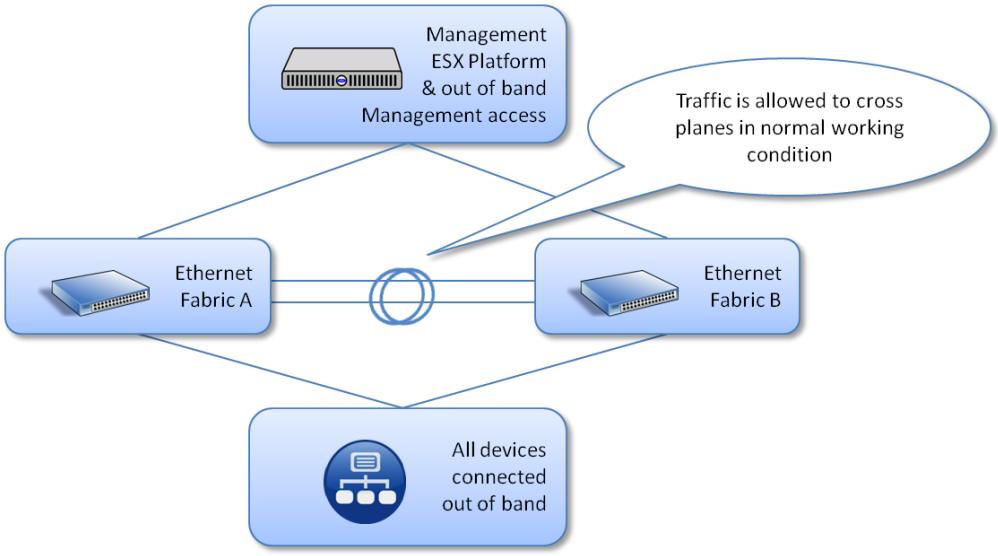


Figure 5. Management Logical View

Management Basic Design:

- All devices have connection to management network with dedicated management port out of band

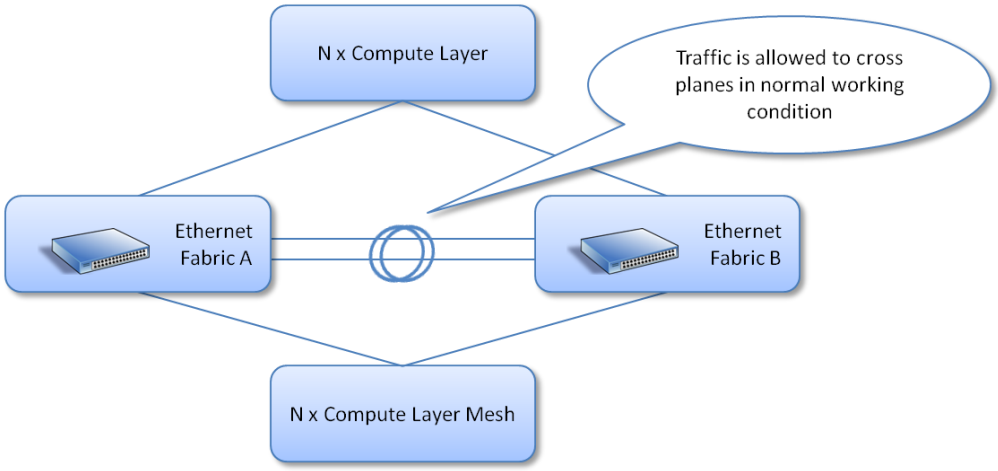


Figure 6. Cluster/HA Logical View

Cluster/HA Basic Design:

- Active trunk LACP L2 or L2 Load Share

Chapter 3 Solution Deployment

This chapter presents the following topics:

Deployment Overview

The deployment process has been designed to simplify system turn up at a customer site. The high level steps are based on how the system was built and tested and provide checkpoints throughout the process to ensure that the system is deployed and ready for business applications once complete. This document also serves as documentation repository for key system variables that are required to operate the system and to provide to customers.

Steps to Deployment:

1. Review all planning checklists in the Appendices
2. Complete Physical Rack installation based on Appendix G
3. Complete Network Layer installation and configuration
4. Complete Server installation and configuration
5. Complete Virtualization Layer installation and configuration
6. Complete Storage Layer installation and configuration
7. Add Storage to Virtualization Layer
8. Validate Solution Deployment
    a. Guest VM to disk traffic test
    b. Guest VM to network traffic test
    c. Guest VM to Guest VM traffic test
    d. Compute to Compute traffic test

Following these steps will reduce the time to install and debug all paths between components and will ensure that the building blocks are built in the correct order such that traffic tests can be successfully completed and and the solution can be handed off to the customer.

Deployment and Interoperability Prerequisites

All components were tested with a basic configuration that ensures the highest level of interoperability. For example, VLAN tagging was used to separate traffic and vswitches. It is not expected that software specific dependencies exist in the design and it is therefore recommended to update all components to the latest versions available before going into production. Each section outlines when software or firmware should be updated before moving to the next building block.

Pre-Deployment Tasks

It is important to ensure all sections for planning are complete before deployment begins. Key checklists that should be reviewed before starting a deployment are listed below. All checklists are found in the Appendices.

1. Power and Rack position planning
2. IP Address and VLAN planning
3. Server CNA and slot planning
4. Software version check on all components with required software versions downloaded and available

It is highly recommended to keep a record of actual deployment data that can be provided to the customer as part of the deployment handoff process. The planning tables should be used as a reference for the data that needs to be documented.

Solution Deployment

This section describes the deployment steps for the Lenovo ThinkServer – EMC VSPEX Solution. The deployment must follow the order as described in this section.

Network Layer Installation and Configuration

This section describes the installation and configuration steps for the Network Layer of the Lenovo ThinkServer – EMC VSPEX Solution.

Pre-Installation Requirements

The following additional tools and equipment should be on-hand prior to starting the Network Layer Installation and Configuration:

- #1 Phillips screwdriver
- Rack mounting screws
- 4x AC Power Cables
- Extreme management console cable
- Twin-Axial or SFP+/Fiber Cables for system connectivity
- Complete and review actual IP Address and VLAN table for deployment

Network Layer Installation and Configuration Steps

Physical Switch Installation

1. Identify the switch space designation within the target rack (refer to Appendix G for rack layout plan).
2. Attach each mounting bracket to the switch housing with the screws.

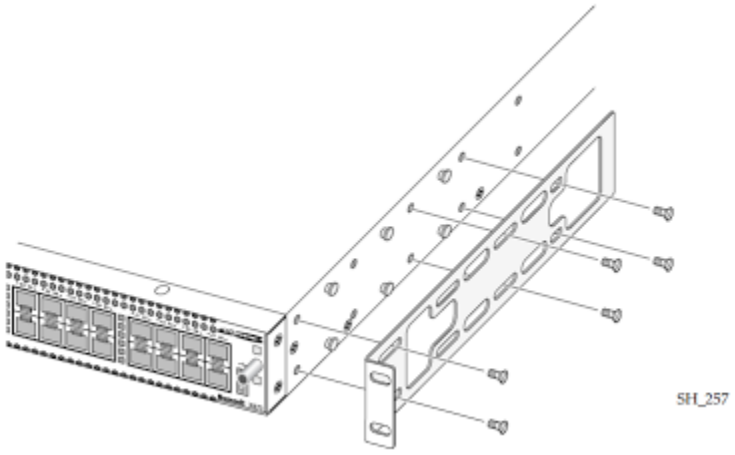


Figure 7. Attaching Extreme Summit 670 Rack Mount Bracket

3. Slide the switch into the rack and secure the mounting brackets into the rack.
4. Repeat steps 1 - 3 for the second switch.

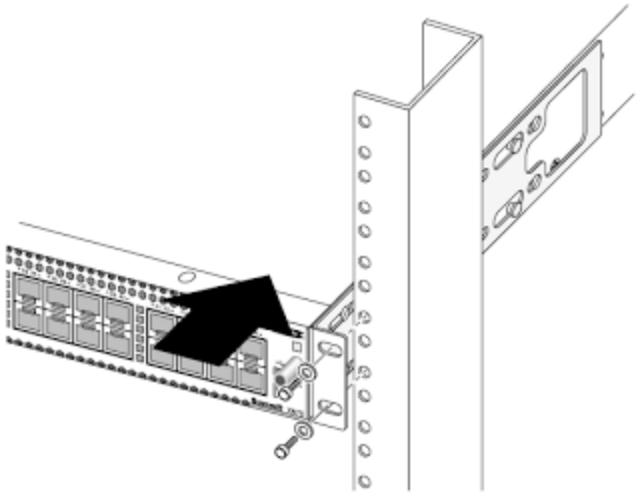


Figure 8. Installing the Extreme Summit x670 Series Switch

Power Cables

1. Power is supplied to all equipment in this design by redundant PDUs with each PDU supplied from a discrete and independent source.
2. Attach power cords from the separate PDUs to both power supplies located at the back of the switch.
3. Make sure the cables are neatly stowed to the side away from fan intakes and exhaust.
4. Repeat steps 1 - 3 for the second switch.

SFPs and Cabling

Passive electrical twin-axial cables at 1M and 3M are recommended for all interconnects although a mix of Extreme SFP and fibre optic cable can be used as an alternative.

1. Review suggested cabling configuration included in Appendix D and proceed with connecting equipment
2. Installing passive electrical twin-axial cable:
   a. Holding the connector by its sides, insert the connector into the port on the switch.
   b. Push the connector into the port until you hear it click into place.
3. Installing SFP and fibre optic cable combination:
   a. Seat SFP modules into designated ports on the switch.
   b. Connect SFPs via a fibre optic cable of appropriate length to ensure tidy deployment.
4. Complete cabling for both switches.

Switch Initial configuration

1. Use the Summit® Family Switches Hardware Installation Guide to complete the initial management access section for the Summit x670.
2. Use the ExtremeXOS® Concepts Guide Software Version 15.1 to configure:
   - Switch Name
   - SNMP Information
   - NTP
3. Save the configuration.
4. Repeat steps 1 - 3 for the second switch.

Upgrade Firmware

1. Download image to secondary partition.

```
Example:
# download image 172.16.41.1 summitX-12.6.1.3.xos vr "VR-
Default" secondary
```

2. Set secondary partition as the boot image.

```
# use image secondary
```

3. Reboot extreme switch to restart with new installed firmware.

```
# reboot
```

4. Verify the firmware version.

```
# show version
```

5. Repeat steps 1 - 4 for the second switch.

Configure Jumbo Frames

Jumbo frames are used between endstations that support larger frame sizes for more efficient transfers of bulk data. Both endstations involved in the transfer must be capable of supporting jumbo frames. Jumbo frames are disabled by default. The default size setting is 9216 which is the maximum size that can be set and is the required setting for this solution. Jumbo frames must be enabled on ports that are used in this deployment.

1. Login into the switch CLI interface.
2. Configure preferred jumbo frame size of 9216.

```
configure jumbo-frame-size 9216
```

3. Enable jumbo frames on ports that are used in this solution:

```
Example: Enable jumbo frames on a particular port
enable jumbo-frame ports 5

Example: Enable jumbo frames on multiple ports:
enable jumbo-frame ports 5,6,10
```

4. Repeat steps 1 - 3 for the second switch.

Configure Sharing

1. Login into switch CII.
2. To configure sharing add ports using the following syntax:

```
configure sharing <master_port> add ports <port_list>

Example:
configure sharing 3:9 add ports 3:13
```

3. Repeat steps 1 - 2 for the second switch.

Configure QoS Queues

Quality of Service (QoS) allows traffic groups higher priority access to network resources in the event of network contention. Bandwidth can be reserved for special groups of traffic. It is recommended that the *Fault Tolerance* VLAN be configured with the highest traffic priority, and sufficient bandwidth for the level (LockStep mirror, warm recover, etc) of Fault Tolerance required by the deployed application.

Create and configure VLANs

1. Login into switch Cll.
2. Create desired VLAN and VLAN tag.

```
Example:

create VLAN "VSPX-CUS0"
configure VLAN VSPX-CUS0 tag 2100
```

3. Repeat for all VLANs in the VLAN list.
4. Repeat steps 1 - 3 for the second switch.

Refer to Appendix A for sample VLAN and IP Address layout.

Configuring ports (names)

Descriptive port names, or "*display-strings*", assist with debugging and switch management. A list of suggested port display-strings are included in Appendix E.

1. Log into the switch CLI
2. Configure the port display string.

```
Example:
configure ports 7 display-string "VNX5300-SPb6-0"
```

3. Validate port names are configured as expected.

```
Example:
show ports 7
```

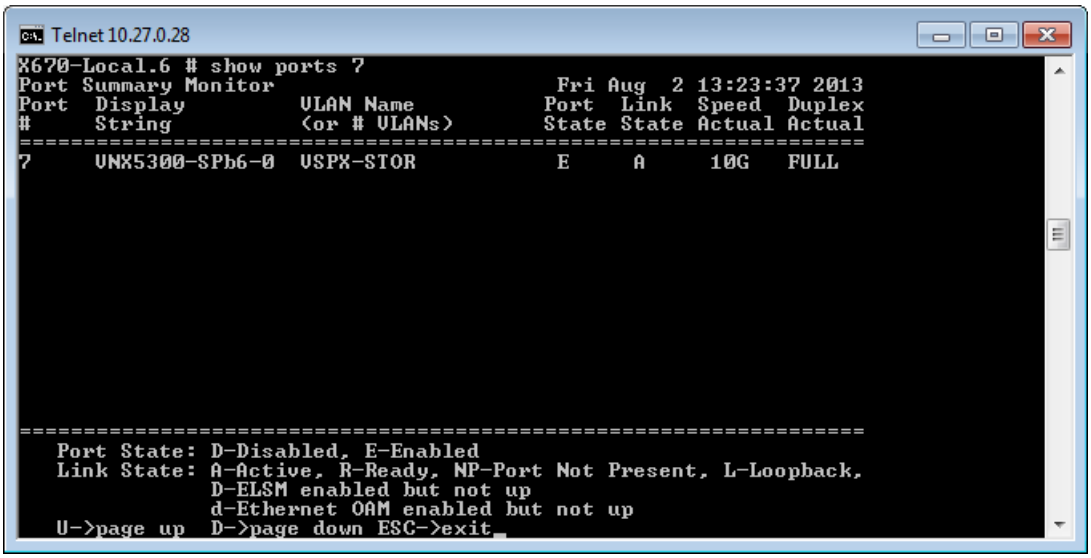


Figure 9. Example CLI for Port Display String Validation

Add Ports to VLANS

1. Login into the switch Cll.
2. Create the desired VLAN and VLAN tag.

```
Example:
configure VLAN VSPX-CUS0 add ports 9, 11, 13, 16, 24, 39
tagged
configure VLAN VSPX-CUS1 add ports 9, 11, 13,  24, 39
tagged
```

3. Repeat for all VLANs in the deployment VLAN list.
4. Repeat steps 1 - 3 for the second switch.

Server Installation and Configuration

This section describes the installation and configuration steps for the Servers required for this deployment.

You will need to have the following document handy for reference:

http://download.lenovo.com/ibmdl/pub/pc/pccbbs/thinkservers/rd630ug_en.pdf

Refer to the listed pages to complete the following tasks. These tasks are completed for all servers in this solution.

1. Review the Guidelines and Precautions sections – Page 69
2. Remove the server cover – Page 71
3. Remove cooling shroud – Page 76
4. Install RAM – Page 80
5. Install NICs into slots specified in Appendix F – Page 87

6. Install CPUs – Page 114
7. Re-install cooling shroud and server cover
8. Install redundant PSU – Page 108
9. Connect Ethernet cables following port recommendations in Appendix D
10. Connect power cables
11. Update firmware for BIOS, BMC, iKVM and Raid Controller by using ThinkServer EasyUpdate firmware updater. The latest version of Easy Update can be found at http://www.lenovo.com/drivers and navigating to the RD630 server.
12. Create a RAID1 local LUN for operating system boot – Page 64
13. Enable Hyper-Threading and Intel Virtualization, and configure Boot order (Boot from Local RAID1 LUN) by using the pre-boot BIOS Setup Utility – Page 53
14. Assign IP Addresses and user accounts to ThinkServer Management Module (TMM) and iKVM using the guide found at http://download.lenovo.com/ibmdl/pub/pc/pccbbs/thinkservers/rd530rd630tmmug_en.pdf

Virtual Layer Installation and Configuration

Installation and Configuration

This section describes the installation and configuration steps for the Virtual Layer.

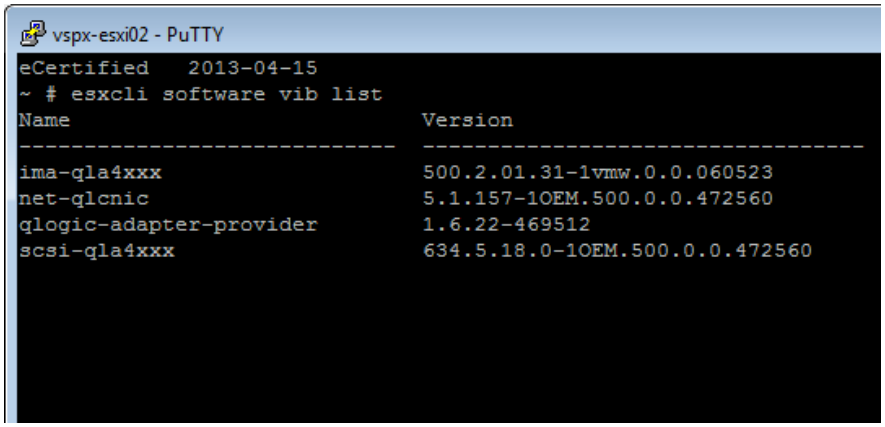
Pre-installation Requirements

- VMware media
- VMware Documentation - http://pubs.vmware.com/vsphere-51/index.jsp?topic=%2Fcom.vmware.vsphere.install.doc%2FGUID-7C9A1E23-7FCD-4295-9CB1-C932F2423C63.html
- VMware license keys
- Physical server installation completed
- CNA drivers from Qlogic website
- All appendix checklists completed

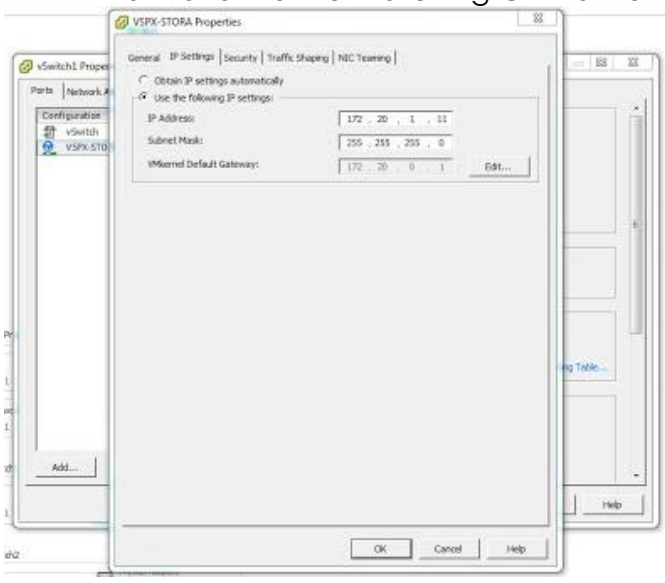
OS Installation

1. VMware DVD can be inserted in DVD drive (Keyboard mouse monitor connected to server)
2. Reboot server and manually interrupt boot progress to boot from DVD.
3. Set management IP address for out of band management port during installation
4. Connect management port as per appendix cabling table

5. Verify ping to management port on OS before continuing
6. Download the vSphere client from this host by pointing a browser at the management IP address provisioned above
7. Install vSphere client and login to ESX host to continue
8. OS Post Configuration (networking/management)
9. Check the ESX host networking configuration to ensure all cards were detected by the installation
10. Enable SSH access on the ESX host (for driver installation)
11. Install CNA drivers as per Qlogic instructions supplied with the driver download

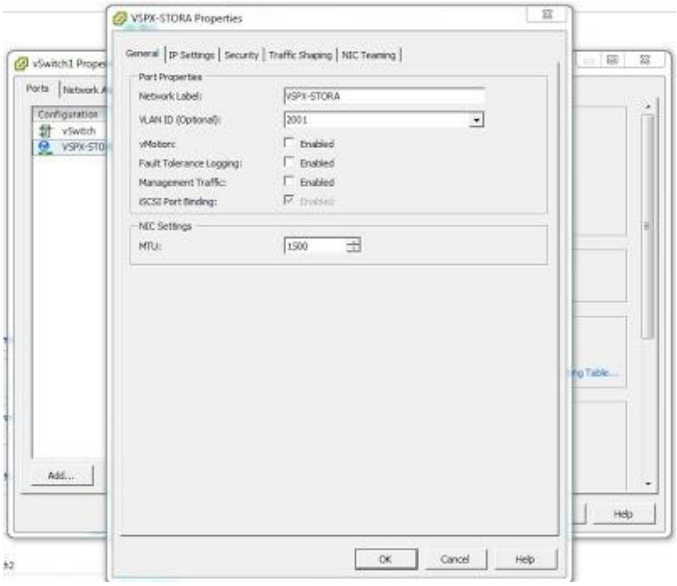


12. Following the CNA slot guide in Appendix B assign IP address and VLAN information to the matching CNA driver on the host

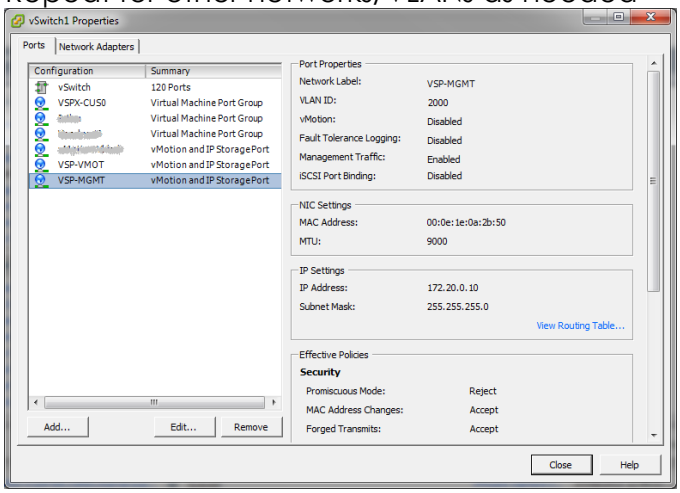


13. Repeat steps for IP and VLAN for Vmotion network interfaces, Customer access interfaces using the slot table and IP

address and vlan tables in the appendix for data to complete the steps on each network card

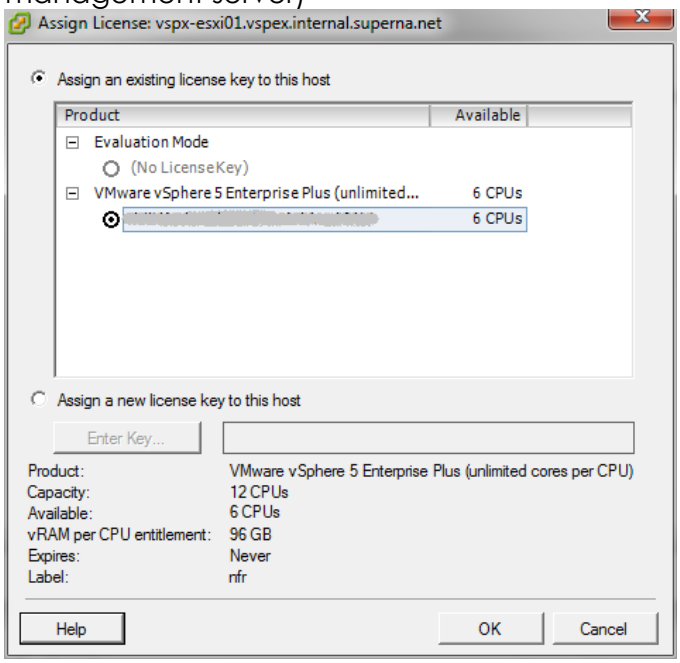


14. If enabling vMotion you must check the box for vMotion
15. If Management Traffic to the ESX host the check box must be enabled
16. If enabling Fault Tolerance features the check box must be enabled
17. If enabling for iSCSI the check box must be enabled
18. Repeat for other networks/VLANs as needed

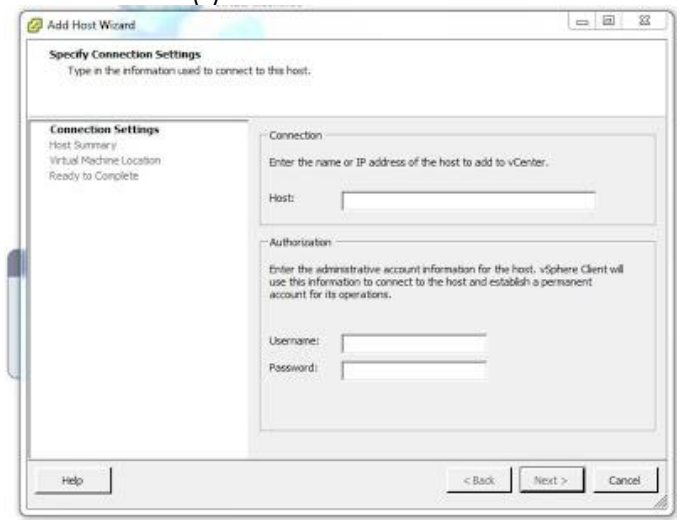


vCenter/Licensing

1. Add licenses to Vcenter installation (installed separately on management server)



2. Add ESX host(s) to Vcenter



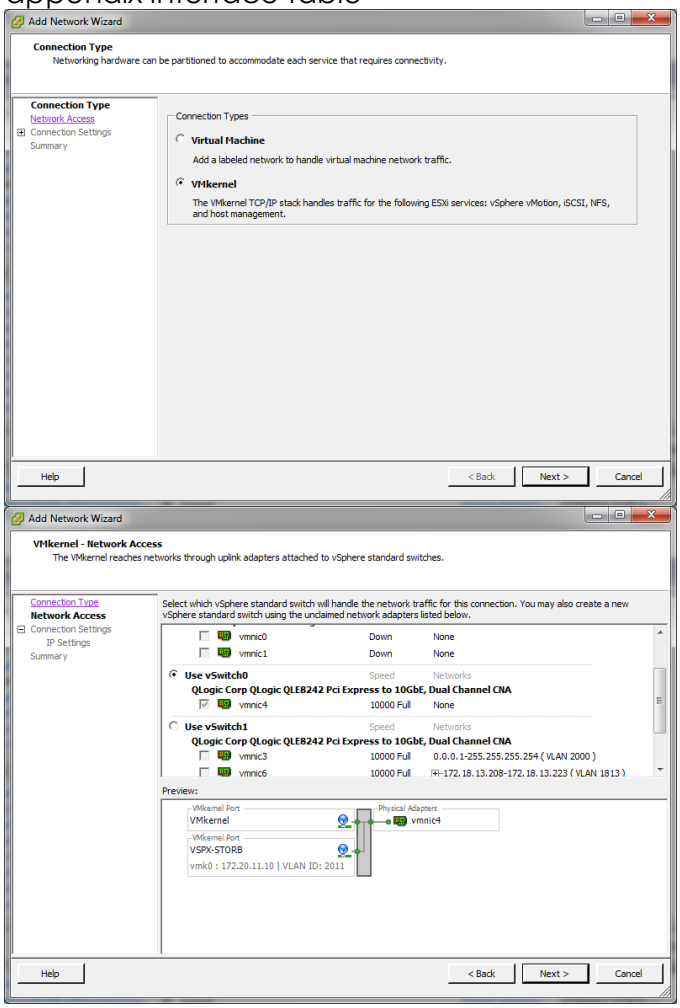
vCenter Configuration Creation

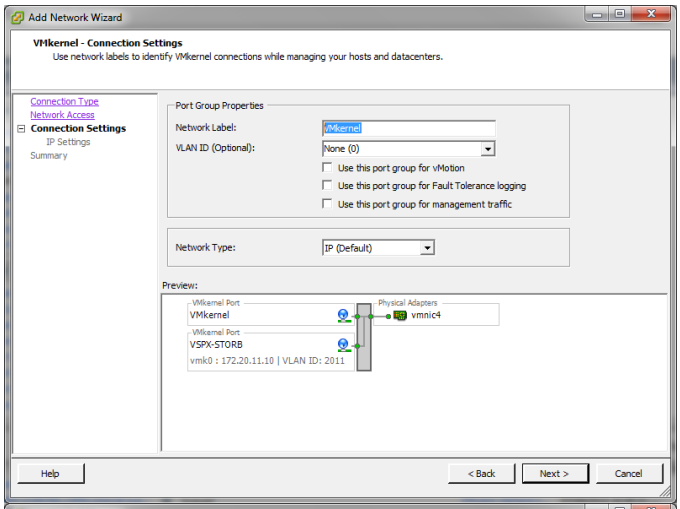
Configure Data Center and HA DRS if licenses have been purchased to automate failover policy of VM's between hosts

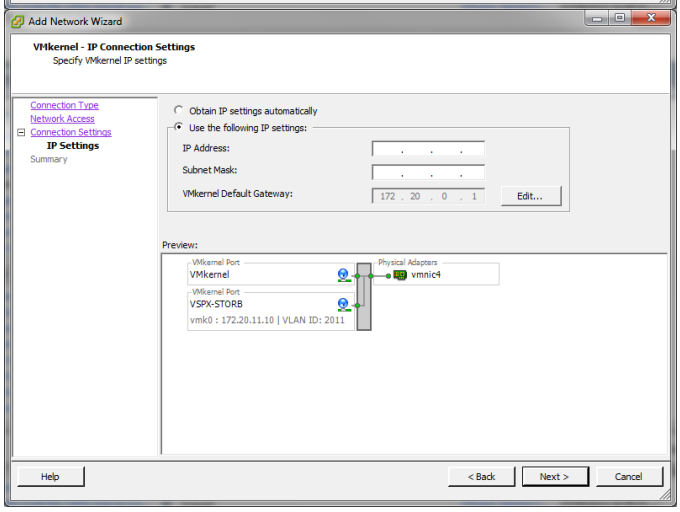
1. Optional - set NTP IP address, SMTP Configuration for Vcenter
2. Optional - Startup Options for VM's and boot order

Network and VLAN configuration

1. vSwitches and vlan should be configured on all interfaces from the appendix interface table

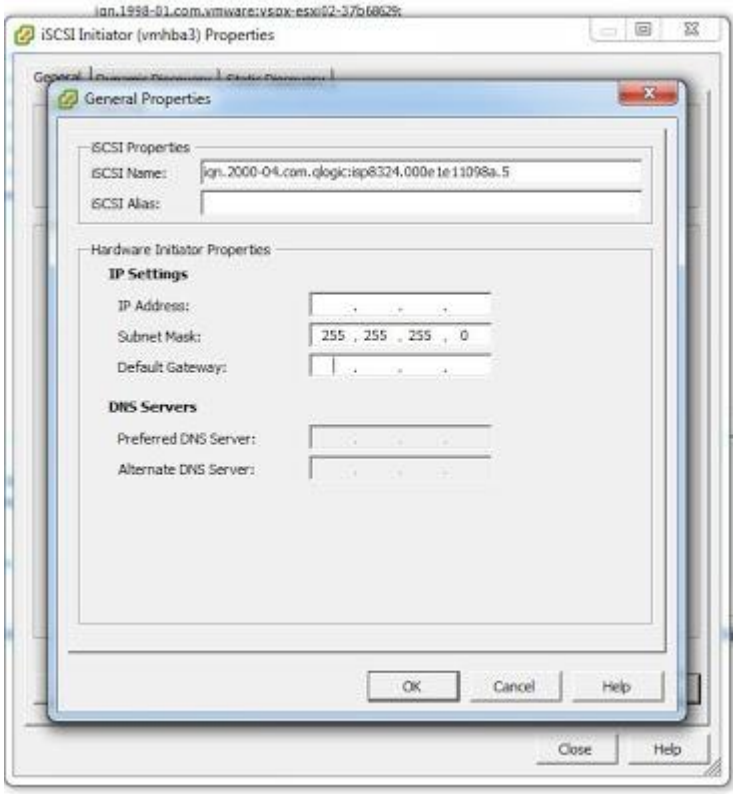



Add Network Wizard
VMkernel - Connection Settings
Use network labels to identify VMkernel connections while managing your hosts and datacenters.
Connection Type
Network Access
Connection Settings
IP Settings
Summary
Port Group Properties
Network Label:
vMkernel
VLAN ID (Optional):
None (0)
Use this port group for vMotion
Use this port group for Fault Tolerance logging
Use this port group for management traffic
Network Type:
IP (Default)
Preview:
VMkernel Port
VMkernel
VMkernel Port
VSPX-STORB
vmk0 : 172.20.11.10 | VLAN ID: 2011
Physical Adapters
vmnic4
Help
< Back
Next >
Cancel

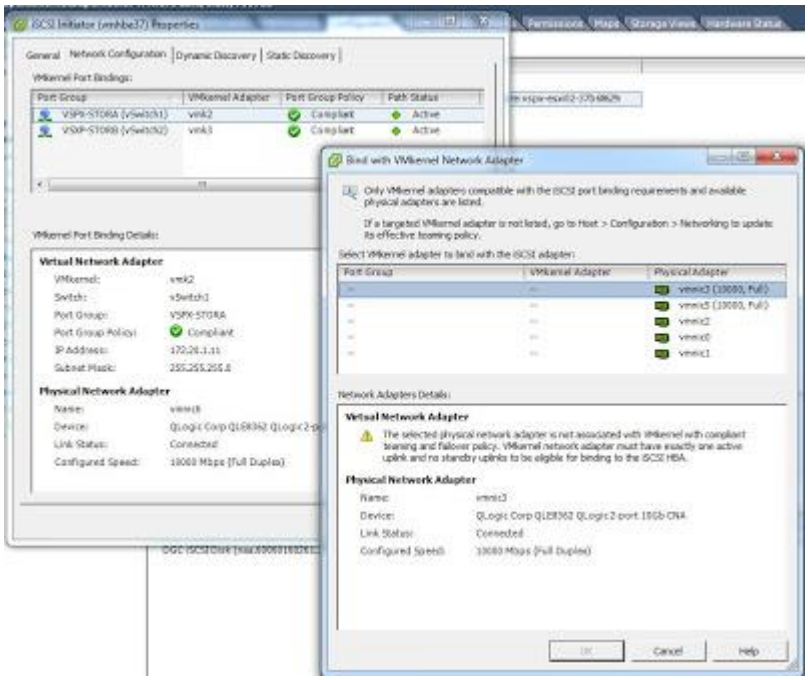

Add Network Wizard
VMkernel - IP Connection Settings
Specify VMkernel IP settings
Connection Type
Network Access
Connection Settings
IP Settings
Summary
Obtain IP settings automatically
Use the following IP settings:
IP Address:
Subnet Mask:
VMkernel Default Gateway:
172 . 20 . 0 . 1
Edit...
Preview:
VMkernel Port
VMkernel
VMkernel Port
VSPX-STORB
vmk0 : 172.20.11.10 | VLAN ID: 2011
Physical Adapters
vmnic4
Help
< Back
Next >
Cancel

Storage Configuration

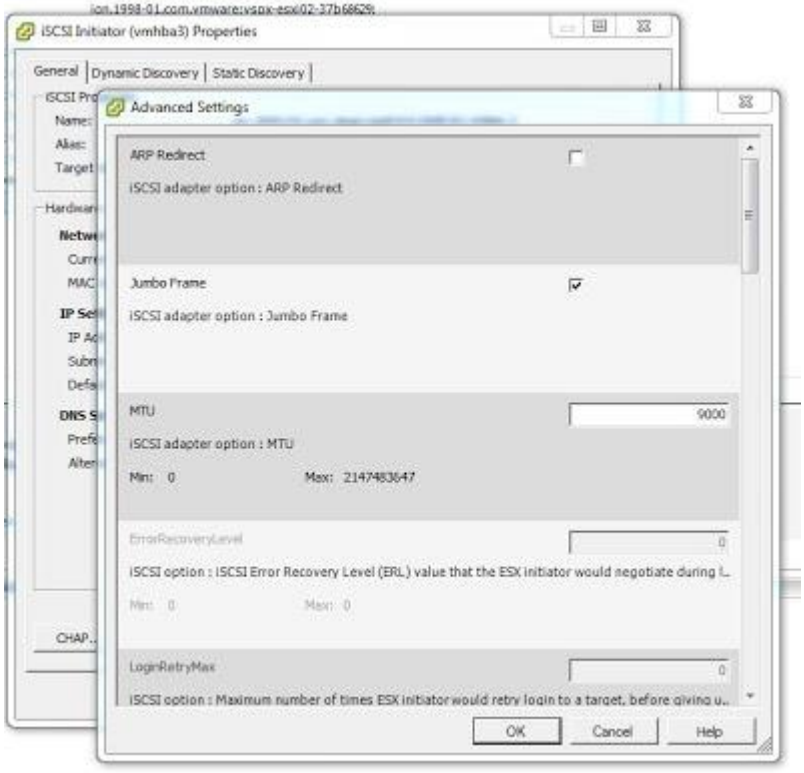
1. iSCSI configuration requires binding iSCSI kernel to CNA and set IP address information



2. With dual paths to storage, two kernel drivers will be visible once all bindings are complete. These steps are repeated on all cards with the appendix VLAN and IP address information as a guide to which ports on each host should be connected to each switch, VLAN, and target SPA or SPB ports on the VNX array

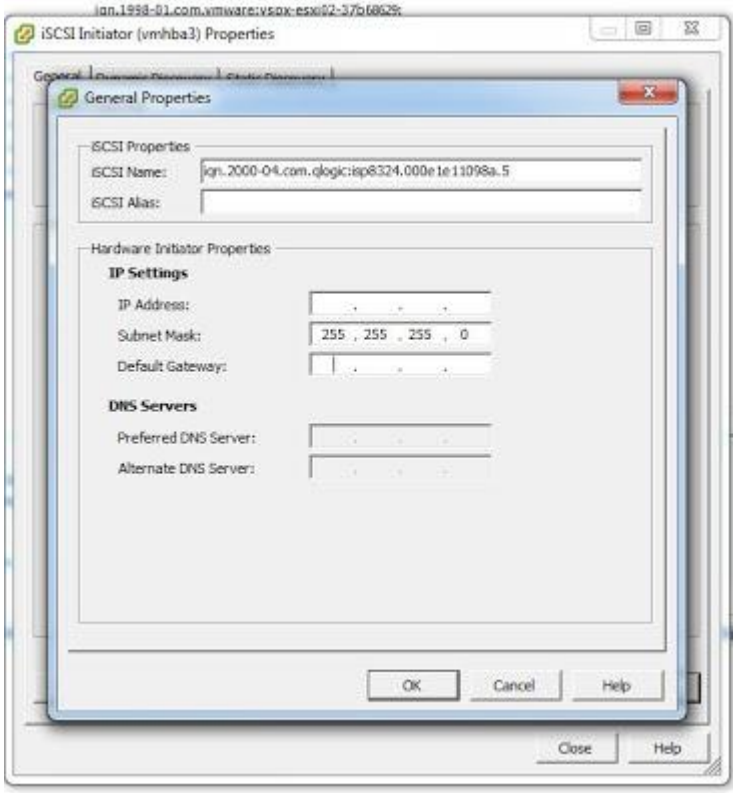


3. It's recommended to enable jumbo frames for storage traffic. This also requires storage port configuration on the VNX and network switch to match the selected MTU recommend value 9000 bytes. This is done under advanced settings

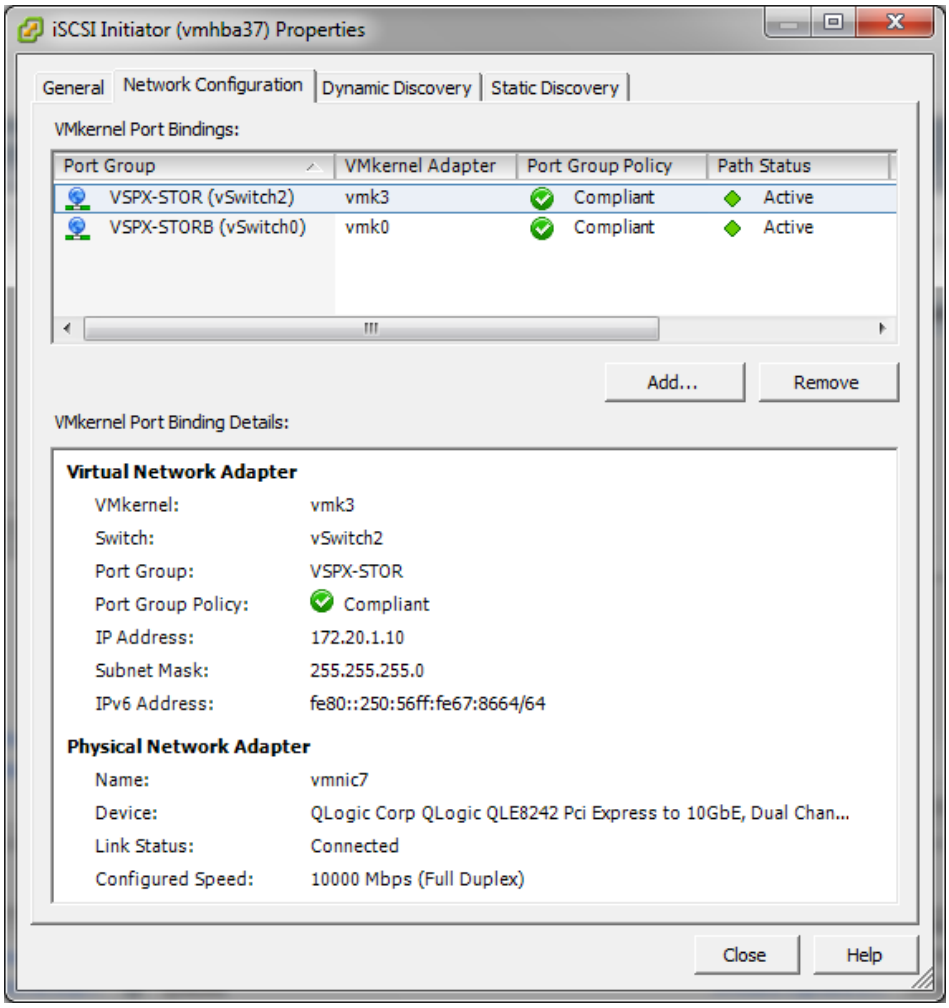


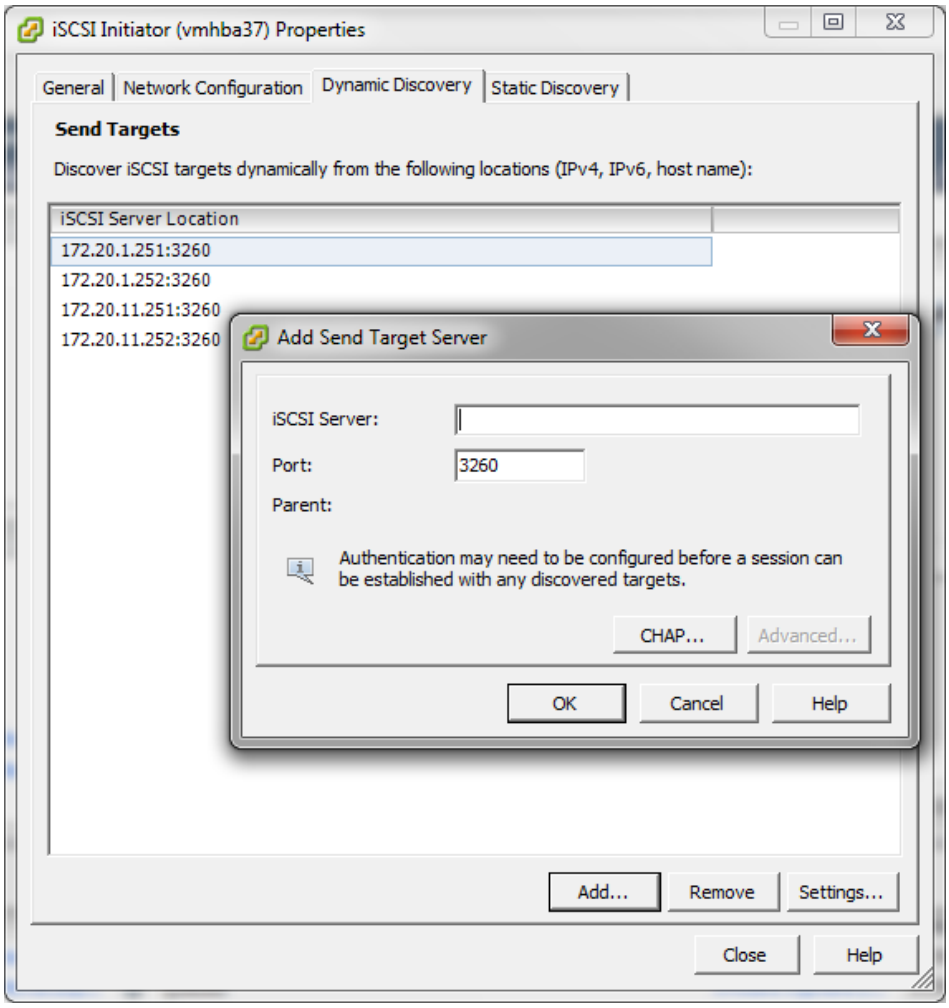
4. Confirm ping traffic initiated from the network switch can reach all ports in the storage, customer, vmotion and management networks.

5. Configure iSCSI initiator parameters on the iSCSI kernel driver.

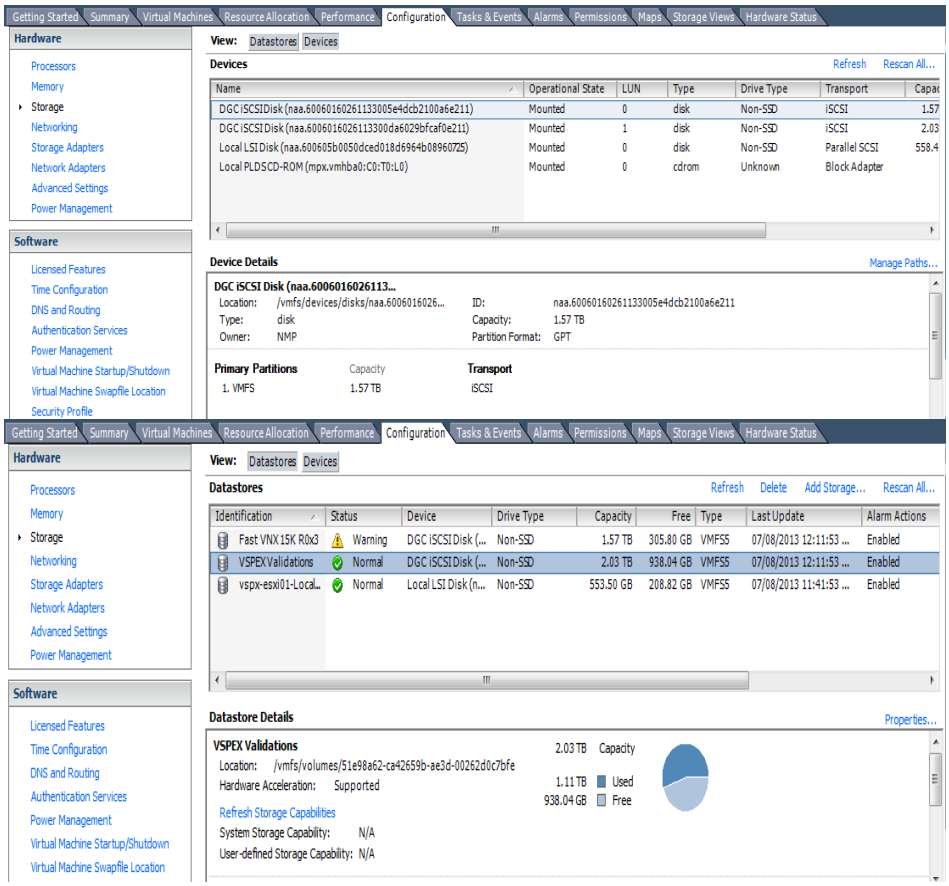


6. Ensuring that there is a working path to the storage arrays, the targets can be added either statically or dynamically.


iSCSI Initiator (vmhba37) Properties
General
Network Configuration
Dynamic Discovery
Static Discovery
VMkernel Port Bindings:
Port Group
VMkernel Adapter
Port Group Policy
Path Status
VSPX-STOR (vSwitch2)
vmk3
Compliant
Active
VSPX-STORB (vSwitch0)
vmk0
Compliant
Active
Add...
Remove
VMkernel Port Binding Details:
Virtual Network Adapter
VMkernel:
vmk3
Switch:
vSwitch2
Port Group:
VSPX-STOR
Port Group Policy:
Compliant
IP Address:
172.20.1.10
Subnet Mask:
255.255.255.0
IPv6 Address:
fe80::250:56ff:fe67:8664/64
Physical Network Adapter
Name:
vmnic7
Device:
QLogic Corp QLogic QLE8242 Pci Express to 10GbE, Dual Chan...
Link Status:
Connected
Configured Speed:
10000 Mbps (Full Duplex)
Close
Help



7. Rescan all adapters and devices should populate. From there the devices can be configured as datastores



Storage Layer Installation and Configuration

This section describes the installation and configuration steps for the Storage Layer.

Storage Layer Installation and Configuration Steps

The following additional tools and equipment should be on-hand prior to starting the Network Layer Installation and Configuration:

- Phillips screwdriver to install the system in a rack.
- Laptop or PC with Internet access to register for EMC Online Support, and with local network access to confgire the VNXe system
- Two 110/220 volt AC circuits.
- VNXe Connection Utility (Download from EMC)
- DNS, NTP for network name resolution and network time synchronization
- Four ethernet cables - bulk Cat5 or higher for internet ip connectivity to network

- Review the Sizing Guidelines section in the 100 VM Reference Architecture document.
- Reference documentation:
- Quickstart Guide: https://community.emc.com/servlet/JiveServlet/downloadBody/16485-102-4-65899/docu31492_VNXe-Series-Quick-Start.pdf
- 100 VM Reference Architecture Document:

  http://www.emc.com/collateral/technical-documentation/h11328-vspex-pi-pc-vmw-vnxe.pdf

Unpack VNXe, DAEs, Drives and Accessories

1. Unpack (1)VNXe DPE and (5)DAEs
2. Insert drives into DPE and DAE slots if they have not already been installed.
3. Start with DPE and insert drives all free slots.
4. Repeat for DAE 1 and DAE 2.
5. Insert drives into slots 0-13 in DAE's 3 and 4
6. Insert drives into slots 0-6 in DAE 5.
7. Install rack rails for DAEs and DPE into frame as per rack layout diagram

VNXe Installation and Initial Configuration

Refer to the VNXe System Installation Guide (bundled in with the VNXe system) for details.

1. Connect cables between DPE and DAEs and connect DPE to Extreme Networks switch
2. Connect power to VNXe components and wait until the LEDs indicate that the system is ready.
3. Connect the SPA and SPB Ports (0 and 1) to the Extreme switches as defined in Appendix D.
4. Download and install the VNXe Connection Utility to assign a static IP address to the VNXe system
5. Point a web browser to the ip address assigned to the VNXe in the previous step
6. Login to Unisphere with the following credentials:

   Username: admin

   Password: Password123#

7. The Unisphere Configuration Wizard will guide you through configuring the following system settings:

   Passwords for system administrators and service accounts

   ESRS and ConnectEMC features for advanced proactive EMC support

   DNS and NTP time synchronization

8. Skip Storage Pool Configuration

9. Obtain license files and complete system registration

10. Update system software, firmware and language packs following the available online guides.

11. Assign IP's to VNXe iSCSI interfaces.

12. From Unisphere, click on the System, Settings, Network, Setting for Block.

13. Scroll down to Slot A1 Port 0 (SP Port A-6), RT Click and select properties.

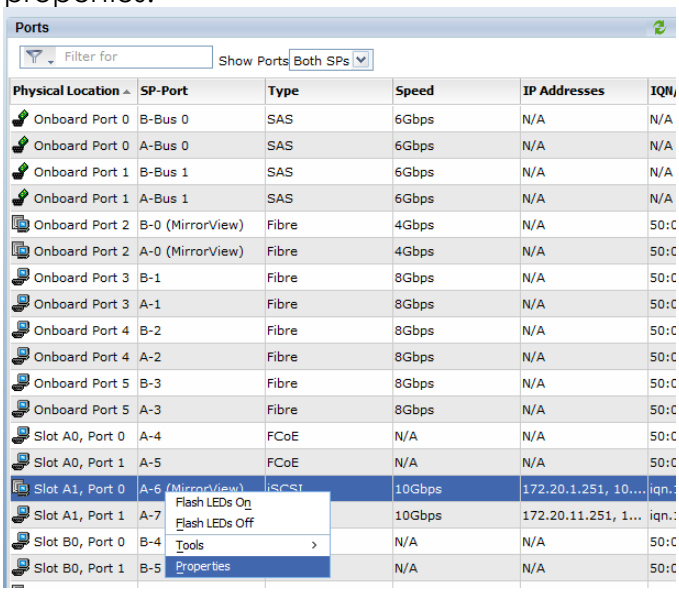


Figure 10. Configure SP Interface Properties

14. Configure MTU on the port by selecting 9000 from the MTY drop down.

15. Add a virtual port by clicking on Add, then entering the IP information (address, gateway, netmask and tag) for port SP-A port 0.

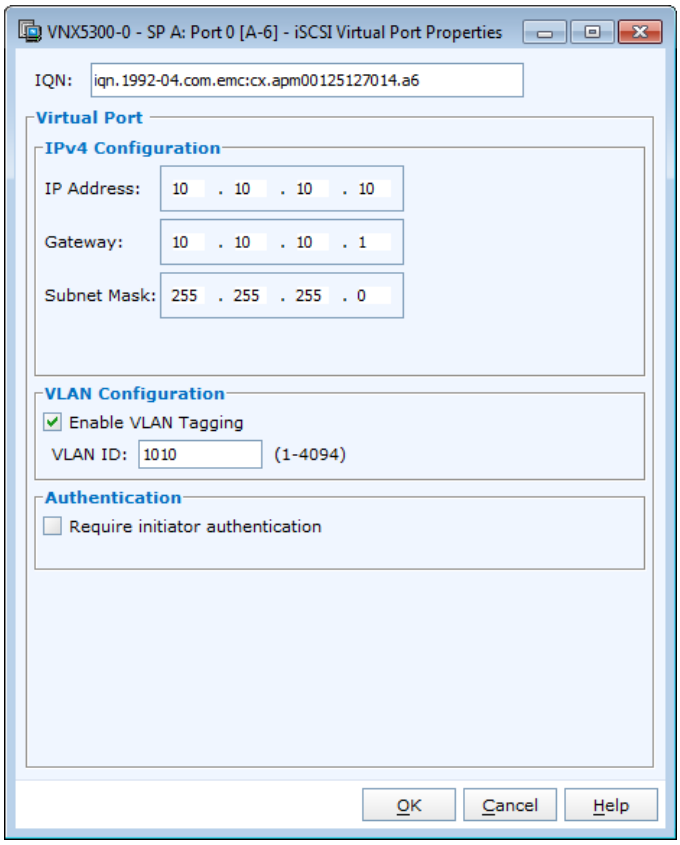


Figure 11. Configure iSCSI Virtual Port Properties

16. Repeat for SP A Port 1, SP B port 0 and SP B Port 1.

Test connectivity of each port by right clicking on the port, selecting tools, and then Ping. Select the relevant source IP from the dropdown box, then enter the destination address for the destination field. Ping the relevant initiator configured in the virtualization section above.

Debugging Tip: If ping is not working as expected, perform the following steps to troubleshoot.

Is link up? Check the VNX, Switch and Initiator ports to confirm physical connectivity. Each connected port should have an enabled link light. and should be flashing with some activity. Resolve any physical connectivity issues by cleaning/testing fibers and SFP's using an optical meter, and fiber cleaning pads.

Are MAC's being learned? After physical connectivity has been confirmed, log on to the switch and check that mac addresses are being learned on the correct ports and VLANs. Record MAC addresses of endpoints (initiators and targets) then confirm that the MAC addresses are being learned by the switch

Checking FDB on Ports:

Run the show fdp ports {*port-range*} command.

```
show fdb ports 7,8
```

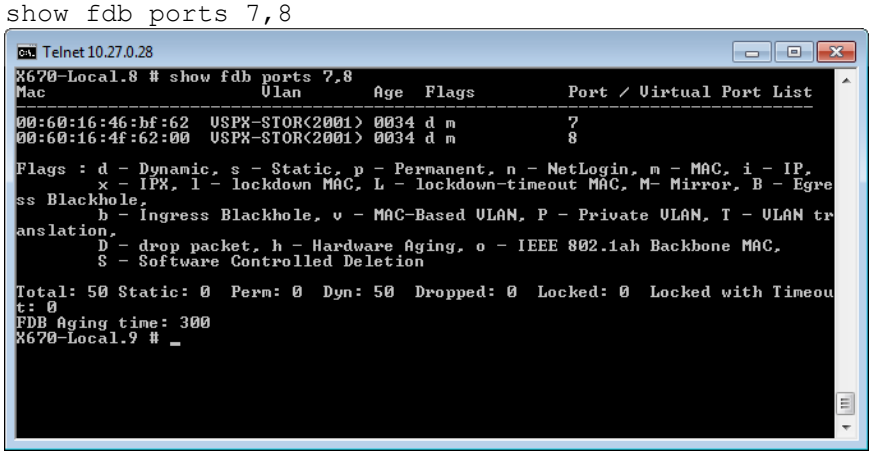


Figure 12. Check for VNXe MAC Addresses

MAC addresses for each VNXe should be learned on the ports that were configured above.

And:

```
show fdb ports 9,10
```

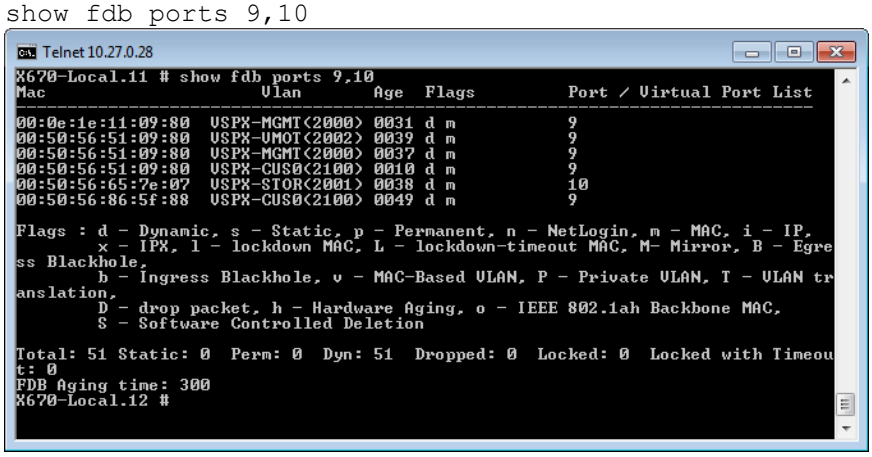


Figure 13. Check for Host Initiator MAC Addresses

MAC addresses for iSCSI initiators should be learned on the ports configured above.

VLANS should contain MAC addresses for both targets and initiators.

```
show fdb vlan VSPX-STOR
```

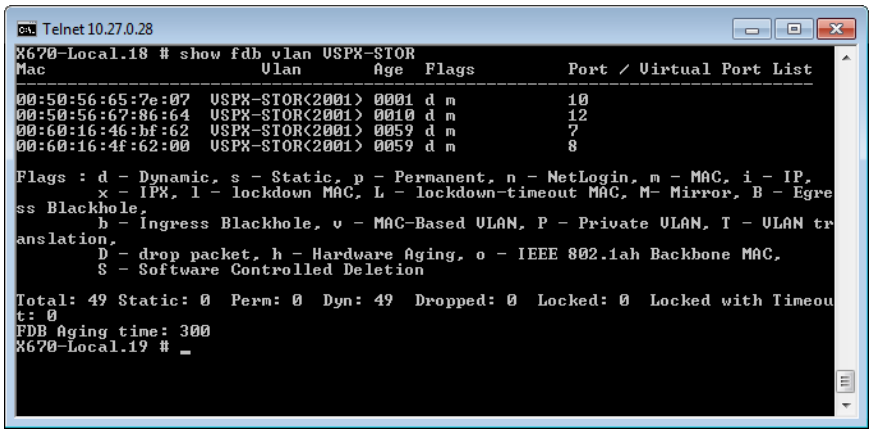


Figure 14. Confirm Host and VNXe MACs

This confirms the devices have the transport to communicate with each other.

Still Can't Ping? If Ping fails at this point, there is an issue with IP addresses or netmasks. Confirm the IP addresses and netmasks.

Create Storage Pools

1. Create the storage pool by clicking on the Storage, Storage Configuration, Storage Pools and then Create.

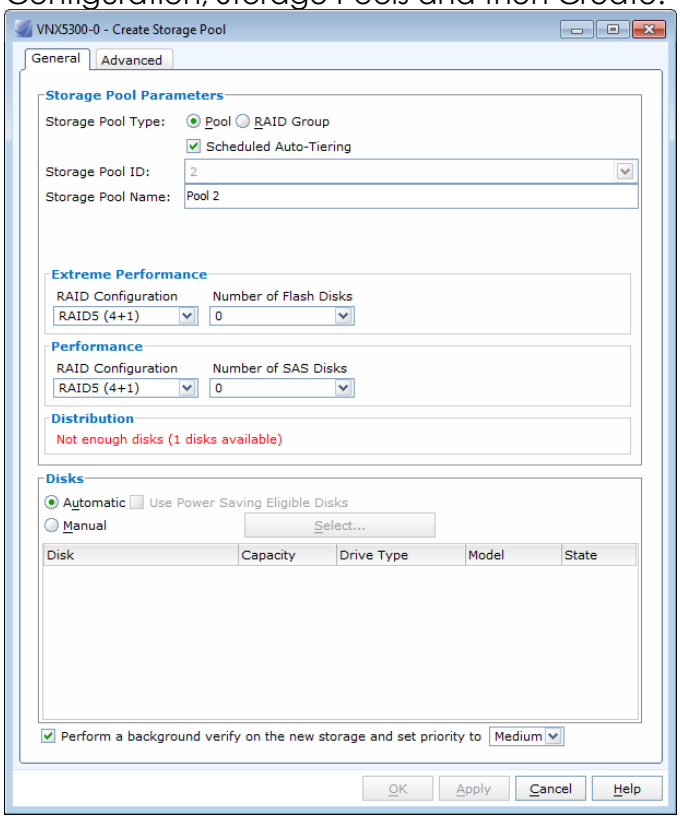


Figure 15. Create Storage Pool

2. Select Pool for Storage Pool Type, Tick Scheduled Auto-Tiering, and then enter a Storage Pool Name.
3. Select Raid5 (6+1)
4. Tick Manual, then click Select. Drives as follows:

Table 3. VNXe Raid Group Layout

Raid5 Group Number	Enclosure	Drives
1	0	0-6
2	0	7-13
3	1	0-6
4	1	7-13
5	2	0-6
6	2	7-13
7	3	0-6
8	3	7-13
9	4	0-6
10	4	7-13
11	5	0-6

5. Follow the above table to complete the storage pool creation. This storage pool is used to present LUNS to the ESX hosts in this solution.

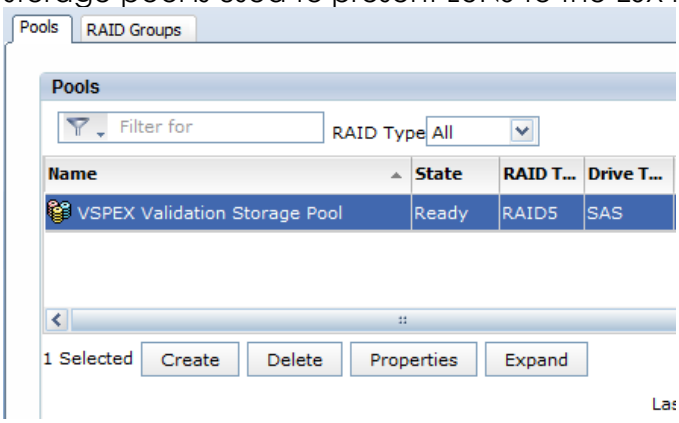


Figure 16. Create Storage Pool

Creating LUNS

To create a LUN:

1. Log into Unisphere

2. Click Storage, then LUNS then Create.

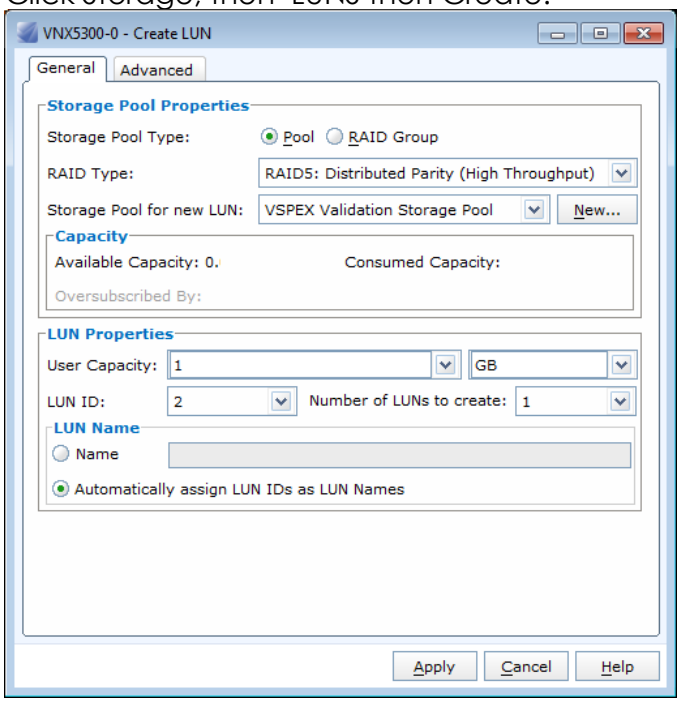


Figure 17. Create LUNs

Create at least 10 LUNs for the VSPEX solution. LUNS can be sized according to application requirements. Each of these LUNs will be presented to vSphere as Datastores or RDMs.

TIPS:

- 10 LUNs be created at once. Take the available capacity, and divide that by 10. Enter the result into the "User Capacity" box, then select 10 in the "Number of LUNs to create" box.
- Assign descriptive names to LUNs
- Record LUN ID's

Register Hosts and "Log" Initiators into the VNXe

Hosts must connect to the VNX, and then be registered in order to be added to storage groups.

IMPORTANT: Confirm connectivity between ESXi Hosts iSCSI initiators and the VNXe iSCSI Target interfaces prior to this section by completing the "Test Connectivity" steps previously detailed.

1. Log into vCenter
2. Select ESXi host 1
3. Click on Configuration, then Storage Adapters

4. Right click on the iSCSI Software Adapter and select properties.

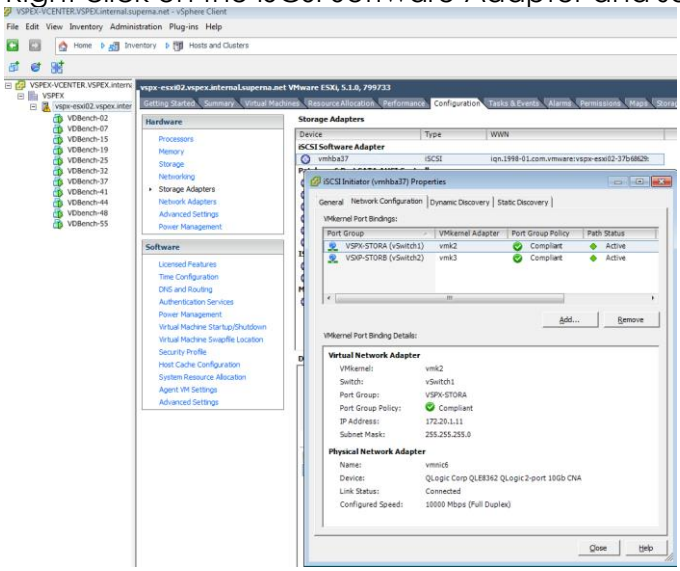


Figure 18. Configure VMware iSCSI Software Adapter

5. Static Discovery Tab. At this point the tab should not be populated.

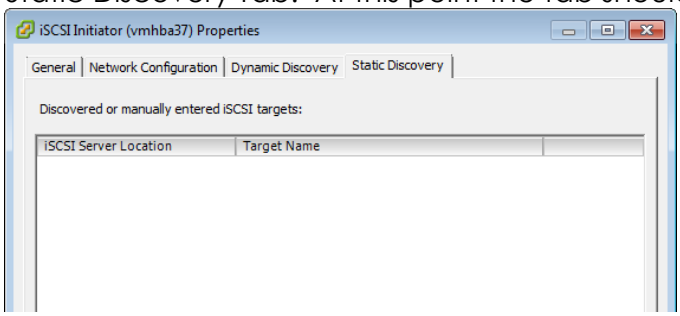


Figure 19. iSCSI SW Initiator Dynamic Discovery

6. Now click on the Dynamic Discovery tab. This should also be blank.
7. Click on the Add button

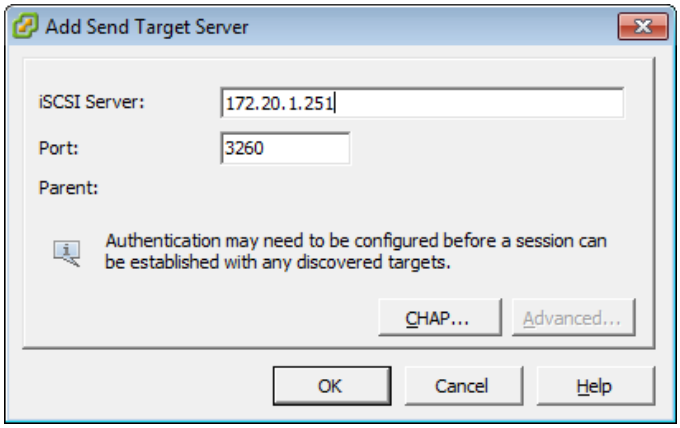


Figure 20. Configure iSCSI SW Initiator Target IP

8. Enter the iSCSI IP address on Storage VLAN 1 for SP-A as configured on the VNXe in previous steps, then click on OK.

9. This initiates a login request from the host initiator to the VNXe. The task will complete after a brief moment.
10. Click on the Static Discovery Tab. The tab will be populated with the Storage VLAN 1 SP-A and SP-B targets, which confirms connectivity

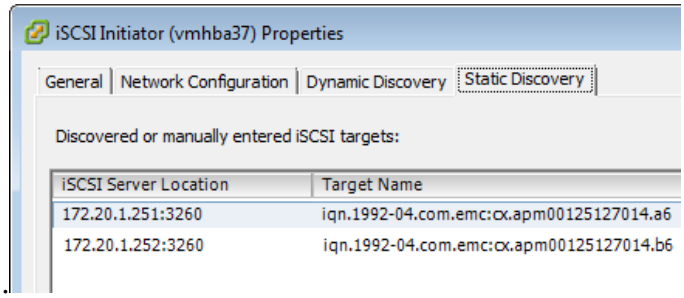


Figure 21. iSCSI SW Initiator Static Discovery

11. Click on the Dynamic Tab once again and repeat steps to add Storage VLAN 2 SP-A.
12. A list of four iSCSI Server Locations on the Static Discovery tab confirms configuration and connectivity from host initiator to the VNXe iSCSI storage array.

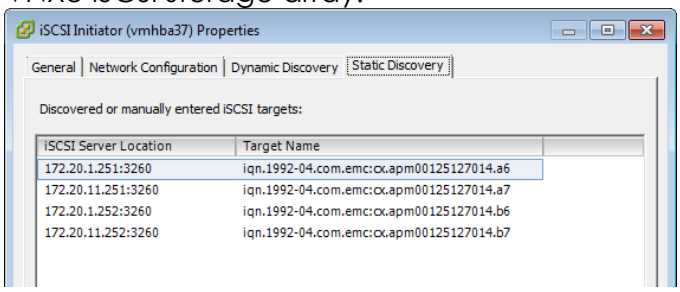


Figure 22. iSCSI SW Initiator Static Discovery Populated

NOTE: SPA Port 6 and SPB Port 6 are connected to Storage VLAN 1 and SP-A Port 7 and SP-B Port 7 are connected to Storage VLAN 2. This can be confirmed by matching the statically discovered target IQN to the IP's listed in the Static Discovery tab. The IQN's are suffixed by a6, b6, a7, and b7 which correspond to SP-A Port 6, SP-B Port 6, SP-A Port 7 and SP-B Port 7 respectively. The IPs should match what was configured in previous steps. In the screen captures above, Storage VLAN 1 is 172.20.1.0/24 and Storage VLAN 2 is 172.20.11.0/24. SP-A is '251' and SP-B is '252'.

13. Click on OK to close this wizard. When asked to Rescan HBA, click OK. This is process that *logs* the initiators *into* the VNXe array and will allow the initiators to be registered in the next section.
14. Repeat this section for the remaining ESXi hosts in this solution.

Once completed you will notice 2 *Connected Targets*, 1 *Device* and 4 *Paths* in the details section. This indicates that the hosts are connected to the VNXe, but have not be 'allowed' to see any LUNS. This is expected.

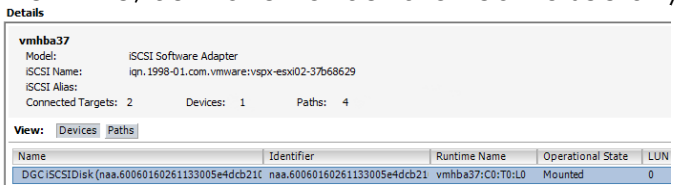


Figure 23. VNXe Discovered

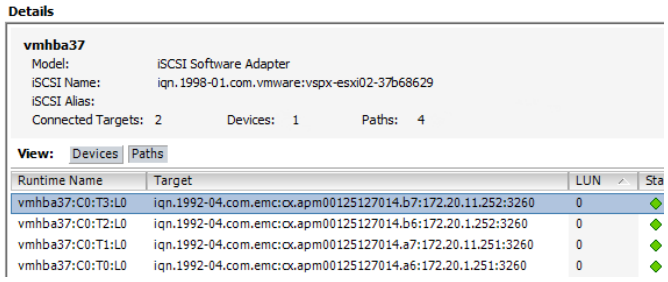


Figure 24. Paths to VNXe

After all ESXi hosts have been logged into the VNXe, return to the Unisphere GUI to *Register* the hosts.

Registering Hosts

1. Login to the Unisphere GUI, click on the Hosts tab then select Initiators

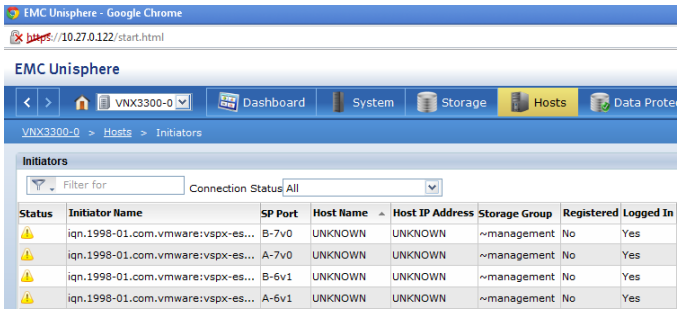


Figure 25. VNXe Discovered Initiators

At this point, initiators should be *Logged In* but not *Registered* and should be in the *~management* Storage Group. This indicates that the hosts initiators have connected to the storage, but have not yet been accepted, and not been permitted to connect to any LUNs.

2. Select the initiator connected to SP Port A-6v1 and select Register to start the registration wizard.

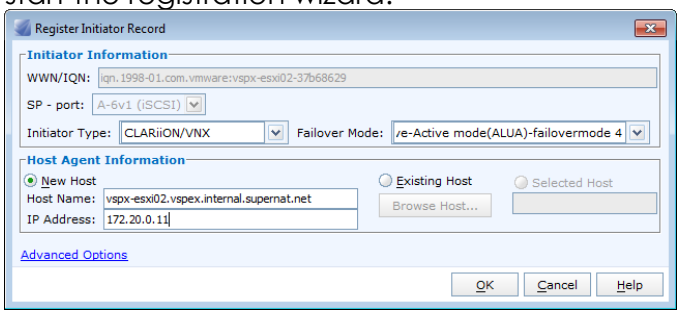


Figure 26. VNXe Host Initiator Registration

3. Select CILARiiON/VNX for Initiator Type and ALUA-failovermode 4 for Failover Mode.

4. Select New Host and enter the Host Name and IP Address of the host being registered, then click on OK.

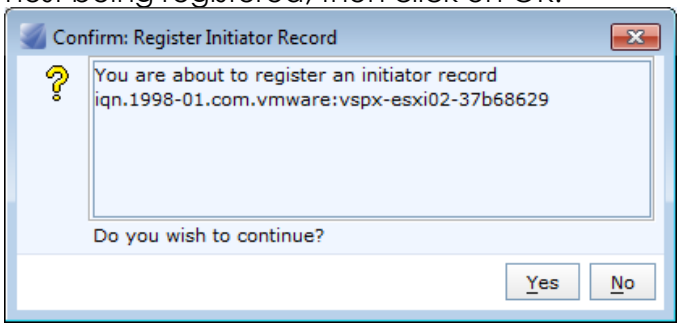


Figure 27. Confirm Initiator Registration

5. Click Yes to confirm.

This registers all Initiators for the host. The initiators will now appear as logged in, and registered, but will still be in the *~management* storage group.

6. Repeat this section for all hosts in the solution.

Creating Storage Groups

Once all initiators have been registered, and LUNs created, click on the Hosts tab in the Unisphere GUI and select Storage Groups to create a Storage Group.

1. Click on Create to launch the Storage Group Wizard.

2. Enter a name in the Storage Group Name box, click on OK then Yes

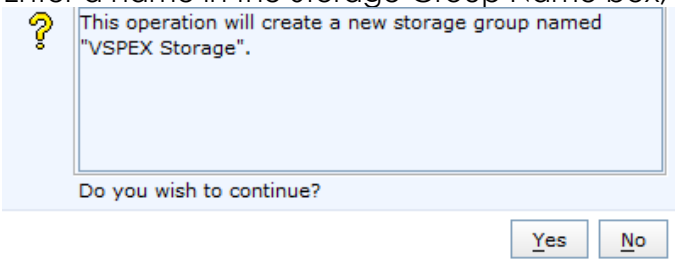


Figure 28. VNXe Storage Group Configuration

3. The new Storage Group is created.
4. Click Yes to add LUNS or connect hosts now.

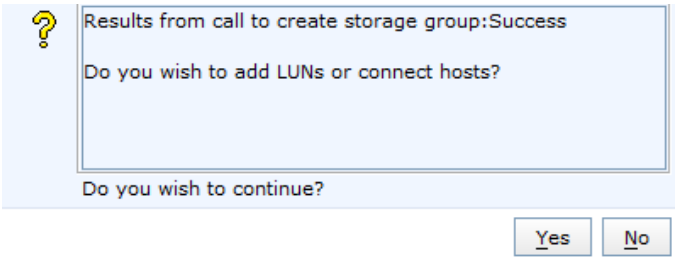


Figure 29. Confirm VNXe Storage Group Hosts and LUNs

5. Click on the LUNs tab and expand SP-A and SP-B then select all LUNs created in the previous steps, and click Add.
6. The LUNs will appear in the Selected LUNs box.
7. Click the Hosts tab.
8. Select all Hosts registered in the previous steps and Click on the *Right Arrow* 
9. The Hosts will appear in the "Hosts to be Connected" Box.
10. Review Hosts and LUNs to be added to group, then Click on OK once finished.

Adding Storage to Virtual Machines

Rescan HBA to view a list of the newly added LUNS in vCenter. Create Datastores or RDM's and present to virtual machines as required.

Chapter 4 Acknowledgements

This chapter presents the following topic:

Acknowledgements

The Lenovo ThinkServer - EMC VSPEX Private Cloud solution for VMware vSphere 5.1 was independently validated at Superna (http://www.superna.net).

Chapter 5 References

This chapter presents the following topic:

References

VSPEX Solution References:

EMC VSPEX Private Cloud Proven Infrastructure Guide

http://www.emc.com/collateral/technical-documentation/h11553-vspex-pi-pc-vmware-vnx.pdf

Lenovo Thinkserver – EMC VSPEX Private Cloud Validated Reference Architecture

<insert link to published Lenovo VSPEX Solution Reference Architecture document>

Extreme Summit References:

Legacy CLI Quick Reference Guide

http://www.extremenetworks.com/libraries/services/Legacy_CLI_Quick_Reference_Guide.pdf

ExtremeXOS ScreenPlay User Guide

http://www.extremenetworks.com/libraries/services/ExtremeXOS_ScreenPlay.pdf

ExtremeXOS® Concepts Guide Software Version 15.1

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http://www.extremenetworks.com/libraries/services/100286-00_Rev18_InstallGuide.pdf

Lenovo ThinkServer References:

ThinkServer User Guide

http://download.lenovo.com/ibmdl/pub/pc/pccbbs/thinkservers/rd630ug_en.pdf

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VMWare References:

vSphere Installation and Setup

http://pubs.vmware.com/vsphere-51/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-51-installation-setup-guide.pdf

EMC VNX References:

EMC® VNX™ VNXe3300™ Installation Guide

https://support.emc.com/docu31489_VNXe3300-Installation-Guide.pdf?language=en_US

EMC® VNXe™3300 System Hardware Installation Guide for Telco Racks

https://support.emc.com/docu34546_VNXe3300-Enclosures-Hardware-Installation-Guide-for-Telco-Racks.pdf?language=en_US

EMC® VNXe™ Series: Using a VNXe System with VMware NFS or VMware VMFS

https://support.emc.com/docu31486_VNXe-Series-Using-a-VNXe-System-with-VMware.pdf?language=en_US

Appendix A VLAN and IP Address Schema

This appendix presents the following topic:

VLAN and IP Address Schema

Each device should have its VLAN and IP address match the table below. The subnet schema embeds the VLAN number into the IP address to simplify the mapping when debugging. This design allows simplified debugging without needing to refer to documents when looking at IP addresses or VLAN's as the rule allows administrators to map them as per the numbers. For example VLAN 2500 would translate to 172.25.0.x and VLAN 3500 translates to an IP address of 172.35.0.x.

Table 4. Sample IP Address Schema

Device	VID	IP
ESXi-1 Mgmt	1001	172.10.1.10
esx-1 Storage ESXi-1 Storage Fabric A	2001	172.20.1.10
ESXi-1 Storage Fabric B	2011	172.20.11.10
ESXi-1 vMotion A	2002	172.20.2.10
ESXi-1 vMotion B	2012	172.20.12.10
ESXi-1 Fault Tolerance/HA A	2003	172.20.3.10
ESXi-1 Fault Tolerance/HA B	2013	172.20.13.10
VNX Mgmt SPa	1001	172.10.1.201
VNX Mgmt SPb	1001	172.10.1.211
VNX mgmt (virtual)	1001	172.10.1.200
VNXe iSCSI Fabric A	2001	172.20.1.200
VNXe iSCSI Fabric B	2011	172.20.11.200

Appendix B Compute Card Schema

This appendix presents the following topic:

CNA Network Assignments

To ensure post deployment supportability, the table below will greatly assist network and server administrators debug physical issues with cabling and data flow through the VSPEX system. All servers should be listed below. The slot naming convention should be based on visual arbitrary slot numbers and not PCI bus numbers as they will not match the physical view from outside the server.

The information will also assist in the installation of new hosts when slotting cards to different network devices. The term fabric is used to break the design down into logical areas. Fabric A and Fabric B is a logical division of all devices in the system and ensures a correct cabling of a device, slot, and port to the correct fabric. This step is critical as all logical flow troubleshooting post deployment is based on the assumption data will flow over certain paths and fabric as primary or secondary paths.

When loading sharing is enabled or multi-pathing data can take different paths through the fabrics, which complicates debugging of the physical to logical design.

Table 5. CNA Network Assignments

Host	Card Type	Slot	Protocol	Port	Fabric (A or B)	QTag	Networks
ESXi	CNA	1	IP	1	A	yes	vMotion, Customer, Management, FT
ESXi	CNA	1	iSCSI, IP	2	A	yes	Storage
ESXi	CNA	2	IP	1	B	yes	vMotion, Customer, Management, FT
ESXi	CNA	2	iSCSI, IP	2	B	yes	Storage

Appendix C Sample Network Configuration

This appendix presents the following topic:

Sample Network Configuration

Fabric A

```
#Disable unused ports
disable port 1-48
#Clear unused ports out of Default VLAN
configure VLAN default delete ports all
#Delete unused ports from vr
configure vr VR-Default delete ports 1-48
#Ensure relevant ports are attached to vr
configure vr VR-Default add ports 7 - 14, 16, 24, 39,40
#Create Trunk
enable sharing 39 grouping 39-40 algorithm address-based L2
lacp
# Create and tag VLANs
create VLAN "VSPX-CUS0"
configure VLAN VSPX-CUS0 tag 2100
create VLAN "VSPX-CUS1"
configure VLAN VSPX-CUS1 tag 2101
create VLAN "VSPX-CUS2"
configure VLAN VSPX-CUS2 tag 2102
create VLAN "VSPX-CUS3"
configure VLAN VSPX-CUS3 tag 2103
create VLAN "VSPX-FLTT"
configure VLAN VSPX-FLTT tag 2003
create VLAN "VSPX-MGMT"
configure VLAN VSPX-MGMT tag 2000
create VLAN "VSPX-STOR"
configure VLAN VSPX-STOR tag 2001
create VLAN "VSPX-VMOT"
configure VLAN VSPX-VMOT tag 2002
#Add ports to VLANs
configure VLAN VSPX-CUS0 add ports 9, 11, 13, 16, 24, 39
tagged
configure VLAN VSPX-CUS1 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-CUS2 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-CUS3 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-FLTT add ports 9, 11, 13, 39 tagged
configure VLAN VSPX-MGMT add ports 9, 11, 13, 16, 24, 39
tagged
configure VLAN VSPX-STOR add ports 7-8, 10, 12, 14 tagged
configure VLAN VSPX-VMOT add ports 9, 11, 13, 39 tagged
# Enable Jumbo Frames
enable jumbo-frame ports 7-14,16,24,39
# Enable Ports
enable ports 7-14,16,24,39
```

Fabric B

```
#Disable unused ports
disable port 1-48
#Clear unused ports out of Default VLAN
configure VLAN default delete ports all
#Delete unused ports from vr
configure vr VR-Default delete ports 1-48
#Ensure relevant ports are attached to vr
configure vr VR-Default add ports 7 - 14, 16, 24, 39,40
#Create Trunk
```

```
enable sharing 39 grouping 39-40 algorithm address-based L2
lacp
# Create and tag VLANs
create VLAN "VSPX-CUS0"
configure VLAN VSPX-CUS0 tag 2100
create VLAN "VSPX-CUS1"
configure VLAN VSPX-CUS1 tag 2101
create VLAN "VSPX-CUS2"
configure VLAN VSPX-CUS2 tag 2102
create VLAN "VSPX-CUS3"
configure VLAN VSPX-CUS3 tag 2103
create VLAN "VSPX-FLTT"
configure VLAN VSPX-FLTT tag 2003
create VLAN "VSPX-MGMT"
configure VLAN VSPX-MGMT tag 2000
create VLAN "VSPX-STORB"
configure VLAN VSPX-STORB tag 2011
create VLAN "VSPX-VMOT"
configure VLAN VSPX-VMOT tag 2002
#Add ports to VLANs
configure VLAN VSPX-CUS0 add ports 9, 11, 13, 16, 24, 39
tagged
configure VLAN VSPX-CUS1 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-CUS2 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-CUS3 add ports 9, 11, 13,  24, 39 tagged
configure VLAN VSPX-FLTT add ports 9, 11, 13,  39 tagged
configure VLAN VSPX-MGMT add ports 9, 11, 13, 16, 24, 39
tagged
configure VLAN VSPX-STORB add ports 7-8, 10, 12, 14 tagged
configure VLAN VSPX-VMOT add ports 9, 11, 39 tagged
# Enable Jumbo Frames
enable jumbo-frame ports 7-14,16,24,39
# Enable Ports
enable ports 7-14,16,24,39
```

Appendix D Sample Cabling Guide

This appendix presents the following topic:

Sample Cabling Guide

Table 6. Cabling Guide

Switch	Switch Port	Device	Device Port
Switch A	1	Uplink 1	N/A
Switch A	7	VNXe	SP A Port 0
Switch A	8	VNXe	SP B Port 0
Switch A	9	Server 1	CNA 1 Port 1
Switch A	10	Server 1	CNA 1 Port 2
Switch A	11	Server 2	CNA 1 Port 1
Switch A	12	Server 2	CNA 1 Port 2
Switch A	13	Server 3	CNA 1 Port 1
Switch A	14	Server 3	CNA 1 Port 2
Switch A	39	Switch B	39
Switch A	40	Switch B	40
Switch B	1	Uplink 2	N/A
Switch B	7	VNXe	SP A Port 1
Switch B	8	VNXe	SP B Port 1
Switch B	9	Server 1	CNA 2 Port 1
Switch B	10	Server 1	CNA 2 Port 2
Switch B	11	Server 2	CNA 2 Port 1
Switch B	12	Server 2	CNA 2 Port 2
Switch B	13	Server 3	CNA 2 Port 1
Switch B	14	Server 3	CNA 2 Port 2
Switch B	39	Switch A	39
Switch B	40	Switch A	40

Appendix E Sample Switch Port Labeling Guide

This appendix presents the following topic:

Sample Switch Port Labeling Guide

Table 7. Sample Switch Port Labeling Guide

SwitchPort	Display-String (Switch A)	Display String (Switch B)
7	VNX5300-SPb6-0	VNX5300-SPb7-0
8	VNX5300-SPa6-0	VNX5300-Spa7-0
9	vs-esx01-83aP1v3	vs-esx01-83bP1v3
10	vs-esx01-83aP2v4	vs-esx01-83bP2v4
11	vs-esx02-83aP1v4	vs-esx02-83bP1v4
12	vs-esx02-83aP2v4	vs-esx02-83bP2v4
13	vs-esx03-83aP1v4	vs-esx03-83bP1v4
14	vs-esx03-83aP2v4	vs-esx03-83bP2v4
24	Uplink A	Uplink B
39	VS-TRUNK-M	VS-TRUNK-M
40	VS-TRUN-S	VS-TRUN-S

Appendix F Compute Firmware and Hardware Installation

This appendix presents the following topics:

PCIe Slot Assignment

Table 8. PCIe Slot Assignment

PCIe Slot	Card
1	Qlogic 8362 - A
2	Qlogic 8362 - B
3	Raid 700 Controller

Recommended Firmware Release (TBC)

Table 9. Recommended Firmware Release

BIOS	Release
MGMT Server	2.12
Compute Fabric	2.12
Compute Fabric RAID	2.120.183-1415
Compute Fabric BMC	1.12

Appendix G Power and Rack Position Planning

This appendix presents the following topic:

Power and Rack Position Planning

Figure 30. Power and Rack Position Planning