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VMware vSphere 5.5: Gen 5 (16Gb) Fibre Channel SANs with Dell PowerEdge R820 Rack Server & Compellent SC8000

Create robust, highly available vSphere 5.5 environments with
best-of-breed Fibre Channel storage and Dell PowerEdge servers



Solution
Implementer's
Series™

Emulex OneConnect® Network Adapters

 **EMULEX®**

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Emulex Solution Implementer's Series

This document is part of the Emulex Solution Implementer's Series, providing implementers (IT administrators and system architects) with solution and deployment information on popular server and software platforms. As a leader in I/O adapters – FC, Ethernet, iSCSI and Fibre Channel over Ethernet (FCoE) – the Emulex technology team is taking a lead in providing guidelines for implementing I/O for these solutions.

The white paper will cover the following:

- An overview of the solution components for Gen 5 FC solution supported by VMware.
- Pre-deployment requirements before deploying the configuration. Topics that are included are networking and storage configuration.
- Post-deployment requisites covering topics such as NPIV, storage multipathing and management plug-ins.
- Management tools to use for Emulex OneConnect adapters, Brocade and Dell Compellent Storage plug-ins.

Executive summary

With vSphere ESXi 5.5, VMware continues to raise the bar for hypervisor products, introducing many new features along with support for more and larger virtual machines (VMs). vSphere ESXi 5.5 does not utilize a service console operating system (OS); VMware agents and CIM providers run directly on the hypervisor layer (VMkernel). There are three options for communicating with VMkernel: VMware vSphere's enhanced CLI, vSphere PowerCLI or the vSphere Management Assistant (vMA) virtual appliance.

VMware vSphere ESXi 5.5 provides many new features and enhancements in areas such as storage and networking. Indeed, VMware has indicated¹ that there are more than 100 new features. For example, they claim that vSphere ESXi 5.5 can run VMs that are four times as powerful as those supported by earlier versions. However, as shown in Table 1, the new, larger VM will place heavy demands on data center infrastructure.

Resource	Requirements for 95% of applications	ESX 1	ESX 2	VMware infrastructure 3.0/3.5	vSphere 4	vSphere 5
CPU	1 – 2 CPUs	1 vCPU	2 vCPUs	4 vCPUs	8 vCPUs	32 vCPUs
Memory	<4GB (peak)	2GB/VM	3.6GB/VM	16 – 64GB/VM	256GB/VM	1,000GB/VM
Network	<2.4Mbps	<0.5Gbps	0.9Gbps	9Gbps	30Gbps	>36Gbps
Storage	<10,000 IOPS	<5,000 IOPS	7,000 IOPS	100,000 IOPS	300,000 IOPS	1,000,000 IOPS

Table 1. Resources supported by various VMware hypervisors.

To help you transition to an infrastructure that can support the storage needed by this new generation of VMs, Emulex has validated the functionality of ESXi 5.5 in conjunction with Gen 5 FC connectivity. The tested environment included the best-of-breed Dell PowerEdge R820 server equipped with a dual-channel Gen 5 FC adapter produced for Dell by Emulex. Storage was provided by a Dell 16GFC Compellent SC8000 system.

The testing demonstrated that Gen 5 FC implementation based on the latest support for 16Gb end-to-end from VMware using Emulex FC adapter technology, worked flawlessly, while also reducing CPU utilization on the ESXi 5.5 host.

Intended audience – This document is intended for engineers, system administrators and VMware administrators interested in deploying ESXi 5.5 on a Dell PowerEdge server featuring an Emulex LPe16000 Gen 5 FC adapter.

¹ <http://www.vmware.com/files/pdf/press-kit/vmw-vsphere-cloud-infrastructure.pdf>

Introduction

vSphere ESXi 5.5 supports an unprecedented number of VMs on a single host; moreover, these VMs can reach unprecedented size. As a result, Emulex expects to see more and more workloads being virtualized, as well as additional resources being assigned to existing VMs to meet the needs of particular workloads. As noted by VMware,² “the VM will only get bigger and faster.” VMware expects³ more VMs to be deployed than ever before, with ESXi 5.5 allowing these VMs to grow as much as four times larger. With this increased density, virtualized environments must be able to provide additional network and storage resources in order to support the workloads.

About this guide

This implementer's guide describes how to configure a Gen 5 FC Storage Area Network (SAN) with a PowerEdge R820 server in a vSphere 5.5 environment. Guidelines and instructions are provided for configuring servers, adapters and storage using technical documentation provided by Emulex, Dell and VMware.

While the key objective was to describe the configuration and validation of this end-to-end solution, this guide also outlines the following:

- Implementing BfS
- Using the Emulex OneCommand Manager plug-in for VMware vCenter Server
- D-Port diagnostics support by both Brocade and Emulex

Solution components

Emulex built the end-to-end test environment shown in Figure 2 in order to validate Gen 5 FC connectivity with ESXi 5.5.

Table 2 and Figure 1 outline the key components deployed in this environment.

Component	Device	Comments
Tested server	Dell PowerEdge R820	Virtualization host running ESXi 5.5; 10 identically-configured VMs
Management server	Dell PowerEdge R710	vSphere ESXi 5.0 Two VMs: <ul style="list-style-type: none"> • vMA (Linux appliance) • vSphere client and Emulex OneCommand Manager or the Emulex OneCommand Manager plug-in for VMware vCenter Server
AD and DNS server	Generic Microsoft Windows Server 2008 system	Support for Microsoft Active Directory (AD) and Domain Name System (DNS)
Storage	Dell Compellent SC8000	Gen 5 FC array
FC connectivity	Gen 5 FC HBA	Emulex LightPulse® LPe16002B Gen 5 dual-port FC HBA
	Gen 5 FC fabric switch	Brocade 6510 24-port SAN switch

Table 2. Test environment.

² <http://www.vmware.com/files/pdf/press-kit/vmw-vsphere-cloud-infrastructure.pdf>

³ Based on interim results of VMware customer surveys performed in January 2010 and April 2011

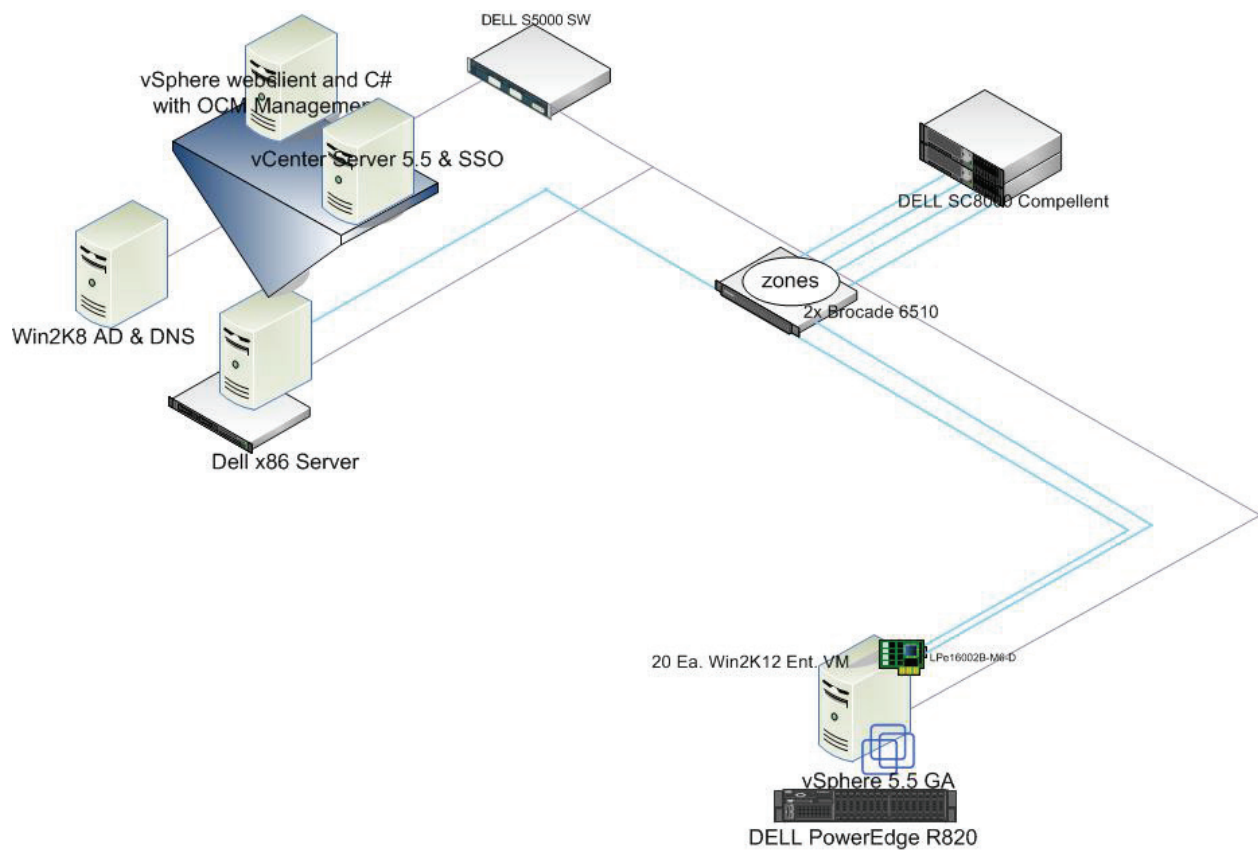


Figure 1. Test environment.

If this is your first time installing VMware products on a PowerEdge server, it is important to have a basic understanding of each of the solution components so the terminology used in this guide is clear.

vSphere ESXi 5.5

VMware's latest hypervisor, ESXi 5.5, extends the core capabilities of vSphere 5.0 and it provides the foundation for a cloud infrastructure, whether public or private. Areas where you can expect to see improvements after deploying vSphere ESXi 5.5 include server consolidation, performance, management, provisioning and troubleshooting.

For more information on vSphere 5.5, refer to "What's New in VMware vSphere 5.5 Platform," available at www.vmware.com/files/pdf/vsphere/VMware-vSphere-Platform-Whats-New.pdf.

Dell PowerEdge servers

PowerEdge R820 servers continue to be the servers of choice for many Dell shops in the VMware space. These servers are widely used – from small and medium-sized businesses to large data centers – due to their high availability, scalability, CPU horsepower and memory capacity. In addition, these 2U rackmount servers save space and power, making them ideal for large data centers moving to a cloud infrastructure.

Using shared storage

When deploying vSphere on PowerEdge servers, you should always consider using a SAN so you can take full advantage of the many hypervisor features and enhancements that require shared storage. There are several supported options available for shared storage including VMware VSAN. At the time of this writing VMware VSAN was not publicly available and is not part of the paper.

While VMware supports most of the more common protocols, FC is the predominant choice for shared SAN storage. Storage protocols continue to evolve, introducing options such as iSCSI and Network File System (NFS) storage arrays; however, this guide focuses on FC connectivity.

Server sizing

Dell has developed a virtualization wiki discussing performance testing and sizing information for running VMware vSphere on Dell servers. For more information, please refer to the following URL, <http://en.community.dell.com/techcenter/virtualization/w/wiki/performance-and-sizing-of-vmware.aspx>.

Dell storage

Designed for customers with critical requirements to improve storage utilization and scalability, the Dell Compellent family of products has become the arrays of choice for mid-range and enterprise virtualized environments. The combination of easy management and rapid Logical Unit Number (LUN) provisioning can accelerate deployment and operations for vSphere 5.5. With its impressive scalability, thin provisioning and performance, a Dell Compellent array can provide shared storage for multiple ESXi hosts while supporting advanced VMware features such as vMotion and Fault Tolerance to name a few. Last, with the announcement of VMware vSphere 5.5, VMware supports full Gen 5 FC support from end-to-end.

The technical documentation provided by Dell can help you help better understand your particular array.

Deploying the solution components

Having introduced the key solution component, this implementer's guide will now describe how to configure Gen 5 FC connectivity. Guidelines are provided for the following areas:

- Pre-installation
- Configuring network connectivity
- Configuring storage
- Deploying ESXi 5.5
- Post-installation

Pre-installation

There are several steps to consider before applying power or installing an OS on any system. First, you need to ensure rack space and appropriate power and cooling are available. A key step is to ensure all hardware and software is at the latest firmware levels and download any necessary patches and drivers. The pre-installation section provides links to verify the latest firmware levels for both Dell and VMware. The pre-installation process provides suggestions in pre-configuring the network for an ESX host, followed by suggestions for storage systems and storage area networking.

As a best practice, Dell recommends verifying with technical support that you are running the very latest Dell firmware and drivers on components such as LAN on Motherboard (LOM) and PCI adapters.

Updating firmware

You can review the latest Dell and VMware firmware at the following locations:

- **Dell** – Visit <http://support.dell.com> to download the latest firmware levels for Dell PowerEdge servers.
- **VMware** – Refer to the VMware Compatibility Guides at www.vmware.com/resources/guides.html.

Before deploying ESXi 5.5 on a PowerEdge server, you should determine the latest versions of the following firmware and if necessary, update:

- ESXi host:
 - System BIOS
 - LOMs and PCI adapters
- Storage array and controllers
- SAN switches

Note – Always contact Dell support to verify the latest firmware updates and drivers.

As always plan your deployment or upgrade before installing software. Read all the documentation provided by VMware and Dell before starting. Planning will speed up the process, particularly if you intend to deploy multiple servers.

With pre-installation activities complete, you can now configure your networking.

Configuring network connectivity

Before installing ESXi 5.5, you need to understand the network requirements for the particular ESXi host and the connectivity supported by the physical server. For example, while many physical servers feature LOM or integrated network interfaces, ports were typically 1Gb Ethernet but newer models may come with 10Gb Ethernet (10GbE) ports standard.

The PowerEdge R820 used in the test environment was equipped with two 10GbE ports. Thus, Emulex was able to configure the ESXi host with a single two port 10GbE Network Interface Cards (NICs), as shown in Table 3. To keep the network as simple as possible in our test environment we used a virtual switch. Your network environment could be different if you already have VMware deployed. If that's the case, consult with your network administrator.

Physical NIC	Virtual switch	Port group(s)
vmnic0	vSwitch0	Management port and vMotion
vmnic1	vSwitch1	VM Network Traffic

Table 3. Four-NIC configuration for ESXi 5.5.

Combining management port traffic, which is relatively light, with vMotion traffic is acceptable in many NIC deployments. Since vMotion traffic is heavier, it is not a good practice to combine this with VM traffic. In practice, you should consider separating vMotion and VM network traffic on different subnets.

Since management port and vMotion traffic is placed on the same virtual switch in the test environment, it is a good practice to use a virtual Local Area Network (vLAN) to enhance security and isolate management port and vMotion traffic.

After deciding how to configure the network, you can now configure storage.

Configuring storage

This section provides information on the following topics:

- Using the VMFS-5 filesystem to support additional storage functionality
- Support for RDM LUNs in ESXi 5.5
- Configuring FC connectivity
 - Implementing fabric zoning
 - Configuring the storage array
 - Configuring Bfs

Using the VMFS-5 filesystem for additional functionality

Introduced with ESXi 5.5, the VMFS-5 filesystem provides support for VMFS volumes up to 64 TB in a single extent. With VMFS-3, 32 extents would have been required to achieve 64 TB.

Note – The volume creation wizard for VMFS-5 uses GUID Partition Table (GPT) format rather than Master Boot Record (MBR), which allows you to create VMFS volumes that are larger than 2TB.

GUID refers to a globally-unique identifier.

With the ability to create large VMFS volumes, you must now manage storage array queue depth, as well as host queue depth. For example, the queue depth of the Emulex LightPulse LPe16002B Gen 5 FC HBA is set by default to 30 and may be adjusted via Emulex OneCommand Manager, the OneCommand Manager plug-in for vCenter Server or vMA.

Other benefits delivered by the VMFS-5 filesystem include:

- Support for up to 130,000 files rather than 30,000 as before
- Support for 64 TB physical-mode RDM LUNs
- Virtual mode allows you to create snapshots, which is beneficial when a file exceeds 2 TB
- For space efficiency, there can now be up to 30,000 8KB sub-blocks
- There is small-file support for files of 1KB or less; in the past, such files would have occupied entire sub-blocks

As you plan the deployment of shared storage, take into consideration the benefits of VMFS-5. For example, if you are migrating from ESXi 4.x to ESXi 5.5, you may also wish to migrate to VMFS-5 to take advantage of the new features and enhancements.

Support for Raw Device Mappings in ESXi 5.5

RDM's are used to map a LUN directly to a VM. The RDM will bypass the hypervisor and be directly written to the disk of the VM by passing the VMFS file system. While RDM LUNs are still supported in ESXi 5.5, Emulex suggests using them sparingly due to manageability issues and lack of real performance benefits. There are some advantages and disadvantages for using RDMs. Here are some to name a few, but the entire list can be found under [Dell's Best Practices for Compellent with VMware vSphere 5.5](#).

Advantages:

- Virtual Mode RDMs support vSphere snapshots
- The volume can be remapped to another physical server in the event of a disaster recovery.
- Ability to create a clustered resource

Again not all advantages are listed so please refer to the link provided.

Disadvantage:

- Adds management overhead due to the number of mappings
- Physical RDMs cannot be used in conjunction with ESXi snapshots
- Limited availability of LUNs that can be mapped to an ESXi host.

Configuring Fibre Channel connectivity

The Emulex FC driver is in-box, making it is easy to transition to Gen 5 FC connectivity from an earlier platform. There is no need to install the driver during the deployment of ESXi 5.5.

Thus, the configuration of Gen 5 FC connectivity via Emulex LightPulse LPe16002B Gen 5 FC HBAs is a simple process in an ESXi 5.5 environment, with just the following stages:

- Implementing fabric zoning for single initiator multiple target zoning
- Configuring the storage array
- Optional – Configuring BfS

Before you begin the configuration, it is a best practice to review the appropriate VMware Compatibility Guide to ensure firmware on the storage array is at the latest level, as shown in Figure 2.

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Model Details

Model: Compellent Storage Center

Manufacturer: DELL

Array Type: FC

Product Id: Compellent Vol

Vendor Id: COMPELNT

Storage Virtual Appliance: No

Notes:
For further details about array firmware, storage product configurations and best practices, please contact the storage vendor.

[rss feed](#)

Model Release Details
Expand All | Collapse All

VMware Product Name : ESXi 5.5

Attention: Storage partners using ESX 4.0 or later may recommend VMW_PSP_RR for path failover policy for certain storage array models. If desired, contact the storage array manufacturer for recommendation and instruction to set VMW_PSP_RR appropriately.

Firmware Version	Test Configuration	Device Driver	MPP Plugin	SATP Plugin	PSP Plugin	Features
+ 6.3	8G FC Switch	lpfc 10.0.100.0-1vmw,qlnativefc 1.0.12.0-1vmw	NMP	VMW_SATP_DEFAULT_AA	VMW_PSP_RR	View
+ 6.3	16G FC Switch	lpfc 10.0.100.0-1vmw,qlnativefc 1.0.12.0-1vmw	NMP	VMW_SATP_DEFAULT_AA	VMW_PSP_RR	View
+ 6.4	8G FC Switch	lpfc 10.0.100.0-1vmw,qlnativefc 1.0.12.0-1vmw	NMP	VMW_SATP_DEFAULT_AA	VMW_PSP_RR	View
+ 6.4	16G FC Switch	lpfc 10.0.100.0-1vmw,qlnativefc 1.0.12.0-1vmw	NMP	VMW_SATP_DEFAULT_AA	VMW_PSP_RR	View
+ 5.6	8G FC Switch	lpfc 10.0.575.8,qlnativefc 1.1.7.0-1	NMP	VMW_SATP_DEFAULT_AA	VMW_PSP_RR	View
+ 6.3	8G FC Switch		Symantec VxDMP v6.1	N/A	N/A	

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Figure 2. Showing firmware levels specified in the VMware Compatibility Guide for a Dell Compellent Storage Center.

IMPORTANT – Whenever there is a need to update code or firmware, Emulex recommends backing up your data and configuration.

Implementing fabric zoning

Zoning has become a standard component of VMware deployments; indeed, most if not all storage array vendors recommend zoning LUNs that are presented to ESXi hosts. Fabric zones can enhance manageability while providing support for advanced features such as vMotion that require multiple hosts to access the same LUN.

Zones can also enhance security. For example, consider what might happen if you were to connect a new server to the same SAN switch as an existing ESXi host. Without zoning or some other security measure, the new server would be able to access the same storage as the existing host and could potentially overwrite the file system, obliterating VM data and files. Thus, since the test environment features two Gen 5 FC HBA ports, there should ideally be two or more fabric switches, each configured with a zone that includes the particular HBA port.

Figure 3 shows the zoning used in the test environment.

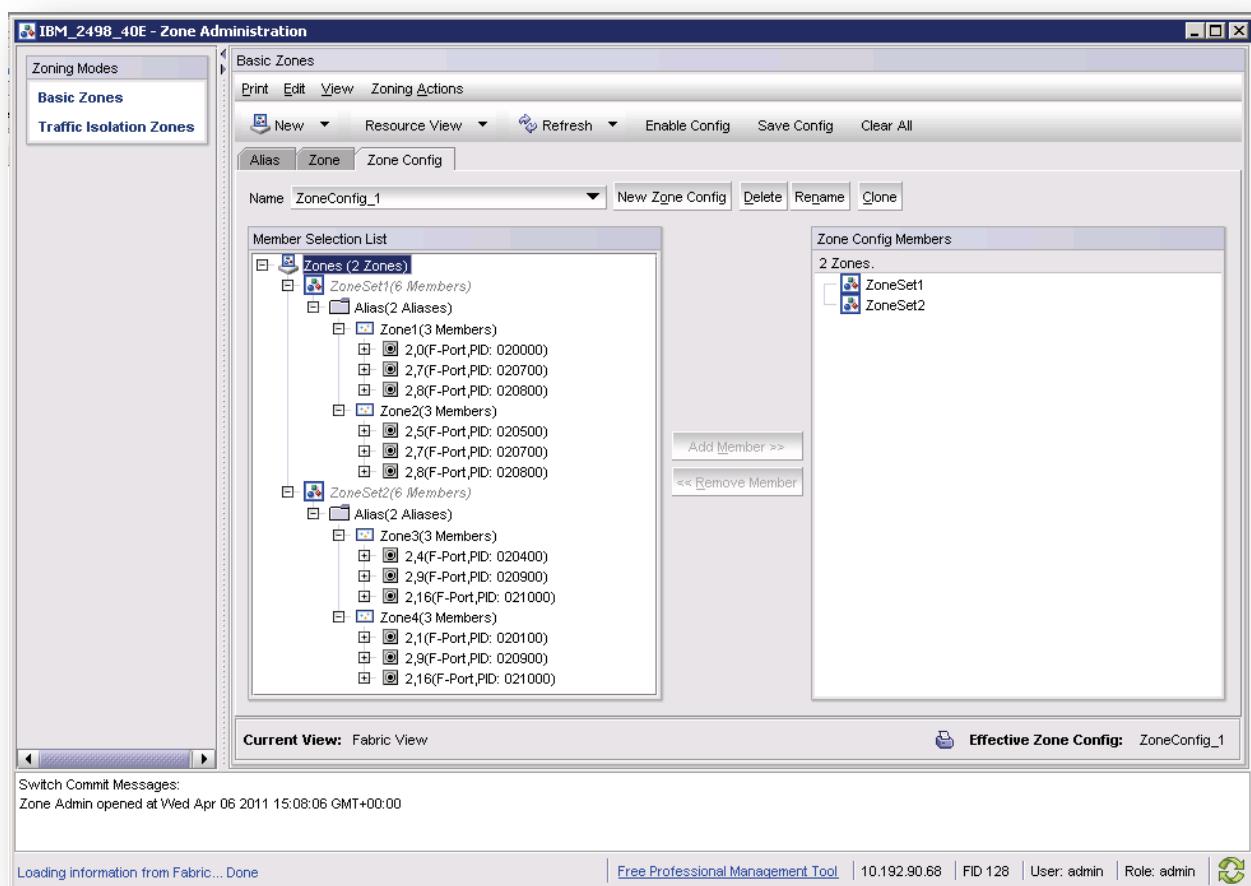


Figure 3. Zoning in the test environment, with four paths to the LUN.

The test environment utilizes two Brocade 6510 Gen 5 FC SAN switches and a total of four zones, as shown in Table 4. The zones were added to an alias zone configuration, which was then activated.

HBA Port	Storage Center front-end ports	Alias	Zone	Zone configuration	Switch
Port 0	Controller1 front-end primary	Zone 1	ZoneSet 1	ZoneConfig_1	1
	Controller2 front-end primary	Zone 2	ZoneSet 1	ZoneConfig_1	1
Port 1	Controller1 front-end primary	Zone 3	ZoneSet 2	ZoneConfig_2	2
	Controller2 front-end primary	Zone 4	ZoneSet 2	ZoneConfig_21	2

Table 4. Zone configuration for HBA.

This zone configuration will give the ESXi host four paths to a single LUN. At this stage of the deployment, no LUNs have been created; thus, LUNs cannot yet be bound to World Wide Port Name (WWPN) on the Emulex LightPulse LPe16002B Gen 5 FC HBA.

Following best practices and Dell recommendations each FC zone created should have a single initiator and multiple targets.

Setting the HBA

There are minimal recommendations for the HBA, but there are a few to consider. The HBAs firmware settings can be located in the Storage Center Administrator's Guide, which is located in the Dell Knowledge Center.

- The topology field should be set to 2 for Auto Topology
- The Node Time Out field "lpfc_devloss_tmo" should be set to 60 seconds
- The following parameter settings should be tested, even though the default can be sufficient at times. The queue depth can be set to 255.
 - The queue depth change from 30 to 255 can be set, since the ESXi VMkernel driver module and Disk Scheduled Number Requests Outstanding (DSNRO) can control the queue depth.

Setting the storage array

Compellent storage arrays are very popular in VMware environments due to their extensive virtualization capabilities and ease of management. Dell has documented deployment and tuning best practices for this simple yet robust and highly available array.

Emulex followed Dell's best practices when configuring the Compellent array by using the Storage Center for the test environment. The purpose of creating shared storage for the white paper was basically VM placement. The hypervisor was installed locally on a pair of RAID 0 drives.

The process included the following stages:

- If necessary, update storage array controller firmware and management software as needed
- Mapping volumes to ESXi server with Dell Storage Center
- Multipath volumes in Storage Center

The first step we took to configure the storage array for VMware hosts was to create a server cluster with Storage Center. Figure 4 shows the window where you add the host and associate it with the HBA. There were a total of 4 hosts added to the cluster used for the testing.

Storage Center 28329 - Create Server

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Folder:

Servers

[Create a New Folder](#)

Name: DEIR820

Operating System: VMWare ESX 5.1

Notes:

[Continue](#)

Figure 4. Assigning the appropriate host mode as part of the storage array set-up to VMware ESXi 5.x.

If the correct zoning and host mode have been applied, LUNs will be visible to the assigned hosts. There should be four paths to each LUN for optimal performance and redundancy. Please refer to figure 5 as an example.

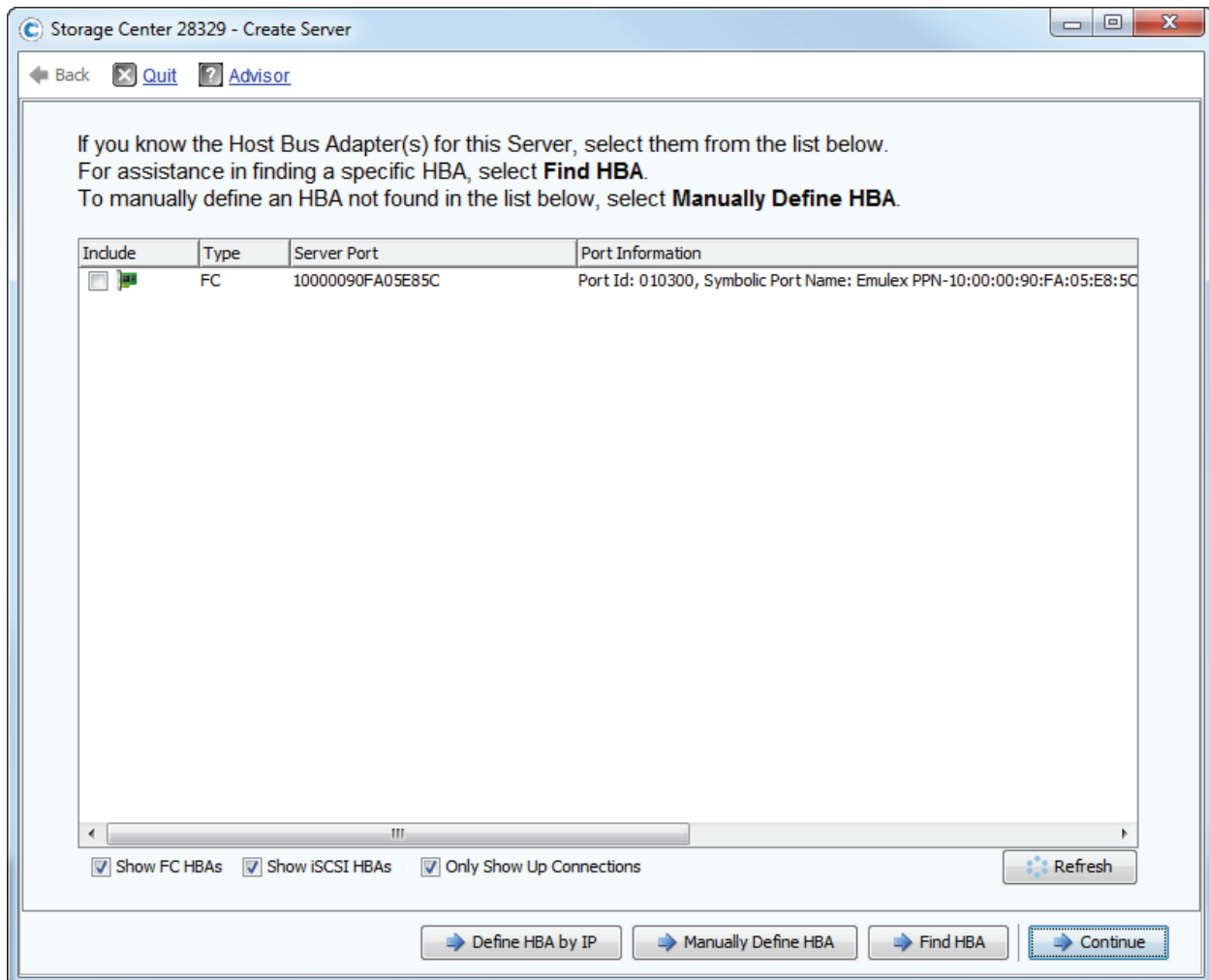
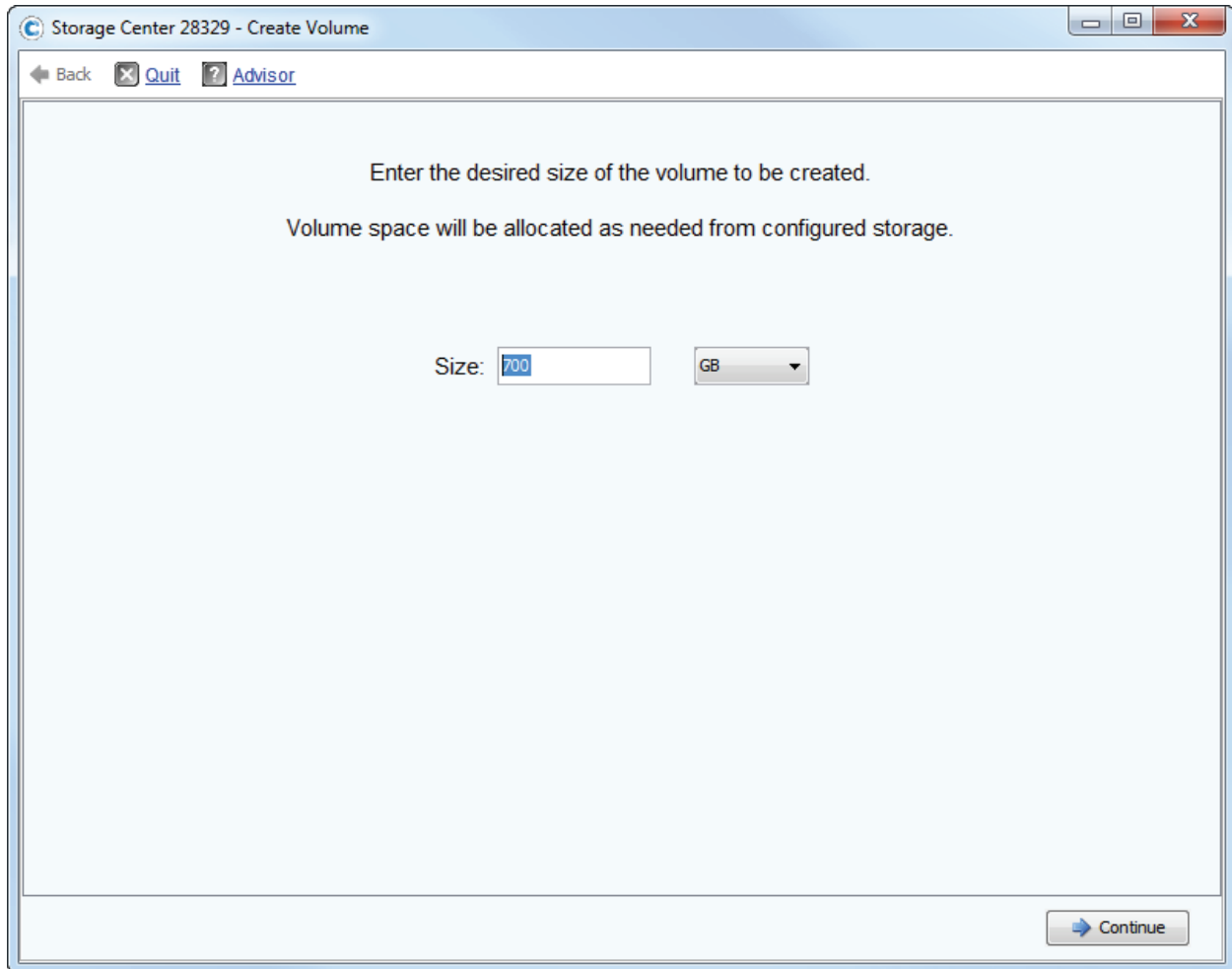


Figure 5. Storage Center – Create server.

The next step was to create the volume(s) to be shared. One volume was created for the host to share called "HOL". The volume size was 700GB in logical size. Please refer to figure 6 as an example.



Storage Center 28329 - Create Volume

Back Quit Advisor

Enter the desired size of the volume to be created.

Volume space will be allocated as needed from configured storage.

Size: 700 GB

Continue

Figure 6. Volume space to be allocated.

Next map the server to the volume. Through Dell's Server Center we mapped the server cluster to the volume called HOL. Please refer to figure 7 as an example.

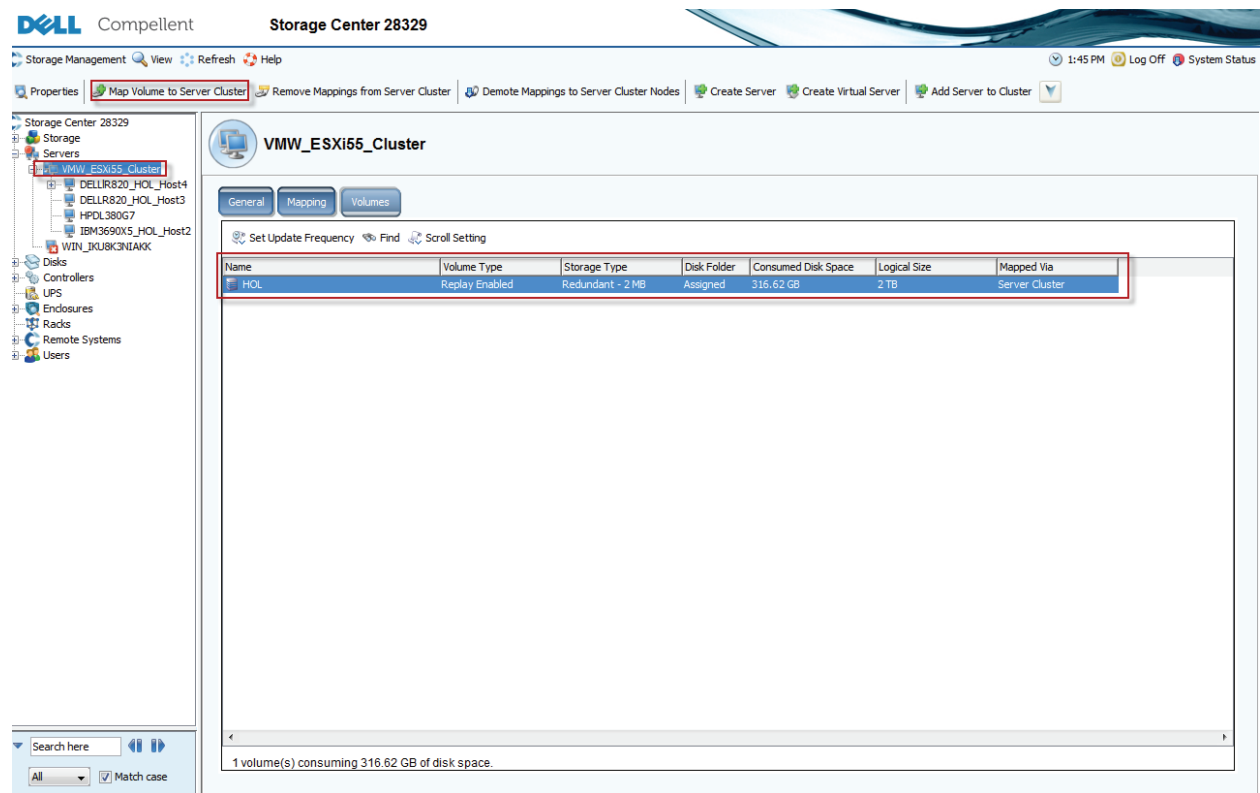


Figure 7. Shows the volume HOL being mapped to server cluster called VMW_ESXi55_Cluster.

Configuring BFS

Enterprise server manufacturers such as Dell continue to offer local disk storage; however, with the growth of virtualization and the increased use of BFS,⁴ server configurations are evolving. For example, Dell offers a diskless server, which would allow you to deploy ESXi via a USB flash drive.

BFS capability is often configured in an ESXi environment, where its benefits include:

- Enhanced manageability
- Faster deployment
- Easier backup⁵
- Enhanced disaster recovery capabilities

The process for configuring BFS via an Emulex LightPulse LPe16002B Gen 5 FC HBA is simple and can be achieved in the following stages:

- Load the latest boot code to the Emulex LightPulse LPe16002B Gen 5 FC HBA
- Configure the ESXi host
- Specify the desired boot volume
- Place the Emulex LightPulse LPe16002B Gen 5 FC HBA first in the boot order

This vendor-specific process is described in more detail in Appendix C – Configuring BFS.

Note – If you plan to install ESXi 5.5 with local storage, Emulex recommends disconnecting the FC cables from the SAN to prevent the OS from being accidentally installed on the SAN.

Once storage has been configured – and you have verified that the hardware has been certified by VMware⁶ – you can deploy ESXi 5.5.

Deploying ESXi 5.5

The deployment section will cover the options available to use for installing ESXi 5.5 to a Dell PowerEdge server. ESXi 5.5 has new deployment options. Since ESXi 5.5 has been designed for flexibility, you have a range of deployment options, including the following:

- Interactive installation: suggested for fewer than five hosts
- Scripted installation: unattended deployment for multiple hosts
- vSphere Auto Deploy installation: suggested for a large number of ESXi hosts with vCenter Server
- Custom installation: vSphere 5 Image Builder CLIs provide custom updates, patches and drivers

Emulex elected to use the interactive method by downloading an ESXi 5.5 image from the VMware website to local storage. The deployment process is fairly straightforward and in many ways, identical to the deployment of earlier versions of ESXi. Since this process is detailed in VMware's technical documentation, it is not described in this guide.

⁴ Whereby the storage array owns the operating system LUN

⁵ Since the array owns the LUN, array-based copies can be made without server intervention

⁶ Refer to the VMware Compatibility Guides at www.vmware.com/resources/guides.html

The main points to remember before beginning the deployment are as follows:

- Check all firmware on host and adapters and make updates as needed
- Check HBA drivers
- Plan the networking configuration
- Plan the FC storage configuration and LUNs
- Decide on local or BFS storage
- Select the most suitable deployment option for your environment

It should not take more than a few minutes to install ESXi 5.5.

After you have configured the management network and if appropriate, enabled lockdown mode, you can proceed with the post-installation process, which includes configuring the ESXi 5.5 host for 8GFC SAN connectivity.

Post-installation

After ESXi 5.5 has been deployed on the ESXi 5.5 host, you should review the installation and perform any necessary updates. Consider the following examples:

- A vendor may have recently released new firmware or drivers.
- Since it is not configured automatically, – unless you are using a scripted installation – you should configure NIC teaming.
- If you are using local storage, remember to reconnect the FC cables to the SAN and then verify that the host can login to the fabric and view any LUNs that have been assigned.

You can now configure the ESXi 5.5 host and storage array for Gen 5 FC SAN connectivity, which may involve the following activities:

- Planning the network environment for the host
- Configuring the HBA
- Using NPIV to identify HBA ports
- Configuring the storage array with features such as multipathing

Note – For host and VM configurations used in the Emulex test environment, refer to Appendix B – Sample configurations for ESXi 5.5 host and VMs.

Updating the lpfc inbox Fibre Channel driver with CLI or VMware Update Manager

VMware vSphere 5.5 provides an inbox driver for Emulex LPe16000 family of adapters. In order to get the optimized driver, it's recommended to update the inbox driver to the latest certified driver by VMware.

For more information on installing drivers please refer to the [Driver's manual](#).

First check to see if the driver is inbox. Login to the ESXi host either through a secure shell client or vMA.

Run the command `#esxcli software vib list | grep Emulex`

Figure 8. Shows the latest lpfc driver installed as of this writing

```
~ # esxcli software vib list | grep Emulex
elxnet                10.2.261.4-10EM.550.0.0.1331820    Emulex  VMwareCertified  2014-06-30
emulex-cim-provider    10.0.774.0-010EM.550.0.0.1331820    Emulex  VMwareAccepted    2014-06-30
lpfc                   10.0.727.44-10EM.550.0.0.1331820    Emulex  VMwareCertified    2014-06-30
```

Figure 8.

Installing an offline bundle locally on ESXi 5.5 with the esxcli command

```
# esxcli software vib install -maintenance-mode -d <offline-bundle.zip>
```

For example, to install 10.0.727.44 release of the lpfc driver in offline mode

```
# esxcli software vib install -maintenance-mode -d /var/tmp/VMW-ESX-5.5.0-lpfc-10.0.727.44-offline_bundle-1894901
```

For example, to install 10.0.727.44 release of the lpfc driver vib file

```
# esxcli software vib install -maintenance-mode -v /var/tmp/lpfc-10.0.727.44-10EM.550.0.0.1331820.x86_64.vib
```

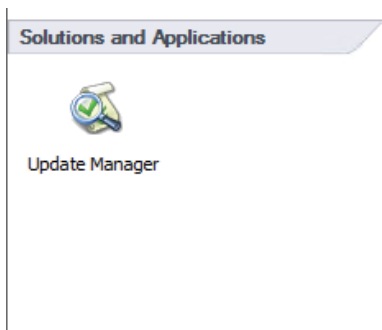
Emulex FC, FCoE, iSCSI and NIC drivers combined with VMware Update Manager.

VMware Update Manager automates and enables a centralized patch management for VMware vSphere. VMware Update Manager offers support for VMware ESX/ESXi hosts, VMs and virtual appliances. For example, the lpfc driver can be installed on multiple hosts instead of one at a time by using the esxcli command line.

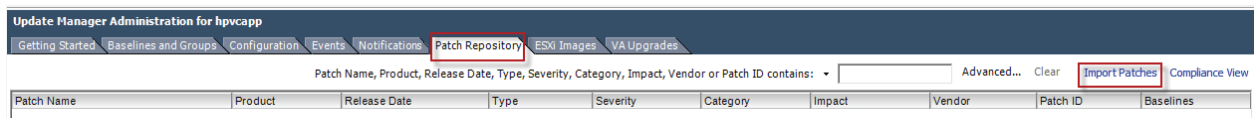
Update Manager can help address the challenge of having to update the FC drivers on several ESX/ESXi hosts. By creating a baseline with the most recent FC driver all of the ESX/ESXi hosts managed by vCenter Server in a cluster or not, can have the lpfc driver update.

The following gives an idea of the steps it takes to create a baseline with Update Manager.

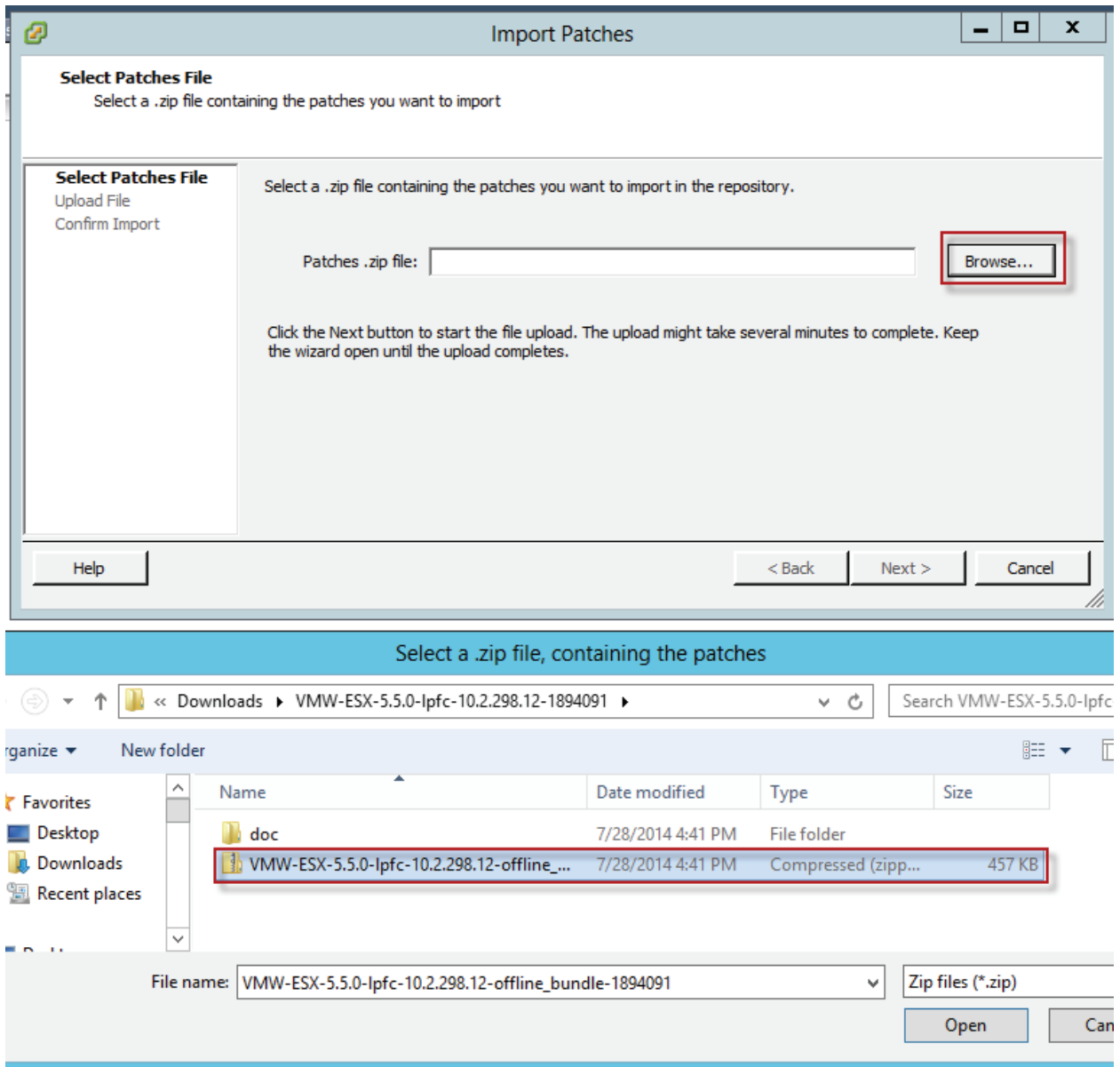
1. Download the latest FC driver and extract the drivers into a temporary place.
2. Open the VMware vSphere client and connect to the vCenter Server. The vSphere web client cannot be used to create baselines and a few other things, since ESXi 5.5 Update 1.
3. Select the Update Manager under the Solutions and Applications section.



4. Select the Patch Repository Tab
5. Select Import Patches

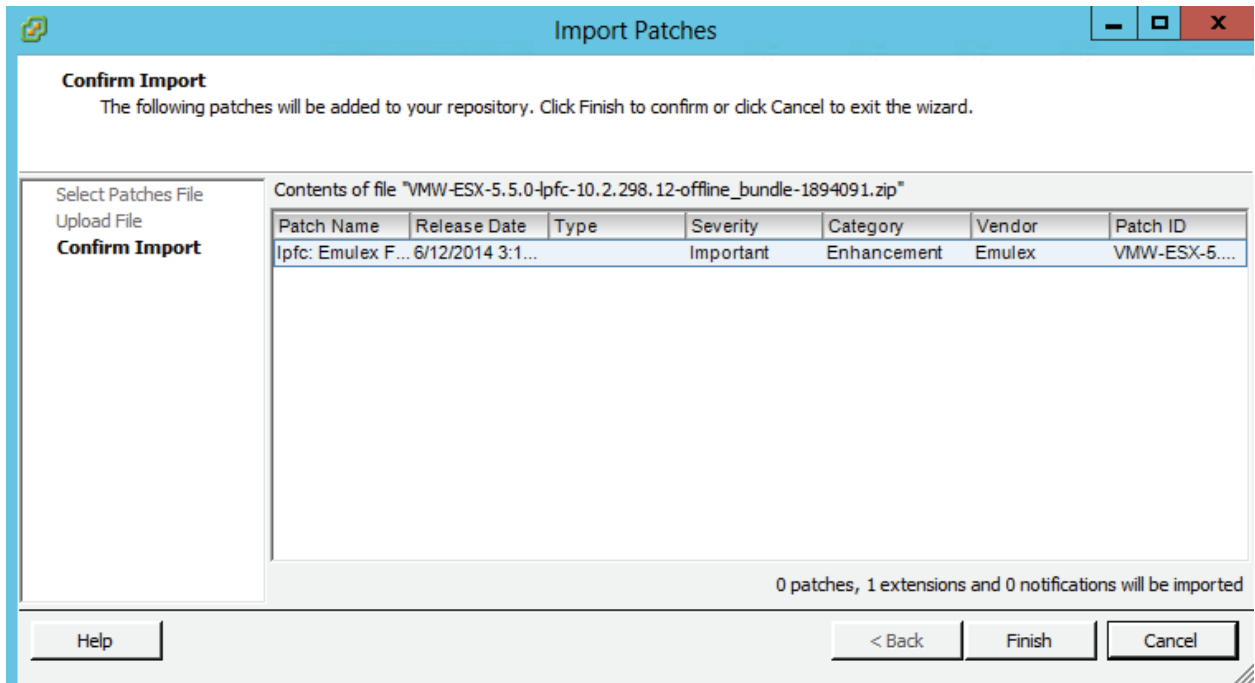


6. Click browse and choose the file that was downloaded.



7. Select Open
8. Click Next. It will take a few seconds to upload the file. The recent Tasks from the vCenter Server console will also show the status until it's completed.

- Once complete it will show the confirmation of the Import with the patch name, release date, type and so on.

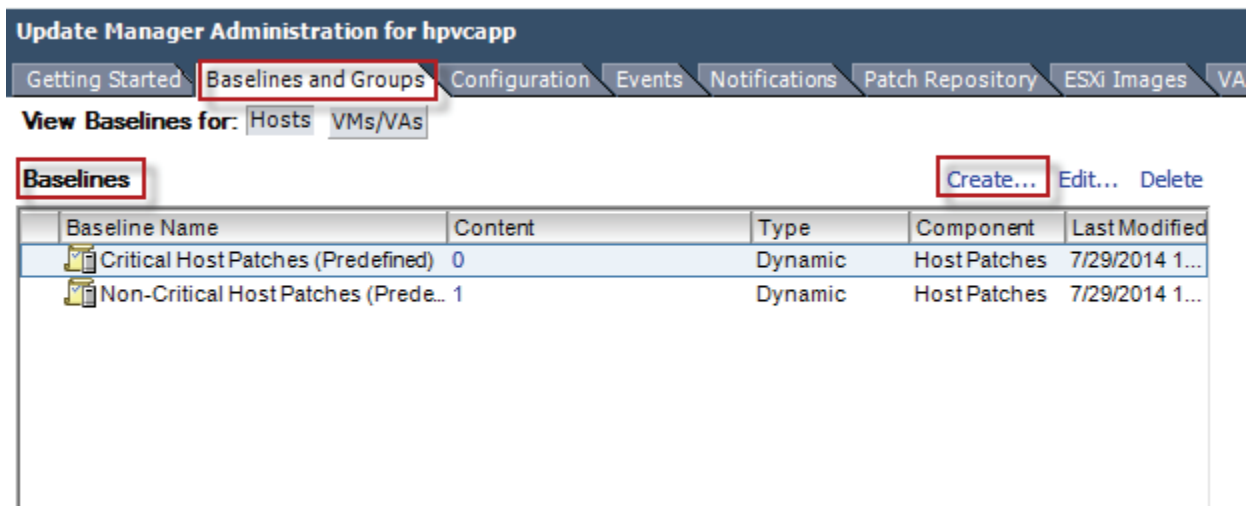


- Select Finish.

This completes the steps to upload the file. At this point you can add it to a baseline or create a patch extension for just the lpfc driver.

The following steps will demonstrate how to create a patch extension for just the Emulex native mode lpfc driver for ESXi 5.5.

- Go to the Update Manager tab from the vCenter Server and select Baseline and Groups.
- Under Baselines select Create.

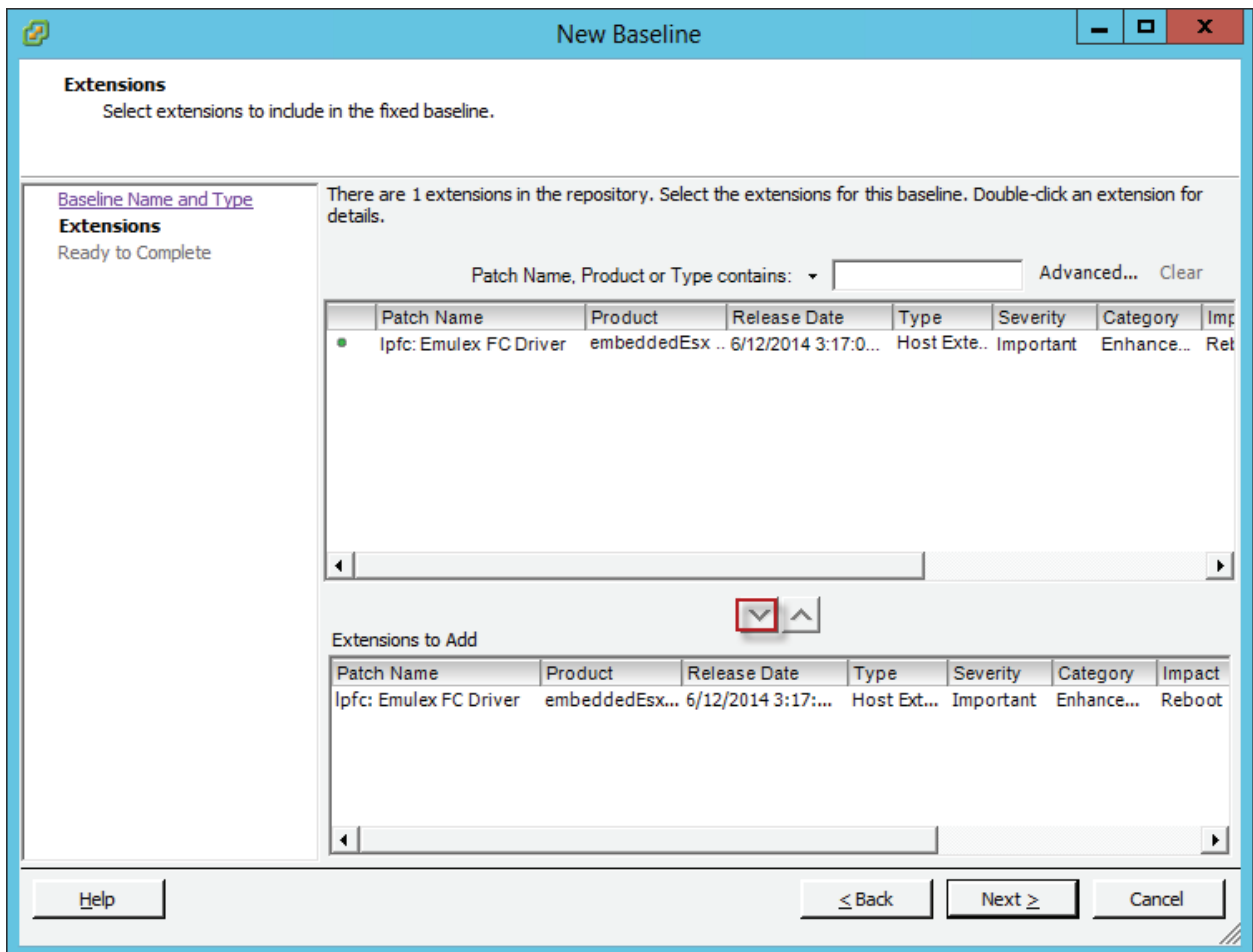


- Give the Baseline a Name and Description. In this example, we are updating the lpfc driver to 10.2.298.12. Make sure to always enter a good description it's good practice.

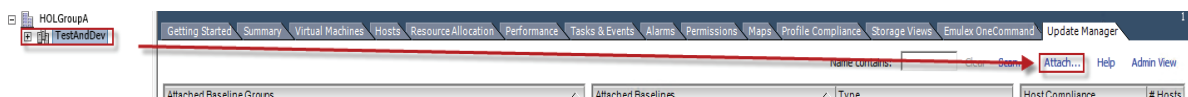
4. Select Host Extension.
5. Select Next.

6. Select the patch by clicking on it.
7. Select the blue down arrow to add the extension.

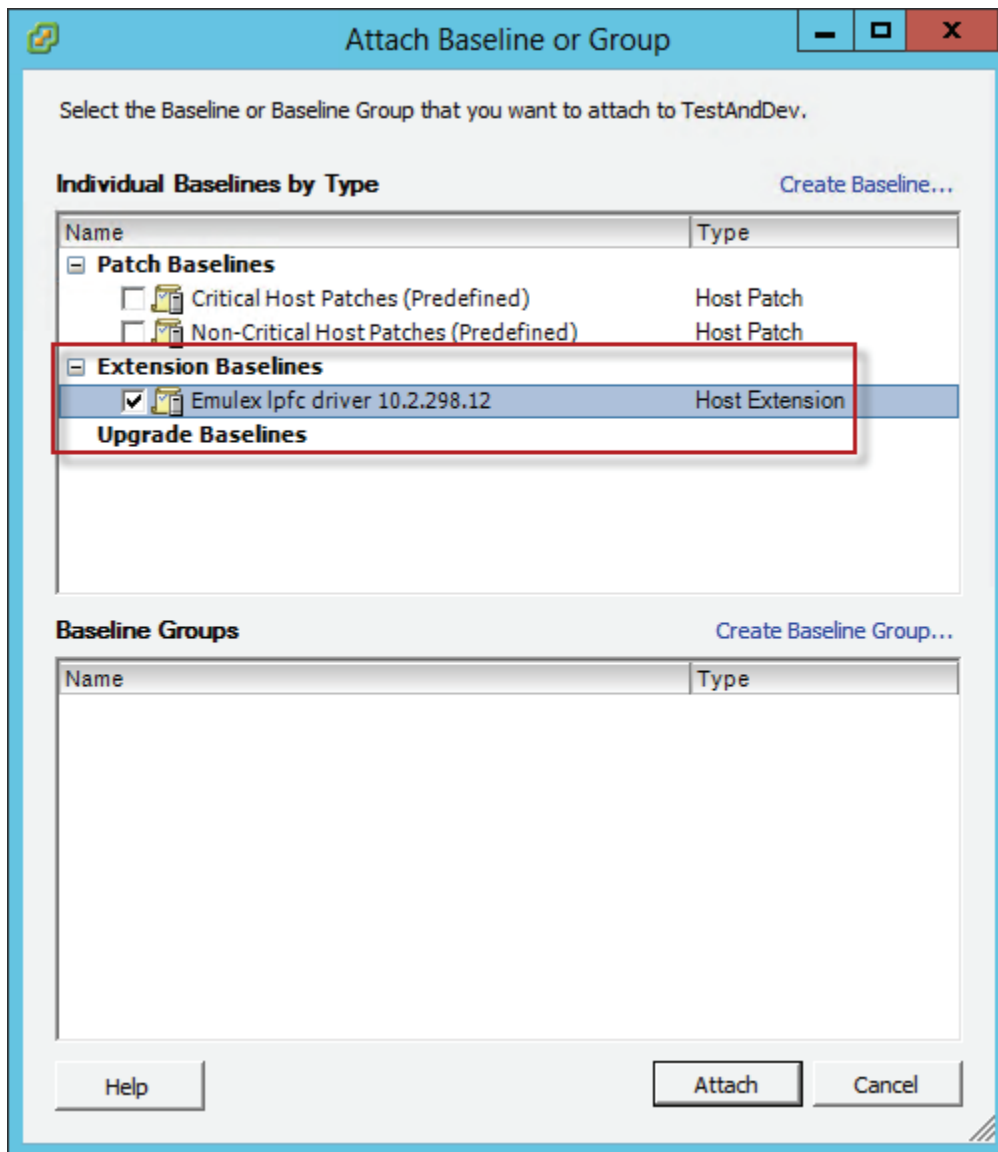
8. Click Next.



9. Select Finish to complete.
10. Select the Cluster or Host to update the Ipfc driver and select the Update Manager tab.
11. Select the Cluster or Host and select Attach.

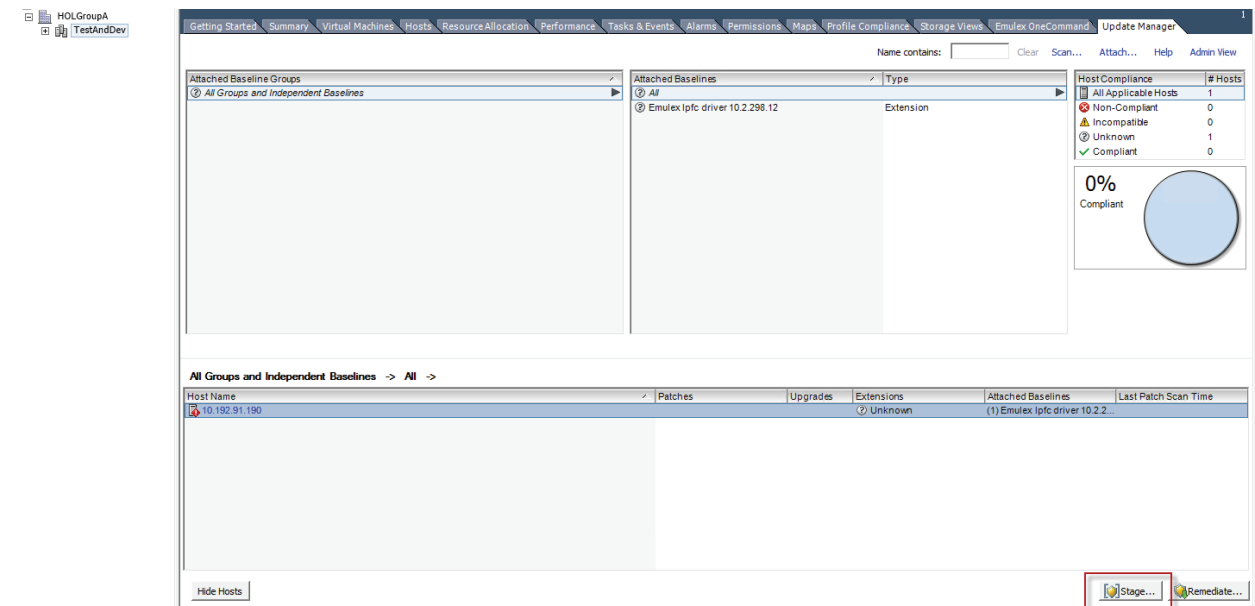


12. Select the Extension Baseline



13. Select Attach

14. Select the Stage button



15. The Stage Wizard will not show the baselines and host. Make sure both the baseline and host are selected with a checkmark.
16. Select Next.
17. Make sure there's a check mark for the lpfc driver in the next Stage Wizard window for Patch and Extension Exclusion.
18. Select Next.
19. Select Finish to stage the patch. View the recent tasks window from vCenter Server.
20. Once it's done there will be a large red circle meaning the ESXi host is not compliant and does not have the latest lpfc driver.

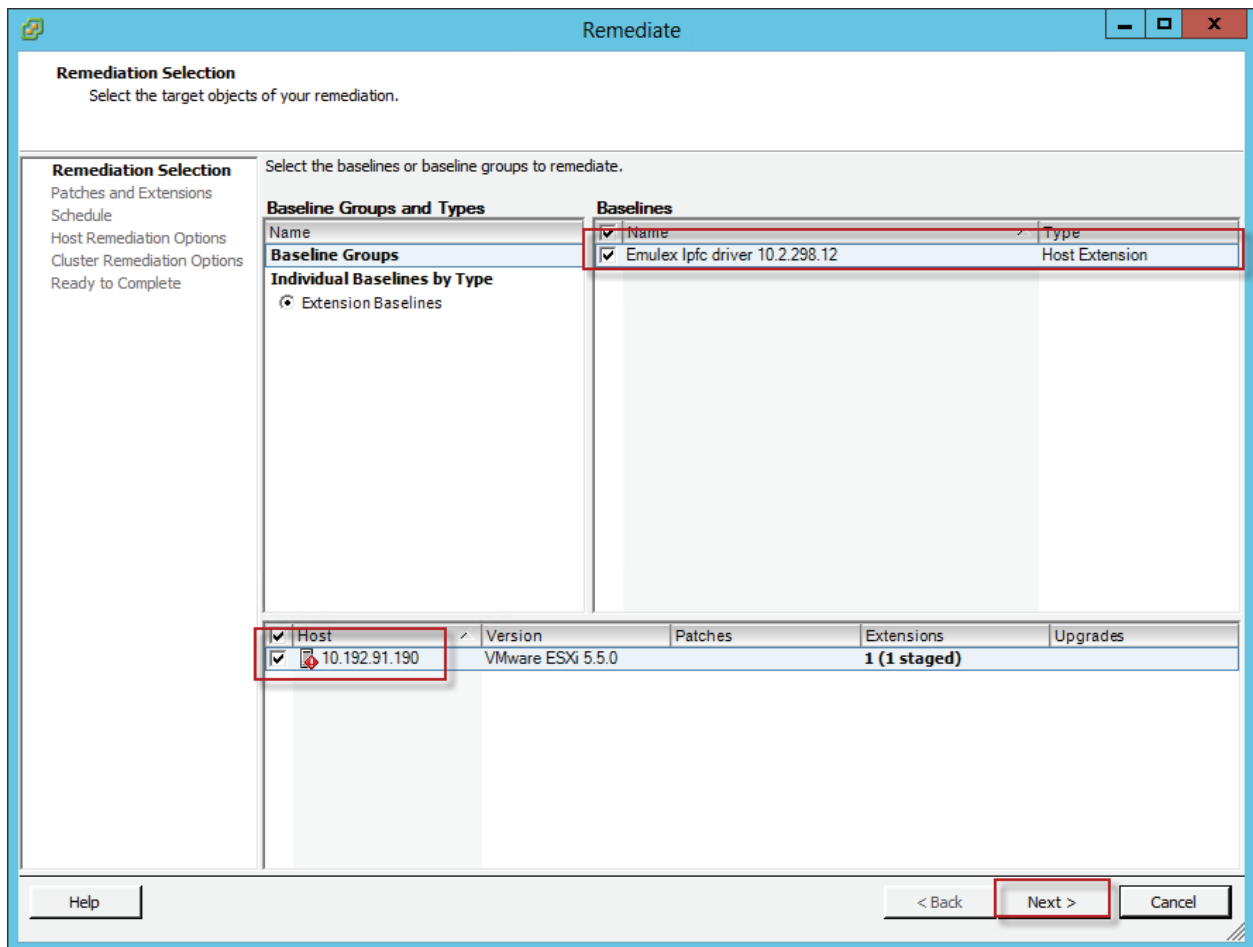
21. Select the Remediate button then Stage the host to begin the install process.

The screenshot shows the Connect deployment tool interface. The top navigation bar includes tabs like 'Getting Started', 'Summary', 'Virtual Machines', 'Hosts', 'Resource Allocation', 'Performance', 'Tasks & Events', 'Alarms', 'Permissions', 'Maps', 'Profile Compliance', 'Storage Views', 'Emulex OneCommand', and 'Update Manager'. The 'Hosts' tab is active, displaying a list of hosts. The 'Attached Baseline Groups' section shows 'All Groups and Independent Baselines'. The 'Attached Baselines' section shows 'All' and 'Emulex ipfc driver 10.2.298.12'. The 'Host Compliance' section shows a red circle indicating 0% compliance. The 'Hosts' table lists the host '10.192.91.190' with a status of 'Non-Compliant'. The 'Stage...' and 'Remediate...' buttons are highlighted with a red box. The 'Recent Tasks' section at the bottom shows a list of tasks with columns for Name, Target, Status, Details, Initiated by, vCenter Server, Requested Start Time, Start Time, and Completed Time.

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Time	Start Time	Completed Time
Stage	10.192.91.190	Completed		com.vmware...	hpcapp	7/29/2014 12:42:57 ...	7/29/2014 12:42:57 ...	7/29/2014 12:43:11 ...
Stage patches to entity	TestAndDev	Completed		root	hpcapp	7/29/2014 12:42:50 ...	7/29/2014 12:42:50 ...	7/29/2014 12:43:17 ...
Check new notifications	hpcapp	Completed		VMware vSp...	hpcapp	7/29/2014 12:39:01 ...	7/29/2014 12:39:02 ...	7/29/2014 12:39:02 ...

22. Make sure the Baseline and Host are selected. If not, then place a check mark in the box.

23. Select Next.



24. Select Next for the specific patches being applied.

25. Schedule the patch update accordingly. Immediate was selected in the test example.

26. Select Next.

27. Select the maintenance mode options, Power State and ESXi 5.x patch settings. The defaults were used in the test example.

28. The default can be used in the Cluster Remediation option. Check to make sure you are familiar with the options.

29. Select Next.

30. Select Finish and it will begin to install the lpfc driver.

For more information on using VMware Update Manager, please refer to VMware's technical publications.
<https://www.vmware.com/support/pubs/>.

Configuring the Emulex LightPulse LPe16002B Gen 5 FC HBA

Configuration is simple, if you are migrating to ESXi 5.5 or installing ESXi 5.5 for the first time and you already installed the Emulex LightPulse LPe16002B Gen 5 FC HBA in an appropriate, full-length PCI slot, with the correct small form-factor pluggable (SFP) transceivers.

Since ESXi 5.5 already provides an inbox VMware driver for FC, there is no need to install a driver. After the installation of ESXi 5.5, review the **Configuration** tab of vCenter Server. You will see your HBAs listed under **Storage Adapters**, as shown in Figure 8.

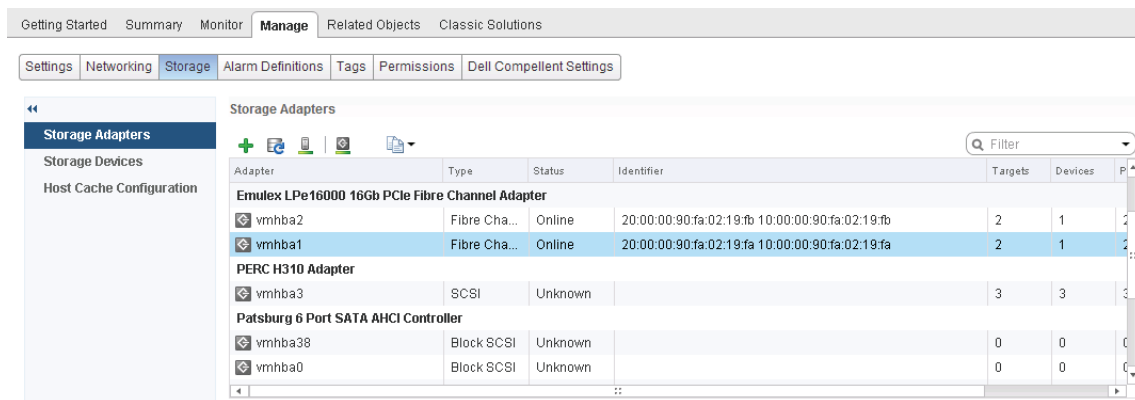


Figure 9. In this example, ESXi has automatically recognized a Gen 5 FC HBA.

If necessary, you can use vMA to remotely send commands to the ESXi host to verify that the driver has been installed.

Using NPIV to identify HBA ports

NPIV is supported in ESXi 5.5. This facility allows a single FC HBA port to register with a fabric using multiple WWPNs, each having a unique entity. To learn more, refer to the VMware technical note “[Configuring and Trouble-shooting N-Port ID Virtualization](#),” which provides specific information on Emulex adapters.

Benefits of using NPIV with Emulex LPe16000B HBAs

NPIV is an ANSI T11 standard describing how a single FC physical HBA port can register with a fabric switch several virtual WWPNs. This enables to be able to assign a virtual WWPN to be assigned to each VM per physical HBA.

Benefit examples of having NPIV:

- Storage provisioning for ESXi hosted VMs, which can use the same methods, tools and expertise in place of physical servers.
- Storage administrators can monitor SAN utilization statistics for each VM giving storage administrators VM level I/O visibility for application level I/O tuning and troubleshooting.
- HBA upgrades are seamless.

Configuring the Dell Compellent SC8000 storage array

In addition to the VMFS-5 filesystem, new storage related feature enhancements in ESXi 5.5 include:

- Support for 62.9 TB Virtual Machine Disk (VMDK)
- MSCS updates
- 16Gb end-to-end support
- Permanent Device Loss (PDL) AutoRemove
- vSphere flash read cache
- vSphere Storage API for Array Integration (VAAI) UNMAP Improvements
- VMFS Heap Improvements

While these valuable new features are beyond the scope of this guide, be aware that you may be facing storage-related issues after you install ESXi 5.5. For example, after mounting a LUN and formatting it with VMFS-5, you may need to determine if additional, array-specific agents are required to support features such as VAAI or vSphere API for Storage Awareness (VASA).

Note – For more information on ESXi 5.5 features that are supported by a particular Dell array, you are advised to consult Dell technical support.

In the test environment, Emulex mounted a LUN and formatted it with VMFS-5. The next concern was multipathing.

Configuring multipathing

By default with ESXi 5.5, the Compellent SC8000 array uses Fixed Path Policy for active storage arrays. This policy maximizes bandwidth utilization by designating the preferred path to each LUN through the appropriate storage controller.

According to Dell documentation, the Compellent SC8000 array also supports the **Round Robin** path policy, which can improve storage performance by load balancing I/O requests between active paths, sending a fixed number of requests through each in turn.

Note – The fixed number of I/Os is user-configurable. You are advised to consult Dell technical support for their recommendations.

Using the OneCommand Manager plug-in for VMware vCenter

Emulex OneCommand Manager for VMware vCenter integrates the in-depth management of Emulex LightPulse HBAs and OneConnect Converged Network Adapters (CNAs) into the vCenter management console.

Note – In order for the OneCommand Manager plug-in for VMware vCenter Server to function, you must also install the appropriate CIM provider on your ESXi 5.5 hosts.

For more information on installing the CIM provider and plug-in, refer to Appendix A – Installing the CIM provider and vCenter Server plug-in.

Using vCenter to update Emulex adapters on multiple ESXi 5.5 hosts can be a daunting prospect for the VMware administrator. To ease this burden, Emulex has developed a plug-in for vCenter – Emulex OneCommand Manager for VMware vCenter plug-in v1.1 – that provides single pane of glass manageability from within vCenter.

Figure 10 presents both supported views from Emulex client and web client plug-in.

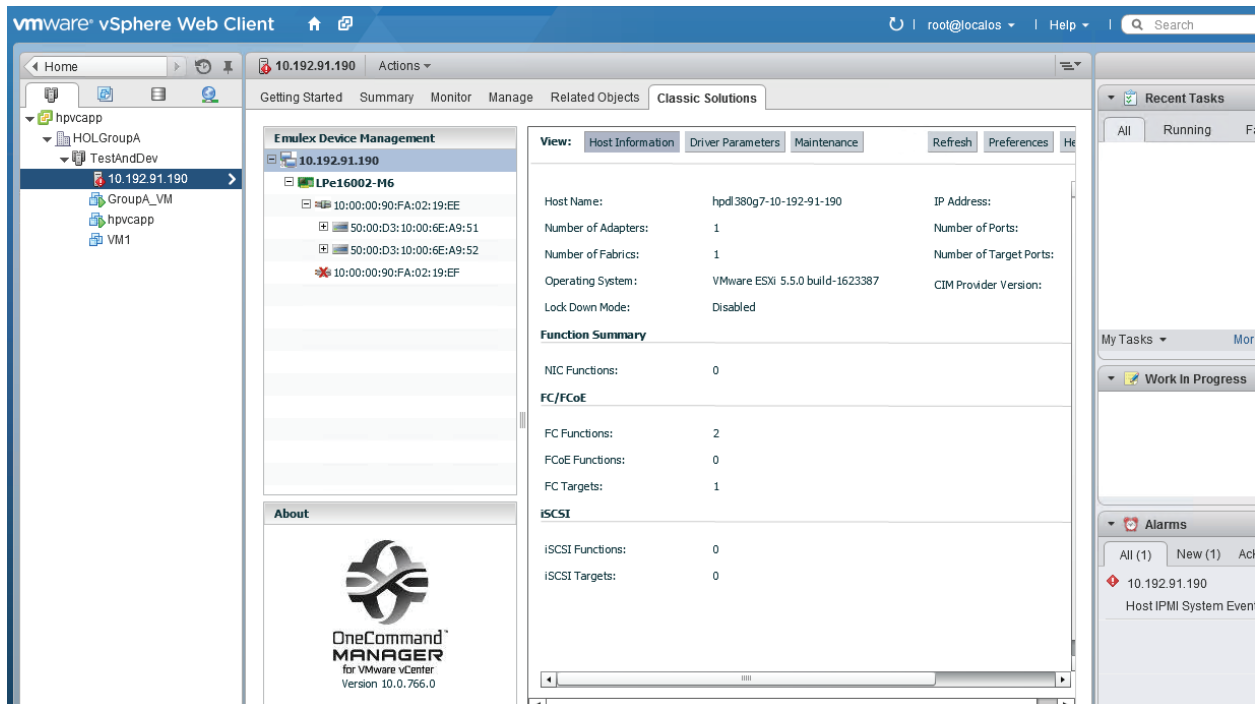


Figure 10. In this example, the OneCommand Manager plug-in is providing information about an Emulex LightPulse LPe16002B Gen 5 FC HBA.

The OneCommand Manager plug-in can manage a mix of Emulex-branded and Emulex OEM adapters (such as the Emulex LightPulse LPe16002B Gen 5 FC HBA).

While OneCommand Manager delivers a range of capabilities, this guide focuses on the plug-in's ability to perform firmware updates on a per port basis while adapters are online, without needing to reboot the host. In addition new logging capabilities added in version 1.1 are outlined.

Note – To activate the new firmware, you must schedule downtime in order to re-boot the host.

Using the plug-in to perform firmware updates

Emulex OneCommand Manager allows you to update the firmware on the Emulex LightPulse LPe16002B Gen 5 FC HBA without having to migrate VMs from the host and reboot the server. You can continue working while OneCommand Manager updates the firmware on the host. At some point in the future the host will need to be rebooted to activate the firmware; however, you will be able to schedule this reboot with the system and vCenter server administrators.

Some environments include not only FC adapters, but also adapters created by Emulex to support other connectivity. In this case, you could, for example, select the desired protocol to only update CNAs on each host.

The process is straight forward by using either the vSphere web client or legacy client. There's more than one way to update the firmware on the servers. The example used to update the firmware is by selecting the server.

Steps that were used to update the adapter on a select firmware are as follow:

1. Select either the cluster or server.
2. Select the Maintenance tab.
3. Then select Update Firmware.
4. Browse for the firmware file.
5. Select Start Update.

Figure 11 shows the maintenance tab to start the process for updating firmware on a particular host.

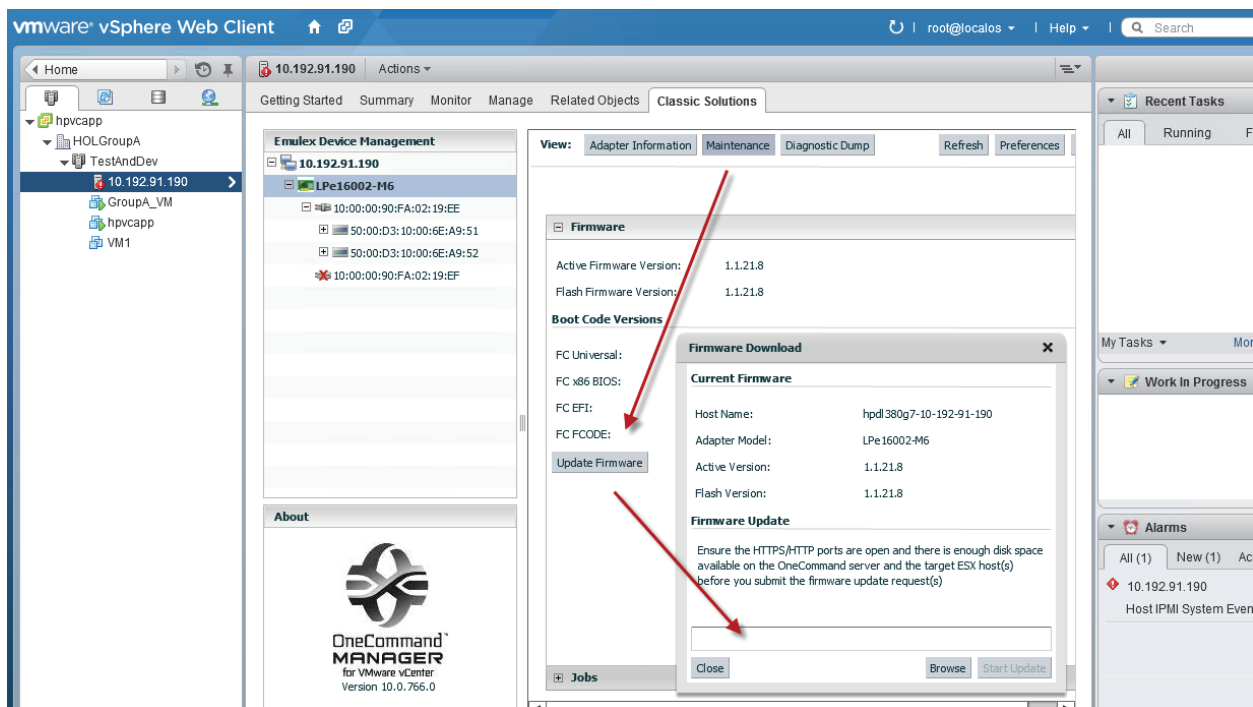


Figure 11. Firmware update on ESXi host.

Best practice – When using OneCommand Manager to update a cluster of servers, Emulex suggests starting by updating hosts in groups of four or five servers at a time.

Using the plug-in to log events

OneCommand Manager also provides the ability to create log files for activities associated with the Emulex LightPulse LPe16002B Gen 5 FC HBA. After this feature is enabled, events are automatically logged; the associated files can be viewed via vCenter's Task & Events tab.

Figure 12 shows event logging being enabled.

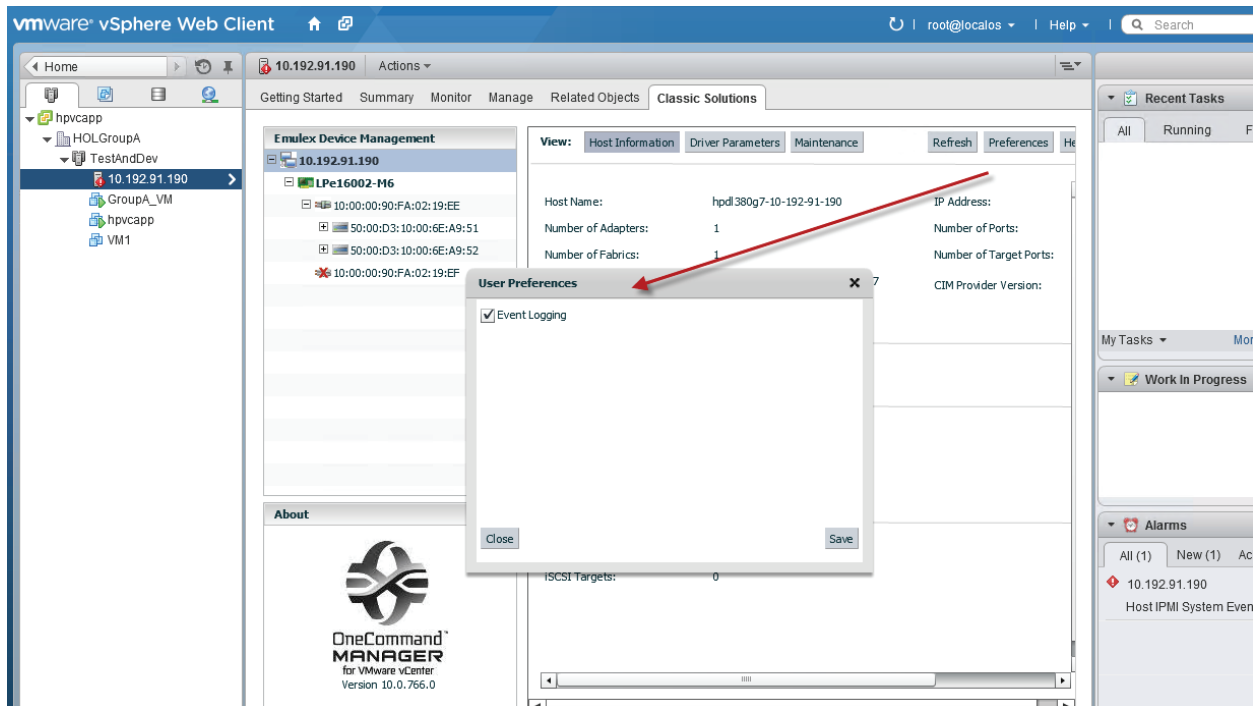


Figure 12. Utilizing User Preferences to enable event logging for the Emulex LPe16002 Gen 5 FC HBA.

One application for event logging is to troubleshoot the status of a particular link – a capability that was missing in earlier versions of OneCommand Manager; however, version 1.1 of the plug-in introduced tighter integration between the plug-in and vCenter.

In the example shown in Figure 13, the Task & Events tab lists event messages indicating that both Emulex LightPulse LPe16002B Gen 5 FC HBA links (that is, both ports) are up. The WWPNs of these ports are also provided.

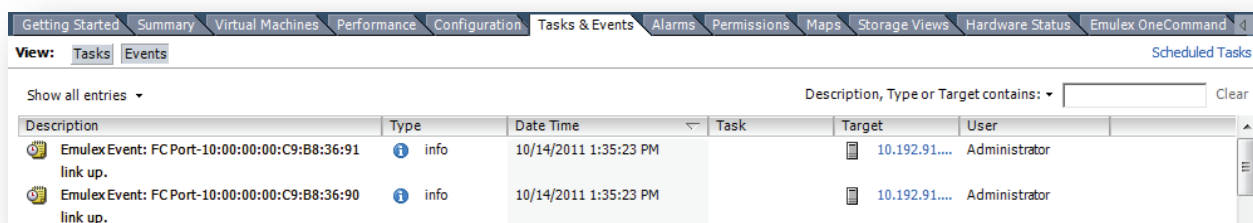


Figure 13. vCenter Server showing the results of enabling event logging for the Emulex LPe12002 Gen 5 FC HBA.

In many occasions there will be several hosts connected to an FC SAN. Supporting the infrastructure can be a challenge with virtualized and non-virtualized servers. There are several hundred optics and cables installed and Emulex OneCommand Manager plug-in may not be enough to support the Emulex adapters. Emulex also provides an enterprise version of their management software called Emulex OneCommand Manager for Windows. Brocade also provides a diagnostic tool called ClearLink, which leverages the unique Brocade Diagnostic Port (D-port) mode to ensure optical and signal integrity for Gen 5 FC optics and cables.

Emulex Gen 5 FC HBA has support for Brocade's ClearLink. By using a Brocade 6510 FC switch in the infrastructure we added support for Brocade's ClearLink D-Port tests. The Brocade 16GFC switch will need to have the appropriate license for Brocade's Fabric Vision. We can now see the events with OneCommand manager through vCenter Server but we can also detect any cable issues from the FC adapter to the switch port.

ClearLink performs the following diagnostics:

- Performs a series of tests on both Brocade Gen 5 FC switches and Emulex Gen 5 FC HBAs.
- Detects physical cabling issues
- Runs a series of tests such as loopback to remote optics, local electric loopback, full device loopback, with data integrity checks and loopback from remote port to the local optics.
- Provides an estimate of cable length which validates a proper buffering scheme is in place.

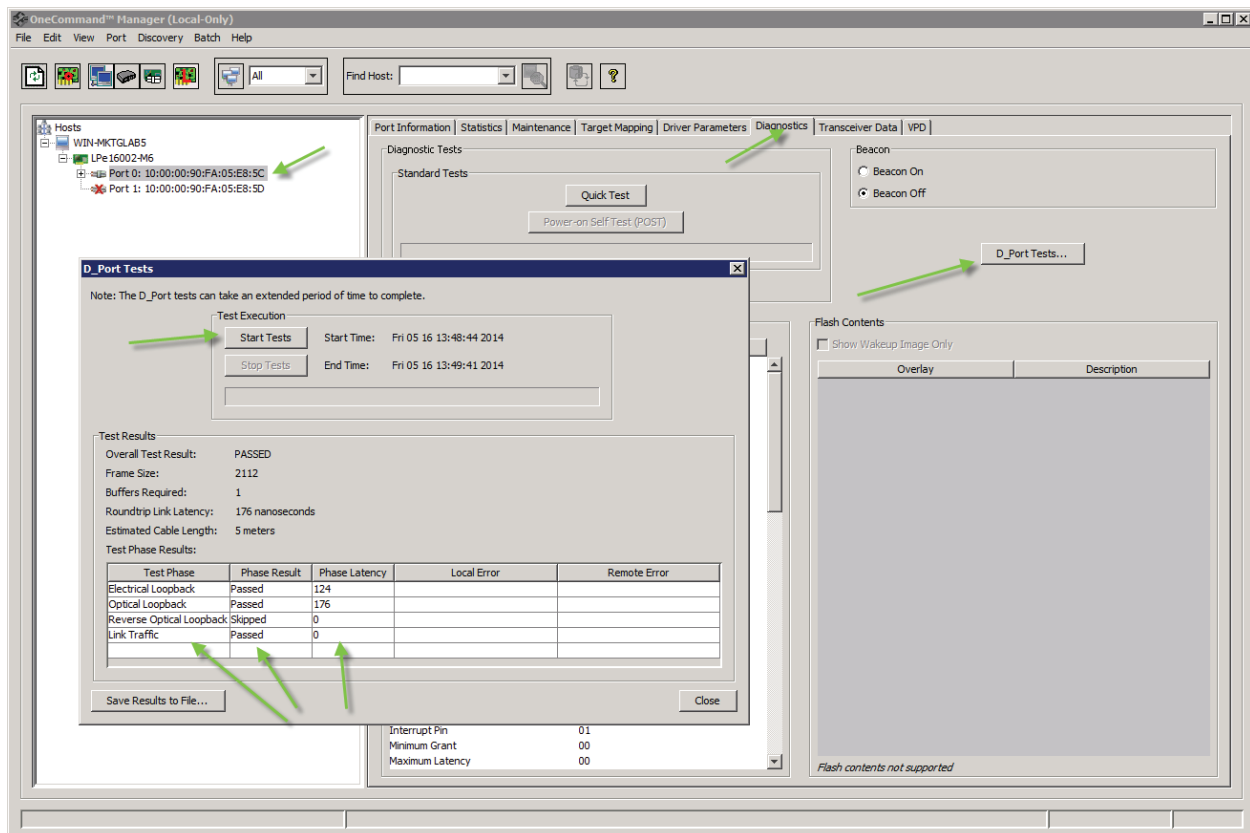


Figure 14. Emulex OneCommand Manager for Windows demonstrates a D-Port test on Port 0.

Summary

In summarizing the white paper, the overview of the solution components needed to successfully deploy a VMware certified solution are provided. All components used were certified and supported by VMware. The pre-deployment process has one of the most important steps before deploying the solution. Planning the deployment of an ESXi 5.5 host – or the migration of an existing host to ESXi 5.5 – is a simple but important process. With the release of VMware vSphere 5.5 there's full 16Gb end-to-end support, which gives us now the ability to combine Gen 5 FC storage with Gen 5 FC switches and adapters, which result with an infrastructure to meet tomorrow's demands of the larger VMs and business critical workloads.

VSphere ESXi 5.5 clearly adds a broad range of features to the hypervisor; however, taking full advantage of these features requires a Gen 5 FC SAN in your virtualization environment.

Finally being able to manage and troubleshoot Gen 5 FC adapters with Emulex OneCommand manager plug-in for vCenter Server makes management easier and less of a burden. The tools provided by both Emulex and Brocade show collaboration with Industry partners.

Appendix A – Installing the CIM provider and vCenter plug-in

In order for the OneCommand Manager plug-in for VMware vCenter to function, you must also install the appropriate Emulex CIM provider on your ESXi 5.5 hosts.

Note – The VMware Knowledge Base provides an Emulex CIM provider overview for ESXi 5.5.

Visit http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=2001548.

The process is as follows:

Note – Ideally, the CIM provider should be installed before deploying any VMs on the particular host. The plug-in can be installed before or after deploying VMs.

1. Download the CIM provider package for ESXi 5.5 to any system that can communicate with the particular host via Secure Shell (SSH). The package is available from the Emulex Downloads site at <http://www.emulex.com/downloads/emulex/vmware/vsphere-50/management.html>.
2. Install the CIM provider on the ESXi 5.5 host (see **Installing the CIM provider**).
3. Reboot the host.
4. Install the vCenter plug-in on a remote system (see **Installing the vCenter Server plug-in**).
5. Register the host.
6. Use vSphere Client to login to vCenter.

Installing the CIM provider

1. Open the SSH port on the ESXi 5.5 host.
2. Use an FTP client (such as WinSCP) to move the CIM package to directory `/var/log/vmware/` on the ESXi 5.5 host.
3. Use an SSH client (such as PuTTY) to login to the vMA.
4. Login to the ESXi host.
5. As shown in Figure A-1, install the CIM provider by typing the following:

```
vi-admin@localhost-> esxcli -s ipaddress software vib install -d /var/log/vmware/name-of-file.zip

vi-admin@localhost:~$ esxcli -s 10.10.10.10 software vib install -d /var/log/vmware/vmw-esx-5_0_0-emulex-3_4_15_5-01-offline_bundle-486461.zip
Enter username: root
Enter password:
Installation Result
  Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
  Reboot Required: true
  VIBs Installed: Emulex-Corporation_bootbank_emulex-cim-provider_3.4.15.5-01
  VIBs Removed:
  VIBs Skipped:
vi-admin@localhost:~$
```

Figure A-1. Installing the CIM provider on the ESXi 5.5 host.

6. After the CIM provider (VIB files) has been installed, reboot the host.
7. As shown in Figure A-2, verify that the CIM provider has been installed by typing the following:

```
vi-admin@localhost-> esxcli -s ipaddress software vib list
```

```
vi-admin@localhost:~> esxcli -s 10.192.91.129 software vib list
Enter username: root
Enter password:
Name                               Version                               Vendor                               Acceptance Level  Install Date
-----                               -
emulex-cim-provider                 3.4.15.5-01                         Emulex-Corporation                VMwareAccepted    2011-10-03
```

Figure A-2. Verifying that the CIM provider has been installed.

After successfully installing the CIM provider on the desired ESXi 5.5 hosts, you should now install the vCenter plug-in on a remote system. Next, use web client to login to vCenter to verify that the Emulex OneCommand Manager plug-in has been added, as shown in Figure A-3.

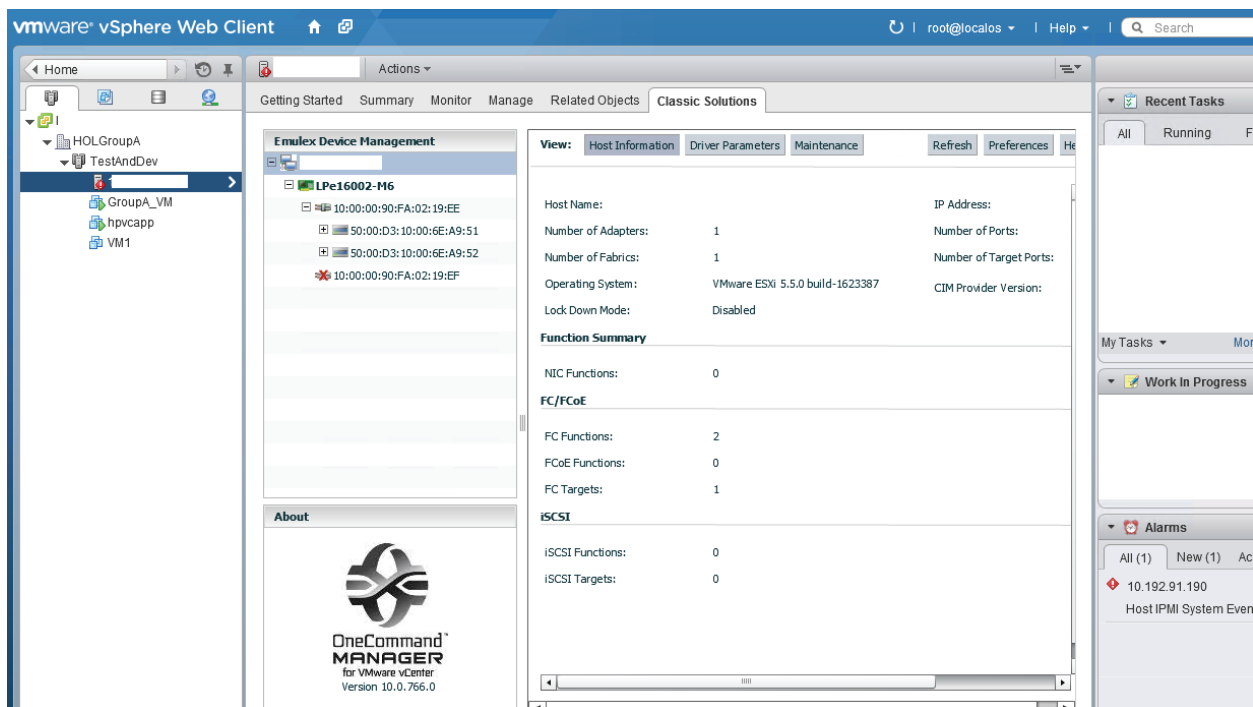


Figure A-3. The Emulex OneCommand Manager has been added to vCenter Server as shown from the vSphere web client.

Note – There may be additional tabs if you have installed CIM providers for other management applications, such as storage.

Appendix B – Configuring BfS

This appendix outlines the process for configuring BfS with PXESelect:

1. Collaborate with your SAN administrator on provisioning a boot LUN and presenting it to the ESXi 5.5 host.
2. Download the Universal Boot Code firmware for your adapter, available at <http://www.emulex.com/downloads/emulex/firmware-and-boot-code/LPe16002/firmware-and-boot-code.html>.
3. Power on the server and, at the prompt, select **Ctrl-E**.
4. Install the boot code firmware.
5. Reboot the host and at the prompt select **Ctrl-E**.
6. Specify the adapter port from which the system will be booting.
7. Scan the array and select the boot LUN.
8. Save the settings and reboot the host.
9. Insert the ESXi 5.5 CD into the CD drive.
10. Initiate the install.
11. Select the appropriate disk on the SAN when asked where to install the media.

Appendix C – Bill of Material (BOM)

QTY	Product	Description
1	PowerEdge R820 Server	
8	32GB RAM	
2	Hard Disk SATA	146GB data hard disk drive
1	LPe16002B	Gen 5 FC Adapter
1	10GbE adapter	Networking adapter
1	DELL Compellent SC8000	Storage Array
	8 TB RAW Drive Space	Storage capacity
2	Brocade 6510 Gen 5 FC switches	FC switches
1	Dell S5000 Ethernet switch	Network switch
2	5M FC cables	cables

For more information

Dell Compellent Best Practices with VMware vSphere 5.5

http://en.community.dell.com/techcenter/extras/m/white_papers/20437942.aspx

Migrating to VMware ESXi

<http://www.vmware.com/files/pdf/VMware-ESXi-41-Migration-Guide-TWP.pdf>

Performance best practices for VMware vSphere 5.5

http://www.vmware.com/pdf/Perf_Best_Practices_vSphere5.5.pdf

VMware vSphere 5 for Dell PowerEdge Servers

http://support.dell.com/support/edocs/software/eslvmwre/VS_5/index.htm

Dell Customized Recovery CD VMware VMvisor 5.5.0 Build 469512

<http://support.dell.com>

To help us improve our documents, please provide feedback at implementerslab@emulex.com.

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