

Dell EqualLogic Multipathing Extension Module

Installation and User's Guide

Version 1.7



Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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About This Manual

PS Series arrays optimize resources by automating performance and network load balancing. Additionally, PS Series arrays offer all-inclusive array management software, host software, and free firmware updates.

Audience

The information in this guide is intended for administrators responsible for managing VMware vSphere environments attached to a PS Series group.

Dell Online Services

To learn more about Dell EqualLogic products, visit the [PS Series support site](#). The site provides links to articles, demos, online discussions, and more details about the benefits of our product family.

Contacting Dell

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services might not be available in your area. To contact Dell for sales, technical support, or customer service issues, go to dell.com/support.

Revision History

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Revision	Date	Description
R1	April 2020	Version 1.7 initial release

Overview

VMware vSphere provides the Pluggable Storage Architecture (PSA), which enables you to configure multipathing for high availability and increased performance. The modular design of the architecture accepts third-party multipathing plugins that enable enhanced functionality specific to storage device models

The Dell EqualLogic Multipathing Extension Module (MEM) provides the following enhancements to the existing VMware multipathing functionality:

- Increased bandwidth
- Reduced network latency
- Automatic connection management
- Automatic load balancing across multiple active paths

Topics:

- [Dell EqualLogic MEM Architecture](#)
- [Dell EqualLogic MEM Configuration Model](#)
- [Determining the Number of Sessions](#)
- [Related Documentation](#)

Dell EqualLogic MEM Architecture

The Dell EqualLogic MEM consists of:

- The EqualLogic kernel mode Path Selection Plugin (PSP) driver — A kernel-mode plugin that the VMware Native Multipathing Plugin (NMP) uses to select the best path for each I/O to EqualLogic storage devices.
- The EqualLogic Host Connection Manager (EHCM) — A user-mode process that runs in a CIM provider and manages the iSCSI sessions to EqualLogic storage devices.

The PSP provides load-balancing capabilities that enable you to maximize I/O throughput. The PSP uses its knowledge of the distributed nature of volumes on the PS Series group and least queue depth to route each I/O packet on the most optimal path to the volume.

EHCM simplifies management by creating the appropriate number of sessions to an EqualLogic volume.

Dell EqualLogic MEM Configuration Model

Figure 1. [Dell EqualLogic MEM Logical Path Configuration](#) shows the logical path configuration that the MEM uses.

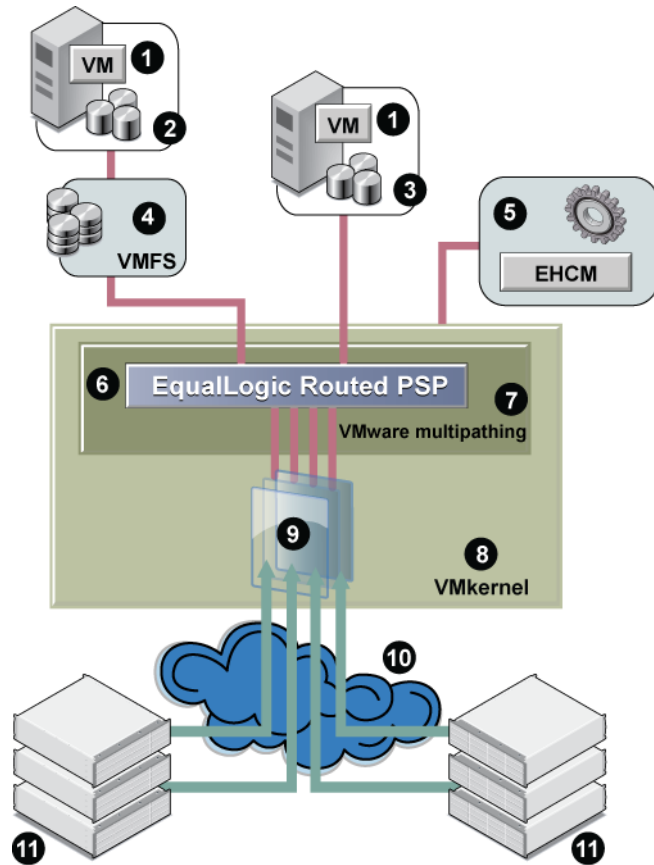


Figure 1. Dell EqualLogic MEM Logical Path Configuration

Table 1. EqualLogic MEM Logical Path Configuration Details describes the components shown in Figure 1. Dell EqualLogic MEM Logical Path Configuration.

Table 1. EqualLogic MEM Logical Path Configuration Details

Callout	Description
1	VMware virtual machines with guest operating system
2	Virtual machine disk format (VMDK)
3	Raw device mapping (RDM) disk
4	VMware file system (VMFS)
5	CIM provider, which hosts EqualLogic Host Connection Management
6	EqualLogic Routed PSP
7	VMware native multipathing, hosting the PSP driver
8	VMkernel, the ESXi hypervisor, including network and storage stacks
9	Host Bus Adapter (HBA) or software initiator
10	Network
11	PS Series group members

Determining the Number of Sessions

EHCM creates the appropriate number of sessions to an EqualLogic volume.

The actual number of sessions is determined by:

1. Calculating the optimal number of sessions to maximize the bandwidth between the host and the member. This calculation takes into account the speed of available host adapters and network interface cards (NICs) on each member hosting part of the volume. The algorithm does not create unnecessary sessions when no performance benefit results. Therefore, in configurations with limited numbers of computer and member Ethernet ports, the actual number of sessions created might be fewer than the user limits specified in step 2.

Example A: You have 2 x 1 Gb host NICs, and are connecting to a volume on members with 4 x 1 Gb eth ports. The optimal number of sessions is 2 per member, because that will saturate the host NICs.

Example B: You have 1 x 10 Gb host NICs, and are connecting to a volume on members with 4 x 1 Gb eth ports. The optimal number of sessions is 4 per member, because that amount will saturate the member eth ports.

Example C: You have 2 x 10 Gb host NICs, and are connecting to a volume on members with 1 x 10 Gb eth ports. The optimal number of sessions is 1 per member, because that amount will saturate the member eth ports.

2. Applying any user-configured session limits. The default behavior is to limit to 2 sessions per volume slice or 6 sessions per volume, whichever is reached first. However, you can modify these limits, as described in [EHCM Configuration File](#).
3. Applying a per-pool throttle to ensure the group remains below 90 percent of the maximum number of allowed connections per pool. This throttling logic ensures the connections are equitably shared among all the pool members and all the hosts using HIT multipathing to connect to volumes on the group. See the *Dell EqualLogic PS Series Storage Array Release Notes* for the current configuration limits.

The number of sessions created by EHCM depends on the topology of your iSCSI SAN and the MPIO settings on the VMware ESXi host. Every volume is distributed across one or more members in the PS Series group. The portion of a volume that is located on a single member is referred to as a volume slice. The default EHCM behavior is to create two sessions per volume slice, with a maximum of six sessions per volume. However, you can alter this behavior (see [EHCM Configuration File](#)).

When you use the Dell EqualLogic MEM, EHCM distributes iSCSI sessions across all configured VMkernel ports and PS Series group Ethernet ports. EHCM monitors the topology of the SAN. If you change the configuration by modifying the number of Ethernet interfaces, or by moving a PS Series volume, or if a network outage affects some of the iSCSI sessions, EHCM automatically reconfigures the iSCSI sessions to reflect these changes.

Related Documentation

It is beyond the scope of this document to provide VMware conceptual information or detailed instructions on configuring VMware vSphere. See the following related documentation.

VMware Documentation

See the [VMware documentation website](#).

Specifically, refer to the following documents:

- *vSphere Installation and Setup Guide*
- *iSCSI SAN Configuration Guide*
- *Installing and Administering vSphere Update Manager*

Dell EqualLogic Product Documentation

For details about managing VMware virtual volumes (VVols), see the following Dell EqualLogic documents:

- *Dell Virtual Storage Manager for VMware Installation and User's Guide*
- *Dell EqualLogic Group Manager Administrator's Guide*

Dell EqualLogic Tech Report

For information about the benefits of the Dell EqualLogic MEM, see the Dell EqualLogic [Configuring and Installing the PS Series Multipathing Extension Module for VMware vSphere and PS Series](#).

Dell EMC PowerStore Documentation

For details about importing EqualLogic storage to a PowerStore array, see *Importing External Storage to PowerStore Guide*.

Installing Dell EqualLogic MEM

This section contains installation information about the Dell EqualLogic Multipathing Extension Module (MEM).

See the *Dell EqualLogic Multipathing Extension Module Release Notes* for installation requirements and information, including:

- Minimum software and firmware prerequisites
- Unsupported VMware environments
- Notes about using EqualLogic MEM with HBAs

Topics:

- [Obtaining the MEM Installation File](#)
- [iSCSI Network Configuration Requirements](#)
- [Using the Setup Script for Network Configuration](#)
- [Configuring Your Network for the Dell EqualLogic MEM](#)
- [Installation Considerations](#)
- [Installing Dell EqualLogic MEM on Your VMware ESXi Host](#)
- [Removing the Dell EqualLogic MEM](#)
- [Verifying the Installation](#)
- [Performing an Upgrade Installation](#)
- [Disabling MEM](#)
- [Using the MEM with AutoDeploy](#)

Obtaining the MEM Installation File

The Dell EqualLogic MEM installation .zip file is available from the Technical Support website. The .zip file has the following contents:

- `setup.pl` – A configuration and installation script. To use this script, install the vSphere CLI on a Linux or Windows host. If you are using vSphere CLI version 6.5 or 6.7, download and install Strawberry Perl version 5.24. See [Installing MEM Using the setup.pl Script](#) for more information about using Perl.
- `dell-eql-mem-esx6-version.zip` – The offline bundle for ESXi 6.0 containing the VIB to install on an ESXi server. Do not extract the bundle, because the installation tools expect it in .zip format. The bundle can be installed through vCenter Update Manager.

 **NOTE: VMware Management Assistant (vMA) does not support vSphere version 6.7 or later.**

iSCSI Network Configuration Requirements

Before you can use the MEM, configure the Dell EqualLogic MEM, VMware ESXi iSCSI networking on your server. Ensure that you complete the configuration tasks identified in [Configuring Your Network for the Dell EqualLogic MEM](#).

Table 2. iSCSI Network Configuration Requirements

Task	Action	Description
1	Create a vSwitch.	Create a vSwitch to use for iSCSI traffic. Assign physical NICs that are used for iSCSI traffic to this vSwitch.
2	Enable jumbo frames.	If you intend to use jumbo frames, enable them for each vSwitch and each VMkernel port (virtual network interface that the VMkernel uses) interface. You can verify that jumbo frames are enabled on the vSwitch and VMkernel port through the vSphere client or by using the commands <code>esxcfg-vswitch -1</code> and <code>esxcfg-vmknic -1</code> . Before enabling jumbo frames, check with your hardware vendors to ensure your physical network adapter and other network equipment support jumbo frames.

Task	Action	Description
3	Decide on VMkernel ports.	Each port must be mapped to a single network port.
4	Create VMkernel ports.	Create VMkernel ports for the iSCSI initiator to use. Create one VMkernel port per physical NIC used for iSCSI multipathing. If you have multiple VMkernel ports sharing an uplink, EHCM uses only one of them, and the excess VMkernel ports are ignored.
5	Remove extra uplinks.	You can use NIC teaming multiple NICs per vSwitch, but each VMkernel port must be mapped to a single uplink (physical NIC). You can verify this mapping by using the command <code>esxcfg-vswitch -l</code> , and you can remove extra uplinks with the <code>esxcfg-vswitch -N</code> command.
6	Enable VMware iSCSI Initiator.	If you are using the software initiator, enable VMware iSCSI Initiator.
7	Bind the VMkernel ports.	Bind the VMkernel ports to the iSCSI daemon with the following command: <code>esxcli iscsi networkportal add</code>
8	Add discovery list.	Add the PS Series group address to the iSCSI Initiator discovery list. If you are using Broadcom iSCSI offload adapters, each adapter port has a separate <code>vmhba</code> . The discovery address must be entered for each adapter name.

See the *VMware iSCSI SAN Configuration Guide* for more information.

NOTE: See the PS Series documentation for group limits and pool limits on total iSCSI sessions. You might need to reduce the number of sessions created per volume in large configurations.

Using the Setup Script for Network Configuration

Use the Dell EqualLogic installation script `setup.pl` for network configuration operations.

Prerequisites for setup.pl Script

The `setup.pl` script is designed to run from the VMware Management Assistant (vMA) or the vSphere CLI from a Linux or Windows host. vSphere CLI version 6.x is supported.

NOTE: VMware Management Assistant (vMA) does not support vSphere ESXi version 6.7 or later.

The `setup.pl` script parameters that are common to multiple operations are shown in the following table:

Table 3. Commonly Used Parameters for setup.pl Script

Parameter	Description
<code>--server</code>	ESXi host or vCenter server against which to run the command.
<code>--username</code>	Administrative user account on the system that the <code>--server</code> parameter specifies.
<code>--password</code>	Password for administrative account on the host. To install MEM on an ESXi host, it must be configured with an administrative password.
<code>--vihost</code>	ESXi host. This parameter is required if <code>--server</code> refers to a vCenter server.
<code>--viusername</code>	Administrative user account for the system that the <code>--vihost</code> parameter specifies.
<code>--vipassword</code>	Password for administrative account for the system that the <code>--vihost</code> parameter specifies.
<code>-reboot</code>	Reboot automatically following a successful installation or uninstall. Applies only to <code>--install</code> and <code>--remove</code> operations.

Configuring Your Network for the Dell EqualLogic MEM

To configure your vSwitch for the Dell EqualLogic MEM, use the following syntax:

```
setup.pl --configure --bestpractices --server=hostname [--username=username]
[--password=password] --nics=NIC1,NIC2,... --ips=IP1,IP2,...
[--vswitch=vswitchname] [--mtu=mtu] [--vlanid=vlanid]
[--vmkernel=vmkernel_prefix] [--netmask=subnet_mask]
[--disable] [--disable --RR] [--disable --Fixed]
[--enableswiscsi] [--nohwiscsi] [--groupip=PS group IP]
[--vds] [--logfile=logfilename] [--heartbeat=IP]
[--chapuser=username] [--chapsecret=secret]
[--vihost=vihostname] [--viusername=viusername]
```

Your configuration may not require all of the parameters. See the following table for a description of the configuration parameters.

Table 4. Parameters Used for vSwitch Configuration

Parameter	Description	Default
--bestpractices	Applies Dell Best Practices when configuring the iSCSI networking. This practice includes setting three parameters on the iSCSI initiator, LoginTimeout to 60 seconds, DelayAck to False, and LRO to Disable. See Dell Best Practices for iSCSI Networking .	none
--nics	Comma-separated list of vmknics to use for multipathing.	none
--ips	Comma-separated list of IP addresses to assign to VMkernel ports used for multipathing.	none
--vswitch	Name of vSwitch to create. setup.pl uses the existing vSwitch if one is found.	vSwitchiSCSI
--mtu	MTU to use for VMkernel ports and vSwitch used for multipathing.	1500
--vmkernel	Prefix to use for VMkernel ports created for multipathing.	iSCSI
--netmask	Subnet mask used for VMkernel ports created for multipathing.	255.255.255.0
--disable	Disable the default routing value of DELL_PSP_EQL_ROUTED. This action changes the routing to VMWARE_PSP_FIXED.	not set
--disable --RR	Disable the default routing of DELL_PSP_EQL_ROUTED and set the routing to VMWARE_PSP_RR (round robin). When the path is set to round robin, the IOPS is set to 3.	not set
--disable --Fixed	Disable the default routing of DELL_PSP_EQL_ROUTED and set the path to VMW_FIXED_PATH.	not set
--enableswiscsi	Enable the VMware software iSCSI initiator if not already enabled.	not set
--nohwiscsi	Ignores any supported iSCSI offload network cards, and uses only the VMware software iSCSI initiator. If the configuration script detects iSCSI offload network cards, it uses this capability by default unless this parameter is set.	not set
--groupip	Sets the specified IP address as a Send Targets discovery address for all iSCSI initiators that were configured to bind vmknics.	none
--vds	Use a vNetwork Distributed Switch instead of a standard vSwitch.	not set
--logfile	Specify a file to use to record a log of network configuration actions.	setup.log
--heartbeat	IP address to use for a highly available VMkernel port on the iSCSI subnet. This VMkernel port uses all physical NICs on the vSwitch so that it remains online if a single NIC or switch failure occurs. This parameter is recommended for ESXi 5.0 and earlier.	none

Parameter	Description	Default
<code>--chapuser</code>	CHAP user name that you use for connecting volumes on the PS Series group IP. CHAP credentials are assigned to the Send Targets discovery address that the <code>--groupip</code> parameter specifies.	none
<code>--chapsecret</code>	CHAP secret that you use for connecting volumes on the PS Series group IP.	none
<code>--vlan-id</code>	Sets the VLAN identification for the vSwitch configured for iSCSI.	0

The `--configure` operation can be run in an interactive mode by specifying only the server name parameter. The script then interactively asks a series of questions to gather the necessary information for network configuration. For example:

```
$ setup.pl --configure --server=192.168.XXX.XXX
```

See [Sample Configuration Commands](#) for examples of the `--configure` operation.

Dell Best Practices for iSCSI Networking

The `--bestpractices` parameter for `setup.pl` enables you to specify recommended values for the iSCSI initiator. This parameter can be applied to ESXi 5.0 or later.

When you set the `--bestpractices` parameter, the following values are set:

- `DelayAck=False`
- `LoginTimeout=60` (seconds)
- `LRO=Disabled`

The settings are applied at the HBA level. If you are configuring multiple types of iSCSI storage and want to limit these settings on only Dell EqualLogic storage, configure them manually on the individual discovery portals instead.

Value	Description
DelayedAck	<p>The default VMware setting for this value is True. Dell recommends setting the value to False.</p> <p>Setting <code>DelayedAck</code> to True enables the delayed acknowledgement of TCP/IP data segments, which in turn reduces acknowledgements of every data segment to every other full-sized TCP/IP segment. Under normal noncongestion network conditions, this behavior could improve TCP/IP efficiency. However, under network congestion conditions, TCP/IP segments are recovered one at a time. If acknowledgements are delayed to every other full-sized segment, this behavior can especially reduce TCP/IP segment read performance and result in frequent maximum response timeouts reported to the VMware VMkernel log. Large buffer sizes worsen these response timeouts.</p> <p>By contrast, when <code>DelayedAck</code> is set to False, congestion recovery then acknowledges every full-sized segment rather than every other one. This behavior will improve read performance under network congestion conditions, avoiding the problems noted.</p>
LoginTimeout	<p>The default VMware setting for this value is 5 seconds. Dell recommends a setting of 60 seconds to allow sufficient time for iSCSI login processing during a single connection failover condition. This additional time can avoid the ESXi/ESX host marking the datastores associated with the iSCSI connections as unavailable, when other iSCSI connections are still available for failover.</p>
LRO	<p>LRO (Large Receive Offload) reassembles incoming network packets into larger buffers and transfers the resulting larger but fewer packets to the network stack of the host or virtual machine. The CPU has to process fewer packets than when LRO is disabled, which reduces its utilization for networking. Dell recommends disabling LRO, which enhances the performance of the host system.</p>

Installation Considerations

- Installation of the Dell EqualLogic MEM requires you to put the ESXi host in maintenance mode using VMware management tools.
- Configuration through the `setup.pl` script requires communicating directly with the ESXi host; therefore lockdown mode must not be enabled.
- Installation requires putting the ESXi host in maintenance mode. You cannot run the installation from a vCenter Server or vCenter Update Manager that is running as a VM on the ESXi host. The VMs must first be migrated to another ESXi host so that they can continue running during the installation.

Installing Dell EqualLogic MEM on Your VMware ESXi Host

The Dell EqualLogic MEM is packaged as an offline bundle containing a VMware Infrastructure Bundle (VIB). The bundle can be installed using one of the following methods:

- [VMware vCenter Update Manager \(vUM\)](#)
- [setup.pl Script¹](#)
- [vSphere CLI](#)

¹Strawberry Perl version 5.24 or later is required.

For network configuration, see [Configuring Your Network for the Dell EqualLogic MEM](#).

To modify the EHCM configuration, see [Sample Configuration Commands](#).

For instructions on uninstallation, see [Removing the Dell EqualLogic MEM](#).

Tasks Performed During the Installation Process

The installation of the Dell EqualLogic MEM performs the following tasks:

- Registers the PSP
- Configures EHCM to automatically start when VMware ESXi is booted
- Sets the EqualLogic PSP as the active PSP for all existing VMware EQLOGIC iSCSI disk devices
- Sets the EqualLogic PSP as the default PSP for any new VMware EQLOGIC iSCSI disk devices

After installation is complete, reboot the ESXi host.

NOTE: For information about adding the capability to import EqualLogic storage to a PowerStore array, see [Importing External Storage to PowerStore Guide](#).

Installing MEM Using vCenter Update Manager

To install the MEM using the vSphere Update Manager (vUM):

1. Install and configure vUM, according to VMware instructions.
2. Import the MEM offline bundle into the vUM package repository by selecting the `Import Patches` option and browsing to `dell-eql-mem-esxn-version.zip`.
3. Create a baseline containing the MEM bundle. Be sure to choose a `Host Extension` type for the baseline.
4. Select all three files in the baseline.
5. (Optional) Add the new baseline to a baseline group.
6. Attach the baseline or baseline group to one or more hosts.
7. Scan and remediate to install the MEM on the hosts. Update Manager puts the hosts in maintenance mode and reboots, if necessary as part of the installation process.

For complete instructions on using vSphere Update Manager, see the *Installing and Administering VMware vSphere Update Manager* documentation available from VMware and the Dell EqualLogic Tech Report *Configuring and Installing the EqualLogic Multipathing Extension Module for VMware vSphere and PS Series SANs*. In this Tech Report, vUM is covered in *Appendix B: Installing the MEM with VMware vCenter Update Manager*.

Enabling PowerStore Import Capability

To enable the capability to import EqualLogic storage to a PowerStore array, do the following on each ESXi host before reboot:

1. Stop `hostd`.

For example:

```
#!/etc/init.d/hostd stop
Terminating watchdog process with PID 67143 hostd stopped.
```

2. Start `hostd`.

For example:

```
#!/etc/init.d/hostd start
hostd started.
```

3. Add import command rules.

For example:

```
#esxcli import equalRule add
```

4. Reboot the system.

For more information about importing to PowerStore arrays, see the *Importing External Storage to PowerStore Guide*.

Installing MEM Using the setup.pl Script

You can use the installation script `setup.pl` for all install, upgrade, and uninstall operations.

- If you are using vSphere ESXi version 6.7, install vSphere CLI version 6.5 or higher.
- If you are using vSphere CLI version 6.5/6.7, you must also download and install Strawberry Perl.

1. Download and install Strawberry Perl version 5.24 or later on a Linux or Windows hosts. See [Strawberry Perl releases](#)

i | **NOTE: Download either the 32-bit or 64-bit version of Strawberry Perl depending on the operating system.**

2. Open the Strawberry Perl CPAN Client, and run the following commands:

```
cpan> install Text::Template
cpan> install UUID
```

3. If you are using Windows, add paths to vSphere CLI (C:\Program Files (x86)\VMware\VMware vSphere CLI\bin) and Strawberry Perl (C:\Strawberry\perl\bin) to the PATH variable.
4. Put the ESXi host into maintenance mode.
5. Open a terminal session or command prompt on a Linux or Windows host.
6. Go to the folder where the `setup.pl` script is located.
7. Run the commands that apply to the ESXi host or vCenter server:

- ESXi host:

```
setup.pl --install --server=hostname [--username=username]
[--password=password] [--bundle=bundle]
[--datastore=datastore-name] [--reboot]
```

- vCenter server:

```
setup.pl --install --server=vCenterIP [--username=vCenterUsername]
[--password=password] [--bundle=bundle]
[--datastore=datastore-name] [--reboot]
```

Parameter	Description
--bundle	Path to the offline bundle file containing the multipathing plug-in (<code>dell-eql-mem-esxn-version.zip</code>). If not specified, the script defaults to the offline bundle in the same directory as the <code>setup.pl</code> script.
--datastore (optional)	Specifies which datastore to use as a staging area to copy the bundle to before it is installed. If not specified, the script uses the first datastore that it finds. (Used for ESXi 5.x and later.)
--reboot (optional)	Automatically reboots ESXi following a successful installation.

For example,

```
./setup.pl --install --server 10.118.186.64 --username root --password my$1234 --bundle /
dell-eql-mem-esx6-<version>.zip
```

The following message appears:

```
Clean install of Dell EqualLogic Multipathing Extension Module.
Before install_package call Bundle being installed:
/home/vi-admin/myName/dell-eql-mem-esx6-<latest version>.zip Copying /home/dell-eql-mem-
esx6-<latest version>.zip
Do you wish to install the bundle [yes]:
```

8. Type yes to continue.

The following message appears:

```
The install operation may take several minutes. Please do not interrupt it.
Do you wish to enable import? Enabling import would claim all PS and PowerStore volumes by
IMPORT SATP and changes the PSP to VMW_PSP_RR [yes]:
```

9. Type yes to enable the capability to import EqualLogic storage to PowerStore arrays.

If you entered yes, the following message appears:

```
Enabling import functionality. In add_claim_rules Clean install was successful.
```

10. Reboot the system.

You must reboot the system before the Dell EqualLogic Multipathing Extension Module with import becomes active.

11. Take the ESXi host out of maintenance mode.

For more information about importing to PowerStore arrays, see the *Importing External Storage to PowerStore Guide*.

Installing MEM Using the vSphere CLI

NOTE: Maintenance mode is required to install packages using `esxcli`, but is not required to remove packages using `esxcli`.

Use the following vSphere CLI command syntax to install MEM:

```
esxcli --server=hostname software vib install --depot bundle
```

The `--depot` parameter specifies the path to the offline bundle file containing the MEM .zip file. (`dell-eql-mem-esxn-version.zip`).

NOTE: To install the offline bundle, first copy it to a location that is accessible from the ESXi host. The `install` command can then be run from any `esxcli` client, giving the full path to the bundle on the host.

For example, if you upload the bundle to a datastore named `datastore1`, you can then install it with the following command:

```
$ esxcli --server 192.168.XXX.XXX software vib install --depot /vmfs/volumes/datastore1/dell-
eql-mem-esx6-<version>.zip
```

```
Enter username: root
Enter password:
Installation Result
Message: Operation finished successfully.
Reboot Required: false
VIBs Installed: Dell_bootbank_dell-eql-host-connection-mgr_1.6.0-469137,
Dell_bootbank_dell-eql-hostprofile_1.6.0-469137,
Dell_bootbank_dell-eql-routed-psp_1.6.0-469137
DellEMC_bootbank_dellemc-import-satp_1.0-14112019.110359
DellEMC_bootbank_dellemc-import-hostagent-provider_1.0-14112019.110359
VIBs Removed:
VIBs Skipped:
```

NOTE:

- Do not extract this bundle, because the installation tools expect it in .zip format.
- Make sure that the path to the bundle you specify is relative to the ESXi host.
- You can specify a bundle that is on an ESXi datastore, or you can specify a full remote URL.

Enabling PowerStore Import Capability

To enable the capability to import EqualLogic storage to a PowerStore array, run the following commands on the host:

1. Stop hostd.

For example:

```
#!/etc/init.d/hostd stop
Terminating watchdog process with PID 67143 hostd stopped.
```

2. Start hostd.

For example:

```
#!/etc/init.d/hostd start
hostd started.
```

3. Add import command rules.

For example:

```
#esxcli import equalRule add
```

4. Reboot the system.

For more information about importing to PowerStore arrays, see the *Importing External Storage to PowerStore Guide*.

Removing the Dell EqualLogic MEM

To remove MEM , either:

- Use the `setup.pl` script
- Use the vSphere CLI

Removing MEM Using the `setup.pl` Script

NOTE:

Uninstalling the host plugin is not recommended If you have enabled the capability to import EqualLogic storage to Powerstore. Uninstalling the host plugin involves host or application down-time and VM/volume re-configuration in some cases. Contact your service provider if you need to uninstall the host plugin after enabling the import to PowerStore function.

To remove the Dell EqualLogic MEM, use the following syntax of the `setup.pl` script:

```
setup.pl --remove --server=hostname [--username=username] [--password=password]
```

Removing MEM Using the vSphere CLI

NOTE:

Uninstalling the host plugin is not recommended If you have enabled the capability to import EqualLogic storage to Powerstore. Uninstalling the host plugin involves host or application down-time and VM/volume re-configuration in some cases. Contact your service provider if you need to uninstall the host plugin after enabling the import to PowerStore function.

To remove MEM VIBs, use the following vSphere CLI command syntax:

```
esxcli --server=hostname software vib remove --vibName [bundle]
```

For example, first obtain a list of the EqualLogic VIBs to be removed:

```
$ esxcli software vib list|grep dell-eql
```

Name	Version	Vendor	Acceptance Level	Install Date
dell-eql-host-connection-mgr	1.5.0-356034	Dell	VMwareAccepted	2019-07-17

dell-eql-hostprofile	1.5.0-356034	Dell	VMwareAccepted	2019-07-17
dell-eql-routed-bsp	1.5.0-356034	Dell	VMwareAccepted	2019-07-17

To properly remove MEM, all three VIBs must be uninstalled. Use the following command line:

```
$ esxcli software vib remove --vibName dell-eql-host-connection-mgr --vibName dell-eql-hostprofile --vibName dell-eql-routed-bsp
```

```
Enter username: root
Enter password:
```

```
Removal Result
```

```
Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
```

```
Reboot Required: true
```

```
VIBs Installed:
```

```
VIBs Removed: Dell_bootbank_dell-eql-host-connection-mgr_1.5.0-356034,
Dell_bootbank_dell-eql-hostprofile_1.5.0-356034,
Dell_bootbank_dell-eql-routed-bsp_1.5.0-356034
```

```
VIBs Skipped:
```

Verifying the Installation

To verify a successful MEM installation, use the `setup.pl --query` command.

For example:

```
$ ./setup.pl --query -server=10.118.1xx.xx --username=root --password=xxxxxx
```

```
Found Dell EqualLogic Multipathing Extension bundle installed: 1.6.0-469137
Default PSP for EqualLogic devices is DELL_PSP_EQL_ROUTED.
Active PSP for naa.603be8ffed75b2e936d57521c4c33be2 is DELL_PSP_EQL_ROUTED.
Active PSP for naa.603be8ffed75920938d59522c4c3eb9e is DELL_PSP_EQL_ROUTED.
Found the following VMkernel ports bound for use by iSCSI multipathing: vmk1
CIM service is enabled.
```

Performing an Upgrade Installation

To perform an upgrade installation of the Dell EqualLogic MEM, use the same procedures that you used for a new installation. See [Installing Dell EqualLogic MEM on Your VMware ESXi Host](#).

NOTE: The upgrade operation requires a reboot before the new version becomes available.

Disabling MEM

MEM is automatically enabled when it is installed. No further action is required to use the Dell EqualLogic MEM. However, if you want to disable and reenble MEM, use the `setup.pl` script as described in this section.

NOTE: Disabling MEM and Reenabling MEM are not supported if the import to PowerStore functionality is enabled.

Disabling MEM sets `VMW_PSP_FIXED` as the active PSP for all existing EqualLogic disk devices, and sets `VMW_PSP_FIXED` as the default PSP for all new EqualLogic disk devices.

Reenabling MEM

Enabling MEM sets `DELL_PSP_EQL_ROUTED` as the active PSP for all existing EqualLogic disk devices, and sets it as the default PSP for all new EqualLogic disk devices. To enable MEM, use the following syntax:

```
setup.pl --enable --server=hostname [--username=username] [--password=password]
```

Using the MEM with AutoDeploy

The Dell EqualLogic MEM supports the AutoDeploy feature in ESXi that allows building images for automatically deploying ESXi hosts. To add the MEM to the boot image, perform the following additional steps while preparing the image profile using the PowerCLI:

NOTE: MEM AutoDeploy is not supported if the import to PowerStore functionality is enabled.

1. Import the MEM offline bundle using the `Add-EsxSoftwareDepot` command. For example:

```
Add-EsxSoftwareDepot depot dell-eql-mem-esxn-version.zip
```

2. Add the three VIBs in the MEM to the image profile. For example:

```
Add-EsxSoftwarePackage -imageprofile name -SoftwarePackage  
dell-eql-routed-bsp  
Add-EsxSoftwarePackage -imageprofile name -SoftwarePackage  
dell-eql-host-connection-mgr  
Add-EsxSoftwarePackage -imageprofile name -SoftwarePackage  
dell-eql-hostprofile
```

See the *vSphere Installation and Setup* documentation available from VMware for more information about AutoDeploy.

The AutoDeploy feature is frequently used with host profiles. For details, see [EqualLogic MEM Configuration Using Host Profiles](#).

Configuring the Dell EqualLogic MEM

EHCM Configuration File

The configuration file that stores configuration parameters is located on the ESXi host at `/etc/cim/dell/ehcmd.conf`. The preferred method of changing the configuration is through the vSphere CLI tools.

The following table shows the parameters and applicable values. Each line in the file uses the format `param=value`.

Table 5. EHCM Configuration Values

Name	Default Value	Maximum	Minimum	Description
RotateLogFiles	yes	Not applicable	Not applicable	Specifies method for handling the EHCMD log rotation policy for the MEM. If the RotateLogFiles parameter is set to false, EHCMD does not handle log rotation. Instead it uses native operating system log rotation policy (if supported).
TotalSessions	512	1024	64	Maximum total number of sessions created to all EqualLogic volumes. You can lower this limit in large configurations to keep the session count within VMware ESXi and PS group limits.
VolumeSessions	6	12	1	Maximum number of sessions that are created to each EqualLogic volume. You can lower this limit in large configurations to keep the session count within VMware ESXi and PS group limits.
MemberSessions	2	4	1	Maximum number of sessions that are created to each volume slice (portion of a volume on a single member).
MinAdapterSpeed	1000	10000	10	Minimum adapter speed for iSCSI multipathing.
MultiLunMemberSessions	4	16	1	Maximum number of MultiLun MPIO sessions used per member per protocol endpoint (PE) target.
MultiLunVolumeSessions	16	64	1	Maximum number of MultiLun MPIO sessions used for entire protocol endpoint (PE) target.

When determining how many sessions to create per volume, EHCM chooses a value that meets all of the constraints that are specified by the `totalsessions`, `volumesessions`, and `membersessions` values.

EHCM does not establish entirely redundant paths (iSCSI sessions that have identical server and array endpoints). Depending on your configuration, the actual number of sessions that are created might be less than you specify for the configuration.

See the Dell EqualLogic PS Series documentation for group limits and pool limits on total iSCSI sessions. For large configurations, you might need to reduce the number of sessions created per volume.

iSCSI Connection Count

As the Dell EqualLogic group's per-pool iSCSI connection count exceeds 90% of maximum, the PS Series array firmware communicates with any hosts or servers using the Dell EqualLogic MPIO plug-ins for VMware, Windows, or Linux, and request that they reduce their iSCSI connection count.

Refer to the following PS Series firmware documentation for pool iSCSI connection count limits and recommendations:

- *Dell EqualLogic Group Manager Administrator's Guide*
- *iSCSI Initiator and Operating System Considerations: Optimizing Your SAN Environment for High Availability*

EqualLogic MEM Configuration Using vSphere CLI Commands

Use the vSphere CLI to configure and inspect the Dell EqualLogic MEM.

For a full description of the vSphere CLI commands, see the VMware documentation.

NOTE: The MEM functionality is available immediately after an installation. However, the new `esxcli` commands that are used to control and report status of the module are not available until the `hostd` agent is restarted. You can restart the agent without rebooting the server by connecting to the ESXi console and running the following command:

```
/etc/init.d/hostd restart
```

You must reboot the ESXi host after installation or after installing MEM.

The following Knowledge Base article provides more information:

<http://kb.vmware.com/kb/2004078>

Viewing Configuration Values

To view the current configuration parameters, use the following vSphere CLI command syntax:

```
esxcli equallogic param list
```

For example:

```
$ esxcli equallogic param list
```

Name	Value	Max	Min	Description
TotalSessions	512	1024	64	Max number of sessions per host.
VolumeSessions	6	12	1	Max number of sessions per volume.
MemberSessions	2	4	1	Max number of sessions per member per volume.
MinAdapterspeed	1000	10000	10	Minimum adapter speed for iSCSI multipathing.
MultiLunVolumeSessions	16	64	1	Max number of multi-lun sessions per volume.
MultiLunMemberSessions	4	16	1	Max number of multi-lun sessions per member per volume.
MultiLunRescanVolPeriod	3600	86400	60	Multi-lun rescan period in seconds for (virtual) volumes.

Setting Configuration Values

To configure the EqualLogic MEM, use the following vSphere CLI command syntax:

```
esxcli equallogic param set --name=parameter_name --value=parameter_value
```

For example:

```
$ esxcli equallogic param set --name=VolumeSessions --value=3
```

EqualLogic MEM Configuration Using Host Profiles

In vSphere, Host Profiles are extended to support third-party providers. The Dell EqualLogic MEM contains such a Host Profile provider, which allows management of some MEM configuration parameters through the host profile framework. Support for host profile operations includes:

- Extracting current MEM configuration from a host
- Editing the configuration settings in an existing host profile
- Checking compliance of a host against a host profile
- Applying a host profile to one or more hosts

See the *vSphere Host Profiles Guide* available from VMware for more information about using host profiles.

Troubleshooting

This chapter discusses topics related to troubleshooting the Dell EqualLogic MEM.

Topics:

- [Log Files](#)
- [CLI Commands for Troubleshooting](#)
- [Troubleshooting Common Issues](#)

Log Files

This section describes the log files used by the Dell EqualLogic MEM

Table 6. Log Files

Log File Name	Description
/var/log/equallogic/ehcmd.log	Contains EHCMD log messages for ESXi
/var/log/equallogic/ehcmcli.log	Includes EHCM CLI log messages for ESXi
/var/log/vmkernel	Includes PSP log messages

Error messages are also sent to syslog on ESXi 5.x.

CLI Commands for Troubleshooting

On ESXi and vSphere, you can use vSphere CLI commands to identify statistics, adapters, and sessions.

Listing Statistics

To view statistics, use the following vSphere CLI command syntax:

```
esxcli equallogic stat {detail | summary} [--device=device] [--path]
```

The following options are available:

- The `detail` parameter reports detailed statistics instead of summary statistics.
- The `device` parameter allows filtering to display statistics for only one device.
- The `path` parameter reports statistics for each path.

For example:

```
$ esxcli equallogic stat summary
```

DeviceId	VolumeName	PathCount	Reads	Writes	KBRead	KBWritten
6090A088F0DEBAD3AFDE24050000E054	esx5vm4	4	334	0	1	0
6090A088F0DEFACBDCDDA400000060F7	vss-control	2	123	0	0	0
6090A088F0DEAAD1AFDEE404000000A3	esx5vm2	4	343	0	1	0
6090A088F0DE6A89E0DD24030000D0CC	olu4clustervol1	4	343	0	1	0
6090A088F0DE9ABFAFDEA40400007008	esx5datastore	4	15275	409	3861733	204
6090A088F0DE9AD2AFDE04050000B055	esx5vm3	4	352	0	1	0
6090A088F0DE8A8BE0DD440300000019	olu4clustervol2	4	352	0	1	0
6090A088F06EF47A50E194040000808D	esx5vm1-2011-07-06-21:11:11.1.1	4	352	0	1	0
6090A088F0DE5AD0AFDEC40400007065	esx5vm1	4	361	0	1	0
6090A088F0DE6AD4AFDE44050000B0B1	esx5vm5	4	361	0	1	0

Listing Adapters

To view adapters, use the following vSphere CLI command syntax:

```
esxcli equallogic adapters
```

For example:

```
$ esxcli equallogic adapters
```

```
VMKernel: vmk1
Ip: 192.168.xxx.xx
Status: Normal
NIC: vmnic1
Speed: 1000
MAC: 00:1e:c9:b5:04:75
HBA: vmhba33
Vendor: VMware:iSCSI Software Adapter
```

```
VMKernel: vmk2
Ip: 192.168.xxx.xx
Status: Normal
NIC: vmnic2S
peed: 1000
MAC: 00:1e:c9:b5:04:77
HBA: vmhba33V
endor: VMware:iSCSI Software Adapter
```

Listing Sessions

To list sessions, use the following vSphere CLI command syntax:

```
esxcli equallogic sessions
```

For example:

```
$ esxcli equallogic sessions
```

VolumeName	SrcIp	TgtIp
-----	-----	-----
esx5datastore	192.168.XXX.61	192.168.XX.212
esx5datastore	192.168.XXX.62	192.168.XX.221
esx5datastore	192.168.XXX.62	192.168.XX.211
esx5datastore	192.168.XXX.61	192.168.XX.222
esx5vm1	192.168.XXX.61	192.168.XX.221
esx5vm1	192.168.XXX.61	192.168.XX.212
esx5vm1	192.168.XXX.62	192.168.XX.211
esx5vm2	192.168.XXX.61	192.168.XX.221
esx5vm2	192.168.XXX.62	192.168.XX.211
esx5vm2	192.168.XXX.61	192.168.XX.222
esx5vm2	192.168.XXX.61	192.168.XX.212
esx5vm3	192.168.XXX.61	192.168.XX.212
esx5vm3	192.168.XXX.62	192.168.XX.211
esx5vm3	192.168.XXX.61	192.168.XX.222
esx5vm3	192.168.XXX.61	192.168.XX.222
esx5vm4	192.168.XXX.61	192.168.XX.221
esx5vm4	192.168.XXX.61	192.168.XX.222
esx5vm4	192.168.XXX.62	192.168.XX.212
esx5vm4	192.168.XXX.62	192.168.XX.221
esx5vm5	192.168.XXX.62	192.168.XX.211
esx5vm5	192.168.XXX.61	192.168.XX.221
esx5vm5	192.168.XXX.61	192.168.XX.212
esx5vm5	192.168.XXX.62	192.168.XX.222

Listing VVol Statistics

 **NOTE:** This command is available on ESXi v6.0 only.

To view VVol statistics, use the following vSphere CLI command syntax:

```
esxcli equallogic vvolstat {detail | summary}
```

For example, to view details of VVol statistics:

```
$ esxcli equallogic vvolstat detail
```

DeviceId	vVolName	PathCount	SeqReads	SeqWrites	SeqKbRead	SeqKbWritten	RandReads	RandWrites	RandKbRead	RandKbWritten
257	PE Target-1	6	4988	9150	131116	40628	11801	3146	141743	23594
101d20000030000	VVol	6	1	0	0	0	1	0	2	0
257	PE Target-2	2	1123	96	3371	3237	3360	1094	10010	965
101d20000030000	VVol	2	69	16	124	1082	180	106	807	275
101d200000100000	VVol	2	2	0	0	0	0	0	0	0
101d200000600000	VVol	2	2	0	0	0	0	0	0	0
101d200000400000	VVol	2	4	1	1	0	1152	10	3169	5

For example, to view a summary of VVol statistics:

```
$ esxcli equallogic vvolstat summary
```

DeviceId	vVolName	PathCount	Reads	Writes	KbRead	KbWritten
257	PE Target-1	6	16789	12296	272859	64222
101d20000030000	VVol	6	2	0	2	0
257	PE Target-2	2	4484	1190	13381	4202
101d20000030000	VVol	2	250	122	931	1357
101d200000100000	VVol	2	2	0	0	0
101d200000600000	VVol	2	2	0	0	0
101d200000400000	VVol	2	1156	11	3170	5

Troubleshooting Common Issues

This section identifies common issues for the Dell EqualLogic MEM. For troubleshooting issues related to importing EqualLogic storage to PowerStore, see the *Importing External Storage to PowerStore Guide*.

Table 7. Troubleshooting the Dell EqualLogic MEM

Problem	Possible Cause/Solution
Cannot install the MEM bundle	<ul style="list-style-type: none"> The VIB was extracted before installation. The VIB was not first copied to the ESXi location.
iSCSI logins cannot be seen from any vmknics	Did not bind vmknics to the iSCSI initiator. See iSCSI Network Configuration Requirements .
iSCSI logins cannot be seen from all vmknics	<ul style="list-style-type: none"> Volume access is not properly set for all vmknics to log in. If using IP ACLs, access must be granted to all VMkernel ports bound to the iSCSI initiator. If using Broadcom iSCSI offload NICs and using IQN for volume access, an IQN entry is required for each Broadcom iSCSI offload NIC that is bound to the iSCSI initiator.
Array limits of iSCSI sessions exceeded	Session limits on ESXi server need to be lowered.
Logins from Broadcom NIC with iSCSI offload cannot be seen	The Broadcom iSCSI offload supports jumbo frames in ESXi 5.1 and later, but not in ESXi 5.0 and earlier. If you are using ESXi 5.0 or earlier, for vmknics and vswitch, MTU must be set to 1500.
Do not see the expected number of sessions for Broadcom NIC with iSCSI offload	The values for the Broadcom session limits are documented in <i>vSphere 5.x Configuration Maximums</i> .
esxcli equallogic commands are not recognized	The hostd agent was not restarted after the MEM installation.
Fewer iSCSI sessions created than expected	<p>This behavior is expected in the following cases:</p> <ul style="list-style-type: none"> Your configuration is exceeding one of the three EHCM maximum settings (<code>TotalSessions</code>, <code>VolumeSessions</code>, or <code>MemberSessions</code>). For example, if you have a single-member pool, and <code>MemberSessions</code> is set to the default value of 2,

Problem	Possible Cause/Solution
	<p>you will see only 2 sessions created to each volume in the pool, regardless of the number of VMkernel ports configured for iSCSI.</p> <ul style="list-style-type: none"><li data-bbox="582 293 1437 376">• The MEM has determined that creating additional iSCSI sessions will not improve performance. For example, doubling up on either array or host eth ports will not improve performance in most cases.<li data-bbox="582 383 1469 439">• Your hosts are exceeding PS group or pool session limits, and the multipath sessions are being automatically reduced by the storage array.

Sample Configuration Commands

This appendix provides examples of using the `setup.pl` script to configure networking for multipathing.

Topics:

- [Configuring a 4-Port NIC Using the VMware Software iSCSI Initiator](#)

Configuring a 4-Port NIC Using the VMware Software iSCSI Initiator

```
$. /setup.pl --server=192.168.XXX.130 --vswitch=vSwitchISCSI --mtu=9000
--nics=vmnic2,vmnic3,vmnic4,vmnic5
--ips=192.168.XXX.132,192.168.XXX.133,192.168.XXX.64,192.168.XXX.65
--heartbeat=192.168.XXX.66 --netmask=255.255.0.0 --vmkernel=iSCSI --nohwiscsi
--groupip=10.127.XXX.210
```

```
Configuring networking for iSCSI multipathing:
vswitch = vSwitchISCSI
mtu = 9000
nics = vmnic2 vmnic3 vmnic4 vmnic5
ips = 192.168.XXX.132 192.168.XXX.133 192.168.XXX.64 192.168.XXX.65
netmask = 255.255.0.0
vmkernel = iSCSI
nohwiscsi = 1
EQL group IP = 10.127.XXX.210
heartbeat = 192.168.XXX.66
Creating vSwitch vSwitchISCSI.
Setting vSwitch MTU to 9000.
Creating portgroup StorageHeartbeat on vSwitch vSwitchISCSI.
Assigning IP address 192.168.XXX.66 to StorageHeartbeat.
Creating portgroup iSCSI0 on vSwitch vSwitchISCSI.
Assigning IP address 10.127.129.61 to iSCSI0.
Creating portgroup iSCSI1 on vSwitch vSwitchISCSI.
Assigning IP address 192.168.XXX.133 to iSCSI1.
Creating portgroup iSCSI2 on vSwitch vSwitchISCSI.
Assigning IP address 192.168.XXX.64 to iSCSI2.
Creating portgroup iSCSI3 on vSwitch vSwitchISCSI.
Assigning IP address 192.168.XXX.65 to iSCSI3.
Creating new bridge.
Adding uplink vmnic2 to vSwitchISCSI.
Adding uplink vmnic3 to vSwitchISCSI.
Adding uplink vmnic4 to vSwitchISCSI.
Adding uplink vmnic5 to vSwitchISCSI.
Setting new uplinks for vSwitchISCSI.
Setting uplink for iSCSI0 to vmnic2.
Setting uplink for iSCSI1 to vmnic3.
Setting uplink for iSCSI2 to vmnic4.
Setting uplink for iSCSI3 to vmnic5.
Bound vmk2 to vmhba33.
Bound vmk3 to vmhba33.
Bound vmk4 to vmhba33.Bound vmk5 to vmhba33.
Refreshing host storage system.
Adding discovery address 10.127.XXX.210 to storage adapter vmhba33.
Rescanning all HBAs.
Network configuration finished successfully.
```

Resulting configuration:

```
$ esxcfg-vswitch --list --server 192.168.XXX.130 --username root --password password
```

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch0	128	10	128	1500	vmnic0
PortGroup Name		VLAN ID	Used Ports	Uplinks	

VM Network	0	0	vmnic0		
Management Network	0	1	vmnic0		
Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitchISCSI	128	10	128	9000	vmnic5, vmnic4, vmnic3,vmnic2
PortGroup Name	VLAN ID	Used Ports	Uplinks		
iSCSI3	0	1	vmnic5		
iSCSI2	0	1	vmnic4		
iSCSI1	0	1	vmnic3		
iSCSI0	0	1	vmnic2		
StorageHeartbeat	0	1	vmnic5,vmnic4,vmnic3,vmnic2		
Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch1	128	1	128	1500	
PortGroup Name	VLAN ID	Used Ports	Uplinks		
Private	0	0			

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