



## Concepts

### VCP

NetApp  
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# Table of Contents

- Concepts ..... 1
  - NetApp Element Plug-in for VMware vCenter Server 5.0 or later ..... 1
  - NetApp Element Plug-in for VMware vCenter Server 4.10 or earlier ..... 5
  - User accounts ..... 8
  - Protection domains ..... 8
  - Linked Mode and the vCenter Plug-in ..... 9
  - QoSIOC ..... 12
  - Virtual volumes (vVols) ..... 13

# Concepts

## NetApp Element Plug-in for VMware vCenter Server 5.0 or later

### Remote plug-in architecture overview

Beginning with NetApp Element Plug-in for vCenter Server 5.0, the plug-in architecture changes from local to remote. With the introduction of the remote architecture, the plug-in is no longer deployed inside a vCenter server. For Element Plug-in for vCenter Server 4.10 or earlier, the plug-in deployment remains local to the vCenter server to which it is registered.

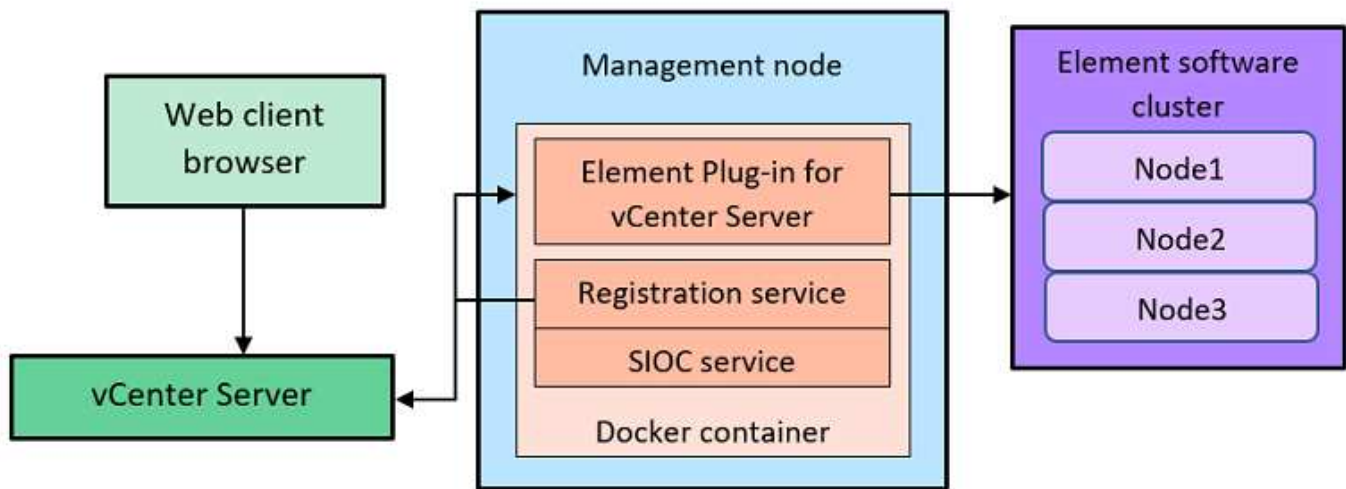
This page describes the implementation of the remote NetApp Element Plug-in for vCenter Server.

The vSphere Client remote plug-in architecture is designed to integrate plug-in functionality into the vSphere Client without having to run inside the vCenter Server. The remote plug-in architecture supports plug-in isolation, enables scale-out of plug-ins that operate in large vSphere environments, and provides the following benefits:

- The plug-in is protected from interference by unstable or compromised plug-ins loaded on the same vSphere Client.
- Plug-in compatibility is robust across vCenter Server upgrades.
- An incompatible plug-in does not interfere with vCenter Server operation.
- You can deploy a number of plug-in versions within the same vSphere environment.
- The remote plug-in user interface only needs to communicate with a single back-end server.
- Deployed plug-in topology is well defined and easy to understand which supports troubleshooting.

### Remote Element Plug-in for vCenter Server high level architecture

Using NetApp Hybrid Cloud Control, the remote Element Plug-in is deployed in a docker container inside a management node along with management services.



The remote Element Plug-in vCenter Server, registration service, and storage I/O control (SIOC) service share the same docker service but listen on different ports.

Description	Port
Remote Element Plug-in vCenter Server	8333
Registration service	9443
SIOC Service	8443

## Remote Element Plug-in communication paths overview

You must first register the remote plug-in with the vCenter Server using the registration service running on a management node (<https://<mnode-ip>:9443/>). On the registration page, you can see the vCenter server username, password, and the `plugin.json` manifest file path.



The default path is populated in the UI. No action is required.

If the details provided are correct, the registration service registers the plug-in with vCenter Server and enters the vCenter details in the plug-in server database.

After registration completes, the plug-in server downloads the `plugin.json` manifest file and initiates the remote plug-in deployment which involves configuring the remote plug-in as an extension with the `vsphere-ui` client. After the deployment completes, you can access the **NetApp Element Remote Plugin** extension point from the `vsphere-ui` web client.

All communication from the plug-in UI occurs through the vCenter Server which runs a reverse proxy service using HTTPS protocol that is responsible for forwarding the requests for the remote plug-in service. The plug-in server interacts with the SIOC service using HTTPS basic authentication and an Element cluster using the Element Java software development kit (SDK).

## Find more information

- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## NetApp Element Remote Plugin extension point

Beginning with NetApp Element vCenter plug-in 5.0, you can access the remote Element Plug-in by using the NetApp Element Remote Plugin extension point, which enables you to configure and manage clusters, nodes, and drives and view cluster information.

The following tabs are available from the NetApp Element Remote Plugin extension point:

- [Getting Started](#)
- [Configuration](#)
- [Management](#)
- [About](#)

### Getting Started

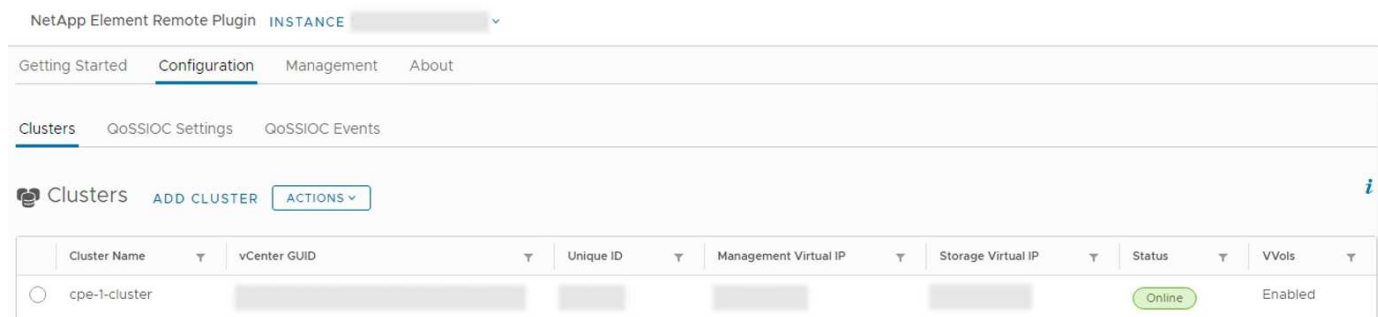
The Getting Started tab introduces the extension points for the plug-in and the actions that can be performed. You can hide the Getting Started pages from each page or restore them from the **About** tab.

### Configuration

The **Configuration** tab allows you to add and manage clusters, and configure management node settings for QoSSIOC.



Your vSphere Web Client might differ slightly from what is shown in the following image depending on the version of vSphere installed.



The following tabs are available from the **Configuration** tab:

- **Clusters:** Manages the NetApp Element clusters controlled by the plug-in. You can also enable, disable, or configure cluster-specific features.
- **QoSSIOC Settings:** Configures your credentials for the QoSSIOC service on the management node to communicate with vCenter.
- **QoSSIOC Events:** Displays information about all detected QoSSIOC events.

### Management

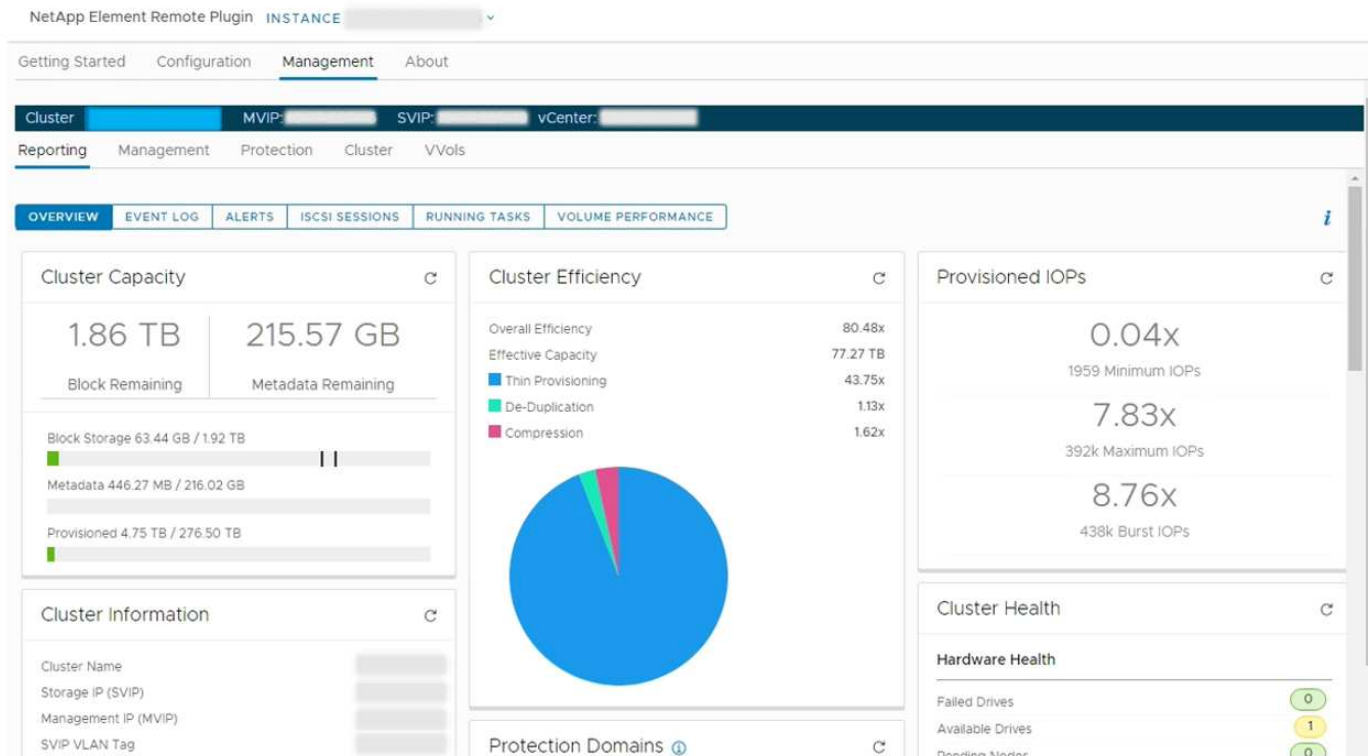
Using the **Management** tab, you can perform the following activities:

- View cluster information

- Manage datastores, volumes, user accounts, access groups, and initiators
- Manage individual group snapshots and add and manage drives and nodes



Your vSphere Web Client might differ slightly from what is shown in the following image depending on the version of vSphere installed.



The cluster navigation bar allows you to quickly switch between clusters that have been added to the plug-in:

- **Cluster:** If two or more clusters are added, ensure that the cluster you intend to use for management tasks is selected in the navigation bar. Select other added clusters from the drop-down list.
- **MVIP:** The management virtual IP address of the selected cluster.
- **SVIP:** The storage virtual IP address of the selected cluster.
- **vCenter:** The vCenter Server which the selected cluster can access. The cluster is assigned access to a vCenter Server when the cluster is added to the plug-in.

The following tabs are available from the **Management** tab:

- **Reporting:** Displays information about cluster components and provides a cluster performance overview. You can also find information about events, alerts, iSCSI sessions, running tasks, and performance volumes from the tab.
- **Management:** Create and manage datastores, volumes, user accounts, access groups, and initiators. You can also perform backup operations, clones, and snapshots. QoS policies are available to be created and managed using NetApp Element software 10 or later.
- **Protection:** Manage individual and group snapshots. You can also create schedules for snapshot creation, pair clusters for real-time replication, and manage volume pairs.
- **Cluster:** Add and manage drives and nodes. You can also create and manage VLANs.
- **VVols:** Manage virtual volumes and their associated storage containers, protocol endpoints, and bindings.

## About

Displays plug-in version information and provides a service bundle download option.

### Find more information

- [NetApp Element Plug-in for vCenter Server overview](#)
- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

# NetApp Element Plug-in for VMware vCenter Server 4.10 or earlier

## NetApp Element Configuration extension point

The NetApp Element Configuration extension point enables you to add and manage clusters, assign storage clusters to vCenter Servers for Linked Mode, and configure management node settings for QoSSIOC.



Using NetApp Element Plug-in for VMware vCenter Server to manage cluster resources from other vCenter Servers using [vCenter Linked Mode](#) is limited to local storage clusters only.



Your vSphere Web Client might differ slightly from what is shown in the following image depending on the version of vSphere installed.

### NetApp Element Configuration

Getting Started **Clusters** QoSSIOC Settings QoSSIOC Events About

Clusters

ADD CLUSTER

ACTIONS

Cluster Name	vCenter IP Address	Unique ID	Management Virtual IP	Storage Virtual IP	Status	VVols
					Online	Enabled

1 items

The following tabs are available from the NetApp Element Configuration extension point:

- **Getting Started:** Introduces the extension points for the plug-in and the actions that can be performed. You can hide Getting Started pages from each page or restore them from the **About** tab in the NetApp Element Configuration extension point.
- **Clusters:** Manages the NetApp Element clusters controlled by the plug-in. You can also enable, disable, or configure cluster-specific features.

- **QoSSIOC Settings:** Configures your credentials for the QoSSIOC service on the management node to communicate with vCenter.
- **QoSSIOC Events:** Displays information about all detected QoSSIOC events.
- **About:** Displays plug-in version information and provides a service bundle download option.

### Find more information

- [NetApp Element Management extension point](#)
- [NetApp Element Plug-in for VMware vCenter Server overview](#)
- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## NetApp Element Management extension point

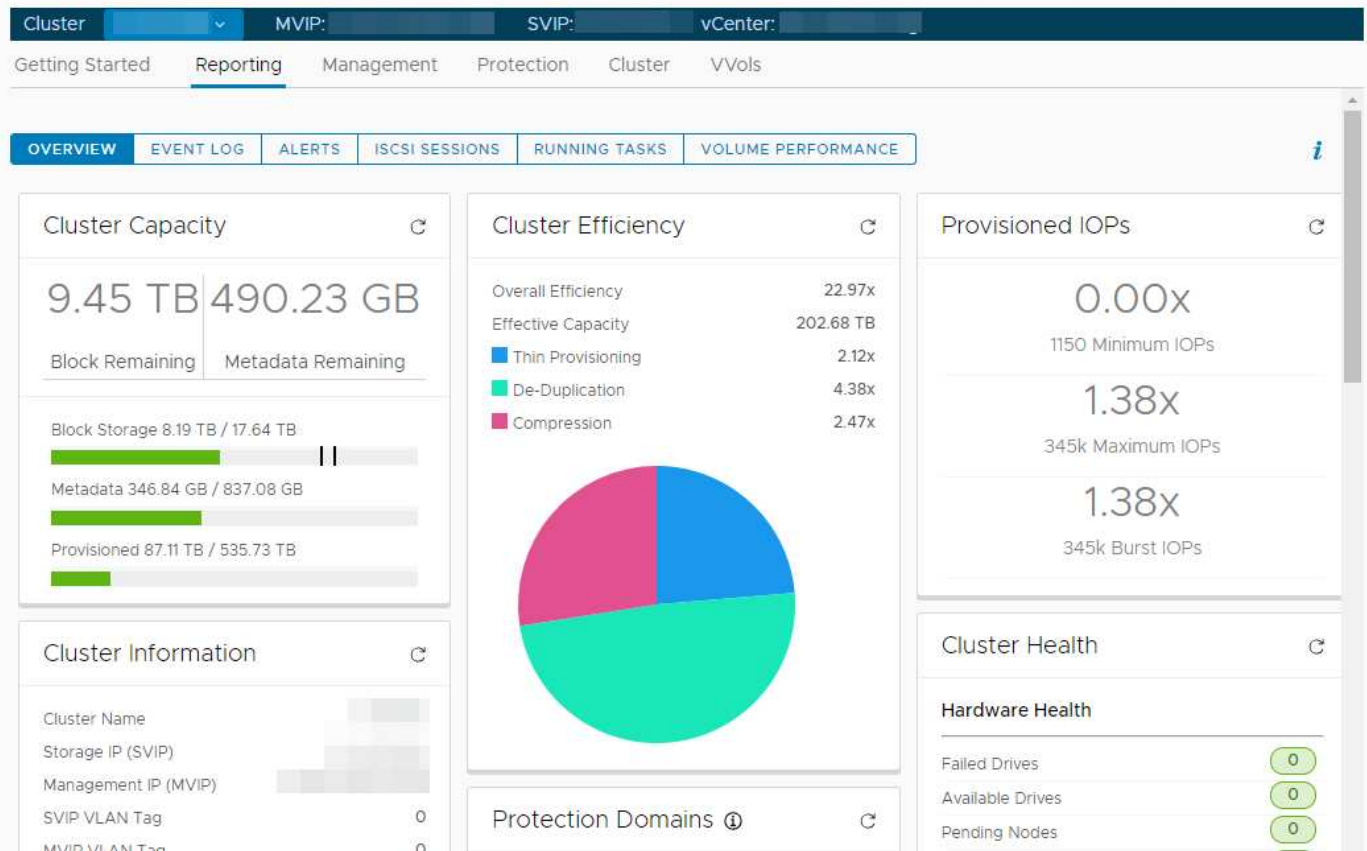
The NetApp Element Management extension point enables you to view cluster information, manage datastores, volumes, user accounts, access groups, and initiators, manage individual group snapshots, and add and manage drives and nodes.



Using NetApp Element Plug-in for VMware vCenter Server to manage cluster resources from other vCenter Servers using [vCenter Linked Mode](#) is limited to local storage clusters only.



Your vSphere Web Client might differ slightly from what is shown in the following image depending on the version of vSphere installed.



The cluster navigation bar allows you to quickly switch between clusters that have been added to the plug-in:

- **Cluster:** If two or more clusters are added, ensure that the cluster you intend to use for management tasks is selected in the navigation bar. Select other added clusters from the drop-down list.
- **MVIP:** The management virtual IP address of the selected cluster.
- **SVIP:** The storage virtual IP address of the selected cluster.
- **vCenter:** The vCenter Server which the selected cluster can access. The cluster is assigned access to a vCenter Server when the cluster is added to the plug-in.

The following tabs are available from the NetApp Element Management extension point:

- **Getting Started:** Introduces the extension points for the plug-in and the actions that can be performed. You can hide Getting Started pages from each page or restore them from the **About** tab in the NetApp Element Management extension point.
- **Reporting:** Displays information about cluster components and provides a cluster performance overview. You can also find information about events, alerts, iSCSI sessions, running tasks, and volume performance from the tab.
- **Management:** Create and manage datastores, volumes, user accounts, access groups, and initiators. You can also perform backup operations, clones, and snapshots. QoS policies are available to be created and managed using NetApp Element software 10 or later.
- **Protection:** Manage individual and group snapshots. You can also create schedules for snapshot creation, pair clusters for real-time replication, and manage volume pairs.
- **Cluster:** Add and manage drives and nodes. You can also create and manage VLANs.

- **VVols:** Manage virtual volumes and their associated storage containers, protocol endpoints, and bindings.

### Find more information

- [NetApp Element Configuration extension point](#)
- [NetApp Element Plug-in for VMware vCenter Server overview](#)
- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## User accounts

User accounts control access to the storage resources on a NetApp Element software-based network. At least one user account is required before a volume can be created.

When you create a volume, it is assigned to an account. If you have created a virtual volume, the account is the storage container. The account contains the CHAP authentication required to access the volumes assigned to it.

An account can have up to 2000 volumes assigned to it, but a volume can belong to only one account.

### Find more information

- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## Protection domains

A protection domain is a node or a set of nodes grouped together such that any node or all nodes in the domain might fail without causing the cluster to lose data availability. The protection domains feature allows you to monitor a cluster's resource capacity to ensure the cluster is still capable of healing from a failure event. You can select monitoring at either a node or chassis domain level:

- **Node level** defines each protection domain per individual node, with each node potentially located across chassis.
- **Chassis level** defines each protection domain by nodes that share a chassis.

A chassis domain requires more potential capacity resources than a node domain to be resilient to failure. When a protection domain threshold is exceeded, a cluster no longer has sufficient capacity to heal from failure while also maintaining uninterrupted data availability.

[Learn more about custom Protection Domains.](#)

### Find more information

- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## **Linked Mode and the vCenter Plug-in**

You can use the NetApp Element Plug-in for VMware vCenter Server to manage cluster resources from other vCenter Servers using vCenter Linked Mode.

## Element Plug-in for vCenter 5.0 or later

Beginning with Element Plug-in 5.0, you register the Element Plug-in from a separate management node for each vCenter Server that manages NetApp SolidFire storage clusters.

### Example

- Register vCenter1: `https://[mnode1]:9443/solidfire-mnode/registration`
- Register vCenter2: `https://[mnode2]:9443/solidfire-mnode/registration`

To set up storage cluster management in a vSphere Linked Mode environment, you can use the following procedure to manually add the storage clusters.

### Steps

1. Deploy the Element Plug-in by registering the plug-in from a separate management node for each vCenter Server in the Linked Mode environment that uses the plug-in.
2. Use the Element Plug-in.
  - a. Log in to the web client of any vCenter Server in the Linked Mode environment.
  - b. On the **NetApp Element Remote Plugin** line, select the **Instance** list.



The screenshot shows the 'NetApp Element Remote Plugin' web interface. At the top, there is a tab labeled 'INSTANCE' with a dropdown menu showing '8333'. Below this, there is a table with the following columns: 'Plugin Instance', 'Version', and 'vCenter Server'. The table contains two rows of data. The first row has a greyed-out instance ID, version '5.0.0.0', and vCenter Server 'MVIP43.mgmt.ict.openenglab.netapp.com'. The second row has another greyed-out instance ID, version '5.0.0.0', and vCenter Server 'MVIP37.mgmt.ict.openenglab.netapp.com'. To the left of the table, there is a sidebar with a 'Getting Started' section and a 'Configuration' section. The 'Getting Started' section is currently selected and shows a 'Getting Started' link. Below the sidebar, there is a text area that says 'The NetApp Element Plug-in for vCenter Server enables you to perform management and storage cluster configuration and management tasks for vCenter Server environments that use NetApp SolidFire storage clusters.'

Plugin Instance	Version	vCenter Server
[REDACTED]	5.0.0.0	MVIP43.mgmt.ict.openenglab.netapp.com
[REDACTED]	5.0.0.0	MVIP37.mgmt.ict.openenglab.netapp.com

- c. Select the vCenter Server that you want to work with.

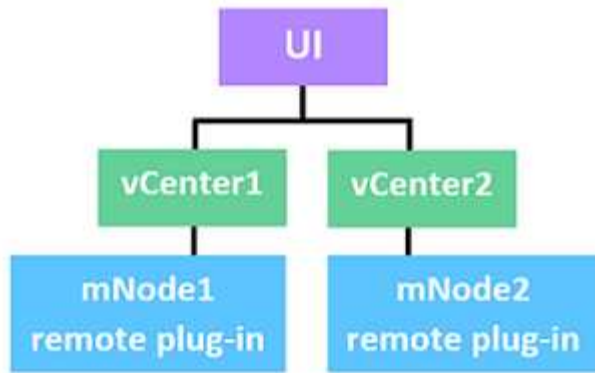
After you have selected the target vCenter Server, you can add and manage the clusters for that vCenter Server environment.



You can only view and manage the storage clusters associated with the selected vCenter Server.

### Example

You have vCenter1 and vCenter2 in Linked Mode and storage cluster1 and storage cluster2. You want vCenter1 to manage cluster1 and vCenter2 to manage cluster2.



After registering the plug-in with a separate management node for each vCenter Server, set up the storage cluster management.

### Steps

1. Log in to the web client of any vCenter Server in the Linked Mode environment.
2. On the **NetApp Element Remote Plugin** line, select the **Instance** list.
3. To manage cluster1 from the vCenter1 web client, select **vCenter1** from the list.
4. Add cluster1 to the Element Plug-in inventory.
5. On the **NetApp Element Remote Plugin** line, select the **Instance** list
6. To manage cluster2 from the vCenter2 web client, select **vCenter2** from the list.
7. Add cluster2 to the Element Plug-in inventory.

### Element Plug-in for vCenter 4.10 or earlier

For Element Plug-in 4.10 or earlier, you can only manage the storage cluster in the Element Plug-in when you are logged in to the destination vCenter web client.

To set up storage cluster management in a vSphere Linked Mode environment, you can use the following procedure to manually add the storage clusters.

### Steps

1. Register the plug-in with each vCenter Server in the Linked Mode environment that uses the plug-in.
2. Log in once to the vSphere Web Client for each linked vCenter Server.

Logging in initiates installation of the plug-in on the web client.

3. Log in to the web client of the destination vCenter that you want to manage the storage cluster.
4. Add the storage cluster to the Element Plug-in inventory.

### Example

You have vCenter1 and vCenter2 in Linked Mode and storage cluster1 and storage cluster2. You want vCenter1 to manage cluster1 and vCenter2 to manage cluster2. To set up the storage cluster management, after registering the plug-in with each vCenter Server, you perform the following steps:

1. Log in to the vCenter1 web client.
2. To manage cluster1 from the vCenter1 web client, add cluster1 to the Element Plug-in inventory.
3. Log in to the vCenter2 web client.

4. To manage cluster2 from the vCenter2 web client, add cluster2 to the Element Plug-in inventory.

## Find more information

- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

## QoSSIOC

The NetApp Element Plug-in for VMware vCenter Server enables, as an optional setting, automatic quality of service (QoS) based on Storage I/O Control (SIOC) settings of all VMs on a standard datastore. QoS and SIOC integration (QoSSIOC), which can be enabled for any standard datastore, runs a scan of all SIOC settings on all associated VMs.

QoSSIOC adjusts QoS values on standard Element volumes when virtual machine events occur, such as power on or power off events, guest restarts or shutdown, or reconfiguration activity. The QoSSIOC service uses the sum of all SIOC reservations or shares and the sum of IOPS limits to determine minimum and maximum QoS for the underlying volume of each datastore. A configurable burst factor is also available.

The following items should be considered before using QoSSIOC automation:

- QoSSIOC automation and QoS policies should not be used together. If you are using QoS policies, do not enable QoSSIOC. QoSSIOC will override and adjust QoS values for volume QoS settings.
- QoSSIOC is best for light use VMs, such as virtual desktops or specialized kiosk-type VMs, that may be rebooted, powered on, or powered off daily or several times a day.
- QoSSIOC is less suitable for service environments, for example, with database, application, or infrastructure servers that rarely reboot and need constant equal access to storage. QoS policies are best suited for these environments.
- QoSSIOC is available only with standard datastores. It does not work with virtual volumes (VVols).



When SIOC settings for a VMDK are at the default shares level of Normal and the default IOPS limit of Unlimited, the Shares and Limit IOPS values contribute toward the total QoS for the underlying volume. If the SIOC settings for the VMDK are not at default levels, SIOC shares contribute to Min QoS and SIOC IOPS limit values contribute to Max QoS for the underlying volume.



It is possible to set a reservation value through vSphere API. If a reservation value is set for a VMDK, shares are ignored and the reservation value is used instead.



[SolidFire Active IQ](#) has a QoS recommendations page that provides advice on optimal configuration and set up of QoS settings.

## Find more information

- [NetApp HCI Documentation](#)
- [SolidFire and Element Resources page](#)

# Virtual volumes (vVols)

vSphere Virtual Volumes is a storage paradigm for VMware that moves much of the storage management for vSphere from the storage system to VMware vCenter. With Virtual Volumes (vVols), you can allocate storage according to the requirements of individual virtual machines.

## Bindings

The NetApp Element cluster chooses an optimal protocol endpoint, creates a binding that associates the ESXi host and virtual volume with the protocol endpoint, and returns the binding to the ESXi host. After it is bound, the ESXi host can perform I/O operations with the bound virtual volume.

## Protocol endpoints

VMware ESXi hosts use logical I/O proxies known as protocol endpoints to communicate with virtual volumes. ESXi hosts bind virtual volumes to protocol endpoints to perform I/O operations. When a virtual machine on the host performs an I/O operation, the associated protocol endpoint directs I/O to the virtual volume with which it is paired.

Protocol endpoints in a NetApp Element cluster function as SCSI administrative logical units. Each protocol endpoint is created automatically by the cluster. For every node in a cluster, a corresponding protocol endpoint is created. For example, a four-node cluster will have four protocol endpoints.

iSCSI is the only supported protocol for NetApp Element software. Fibre Channel protocol is not supported. Protocol endpoints cannot be deleted or modified by a user, are not associated with an account, and cannot be added to a volume access group. You can review protocol endpoint information using the plug-in extension point:

- Beginning with Element vCenter plug-in 5.0, select **NetApp Element Remote Plugin > Management > VVols > Protocol Endpoints**.
- For Element vCenter plug-in 4.10 and earlier, select **NetApp Element Management > VVols > Protocol Endpoints**.

## Storage containers

Storage containers are logical constructs that map to NetApp Element accounts and are used for reporting and resource allocation. They pool raw storage capacity or aggregate storage capabilities that the storage system can provide to virtual volumes. A VVol datastore that is created in vSphere is mapped to an individual storage container. A single storage container has all available resources from the NetApp Element cluster by default. If more granular governance for multi-tenancy is required, multiple storage containers can be created.

Storage containers function like traditional accounts and can contain both virtual volumes and traditional volumes. A maximum of four storage containers per cluster is supported. A minimum of one storage container is required to use VVols functionality. You can create, delete, and view details about storage containers using the plug-in extension point:

- Beginning with Element vCenter plug-in 5.0, select **NetApp Element Remote Plugin > Management > VVols > Storage Containers**.
- For Element vCenter plug-in 4.10 and earlier, select **NetApp Element Management > VVols > Storage Containers**.

You can also discover storage containers in vCenter during VVols creation.

## VASA provider

To make vSphere aware of the vVol feature on the NetApp Element cluster, the vSphere admin must register the NetApp Element VASA Provider with vCenter. The VASA provider is the out-of-band control path between vSphere and the Element cluster. It is responsible for executing requests on the Element cluster on behalf of vSphere, such as creating VMs, making VMs available to vSphere, and advertising storage capabilities to vSphere.

The VASA provider runs as part of the cluster master in Element software. The cluster master is a highly available service that fails over to any node in the cluster as needed. If the cluster master fails over, the VASA provider moves with it, ensuring high availability for the VASA provider. All provisioning and storage management tasks use the VASA provider, which handles any changes needed on the Element cluster.



For Element software 12.5 and earlier, do not register more than one NetApp Element VASA provider to a single vCenter instance. Where a second NetApp Element VASA provider is added, this renders all VVOL datastores inaccessible.



VASA support for up to 10 vCenters is available as an upgrade patch if you have already registered a VASA provider with your vCenter. To install, follow the directions in the VASA39 manifest and download the .tar.gz file from the [NetApp Software Downloads](#) site. The NetApp Element VASA provider uses a NetApp certificate. With this patch, the certificate is used unmodified by vCenter to support multiple vCenters for VASA and VVols use. Do not modify the certificate. Custom SSL certificates are not supported by VASA.

## Find more information

- [NetApp HCI Documentation](#)
- [NetApp HCI Resources page](#)
- [SolidFire and Element Resources page](#)

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