



Using Dell EqualLogic Storage with Failover Clusters and Hyper-V

Microsoft Windows Server 2012 R2

Dell Storage Engineering
May 2014

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Table of contents

- Acknowledgements..... 5
- Revisions..... 5
- Audience..... 5
- Introduction 5
- Objective 5
- 1 iSCSI optimization and recommendations 6
- 2 Failover clustering..... 7
 - 2.1 Windows failover cluster networks..... 9
 - 2.2 Failover clustering steps..... 13
 - 2.3 Install the Failover clustering feature..... 13
- 3 Deploying storage in a cluster..... 23
 - 3.1 Creating a cluster disk 23
 - 3.1.1 Making a volume available to Windows..... 24
- 4 Validating a cluster configuration..... 26
- 5 Creating a Failover cluster..... 36
- 6 Managing a cluster 41
 - 6.1 Connecting to a cluster 41
 - 6.2 Viewing disks in a cluster 42
 - 6.3 Adding disks to a cluster 43
 - 6.4 Renaming cluster disks 48
 - 6.5 Configuring cluster quorum settings 50
 - 6.6 Validating quorum configuration 57
 - 6.7 Configuring cluster networking 63
 - 6.8 High availability and clustered roles 67
- 7 Cluster Shared Volumes 69
 - 7.1 Adding a disk to a CSV 70
 - 7.2 Renaming CSVs 72
- 8 Hyper-V 75
 - 8.1 Hyper-V in a Failover cluster..... 75
 - 8.2 Installing the Hyper-V role 76
 - 8.3 Hyper-V cluster networking..... 89



| | |
|--|-----|
| 8.3.1 Live Migration network | 89 |
| 8.3.2 Configuring virtual networks | 90 |
| 8.3.3 Enable Jumbo Frames..... | 97 |
| 8.4 Create a virtual machine..... | 100 |
| 8.5 Creating a Virtual Hard Disk | 107 |
| 8.6 Modifying virtual machine settings | 110 |
| 8.7 Virtual machine storage options | 112 |
| 8.7.1 VHDs..... | 112 |
| 8.7.2 Pass-through disks..... | 114 |
| 8.7.3 Direct-attached disks | 115 |
| 8.7.4 Server Message Block (SMB) file shares | 117 |
| 8.8 Attaching VHDs and Pass-through disks to virtual machines..... | 118 |
| 8.9 Using Direct-attached disks with virtual machines..... | 128 |
| 8.10 Highly available virtual machines | 132 |
| 8.10.1 Creating virtual machine clustered roles | 133 |
| 8.10.2 Managing virtual machine clustered roles..... | 137 |
| 8.11 Protection and recovery of virtual machines..... | 139 |
| 8.12 Guest clustering | 139 |
| 8.13 Hyper-V Offloaded Data Transfer | 140 |
| A Using Dell EqualLogic storage with Microsoft Windows..... | 141 |
| A.1 Creating a volume in an EqualLogic PS Series Group..... | 141 |
| A.2 Connecting to an EqualLogic volume from Windows | 146 |
| A.3 Making an EqualLogic volume available to Windows | 148 |
| B Additional resources..... | 152 |



Acknowledgements

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Revisions

| Date | Description |
|----------|-----------------|
| May 2014 | Initial release |

Audience

The information in this guide is intended for technology professionals interested in using Dell EqualLogic storage in a Microsoft Windows environment, including Failover Clusters and Hyper-V.

Introduction

Storage plays a critical role in today's business operations. With the ever-growing presence of new applications and data, storage demands continue to grow. EqualLogic provides support for both block storage, with PS Series Firmware, and Network Attached Storage (NAS) with FS Series Firmware, delivering high performance, high availability, scalability and on-demand provisioning in a unified storage environment.

Objective

This deployment and configuration guide details using Dell EqualLogic storage with Microsoft Windows Server 2012 R2 Failover Clusters and Hyper-V, including configuration options and recommendations for servers, storage and networking.



1 iSCSI optimization and recommendations

To ensure high availability of your storage configuration, review the following recommendations:

1. Install the latest Microsoft recommended updates from [Windows Update](#).
2. Install the [Dell EqualLogic Host Integration Tools for Microsoft](#) and enable the MPIO DSM feature.
3. For additional information on optimizing your Storage Area Network (SAN) environment for High Availability, refer to [Dell EqualLogic PS Series Storage Arrays – iSCSI Initiator and Operating System Considerations](#)



Figure 1 Dell EqualLogic PS Series storage arrays

2 Failover clustering

A Failover cluster is a group of physical or virtual servers that is often used to provide high availability and scalability for file shares and applications such as Microsoft Exchange Server, Microsoft SQL Server and Hyper-V, as well as other clustered services and roles that run on Microsoft Windows. If one of the servers, referred to as a node, fails, other nodes in the cluster can continue to provide service for the resources that failed. This is referred to as a failover.

To achieve this high availability, Failover clustering uses shared server, network and storage resources. Refer to [Table 1](#) for Windows Server 2012 and Windows Server 2012 R2 Failover clustering requirements.

For additional information on Failover clustering, refer to:
<http://technet.microsoft.com/en-us/library/hh831579.aspx>



Table 1 Windows Server 2012 / R2 – Failover clustering requirements with Dell EqualLogic

| Server | |
|---|---|
| Component | Minimum requirement |
| Cluster nodes (servers) | <ul style="list-style-type: none"> • A minimum of two identical servers • A maximum of 32 Windows Server 2012 R2 cluster nodes have been tested with Dell EqualLogic PS Series Firmware (Microsoft Windows Server 2012 and later supports up to 64 nodes per cluster). • Failover clustering feature is available on all Windows Editions, including Server Core • All servers must be joined to the same Active Directory Domain and use DNS • Microsoft iSCSI Initiator • Recommended to use the same drive letter for boot volume on all nodes • Recommended to install Dell EqualLogic Host Integration Tools for Microsoft v4.7 or later and enable the Dell EqualLogic MPIO DSM feature. |
| Network Interfaces (iSCSI) (connects servers to SAN) | Recommended to use at least two NICs dedicated to iSCSI per cluster node |
| Network Interfaces (public and private networks) (connects servers to Local Area Network) | At least two dedicated NICs per cluster node: <ul style="list-style-type: none"> • One NIC for Public Network • Another NIC for Private Network |
| Storage | |
| Component | Minimum requirement |
| Dell EqualLogic PS Series (shared SAN) | <ul style="list-style-type: none"> • Storage Array: Redundant control modules • Firmware: Recommended PS Series Firmware v7.0 or later |
| Networking | |
| Component | Minimum requirement |
| Network Switches (provide dedicated interconnection between the cluster nodes and the storage arrays) | <ul style="list-style-type: none"> • At least two network switches dedicated to iSCSI • iSCSI switches must be connected together using stacking or port trunking • Recommended to enable Flow Control and Jumbo Frames on all switches and NICs that use iSCSI traffic |



2.1 Windows failover cluster networks

To maintain high availability and eliminate single points of failure, ensure that all components in the network are redundant. This includes using multiple network cards with NIC teaming or Multipathing I/O (MPIO) and connecting network cards to multiple switches.

Note: Failover clustering detects networks used by the cluster by their logical subnet. It is not necessary or recommended to assign more than a single network adapter per subnet because only one card will be used in the cluster configuration and any additional network cards on the subnet will be ignored. To provide load-balancing and fault tolerance for non-iSCSI networks, consider using NIC teaming.

Network settings

Note: In a cluster, use identical network adapters with static IP addresses and ensure identical configuration settings (Speed, Duplex Mode, Flow Control) on the network adapters and switches. All cluster nodes must use DNS for name resolution. It is recommended to enable Flow Control and [Jumbo Frames](#) on all switches and NICS that use iSCSI traffic.

NIC teaming

NIC teaming (also known as Load Balancing/Failover, or LBFO) combines two or more network interfaces to provide load balancing and fault tolerance.

Note: It is recommended to use NIC teaming for all non-redundant networks. While NIC teaming is supported in the cluster configuration, it is not recommended to use NIC teaming for iSCSI networks. It is recommended to configure NIC teaming before a cluster is created, because once a network has been added to a cluster, it can no longer be modified.

For information about NIC teaming, refer to [NIC Teaming Overview](#) in the Windows Server Technical Library.



When deploying a Windows Failover Cluster, you must plan for several types of network traffic.

Public network

The public network is used to access the LAN network. It is recommended to dedicate at least one network interface per cluster node for the public network. Additional network interfaces can be used to provide redundancy.

Private network

The private network is used for cluster communication and heartbeat. It is recommended to dedicate at least one network interface per cluster node for the private network. Additional network interfaces can be used to provide redundancy. Private networks can have two possible configurations:

- In a two-node cluster, the private network interfaces of each cluster node can be directly connected to each other with a crossover network cable.
- In larger clusters, the private network interfaces of each cluster node should be connected to a network switch.

Note: It is typically not necessary to configure default gateway or DNS settings for private networks. It is also recommended to disable the following on all private network interfaces: DNS registration, LMHOSTS lookup, and NetBIOS over TCP/IP.

iSCSI SAN - Multipathing I/O (MPIO)

The SAN network is used to provide connectivity between servers and data. To provide high availability and redundancy in the server's iSCSI connections to data volumes, install the Dell EqualLogic Host Integration Tools for Microsoft and enable the MPIO DSM feature. It is recommended to dedicate at least two network interfaces per cluster node for iSCSI and that all MPIO configuration settings are identical across all cluster nodes. For more information, refer to: [Configuring and Deploying the Dell EqualLogic Multi-Path I/O Device Specific Module with Microsoft Windows](#).

Refer to Figure 2 and Figure 3 for examples of Windows Failover Cluster networks in a two node and 32 node cluster.



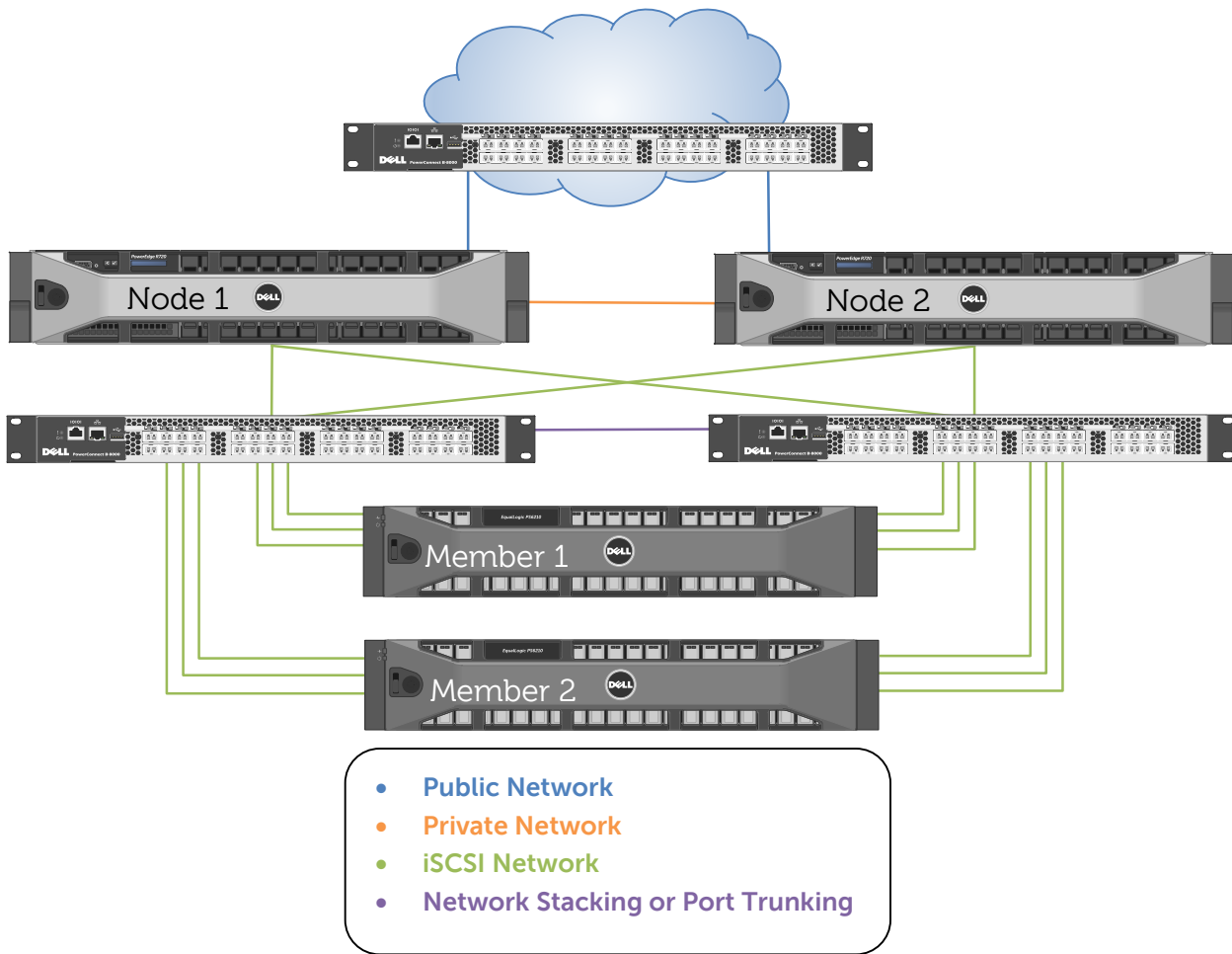


Figure 2 Failover cluster networks in a two node cluster

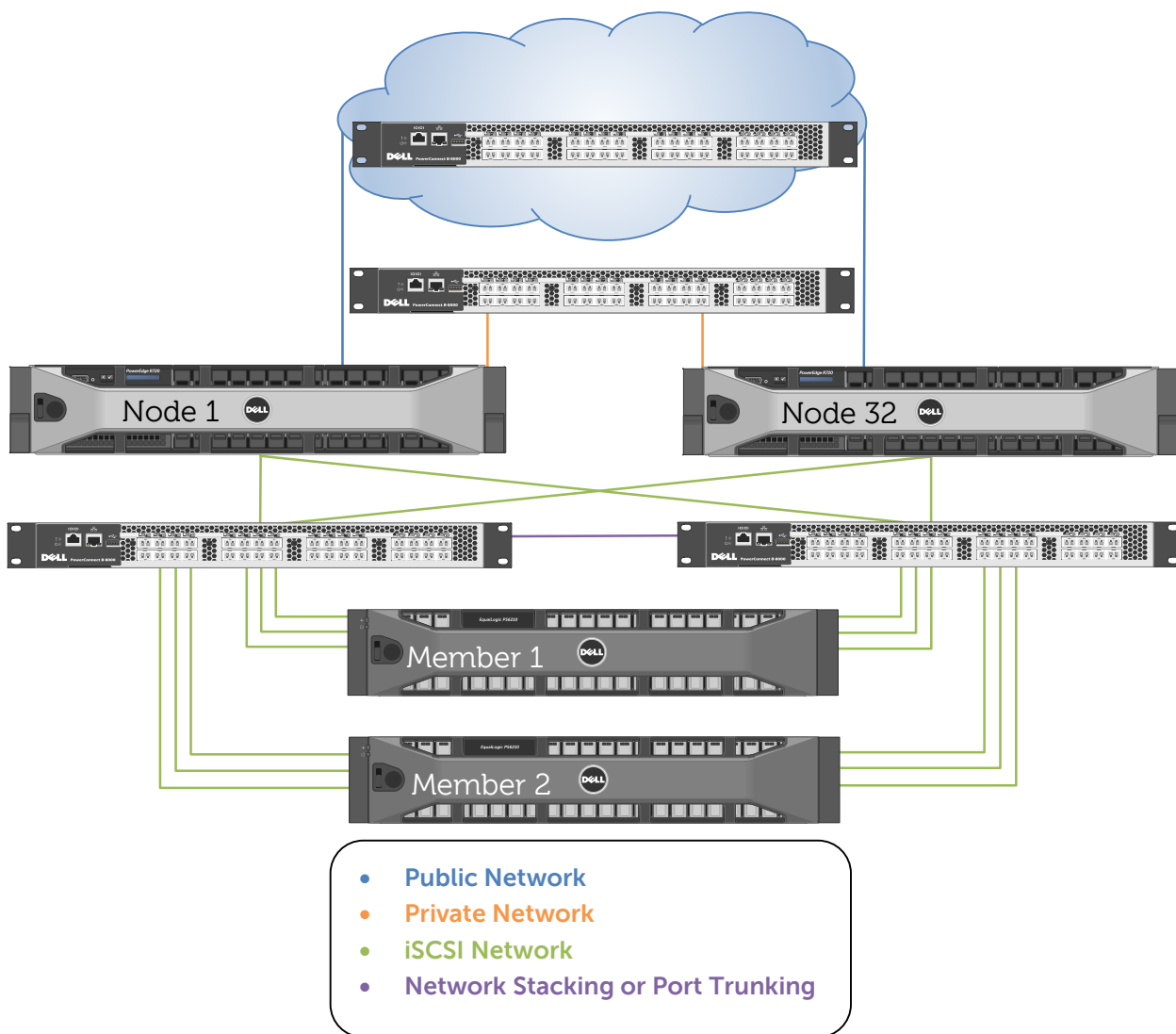


Figure 3 Failover cluster networks in a 32 node cluster

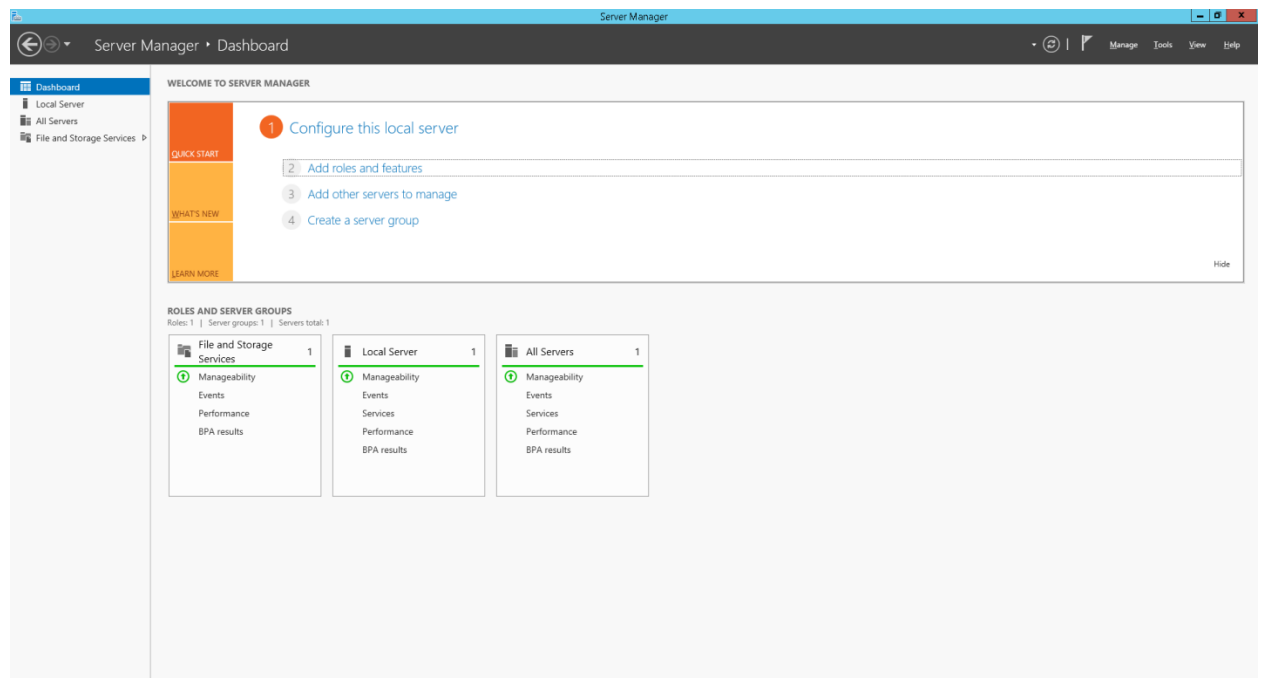
2.2 Failover clustering steps

1. It is recommended that all components on the servers, networking and storage hardware are configured with redundancy.
2. Pre-plan all required cluster configuration information such as: cluster name, cluster name IP, server public and private IP addresses, server iSCSI IP addresses and PS Series Group information.
3. Review [iSCSI optimization and recommendations](#).
4. Configure server networking for public, private and iSCSI networks.
5. Join all servers to the same Active Directory Domain.
6. [Install the Failover clustering feature](#) on all servers.
7. [Create an EqualLogic volume](#) to be accessed by all cluster nodes. This volume is to be used as a [Disk Witness](#) for the cluster.
8. [Run the Cluster Validation Wizard](#) to ensure the system is ready to form a cluster.
9. [Create a Failover Cluster](#) by configuring cluster name, cluster management IP, cluster nodes, storage, and quorum.
10. [Configure additional storage](#), if required.

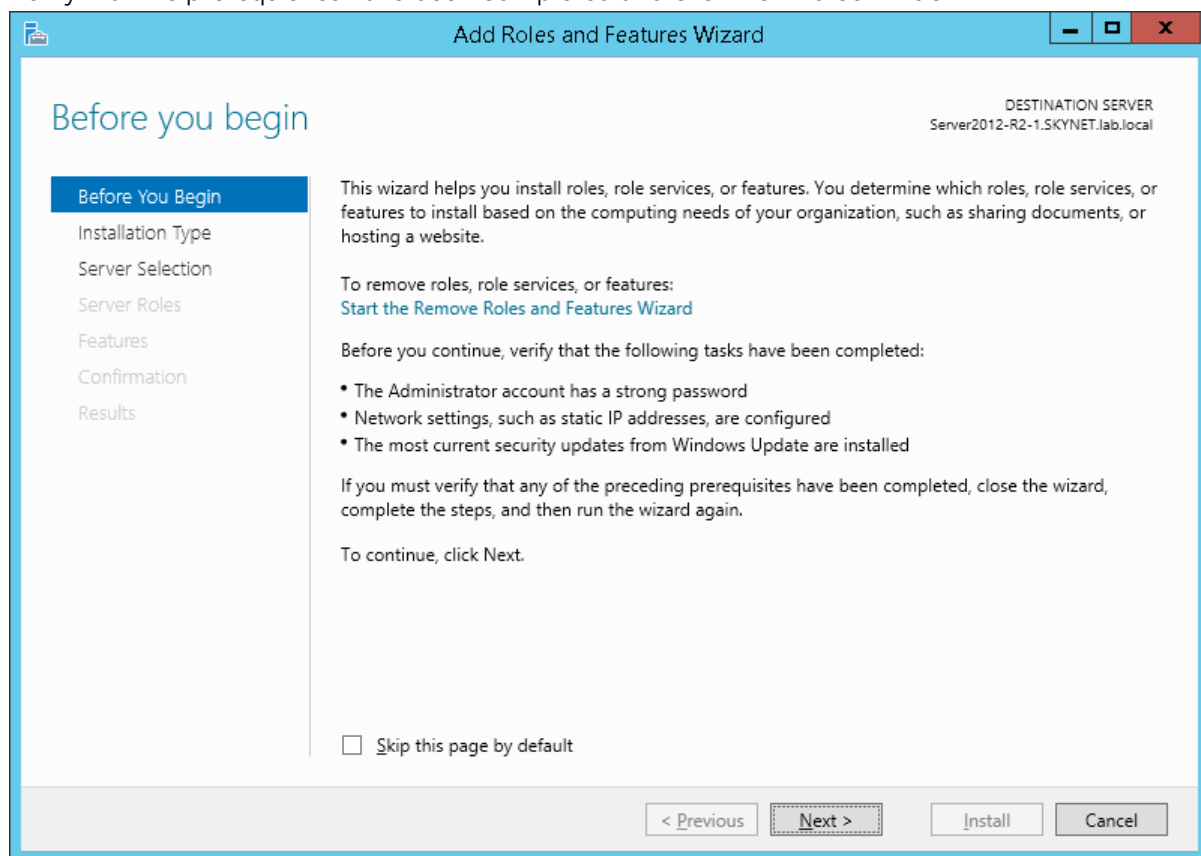
2.3 Install the Failover clustering feature

The Failover clustering feature must be added to each server in the planned cluster. It is recommended to first attach storage before validating and creating a cluster. Each server must be joined to the same Active Directory Domain.

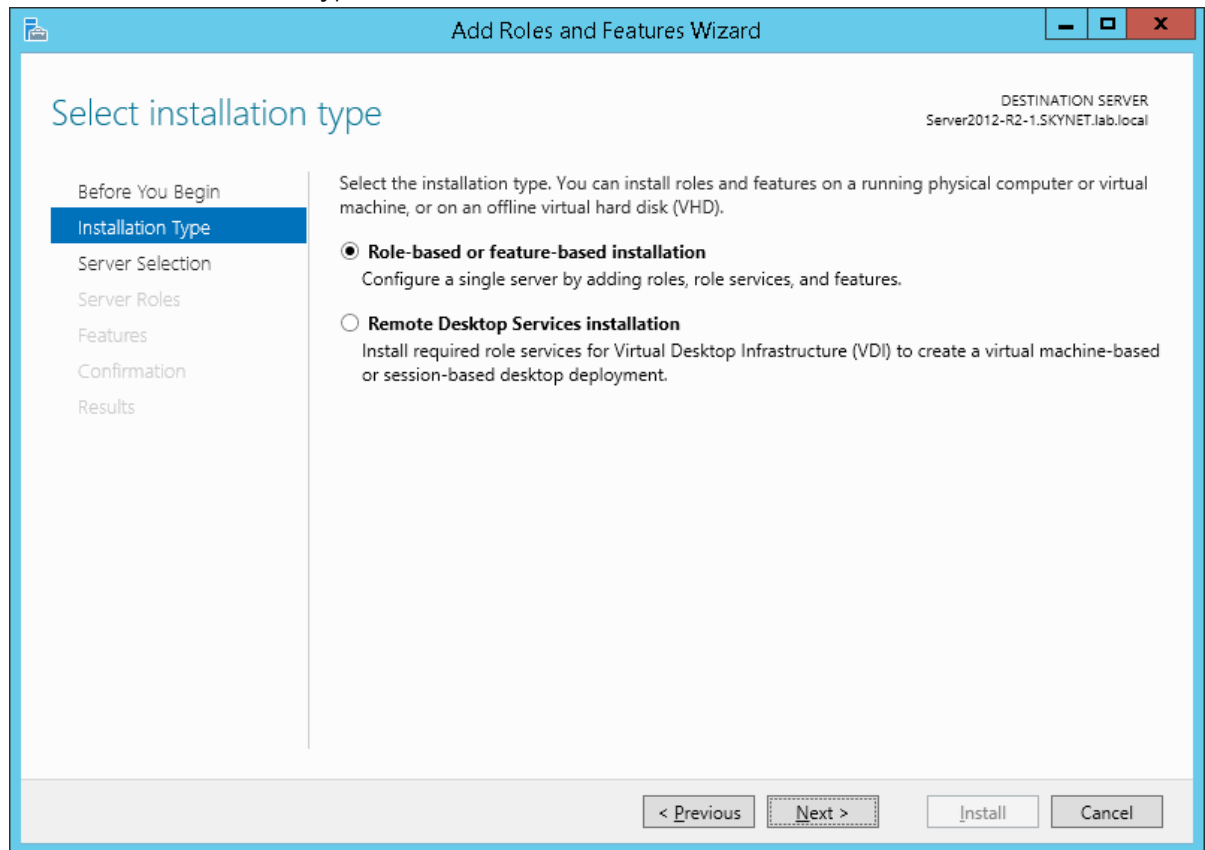
1. Launch Server Manager.
2. Click on **Add roles and features**.



3. Verify that the prerequisites have been completed and click **Next** to continue.



4. To select the installation type, select **Role-based or feature-based installation** and click **Next**.



5. To select the destination server, click **Select a server from the server pool**. Highlight the local server from the list and click **Next**.

The screenshot shows the 'Add Roles and Features Wizard' window. The title bar reads 'Add Roles and Features Wizard'. The main heading is 'Select destination server'. In the top right corner, it says 'DESTINATION SERVER' and 'Server2012-R2-1.SKYNET.lab.local'. On the left, there is a navigation pane with the following items: 'Before You Begin', 'Installation Type', 'Server Selection' (which is highlighted with a blue bar), 'Server Roles', 'Features', 'Confirmation', and 'Results'. The main area contains the following text: 'Select a server or a virtual hard disk on which to install roles and features.' Below this are two radio buttons: 'Select a server from the server pool' (which is selected) and 'Select a virtual hard disk'. Below the radio buttons is a section titled 'Server Pool'. It contains a 'Filter:' text box. Below the filter is a table with three columns: 'Name', 'IP Address', and 'Operating System'. The table has one row: 'Server2012-R2-1.SKYNET.lab.local', '10.10.6.20,10.1...', and 'Microsoft Windows Server 2012'. Below the table is a scrollbar. Below the scrollbar, it says '1 Computer(s) found'. Below that, it says 'This page shows servers that are running Windows Server 2012, and that have been added by using the Add Servers command in Server Manager. Offline servers and newly-added servers from which data collection is still incomplete are not shown.' At the bottom of the window, there are four buttons: '< Previous', 'Next >', 'Install', and 'Cancel'.

DESTINATION SERVER
Server2012-R2-1.SKYNET.lab.local

Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results

Select a server or a virtual hard disk on which to install roles and features.

☒ Select a server from the server pool
☐ Select a virtual hard disk

Server Pool

Filter:

| Name | IP Address | Operating System |
|----------------------------------|--------------------|-------------------------------|
| Server2012-R2-1.SKYNET.lab.local | 10.10.6.20,10.1... | Microsoft Windows Server 2012 |

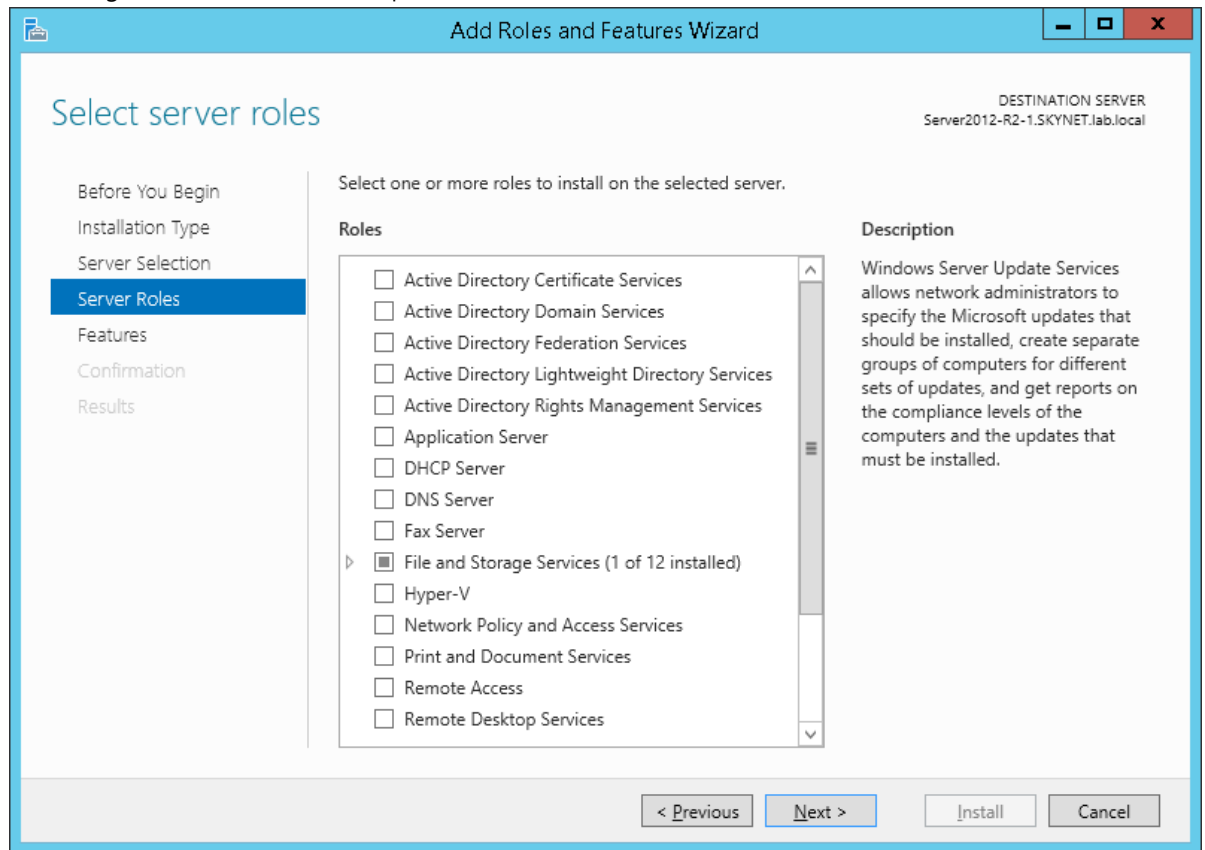
< ||| >

1 Computer(s) found

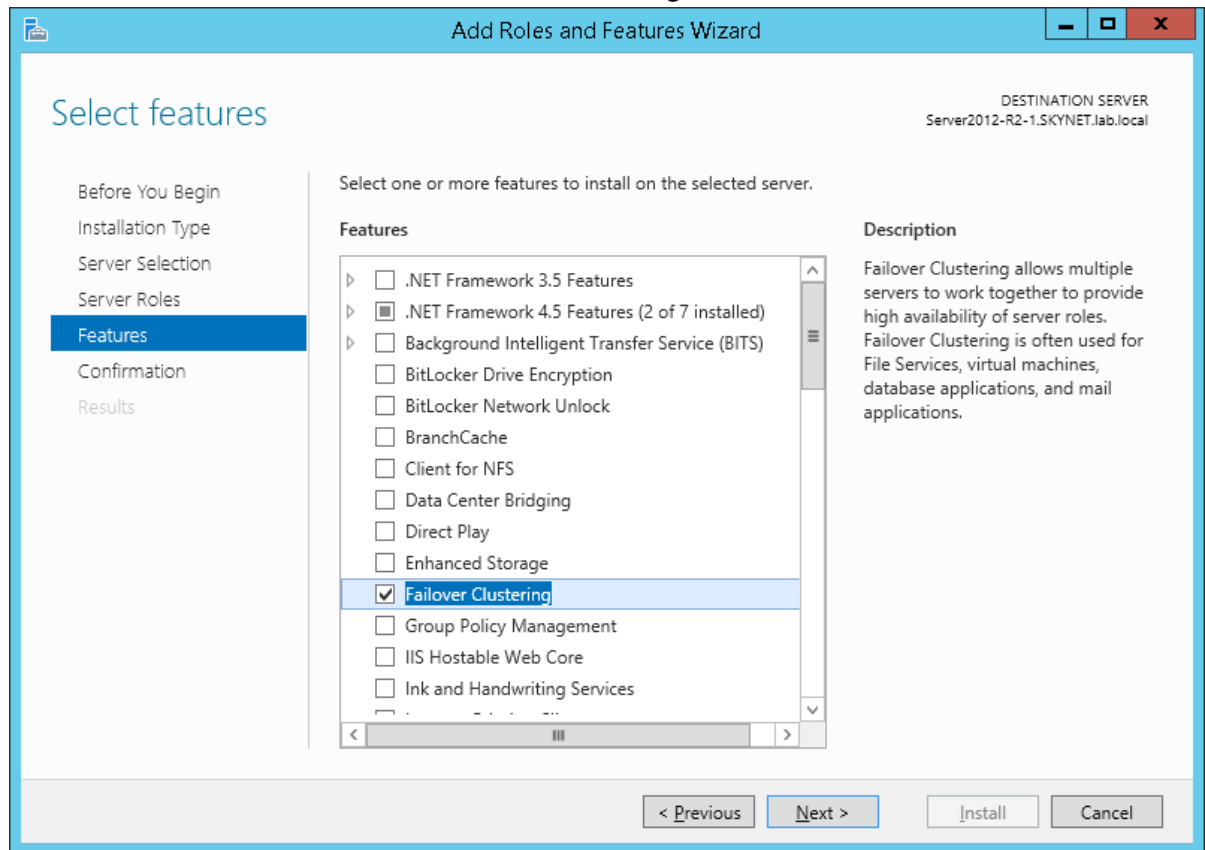
This page shows servers that are running Windows Server 2012, and that have been added by using the Add Servers command in Server Manager. Offline servers and newly-added servers from which data collection is still incomplete are not shown.

< Previous Next > Install Cancel

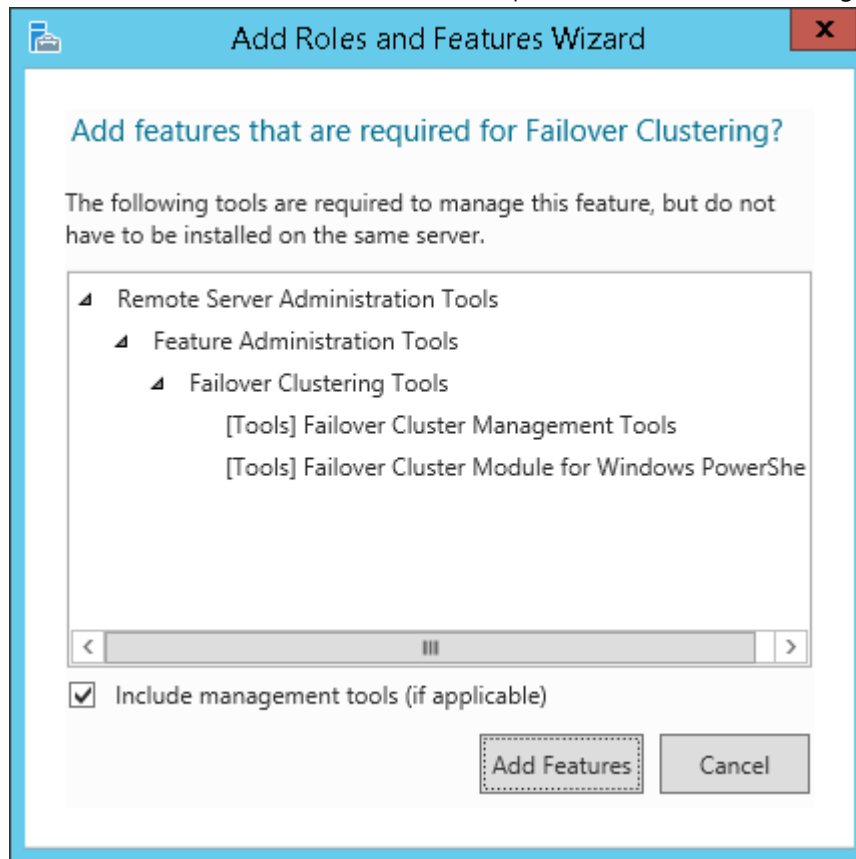
6. Selecting a server role is not required. Click **Next**.



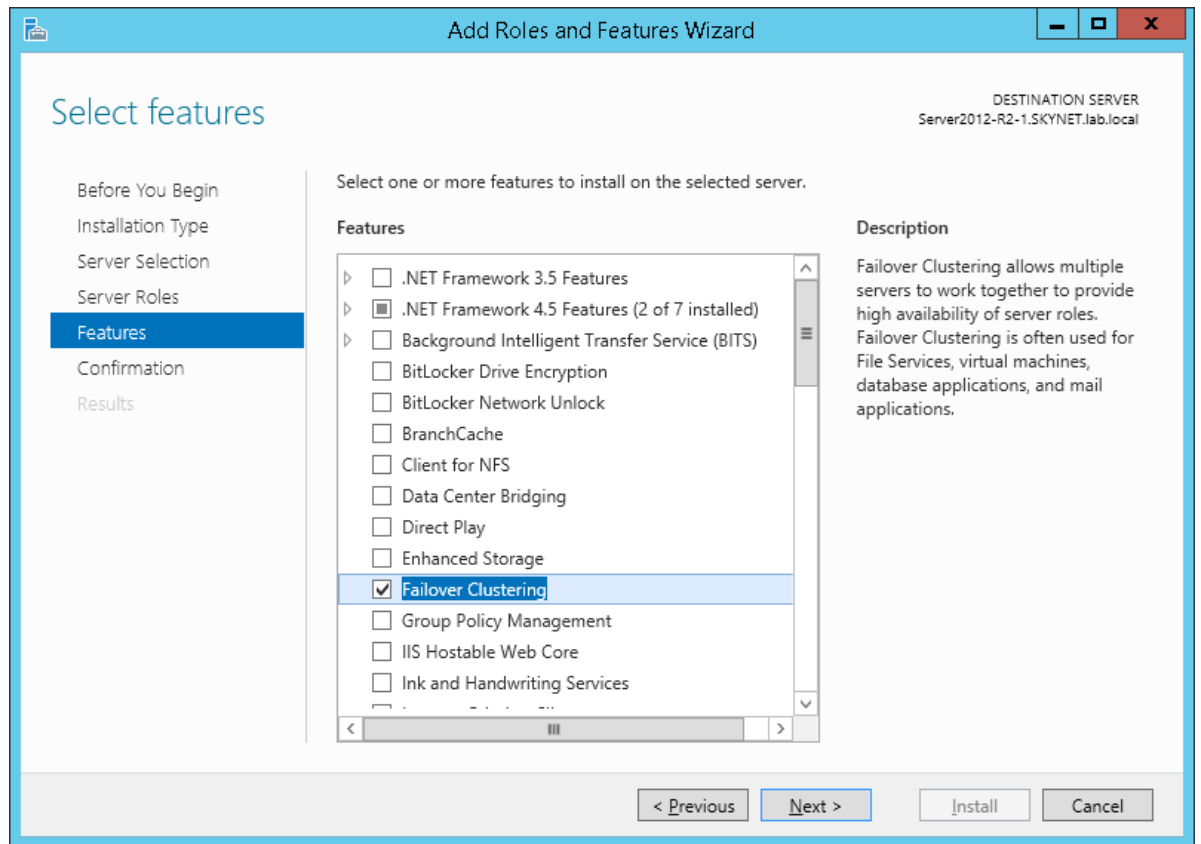
7. To select the feature, click to select **Failover Clustering**.



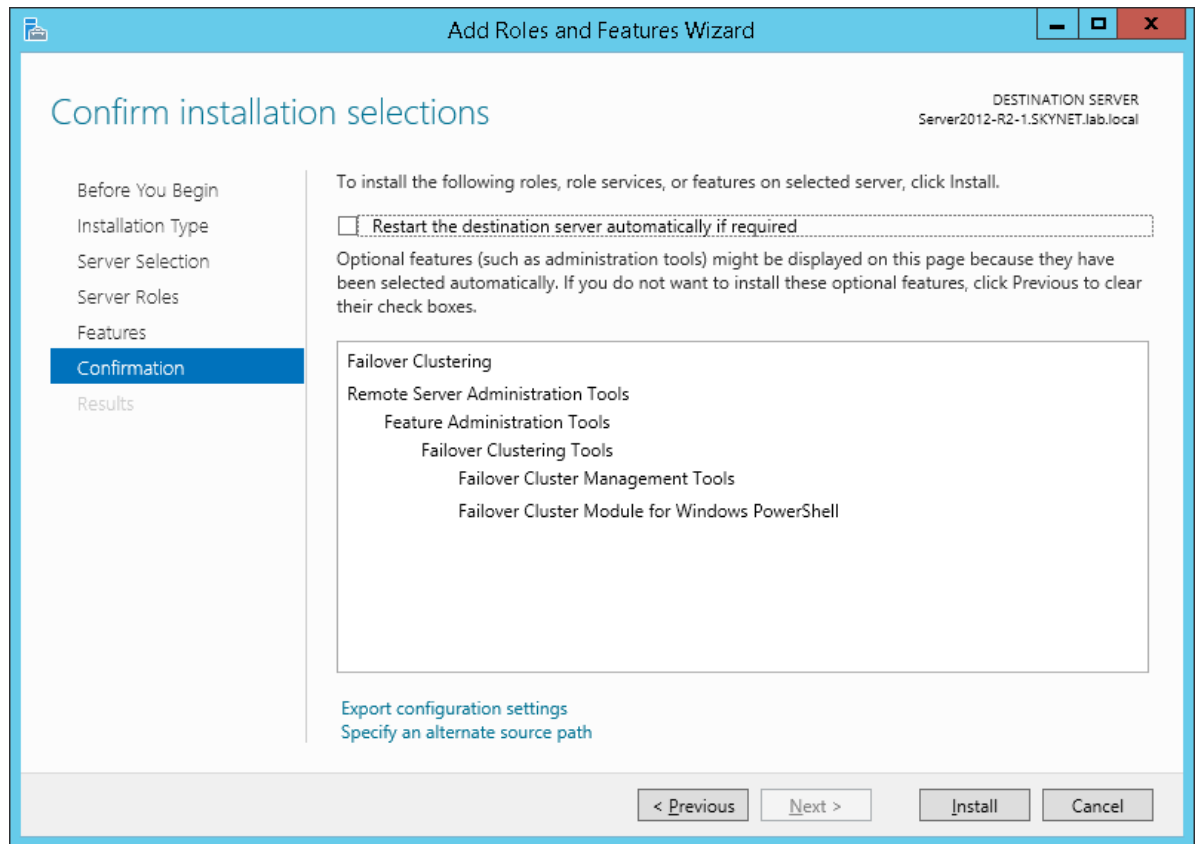
8. To add the additional features that are required for Failover Clustering, click **Add Features**.



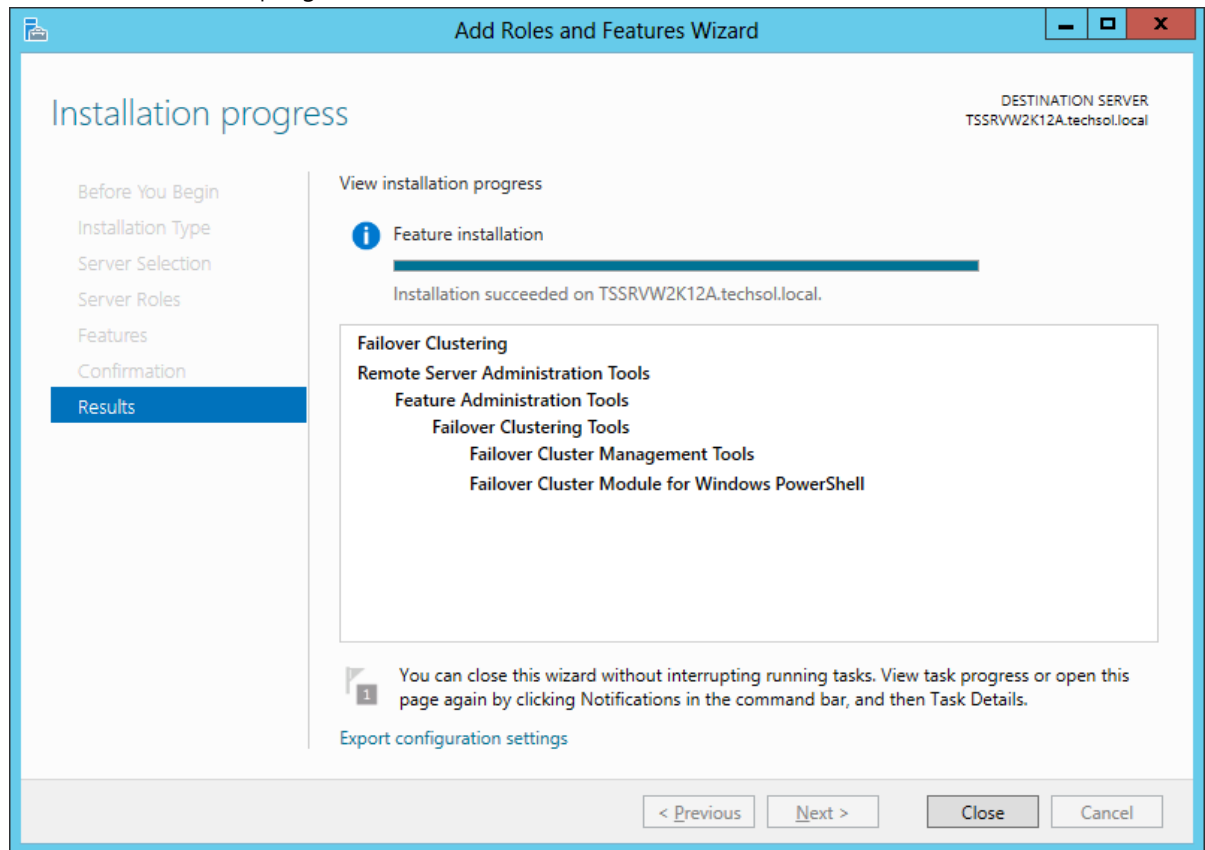
9. To select the feature, click **Next** to continue.



10. Confirm the installation selections, and click **Install**.



11. View the installation progress. Once the installation has succeeded, click **Close**.



3 Deploying storage in a cluster

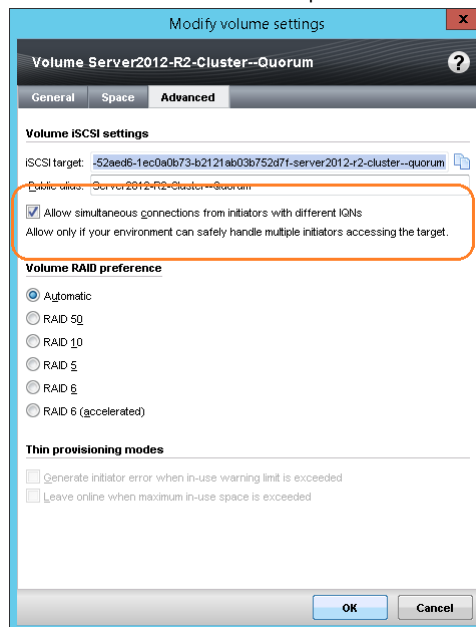
It is recommended to first attach storage before validating and creating a cluster. A Failover cluster will, at minimum, require a quorum disk. Additional storage can then be added to the cluster to support file shares and applications.

3.1 Creating a cluster disk

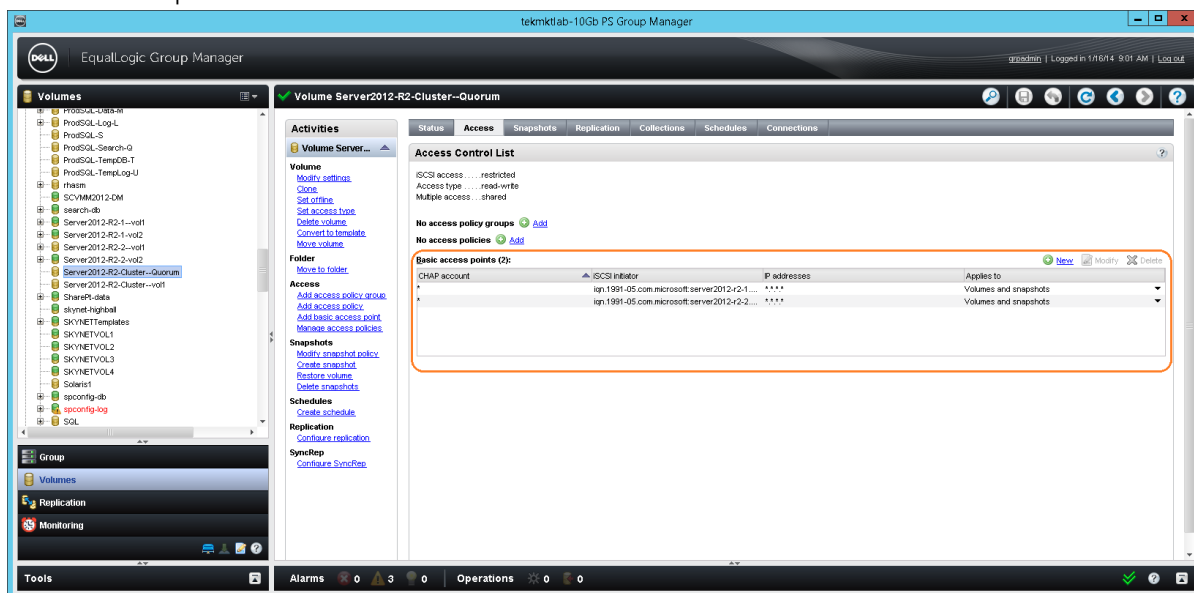
In a Windows Server 2012 R2 Failover cluster, it is typically recommend to configure a quorum witness. A disk witness stores the cluster configuration database and should be excluded from backups and antivirus scanning. For additional information on quorum configurations, refer to [Configuring cluster quorum settings](#).

To create a cluster disk for the quorum or application data:

1. Using Dell EqualLogic management tools, such as Group Manager or PowerShell Tools, create a volume in the Dell EqualLogic PS Series Group.
 - a. For a quorum disk witness, the minimum recommended size for an NTFS partition is 512 MB. It is possible, but not necessary, to use a larger size for a disk witness.
 - b. For a non-quorum cluster disk, such as a Cluster Shared Volume (CSV), size the volume as required for the workload requirements.
2. Modify the volume settings to **Allow simultaneous access to the volume from more than one iSCSI initiator**. This is required for cluster configurations.



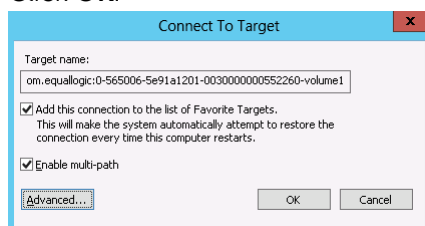
3. Configure access controls on the volume to allow access from each server in the planned cluster. This is required for cluster configurations. To help prevent data corruption, ensure that only the servers in the planned cluster can access the volume.



4. For additional information on creating a volume and modifying volume access controls in a Dell EqualLogic Group, refer to [Appendix A](#).

3.1.1 Making a volume available to Windows

1. From each server in the planned cluster, connect to the volume(s) using an iSCSI initiator.
 - a. When connecting to the target volume with the Microsoft iSCSI initiator, to ensure that the system will automatically attempt to restore the connection to the volume upon reboot, click **Add this connection to the list of Favorite Targets**.
 - b. To enable multi-path, click **Enable multi-path**.
 - c. Click **OK**.



2. From any server in the planned cluster, initialize, online, and format the disks. This is not required to be performed on each server.
 - a. For the partition style, Master Boot Record (MBR) or GUID Partition Table (GPT) are supported.
 - b. It is recommended to use Basic disks with an NTFS partition.
 - c. For a quorum disk witness:
 - i. NTFS and ReFS are supported
 - ii. Should be a dedicated volume
 - iii. Does not need a drive letter assignment
 - iv. Cannot be a CSV
 - d. For CSV, partitions can use NTFS or ReFS (in Server 2012 R2 and later).

Note: Certain features, such as Offloaded Data Transfers (ODX) are not supported on ReFS.

Note: For identification purposes, it is recommended to specify Windows volume labels that match the volume name in the Dell EqualLogic Group.

3. The volume is now available to Windows and is ready to store data and be added to the cluster. For additional information on making a Dell EqualLogic volume available to Windows, refer to [Appendix A](#).

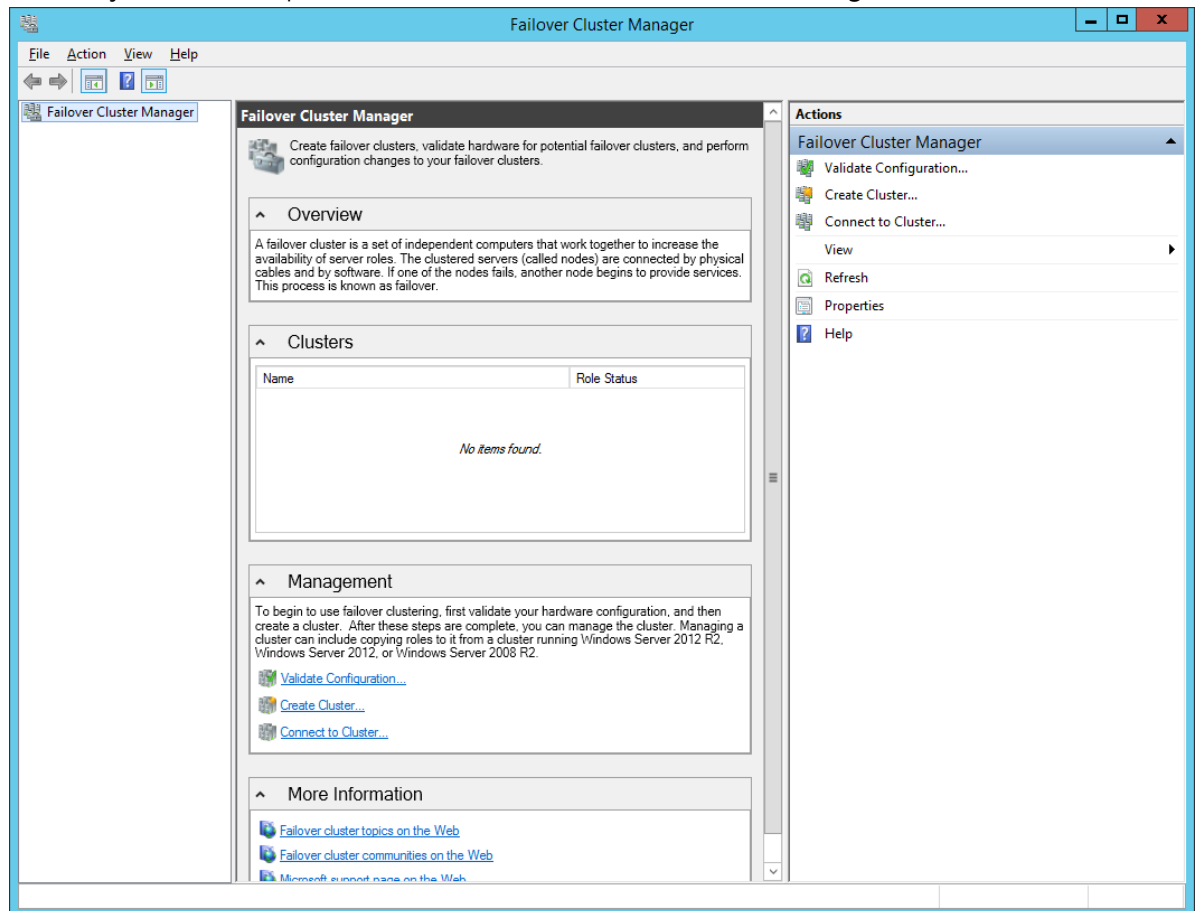


4 Validating a cluster configuration

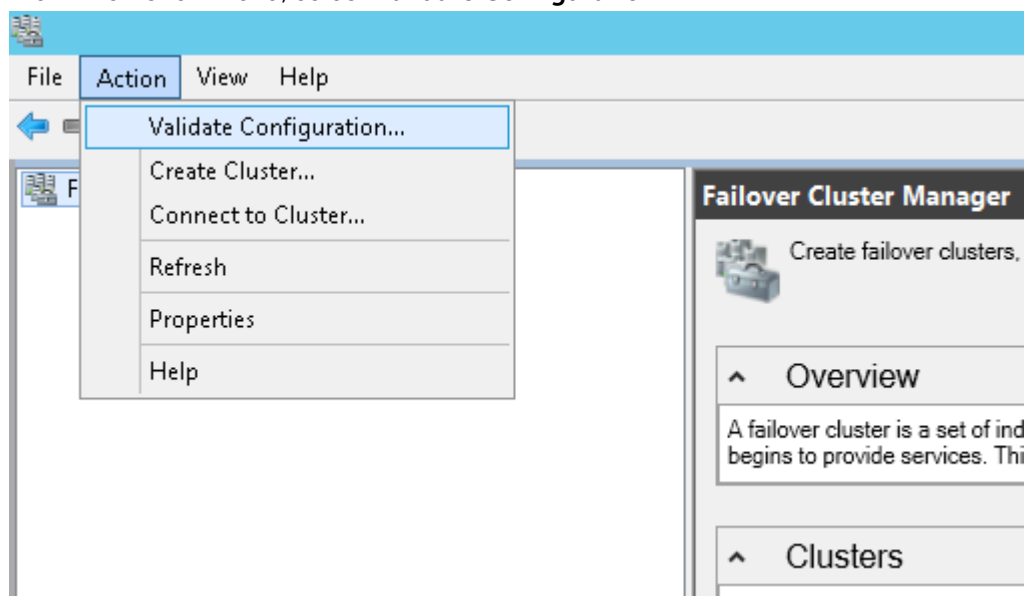
The Validate a Configuration Wizard provides a set of tests for servers, network and storage to assess and report on how well the cluster hardware and software can support Failover clustering.

Note: It is strongly recommended to validate a cluster configuration with all tests before the cluster is created. It is also possible to perform validation after the cluster is created. However, attached storage and other resources may become unavailable to the cluster during tests.

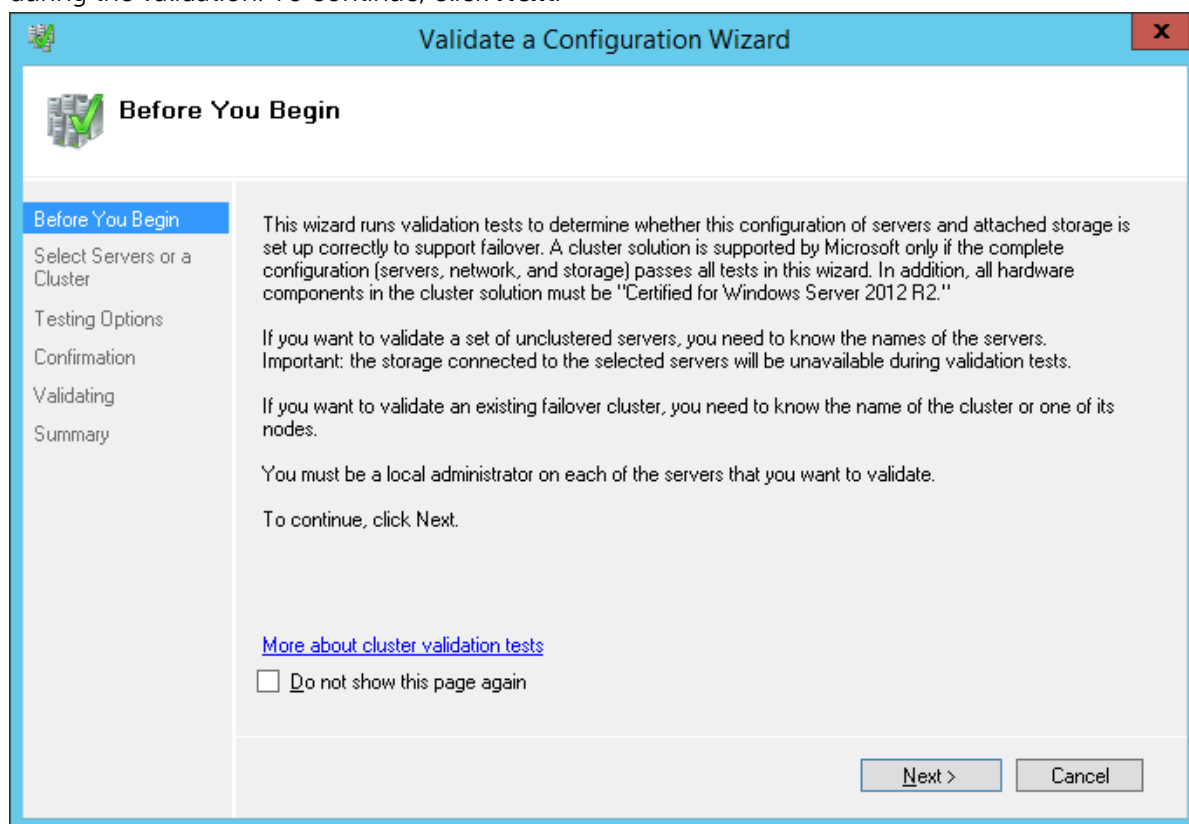
1. From any server in the planned cluster, launch **Failover Cluster Manager**.



2. From the Action Menu, select **Validate Configuration**.



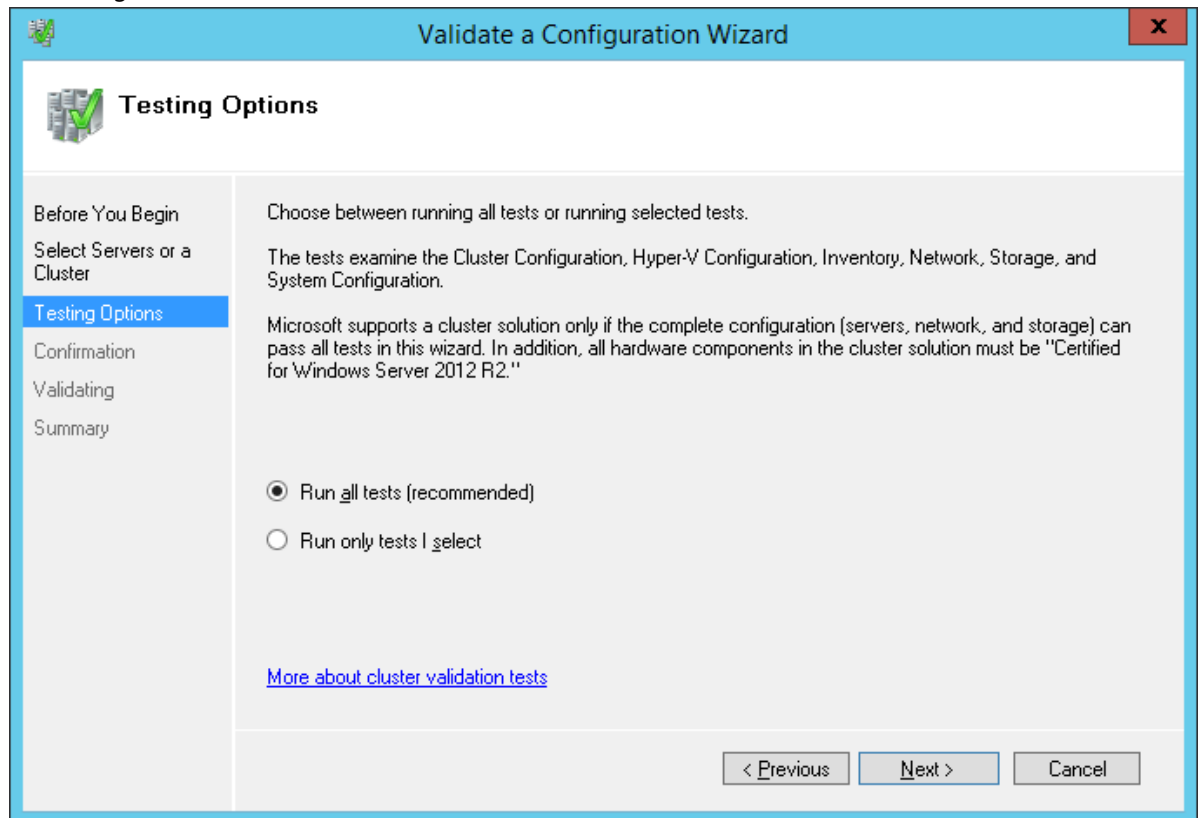
3. Note that storage resources connected to the server may become unavailable to the cluster during the validation. To continue, click **Next**.



4. Add the names of all servers in the planned cluster, and click **Next**.

The screenshot shows a Windows-style dialog box titled "Validate a Configuration Wizard" with a close button (X) in the top right corner. The main title bar is blue. Inside the window, there's a sub-header "Select Servers or a Cluster" with a green checkmark icon. On the left, a vertical sidebar contains a list of steps: "Before You Begin", "Select Servers or a Cluster" (highlighted in blue), "Testing Options", "Confirmation", "Validating", and "Summary". The main area of the wizard contains instructions: "To validate a set of servers, add the names of all the servers. To test an existing cluster, add the name of the cluster or one of its nodes." Below this, there's a label "Enter name:" followed by a text input field and a "Browse..." button. Underneath, there's a label "Selected servers:" followed by a list box containing two entries: "Server2012-R2-1.SKYNET.lab.local" (which is selected with a blue highlight) and "Server2012-R2-2.SKYNET.lab.local". To the right of the list box are "Add" and "Remove" buttons. At the bottom right of the wizard, there are three buttons: "< Previous", "Next >", and "Cancel".

5. Select the testing options and click **Next**. It is recommended to select **Run all tests**. Microsoft will typically require a complete cluster validation report for support issues related to Failover clustering.



6. If existing storage has been previously assigned to the cluster, optionally select the additional storage to validate, and click **Next**. Note that storage resources connected to the server may become unavailable during the validation.

Validate a Configuration Wizard

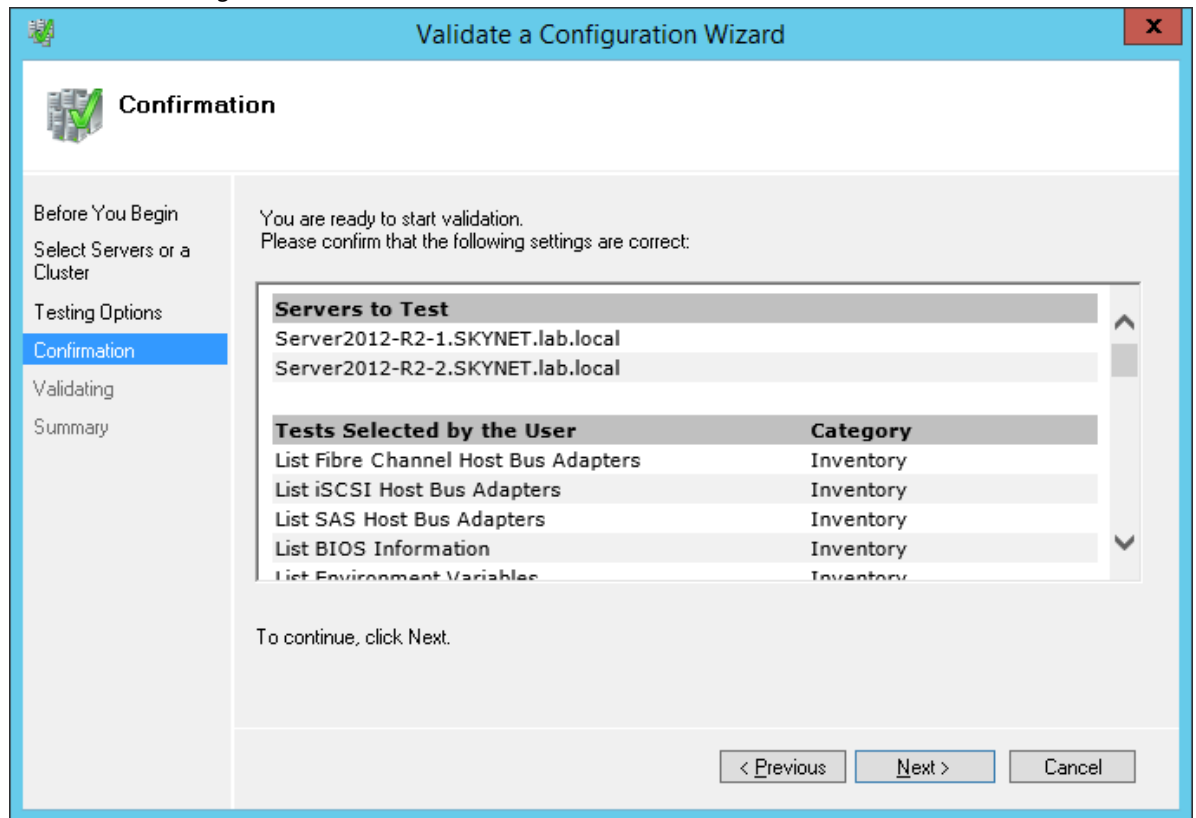
Review Storage Status

You can select additional storage to validate from the list below.

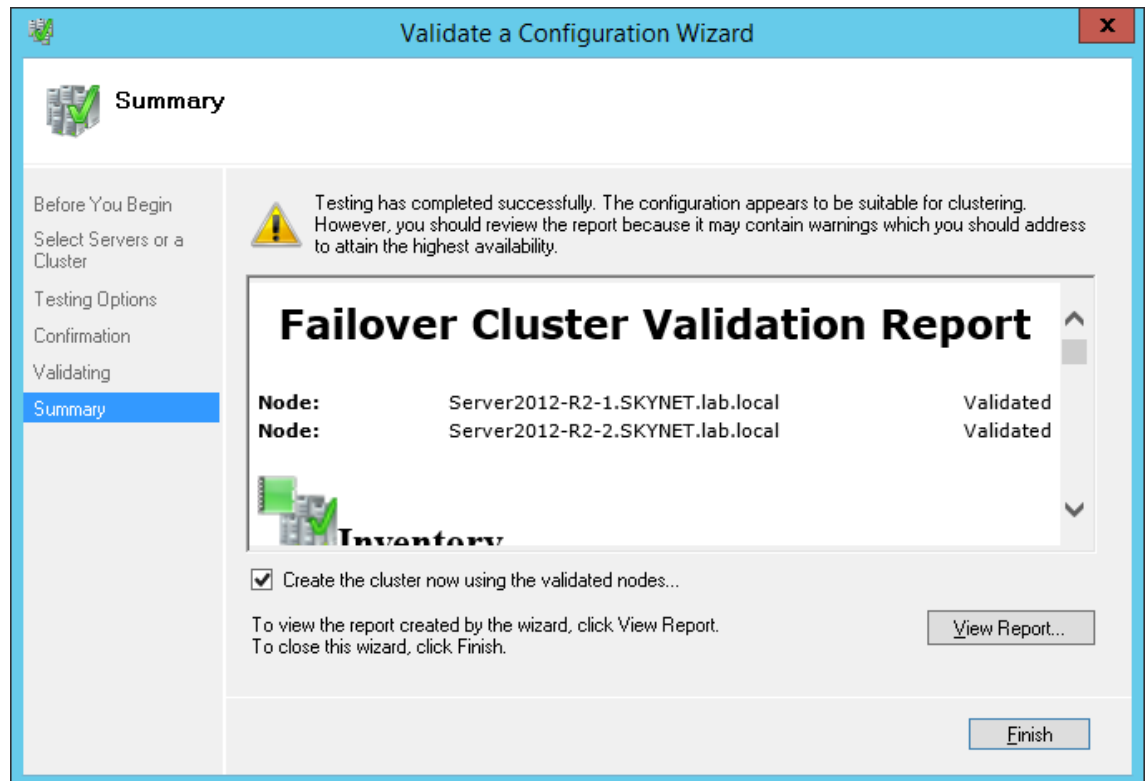
| Name | Assigned To |
|---|------------------------|
| <input type="checkbox"/> Server2012-R2-Cluster-Quorum | Disk Witness in Quorum |
| <input type="checkbox"/> Server2012-R2-Cluster--vol1 | Cluster Shared Volumes |
| <input type="checkbox"/> Server2012-R2-Cluster--vol2 | Available Storage |

< Previous Next > Cancel

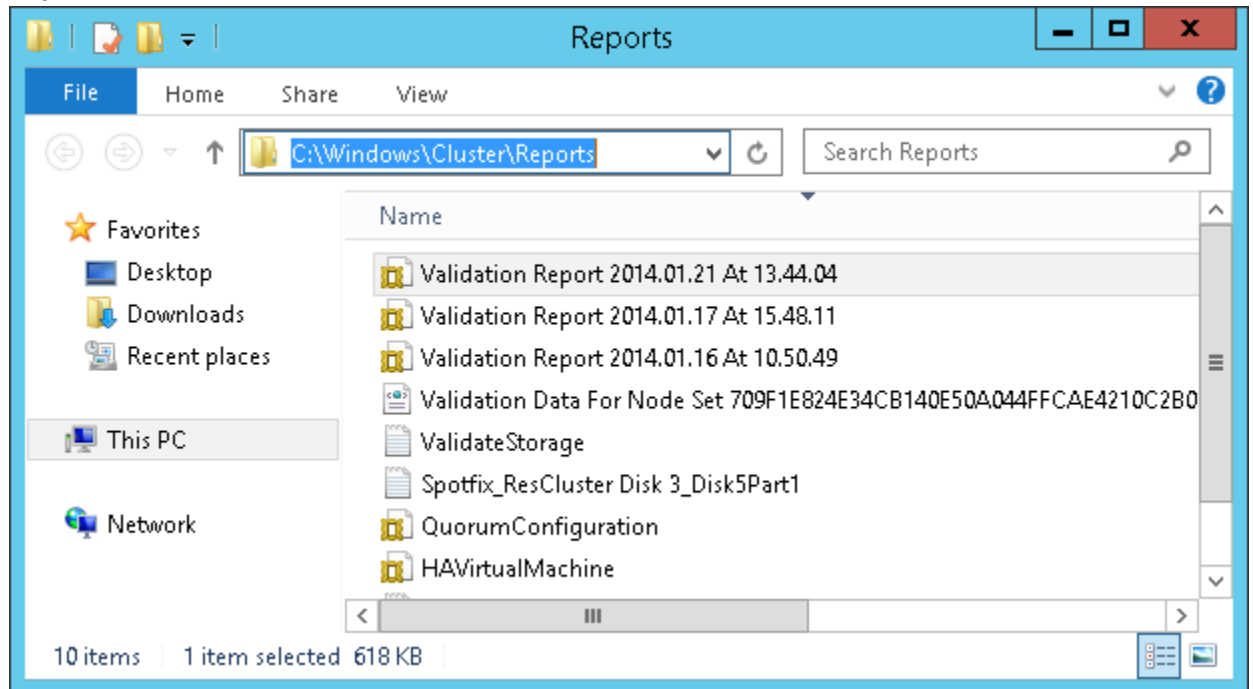
7. Review the settings, and click **Next** to continue.



8. Review the summary.
 - a. To view the report created by the wizard, click **View Report**.
 - b. If testing has completed successfully, optionally click to select **Create the cluster now using the validated nodes**. To close the wizard, click **Finish**.



9. Validation results can be additionally viewed in **%SystemRoot%\Cluster\Reports\Validation Report *date and time*.html**.



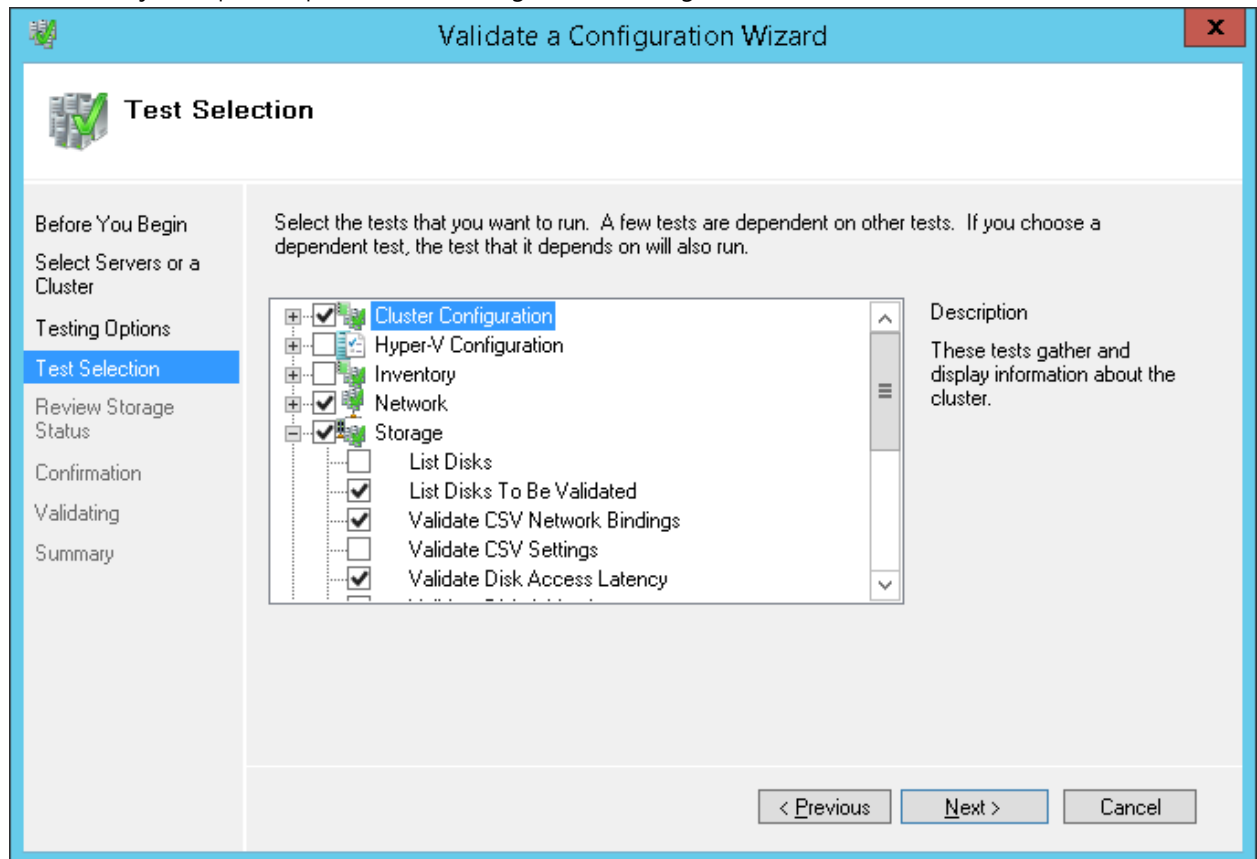
10. After the wizard has completed, the report displays the results in each category. All required tests must pass. In some instances, an acceptable warning will display. Thoroughly review the status of each item and ensure that any identified issues have been resolved. It may be necessary to rerun the Validate a Configuration Wizard multiple times until all items have been addressed.



Storage

| Name | Result | Description |
|--|--------|-------------|
| List Disks | | Success |
| List Disks To Be Validated | | Success |
| Validate CSV Network Bindings | | Success |
| Validate CSV Settings | | Success |
| Validate Disk Access Latency | | Success |
| Validate Disk Arbitration | | Success |
| Validate Disk Failover | | Success |
| Validate File System | | Success |
| Validate Microsoft MPIO-based disks | | Success |
| Validate Multiple Arbitration | | Success |
| Validate SCSI device Vital Product Data (VPD) | | Success |
| Validate SCSI-3 Persistent Reservation | | Success |
| Validate Simultaneous Failover | | Success |
| Validate Storage Spaces Persistent Reservation | | Success |

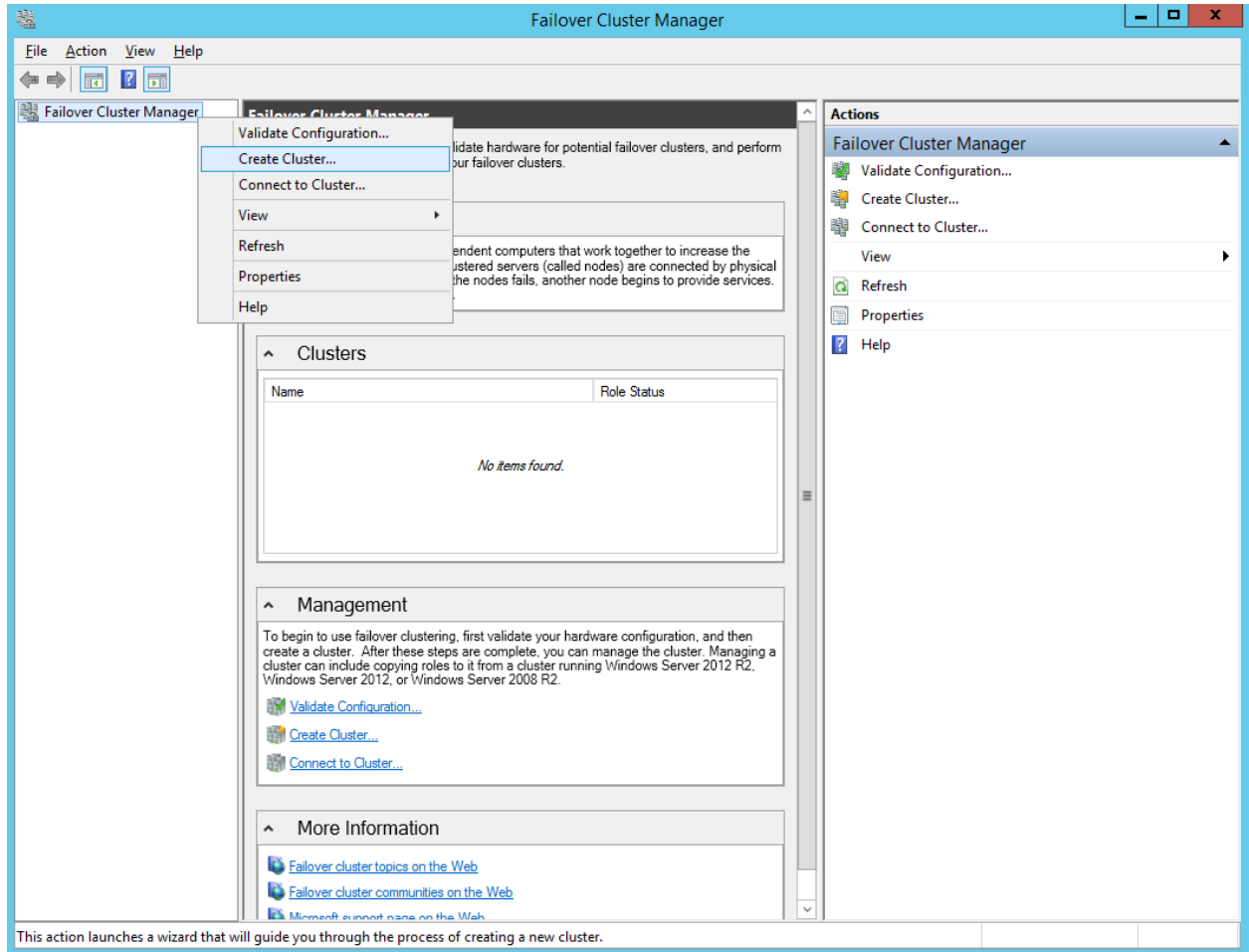
11. When troubleshooting issues or making changes to an existing cluster configuration, such as adding a new node, attaching new storage, and updating device drivers or networking and storage firmware - it may not be necessary to rerun all validation tests. Instead, optionally run specific tests related only the specific problem or configuration change that was made.



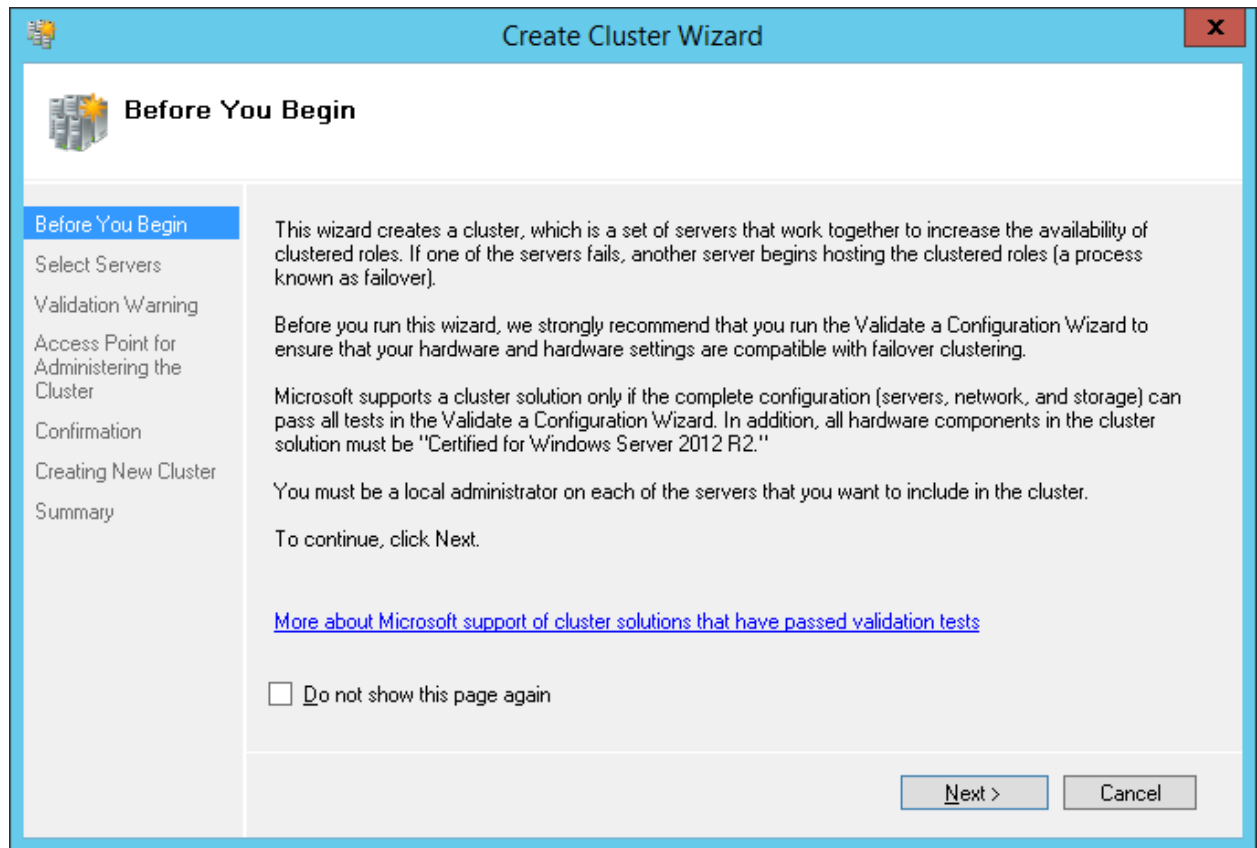
Note: It is recommended to keep a small and unused volume available for storage validation. This allows the Validate a Configuration Wizard to run all of the required storage tests against that specific volume, without negatively impacting storage connectivity to other volumes that are in use by the cluster.

5 Creating a Failover cluster

1. It is recommended to logon to the server as a Domain Administrator with access to all of the servers in the planned cluster.
2. From any server in the planned cluster, launch **Failover Cluster Manager**.
3. From the Action menu, select **Create Cluster**.



4. Click **Next** to continue.



5. Configure the **Access Point for Administering the Cluster**.
 - a. Type the name to be used when managing the cluster.
 - b. For each network to be used, click to select the network and provide a unique IP address.
 - c. Click **Next** to continue.

Create Cluster Wizard

Access Point for Administering the Cluster

Before You Begin
Access Point for Administering the Cluster
Confirmation
Creating New Cluster
Summary

Type the name you want to use when administering the cluster.

Cluster Name:

The NetBIOS name is limited to 15 characters. One or more IPv4 addresses could not be configured automatically. For each network to be used, make sure the network is selected, and then type an address.

| | Networks | Address |
|-------------------------------------|---------------|-------------------|
| <input checked="" type="checkbox"/> | 10.124.4.0/22 | 10 . 124 . 4 . 30 |

< Previous Next > Cancel

6. Review the settings and click **Next** to continue.

Note: By default, the **Add all eligible storage to the cluster** option is selected. This will automatically add all volumes that are currently accessible by all cluster nodes as available storage to the cluster. If this option is selected, the smallest size volume may automatically be designated as a disk witness in the quorum. Once the cluster is created, it is recommended to verify that all disks were assigned properly. Optionally, click to deselect the **Add all eligible storage to the cluster** option if you want to configure storage later.

Create Cluster Wizard

Confirmation

Before You Begin
Access Point for Administering the Cluster
Confirmation
Creating New Cluster
Summary

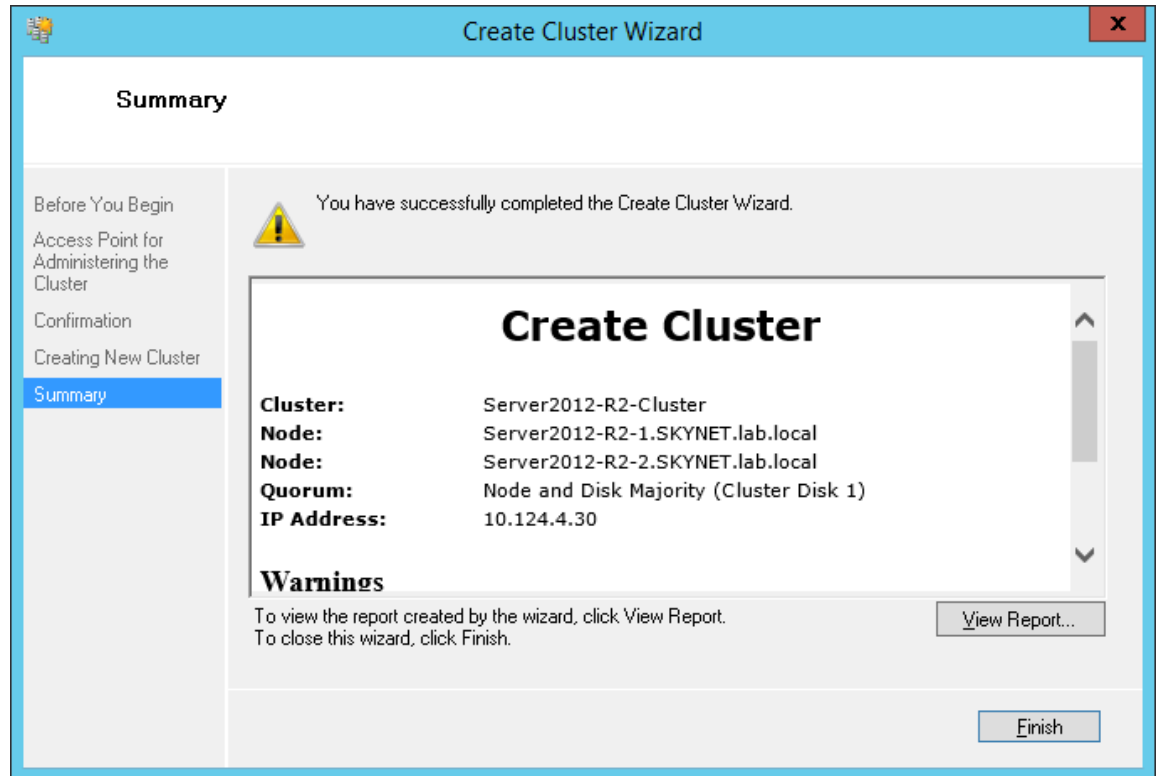
You are ready to create a cluster.
The wizard will create your cluster with the following settings:

| | |
|--------------------|----------------------------------|
| Cluster: | Server2012-R2-Cluster |
| Node: | Server2012-R2-1.SKYNET.lab.local |
| Node: | Server2012-R2-2.SKYNET.lab.local |
| IP Address: | 10.124.4.30 |

☒ Add all eligible storage to the cluster.
To continue, click Next.

< Previous Next > Cancel

7. Review the summary.
 - a. To view the report created by the wizard, click **View Report**.
 - b. To close the wizard, click **Finish**.

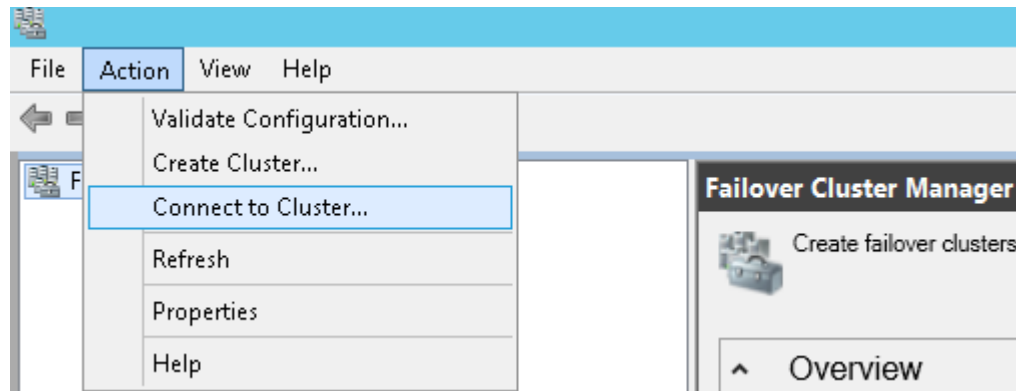


6 Managing a cluster

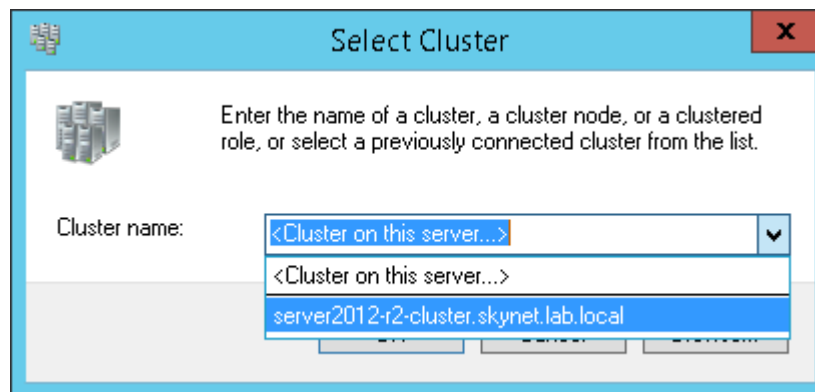
Once a cluster has been created, you can connect to the cluster to configure and manage storage, quorum settings, networking and clustered roles.

6.1 Connecting to a cluster

1. Logon to the server as a Domain Administrator with access to all of the servers in the planned cluster.
2. From any server in the cluster, launch **Failover Cluster Manager**.
3. If required, connect to the cluster.
 - a. From the **Action** menu, select **Connect to cluster**.

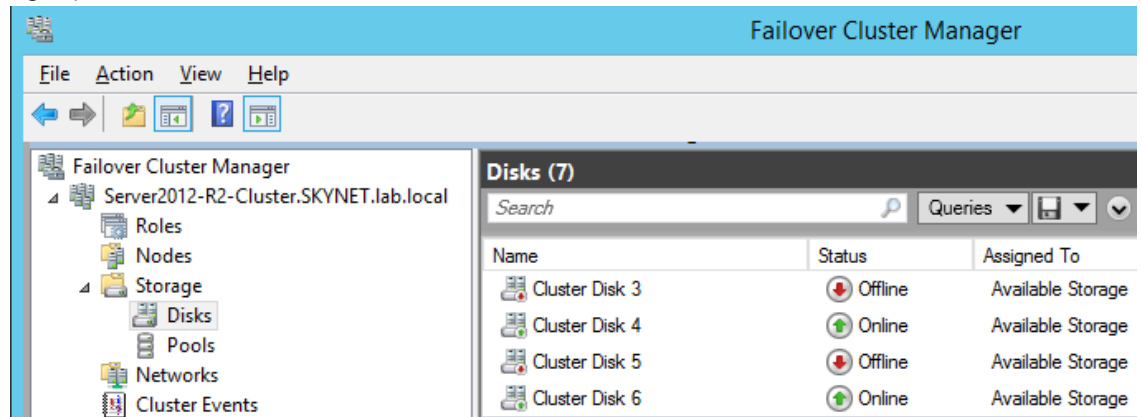


- b. Enter the name of a cluster, a cluster node, or a clustered role, or select a previously connected cluster from the list and click **OK**.



6.2 Viewing disks in a cluster

1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**. Disks that have already been added to the cluster are displayed in the right pane.



6.3 Adding disks to a cluster

Before adding a disk to a cluster, you must first [create the cluster disk and make the volume available to Windows](#).

When adding disks to a cluster, there are two types of disks: Standard clustered disks and CSV:

- **Standard clustered disk:** A volume is able to be accessed by only one cluster node at a time. Only during a failover event can the volume be accessed by another single node. This event will failover the entire volume and impact every other resource on the shared disk. For example, with this limitation, each individual Hyper-V Virtual Machine requires its own dedicated standard clustered disk volume in order to be migrated or fail over independently of other virtual machines. With standard clustered disks, the number of managed volumes must increase with the addition of each virtual machine. This adds complexity to storage management of clustered virtual machines.

Refer to Figure 4 for an example of a Hyper-V environment using standard clustered disks.

- **CSV:** In contrast, CSVs are able to be accessed by all cluster nodes simultaneously. So, all virtual machines that are running across multiple cluster nodes can all access their Virtual Hard Disk (VHD) files at the same time, even though the VHD files potentially reside on a single CSV volume. In a CSV configuration, clustered virtual machines can fail over to another node seamlessly and independently of one another, without impacting other resources on the volume. You can easily continue to add additional virtual machines to a CSV without increasing complexity in storage management.

Refer to Figure 5 for an example of a Hyper-V environment using CSVs.

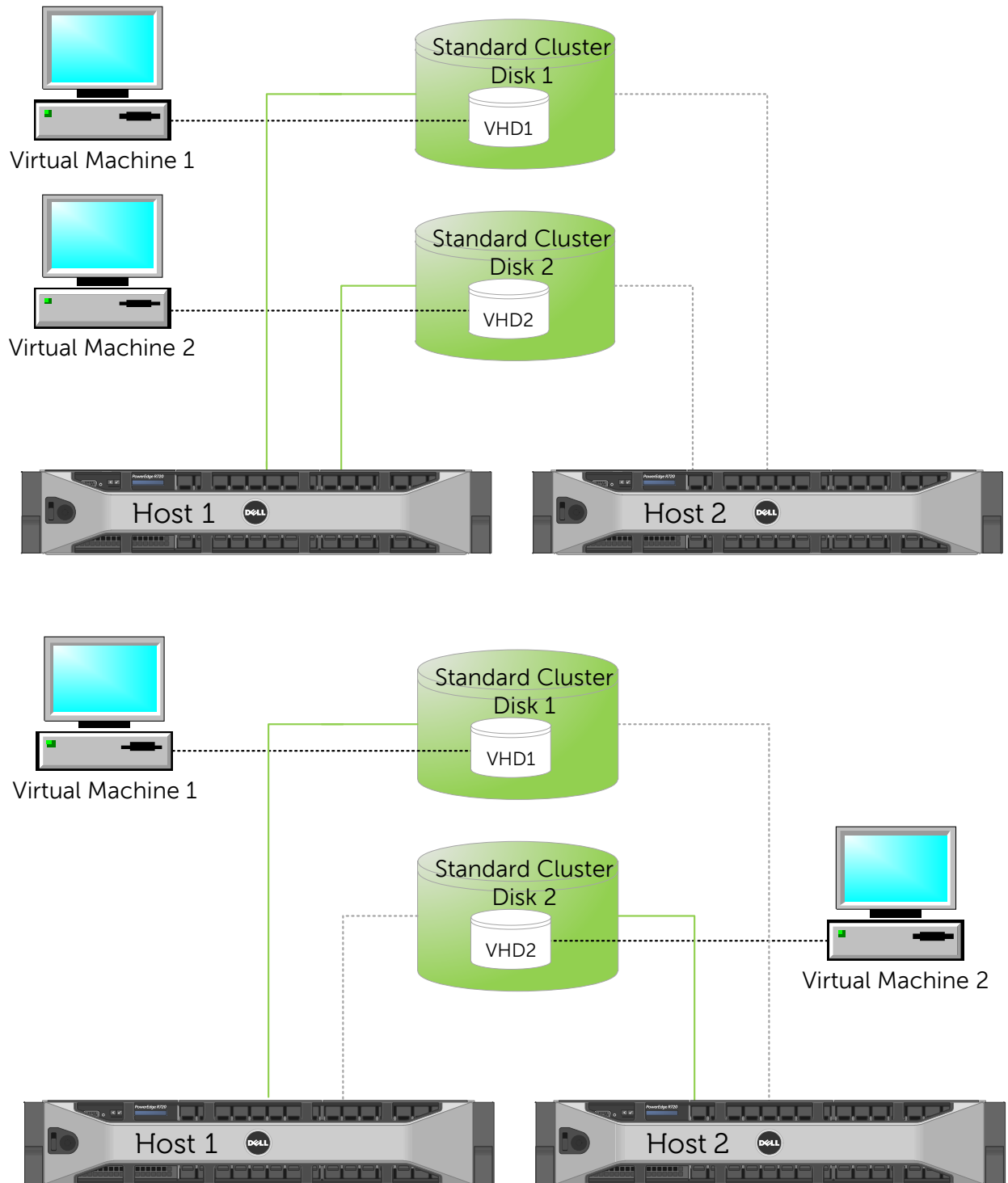


Figure 4 Hyper-V environment using standard clustered disks

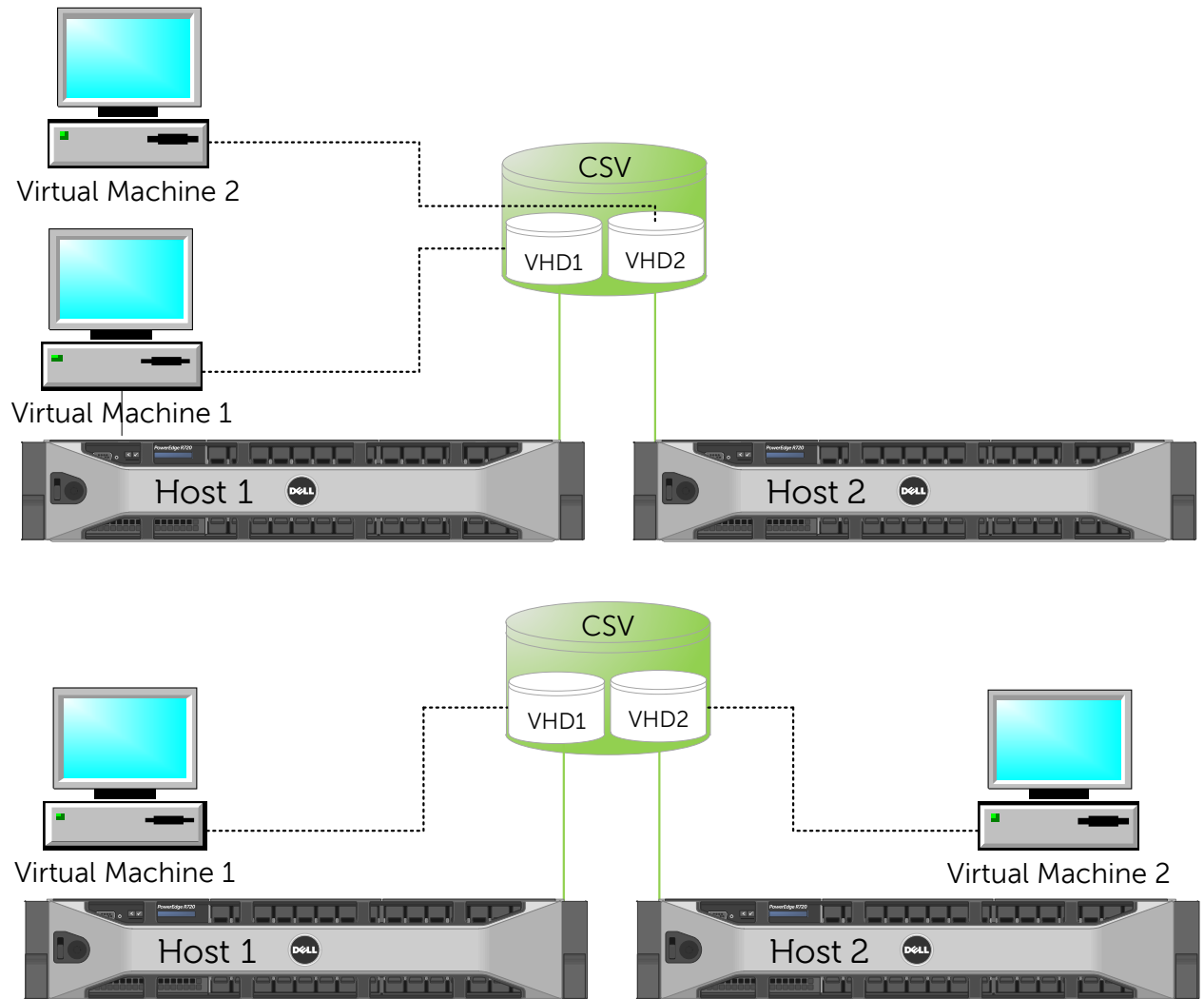
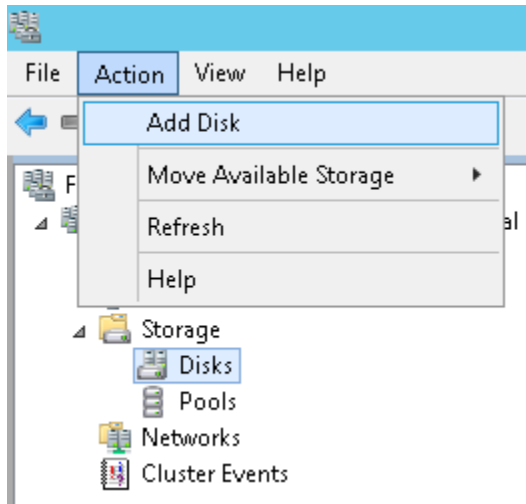


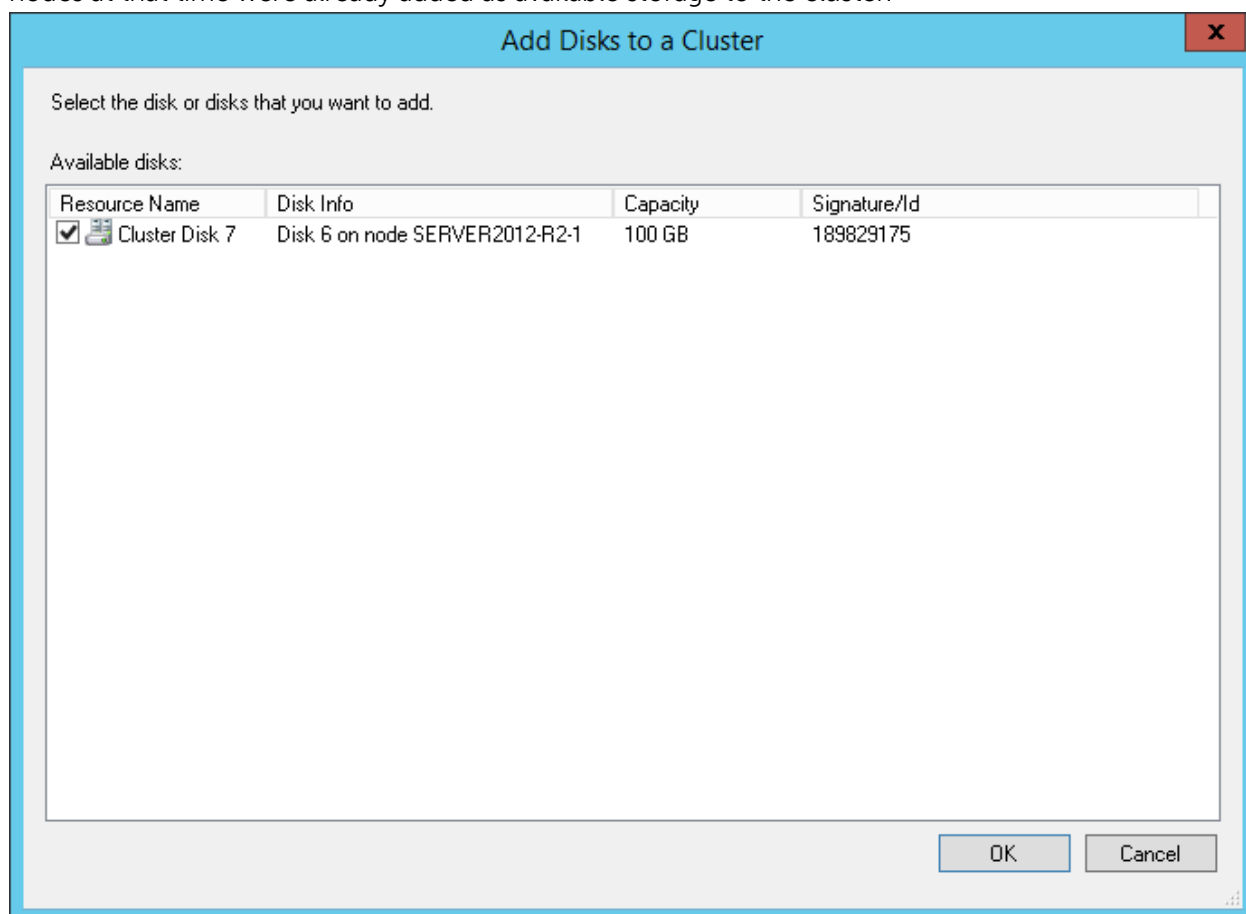
Figure 5 Hyper-V environment using Cluster Shared Volumes

To add a disk to a cluster:

1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**.
2. From the **Action** menu, select **Add disk**.



3. Select the new disk or disks to add to the cluster. If during cluster creation, the option was selected to **Add all eligible storage to the cluster**, all volumes that were accessible by all cluster nodes at that time were already added as available storage to the cluster.

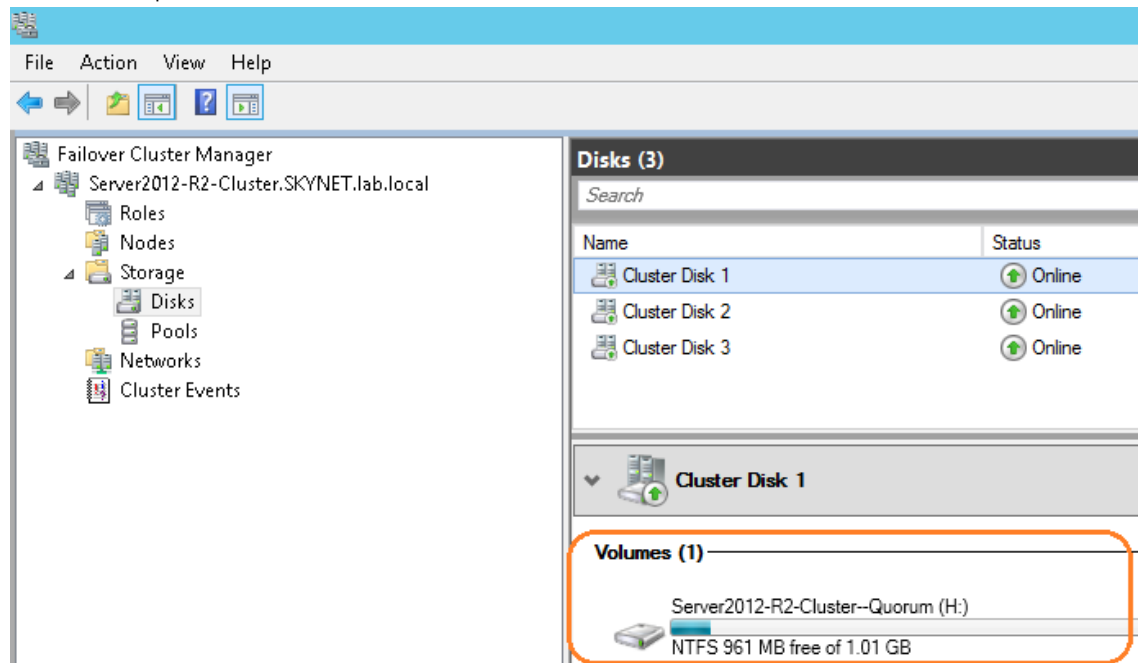


4. To add a disk to a CSV, refer to the section, [Adding a disk to a CSV](#). For additional information on viewing disks in a cluster, refer to the section, [Viewing disks in a cluster](#).

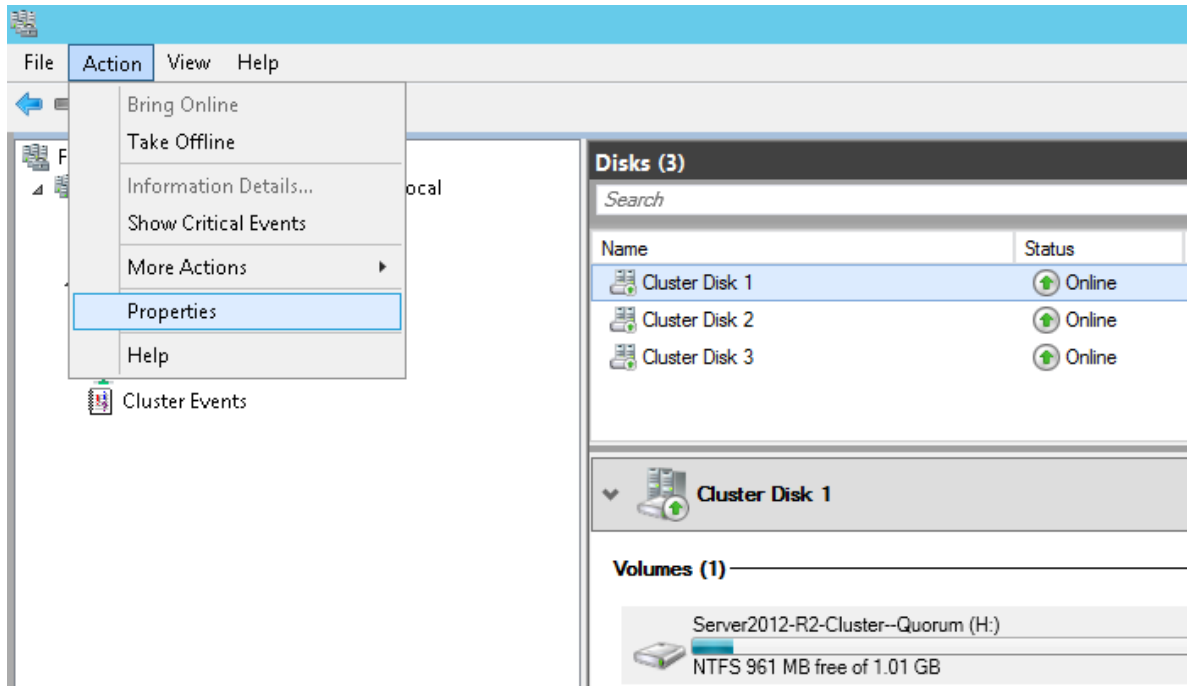
6.4 Renaming cluster disks

Note: For identification purposes, it is recommended to rename cluster disks to match the corresponding Windows volume names.

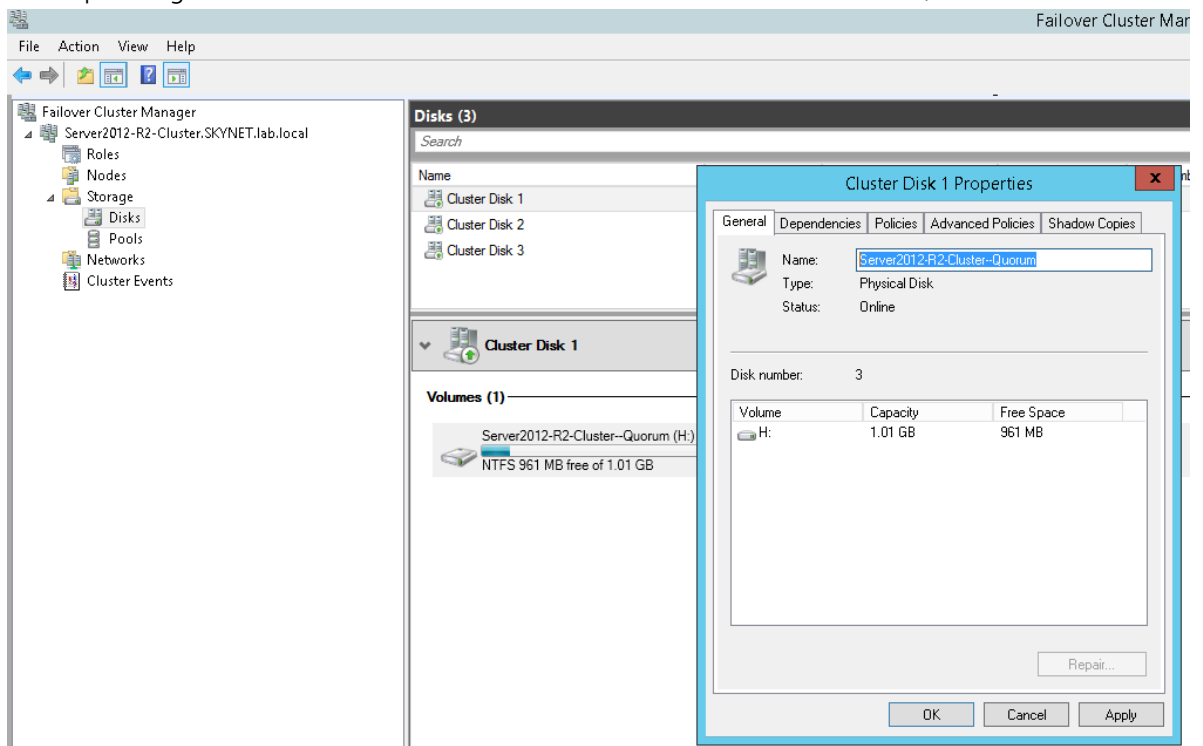
1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**. Disks that have already been added to the cluster are displayed in the right pane.
 - d. Click to select a disk from the right pane. Notice that the corresponding volume is displayed in the bottom pane.



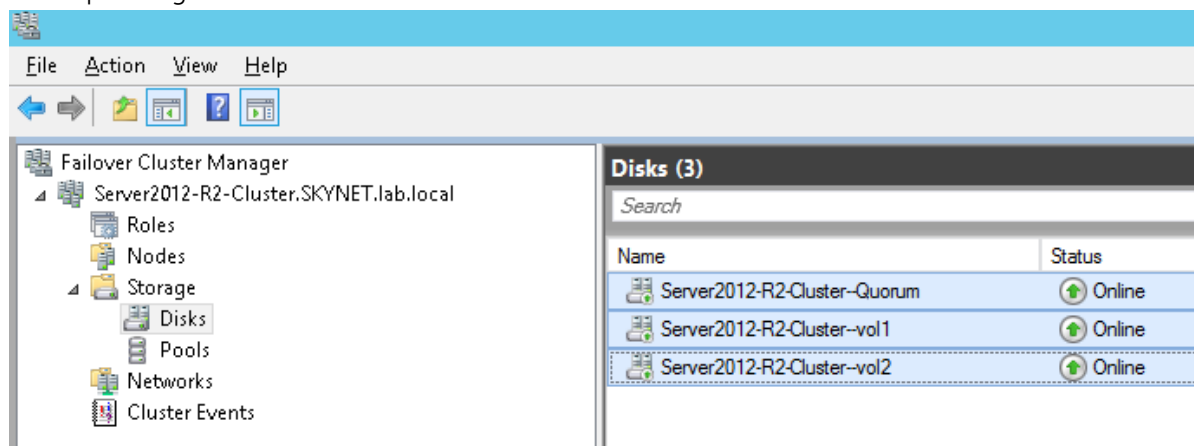
2. From the **Action** menu, select **Properties**.



3. For identification purposes, it is recommended to rename cluster disks to match the corresponding Windows volume names. Provide a name for the cluster disk, and click **OK**.



4. For identification purposes, it is recommended to rename all cluster disks to match the corresponding Windows volume names.



6.5 Configuring cluster quorum settings

A quorum configuration manages the number of failures that a cluster can handle. As it is critical that all cluster nodes are in sync with each other, if the number of failures exceeds what is specified by the quorum configuration, the cluster will stop running to avoid corruption.

When creating a cluster in Microsoft Windows Server 2012 R2, the best quorum configuration is automatically determined based on the number of nodes and availability of shared storage. The configuration can also be manually modified, if required. It is not typically recommended to modify the quorum configuration, unless a node has been added or removed from the cluster using a non-dynamic quorum configuration.

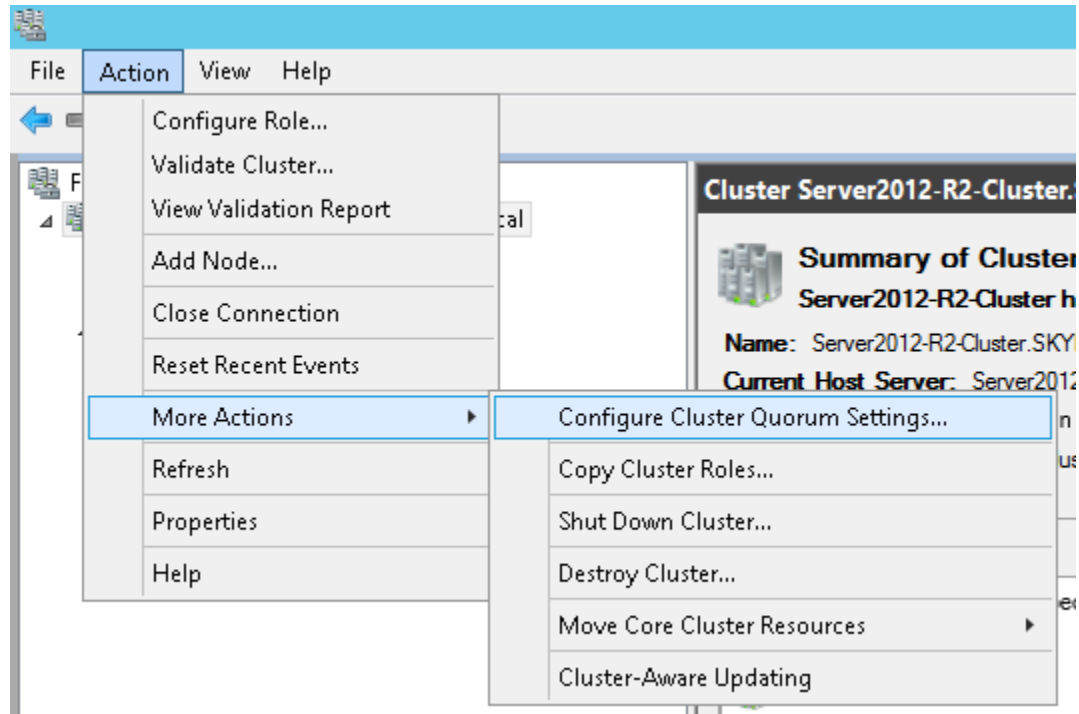
The available quorum configurations are:

- Node Majority: Recommended for clusters with an odd number of nodes. No quorum witness is configured.
- Node and Disk Majority: Recommended for clusters with an even number of nodes. Uses shared storage as a disk witness.
- Node and File Share Majority: For clusters with special configurations, such as multi-site clusters using storage replication or clusters with no shared storage. Uses a file share as a witness.
- No Majority: Disk Only: Not recommended, because a failure of the disk may become a single point of failure. Uses shared storage as a disk witness.

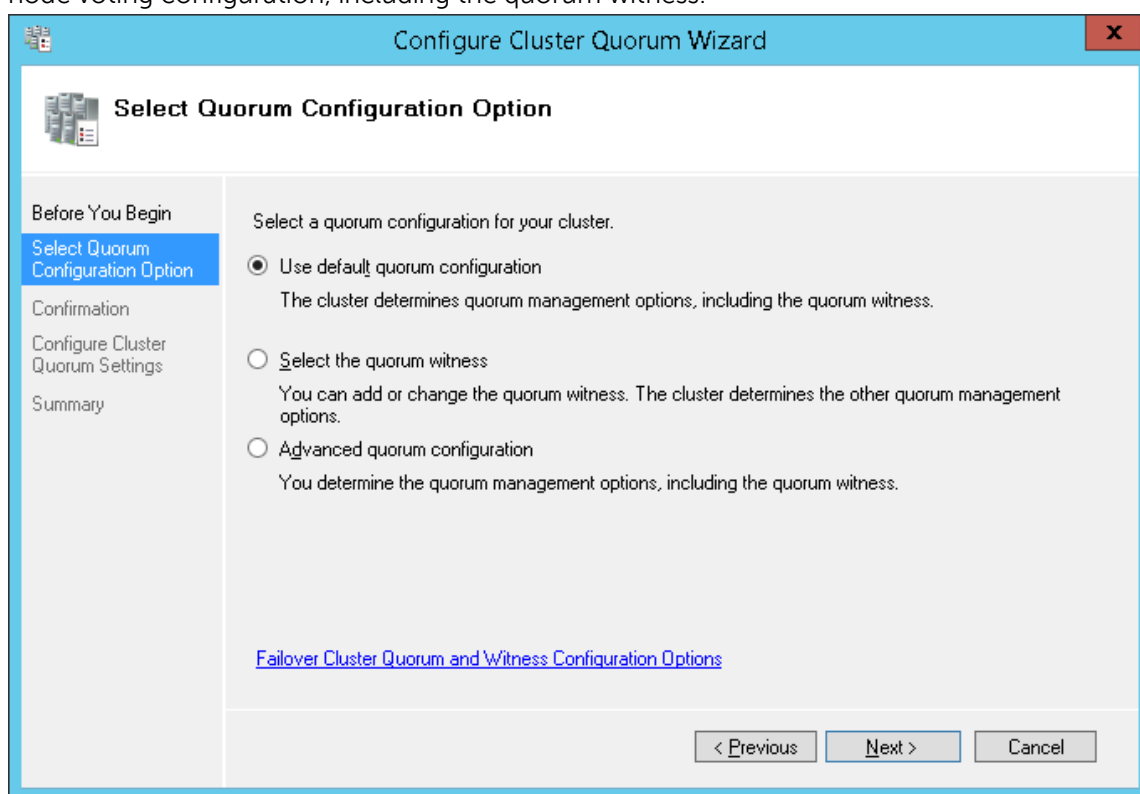
For additional information on quorum configurations, go to:

<http://technet.microsoft.com/en-us/library/cc731739.aspx>

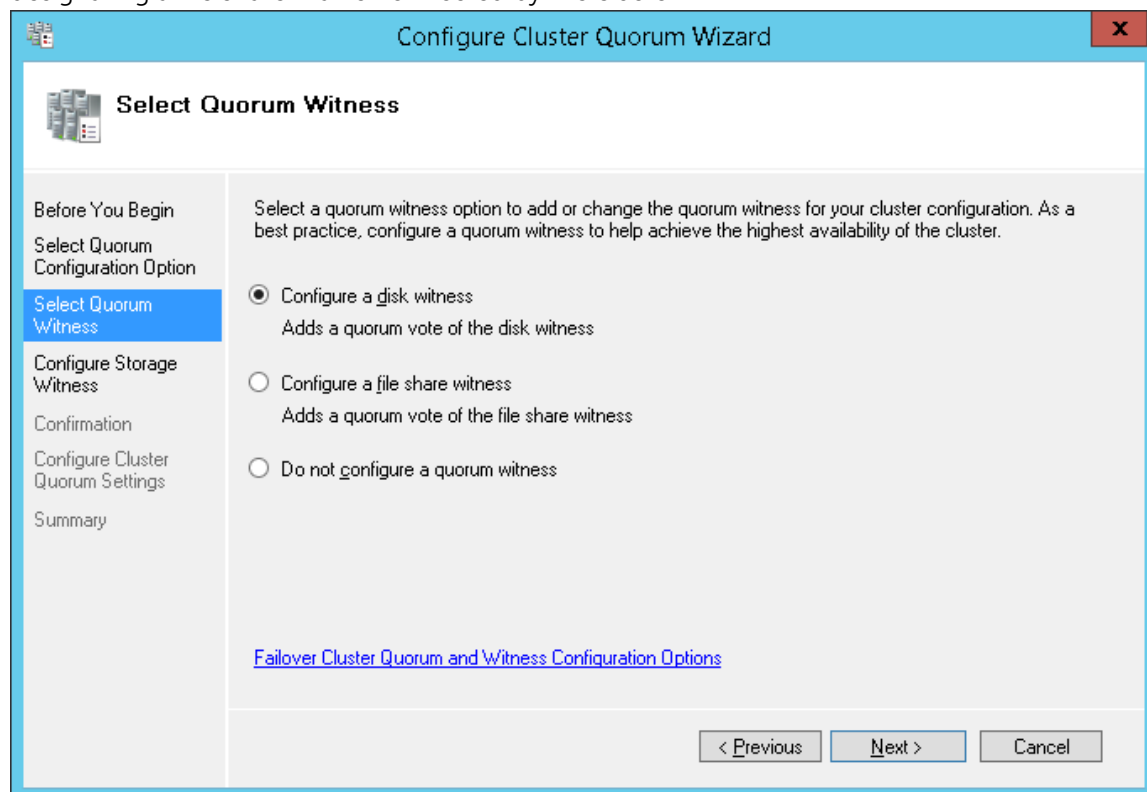
1. To select a quorum configuration option, from the left pane of **Failover Cluster Manager**:
 - a. Click to select the cluster.
 - b. From the **Action** menu, select **More Actions > Configure Cluster Quorum Settings**.



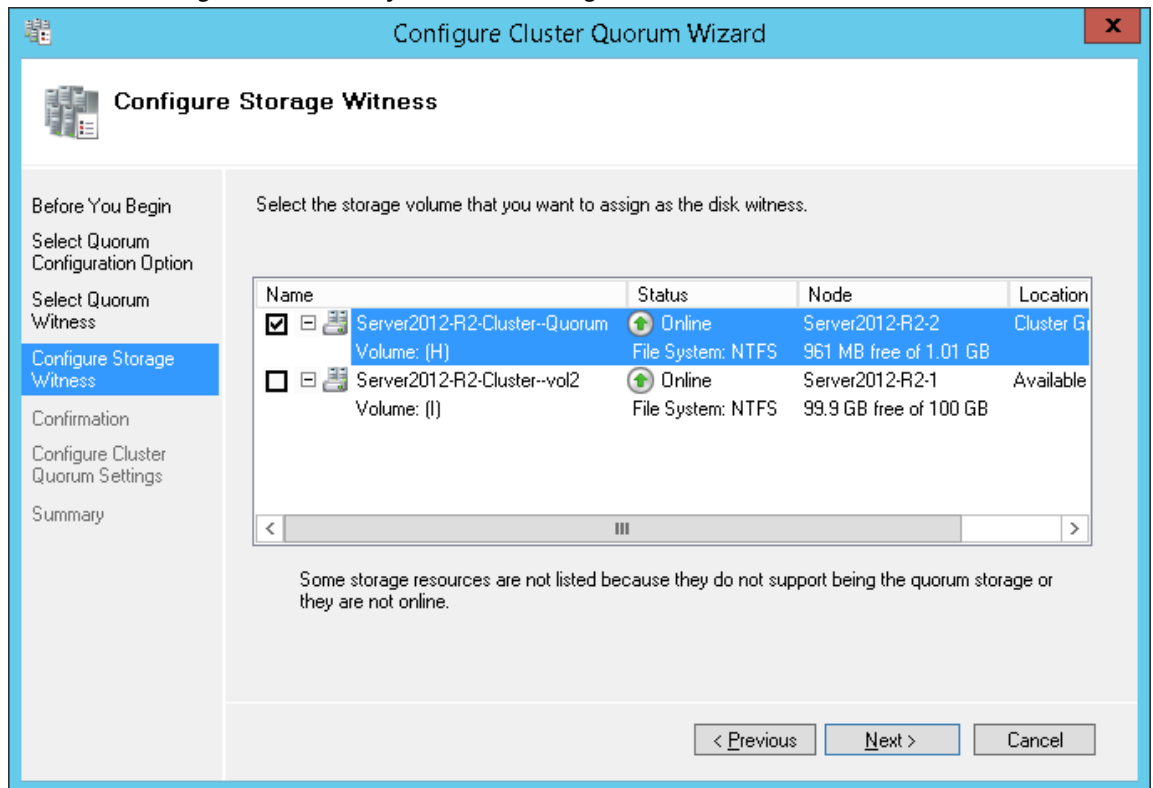
2. Click to select one of the quorum configuration options. The default dynamic witness option significantly reduces the risk that the cluster will fail due to witness failure. In Windows Server 2012, it is required to configure a witness and manually adjust the quorum configuration if nodes are added or removed from the cluster. In Windows Server 2012 R2, it is no longer required to manually adjust the quorum configuration if node membership changes. By default, the cluster will determine the quorum management options, including the quorum witness. To bypass the default configuration and manually configure a disk witness, select from either the **Select the quorum witness** or **Advanced quorum configuration** options.
 - a. **Use default quorum configuration:** The cluster will determine the quorum management options, including the quorum witness.
 - b. **Select the quorum witness:** You can add or change the quorum witness. The cluster will determine the other quorum management options.
 - c. **Advance quorum configuration:** You determine the quorum management options such as the node voting configuration, including the quorum witness.



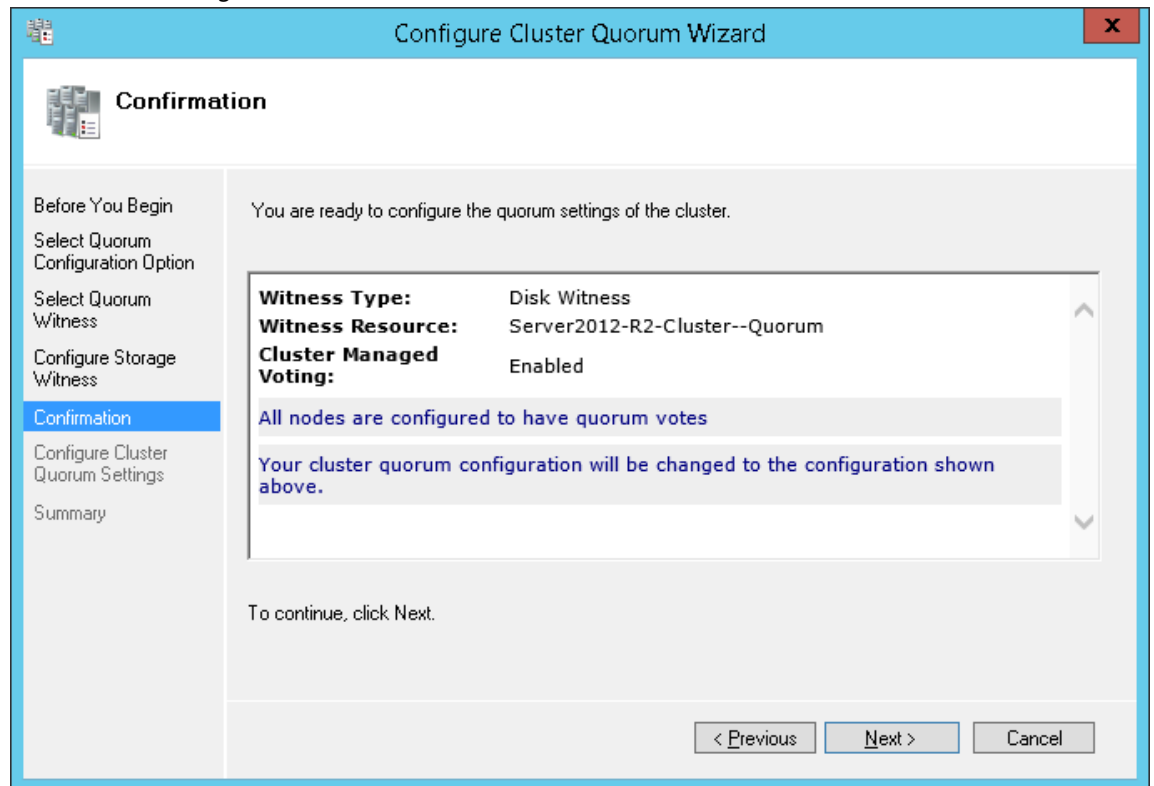
3. When selecting a quorum witness or advanced quorum configuration, to configure a disk witness, select **Configure a disk witness**.
 - a. Optionally, for clusters with special configurations, such as multi-site clusters using storage replication or clusters with no shared storage, you can **Configure a file share witness** by designating a file share that is not hosted by the cluster.



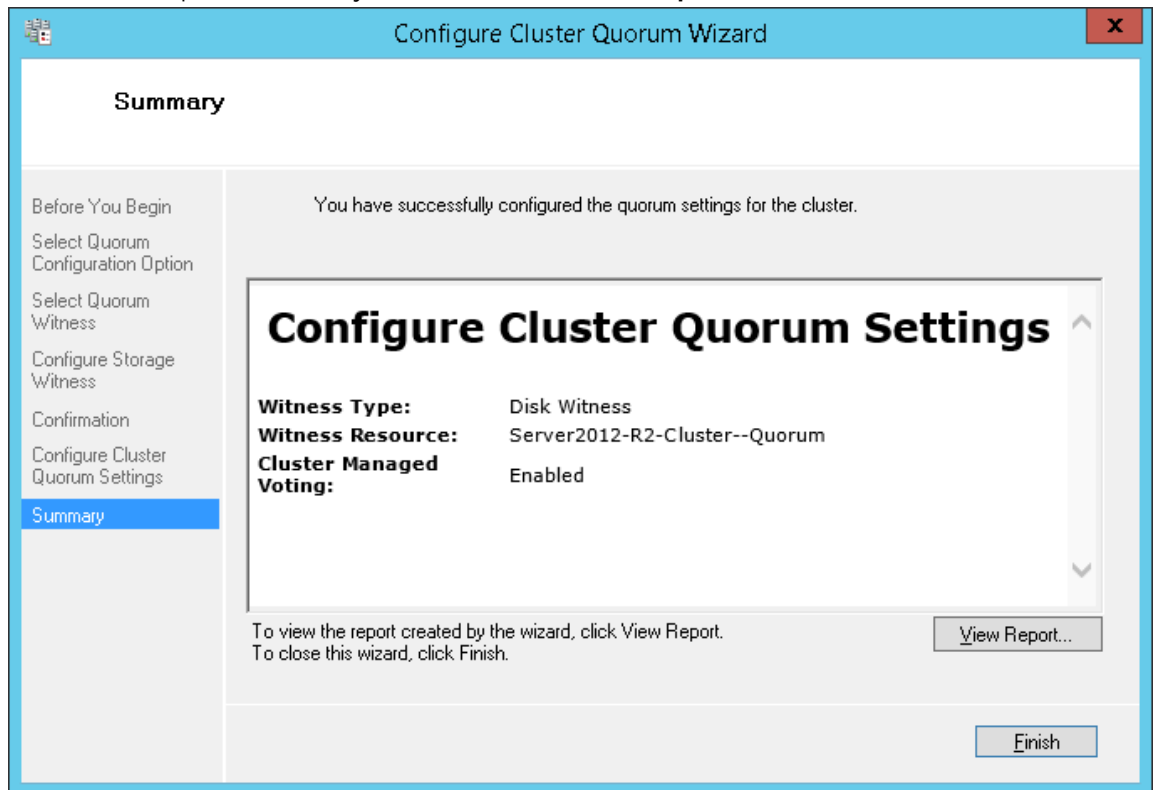
- b. Select the storage volume that you want to assign as the disk witness and click **Next**.



- c. Review the settings and click **Next**.



- d. To view the report created by the wizard, click **View Report**. To close the wizard, click **Finish**.

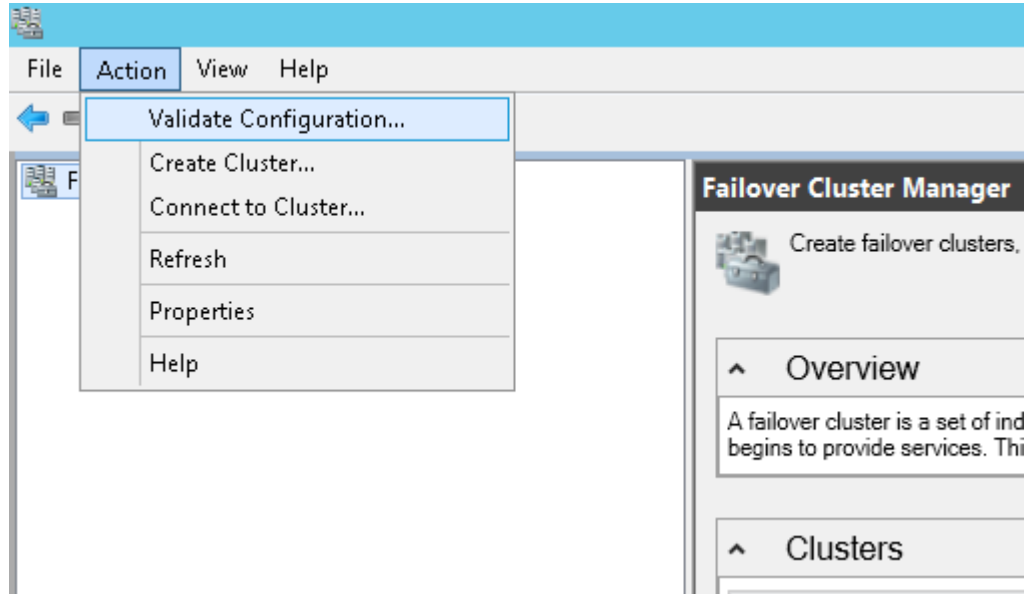


4. After configuring the cluster quorum, it is recommended to run a **Validate Quorum Configuration** test to verify the quorum settings.

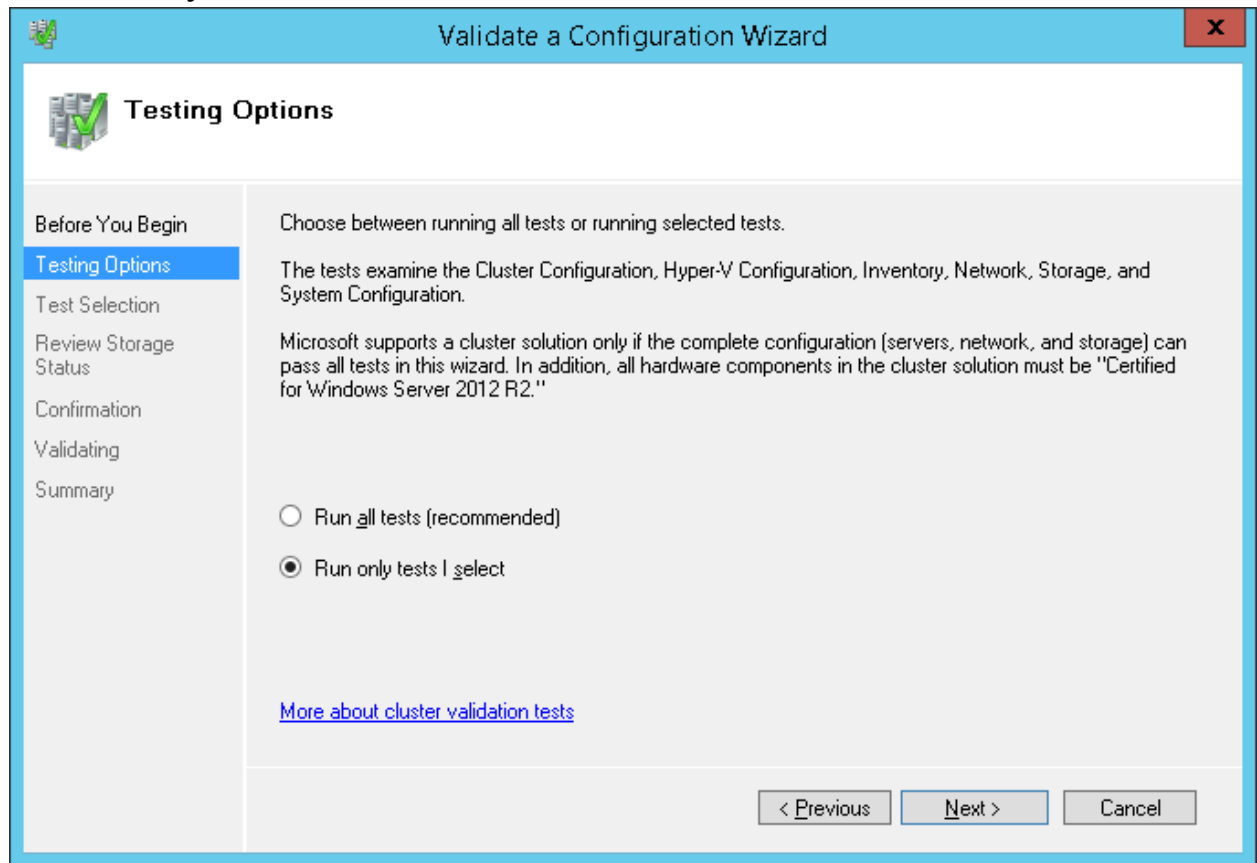
6.6 Validating quorum configuration

To validate the quorum configuration:

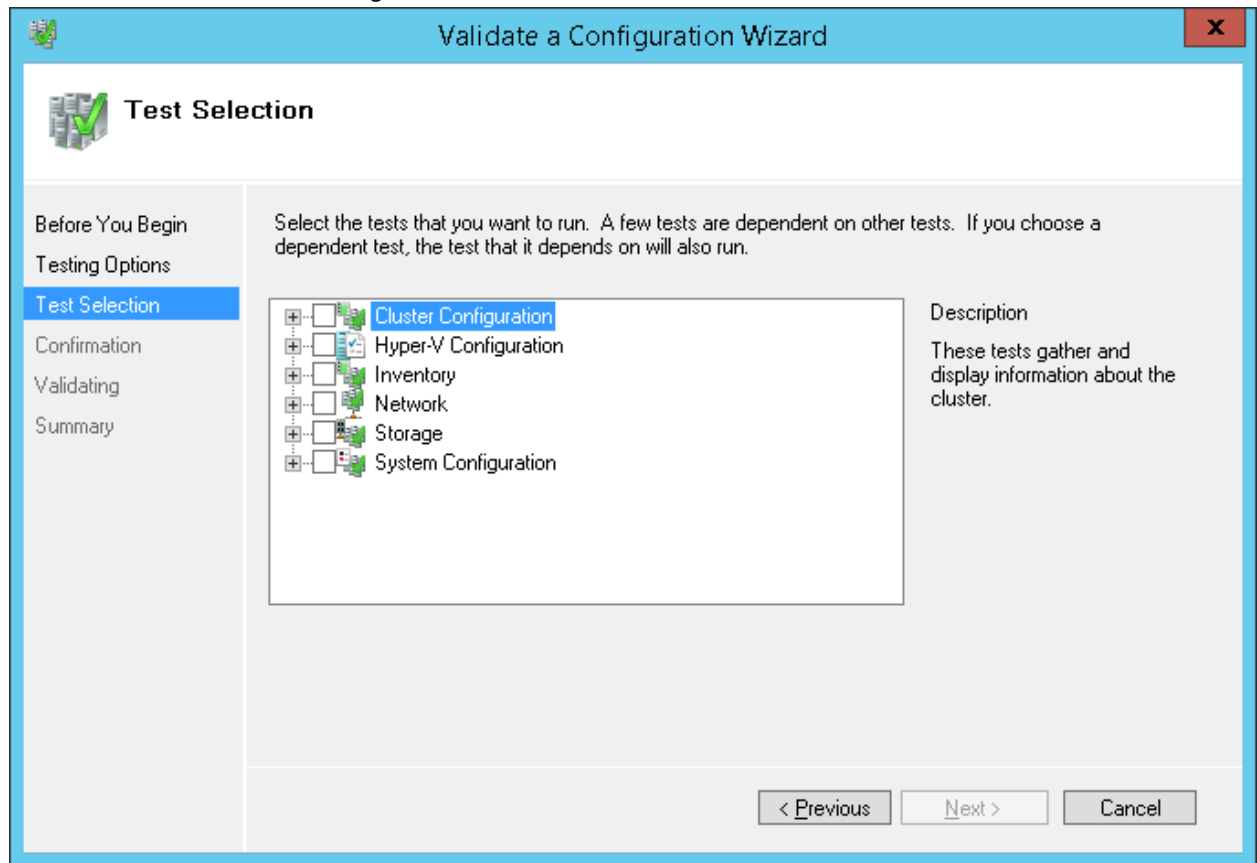
1. In **Failover Cluster Manager**, from the **Action** menu, select **Validate Configuration**.



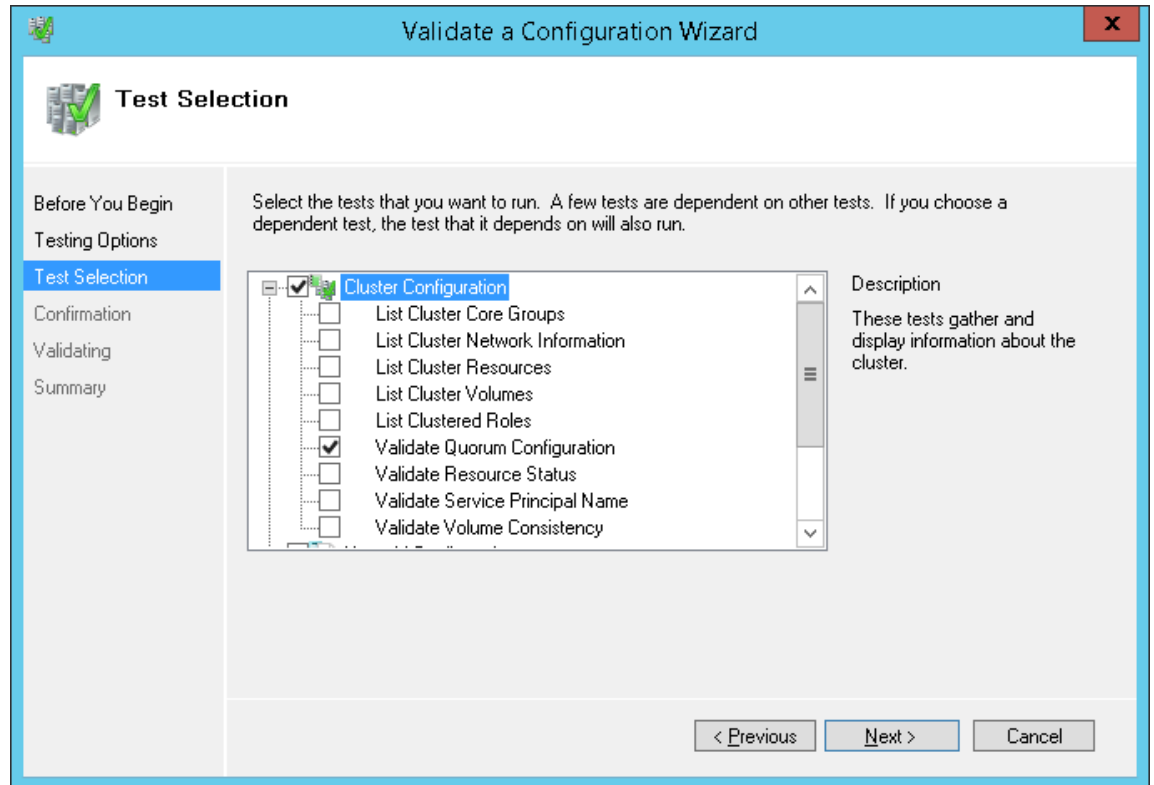
2. Select **Run only tests I select**, and click **Next**.



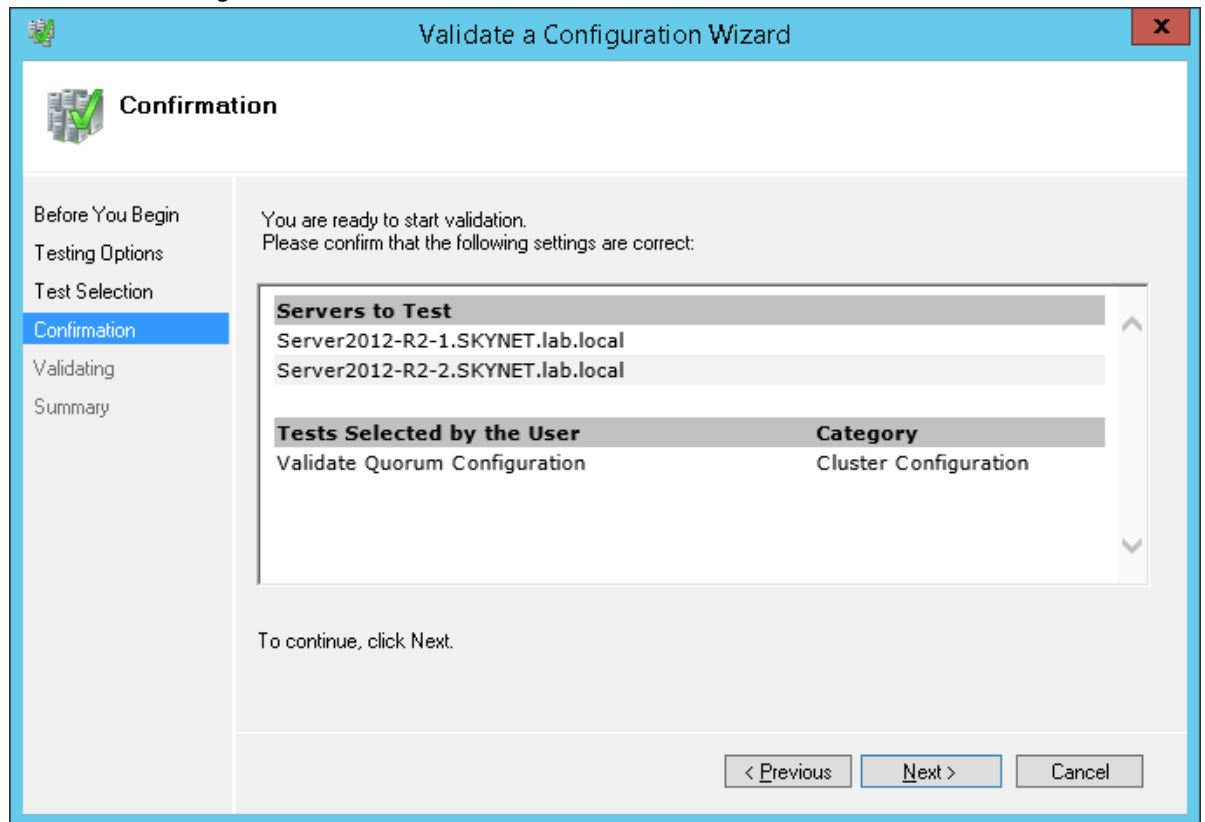
3. Click to de-select all test categories.



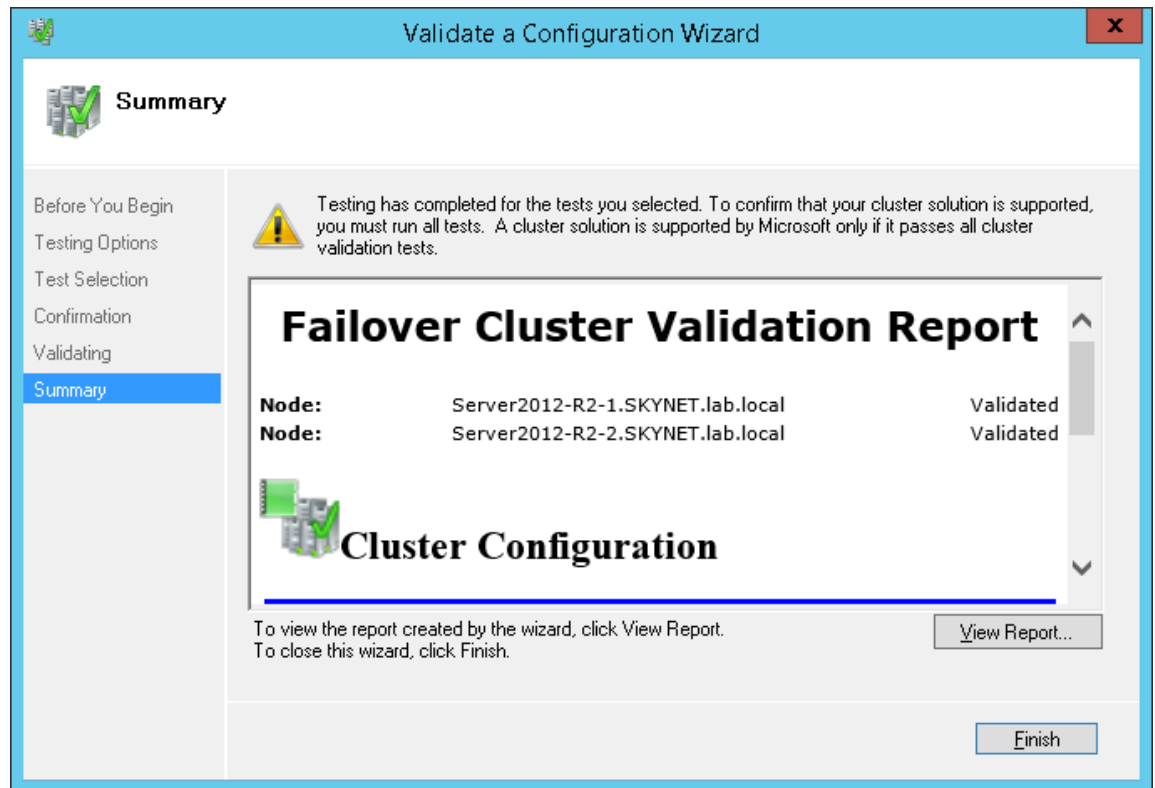
4. Click to expand **Cluster Configuration**.
 - a. Click to select **Validate Quorum Configuration**.
 - b. Click **Next**.



5. Review the settings, and click **Next**.



6. Review the summary.
 - a. To view the report created by the wizard, click **View Report**. Thoroughly review the status of each item and ensure that any identified issues have been resolved.
 - b. To close the wizard, click **Finish**.



6.7 Configuring cluster networking

Cluster networks are automatically created for detected networks connected to all cluster nodes. Cluster networks can be configured for different purposes with the following options:

Table 2 Cluster network options

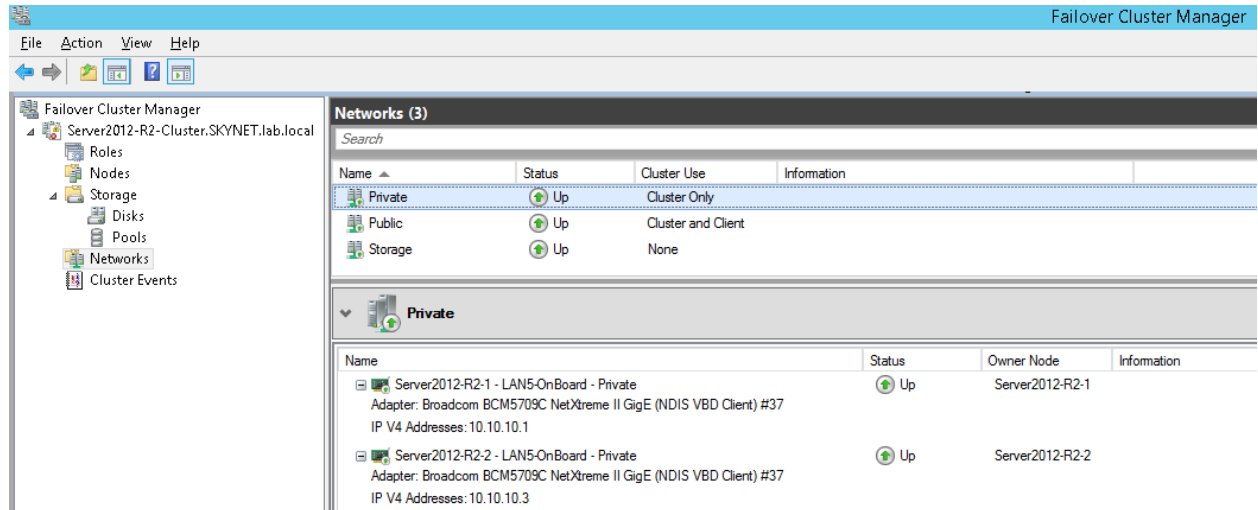
| Setting | Description | Usage |
|--|--|---|
| Allow cluster communications (Cluster Only) | Only cluster nodes will use this network for internal cluster communications and CSV traffic. | Often used for: <ul style="list-style-type: none">• Private networks• Cluster traffic• Heartbeat• Hyper-V Live Migration |
| Allow cluster and client communications (Cluster and Client) | Cluster nodes and clients will use the network. Cluster IP Address resources (Highly Available virtual machines, SQL databases, File Servers, and other resources) can be created on this network for clients to connect to. | Often used for: <ul style="list-style-type: none">• Public networks• Management networks• Hyper-V Replica traffic• Cluster traffic |
| Do not allow cluster network communications (None) | Cluster communications will not be sent over this network | Often used for: <ul style="list-style-type: none">• iSCSI SAN |

Note: It is recommended to allow cluster communications on multiple networks.

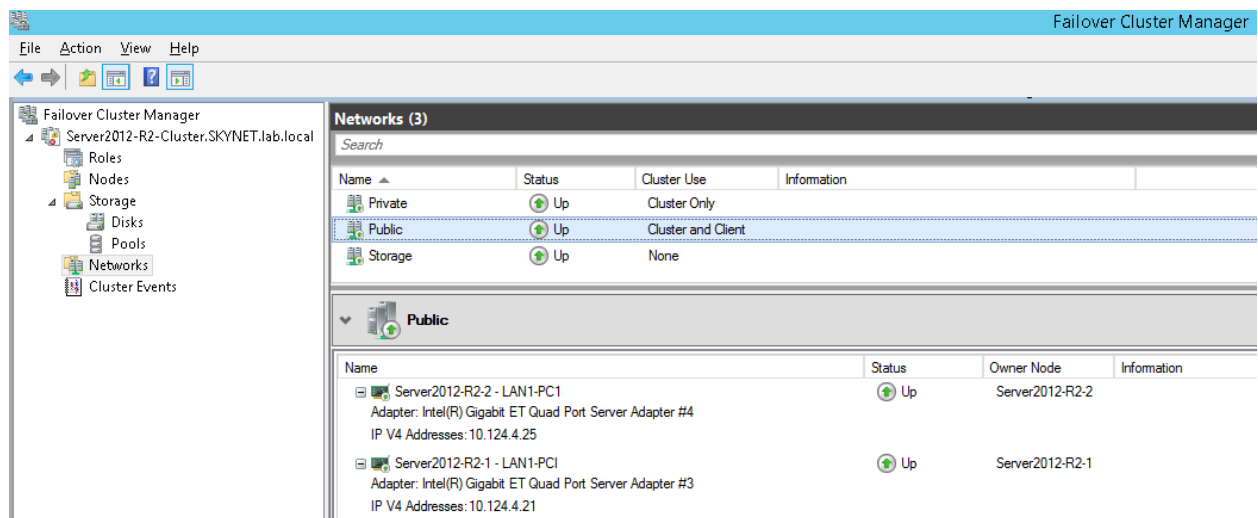


Refer to the following examples of common configurations for Private, Public and Storage cluster networks:

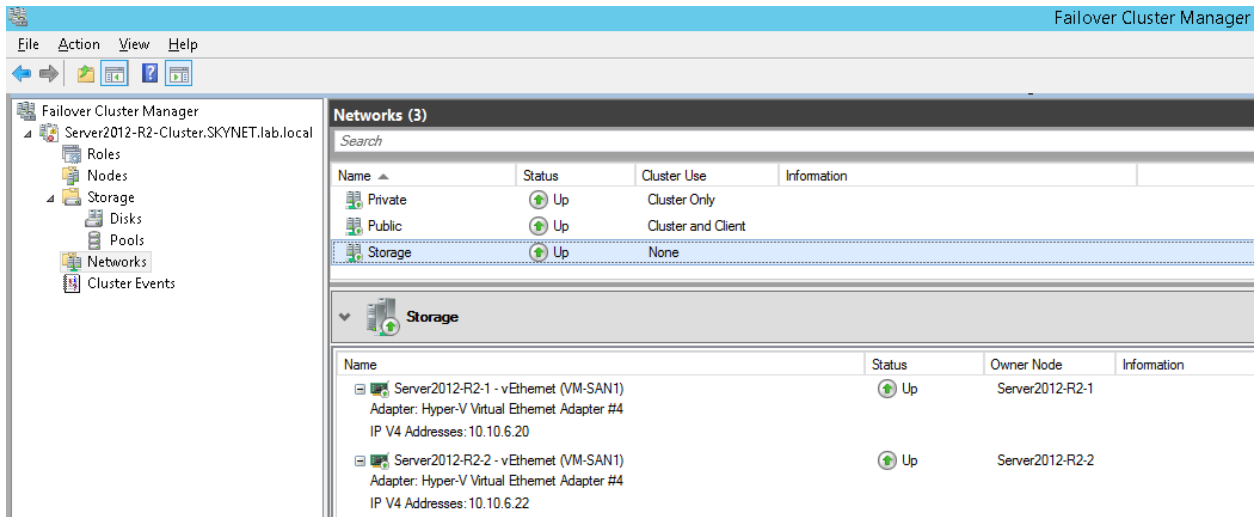
| Network Name | Cluster Use |
|--------------|--------------|
| Private | Cluster Only |



| Network Name | Cluster Use |
|--------------|--------------------|
| Public | Cluster and Client |



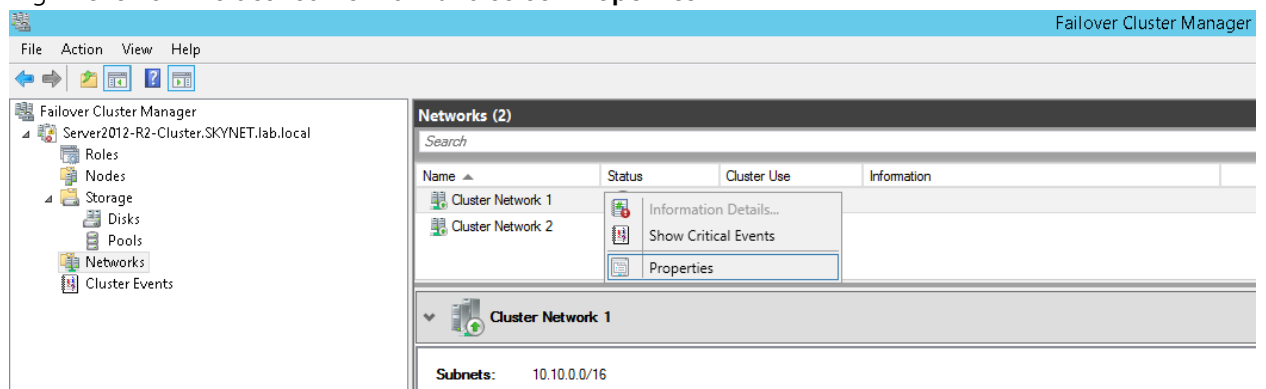
| Network Name | Cluster Use |
|--------------|-------------|
| Storage | None |



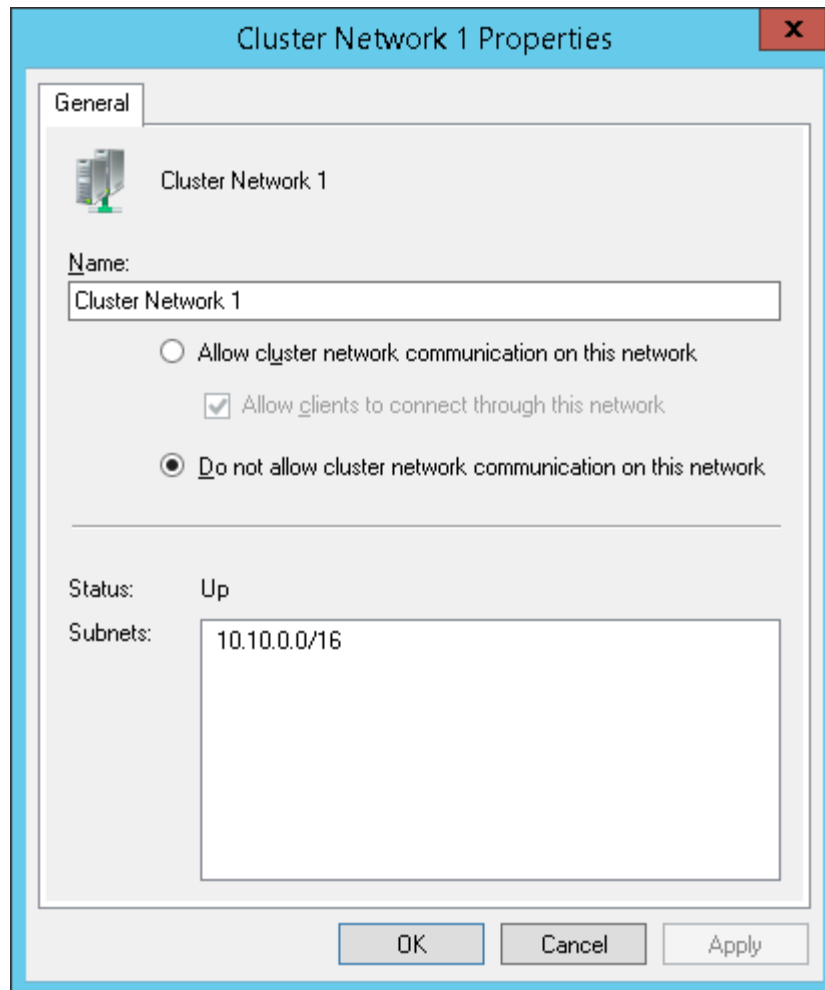
Note: The iSCSI SAN network should be disabled for cluster communications so that the SAN can remain dedicated to storage related traffic.

To modify the settings for a cluster network:

1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click on **Networks**.
2. Networks that have already been added to the cluster are displayed in the right pane.
3. Click on a network to display the associated network adapters.
4. Right-click on the desired network and select **Properties**.



5. Select a configuration option, and click **OK**.
 - a. To allow cluster communication only:
 - i. Select **Allow cluster network communication on this network**.
 - ii. De-select **Allow clients to connect through this network**.
 - b. To allow cluster network and client communication:
 - i. Select **Allow cluster network communication on this network**.
 - ii. Select **Allow clients to connect through this network**.
 - c. To prevent a network from being used for cluster traffic (recommended for iSCSI Networks):
 - i. Select **Do not allow cluster network communications on this network**.



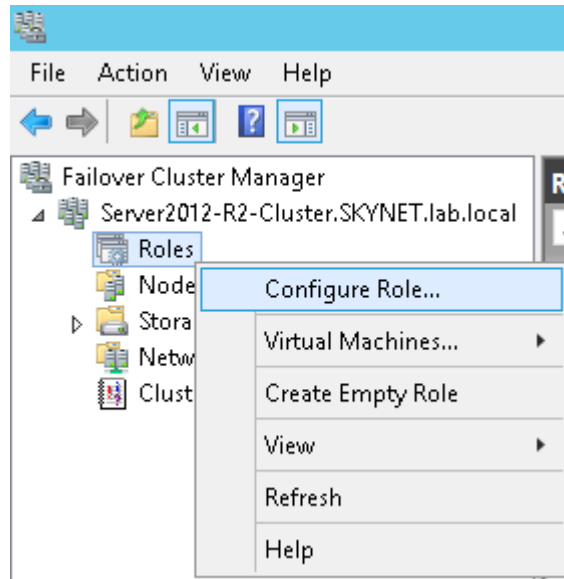
For additional information on configuring Windows Failover Cluster Networks, refer to:
<http://blogs.technet.com/b/askcore/archive/2014/02/20/configuring-windows-failover-cluster-networks.aspx>.

6.8 High availability and clustered roles

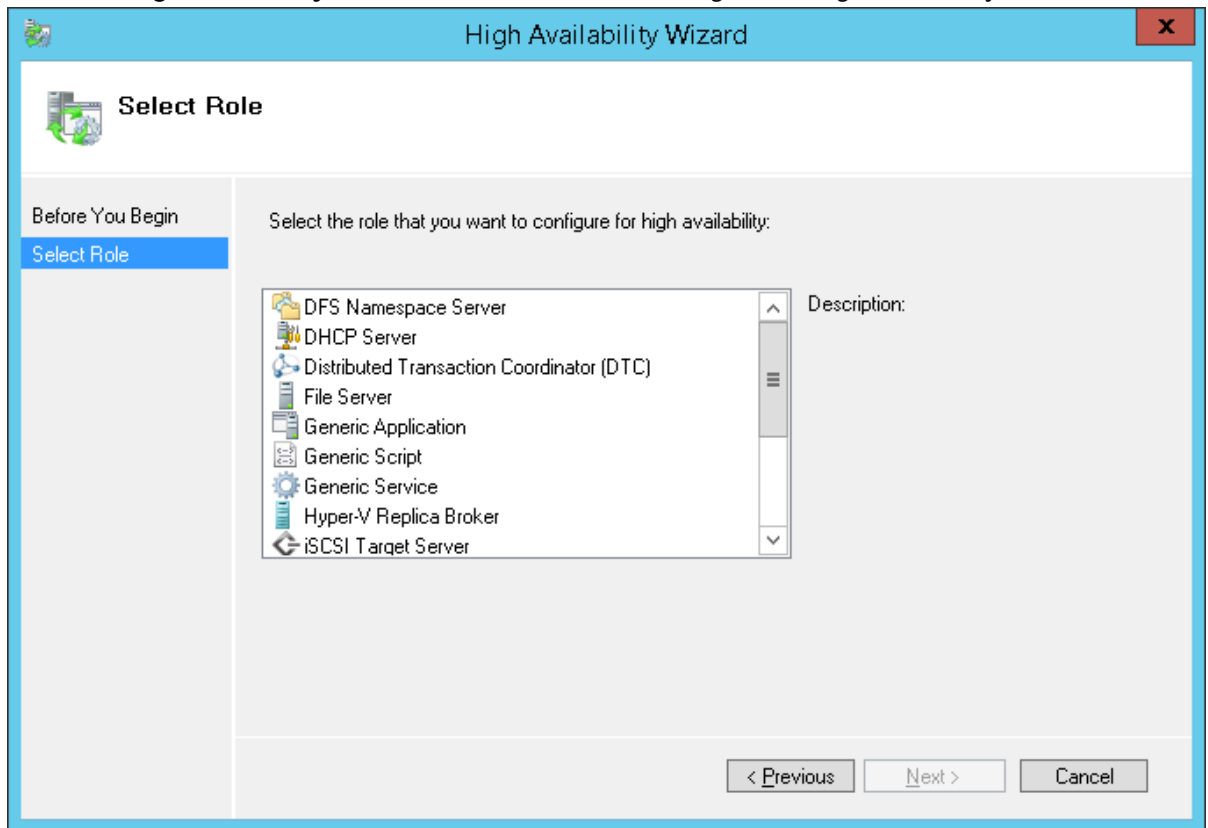
Failover clustering provides high availability and scalability for file shares and applications such as Microsoft Exchange Server, Microsoft SQL Server and Hyper-V, as well as other clustered services and roles that run on Microsoft Windows. If one of the servers, referred to as a node, fails, other nodes in the cluster can continue to provide service for the resources that failed.

To create a clustered role:

1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Right-click on **Roles** and select **Configure Role**.



2. From the **High Availability Wizard**, select the role to configure for high availability.



3. For additional information on creating a Highly Available virtual machine, refer to [Highly Available virtual machines](#).

7 Cluster Shared Volumes

Cluster Shared Volumes (CSV) are a clustered NTFS (or ReFS in Windows Server 2012 R2) file system which enables multiple Failover cluster nodes to simultaneously maintain read-write access to a common volume. This distributed CSV architecture increases disk performance because disk I/O is load balanced across the cluster nodes. With CSVs, resources can fail over independently and seamlessly from one node to another, while allowing the volume to remain online and uninterrupted.

In contrast, since [standard clustered disks](#) (Non-CSV) can only be accessed by a single node at a time, resources on the volume cannot be failed over independently from each other. During failover events of standard cluster disks, all resources that use the volume all failover together. Therefore, if using standard clustered disks (non-CSV) it is recommended to maintain one virtual machine per disk.

CSVs are commonly used for:

- Clustering virtual hard disks (VHD) for Hyper-V virtual machines
- Scale-out file shares to store application data, such as SQL Server data and Hyper-V virtual machine files, for the Scale-Out File Server clustered role

Table 3 CSV requirements

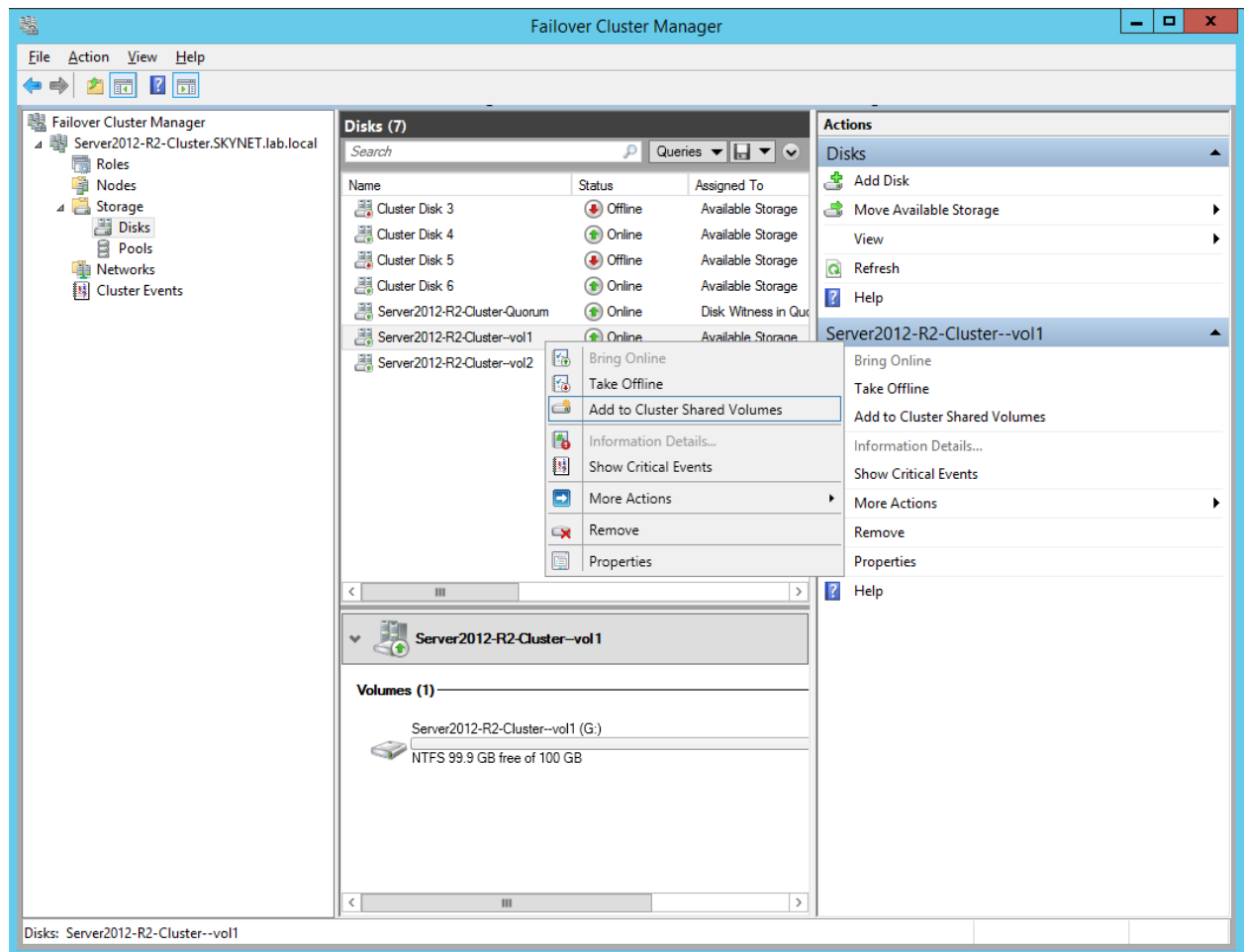
| Item | Description |
|---------------------------------|---|
| File System Format | Basic disk formatted with NTFS, or ReFS (Server 2012 R2 only) |
| System Disk Drive Letter | The system disk drive letter must be the same on all nodes |
| Disk Arrangement | Recommended to isolate system files/page files, and data files on separate CSVs |
| Restrictions | <ul style="list-style-type: none">• Cannot be used as a quorum disk• Cannot be used as a Pass-Through disk for a virtual machine |



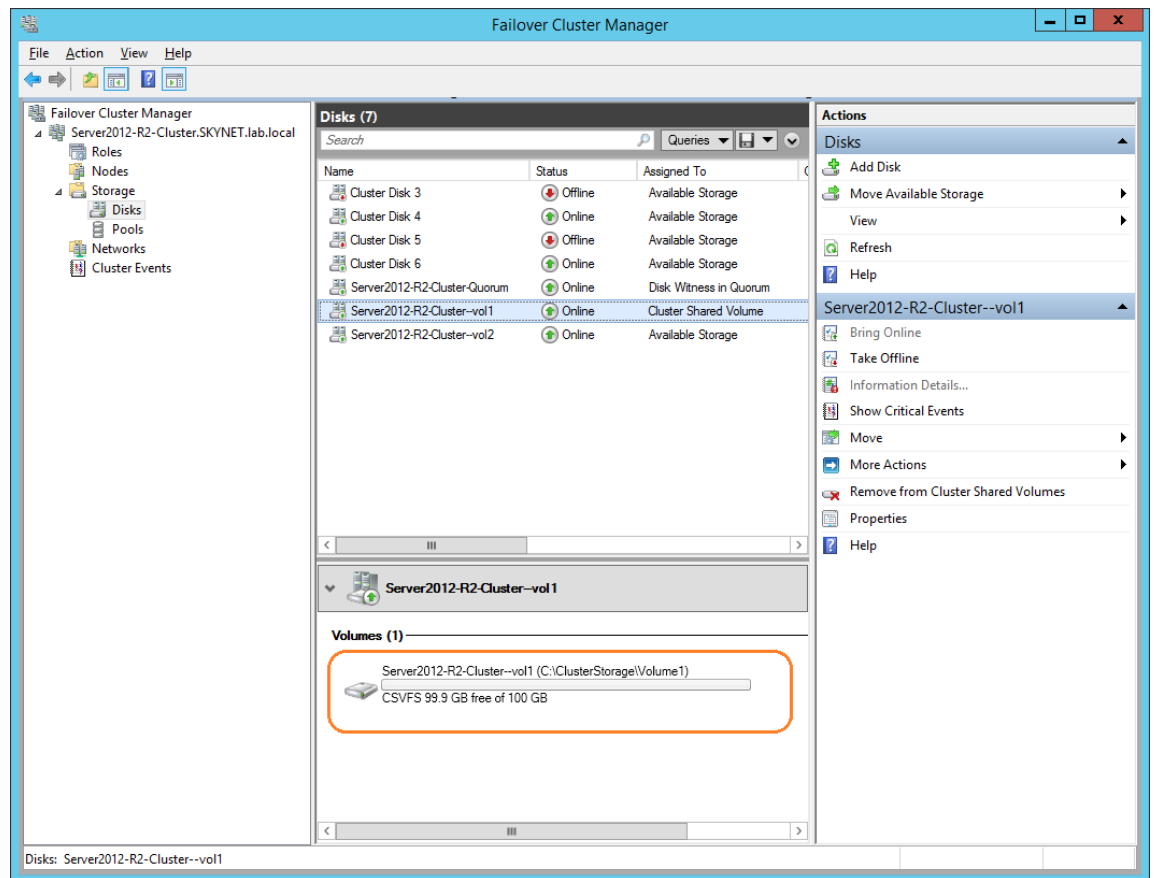
7.1 Adding a disk to a CSV

To add a disk to a CSV, you must first add a disk to the Available Storage group of the cluster (if it has not been previously added). Refer to the following sections for additional information:

- [Creating a Cluster Disk](#)
 - [Making a volume available to Windows](#)
 - [Adding disks to a cluster](#)
 - [Renaming cluster disks](#)
1. To add a disk in Available Storage to a CSV, from the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**.
 2. In the **Disks** pane, right-click on the desired disk from Available Storage and select **Add to Cluster Shared Volumes**.



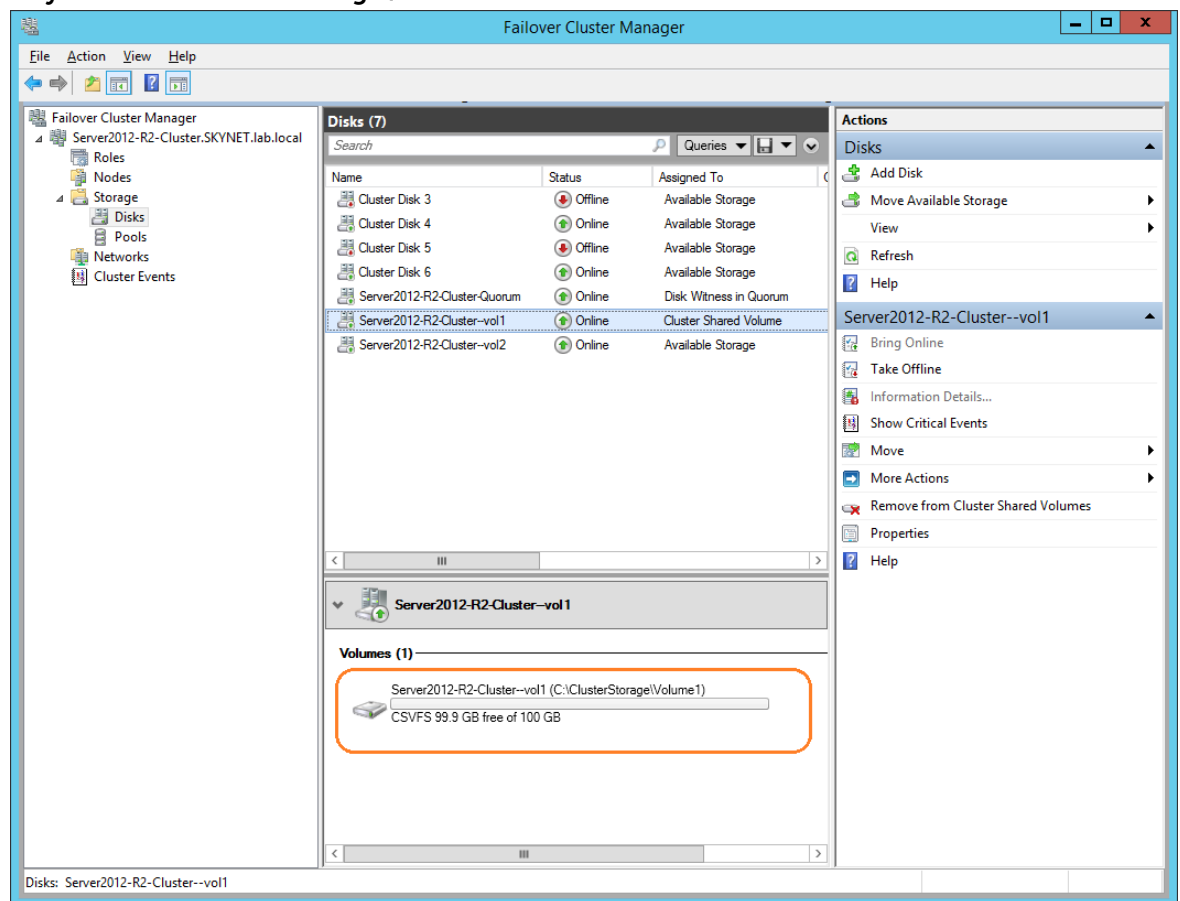
3. Note that the disk has been added to Cluster Shared Volumes. Click to select the disk.
 - a. The CSV is now available as a Windows mount point, with a Cluster Shared Volume File System (CSVFS), to all cluster nodes. Make note of the mount point, **%SystemDisk%\ClusterStorage\<<volume>>**. This is the path that the cluster will use to access resources on the CSV. The CSVFS designation allows the cluster to differentiate the CSV from other NTFS or ReFS volumes. While CSVFS supports the same general functionality as NTFS or ReFS, certain storage features such as compression are not supported in Windows Server 2012 R2.



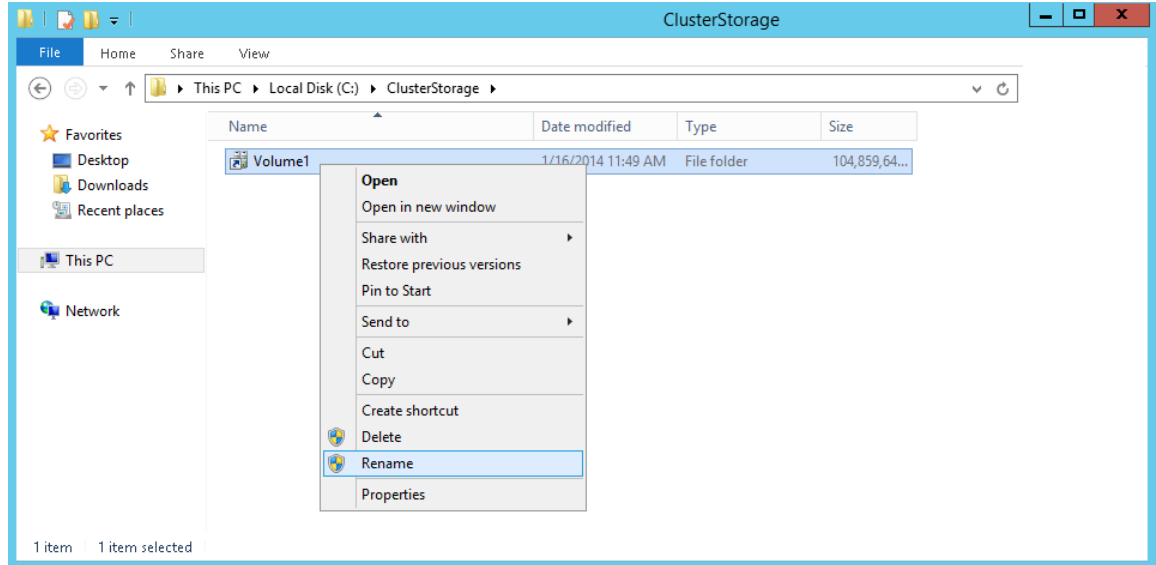
7.2 Renaming CSVs

Note: For identification purposes, it is recommended to rename CSV mount points to match the corresponding cluster disk and NTFS volume names. It is recommended to first rename CSV mount points before configuring cluster resources, because renaming a CSV mount point for a CSV that has active cluster resources will cause the cluster resources to fail.

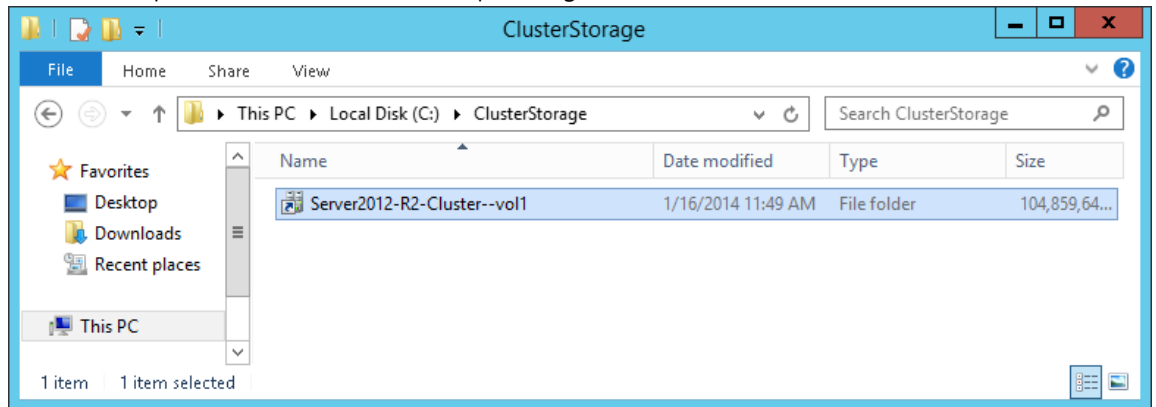
1. From the left pane of Failover Cluster Manager:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**.
 - d. In the **Disks** pane, click to select the CSV.
 - e. In the **Volumes** section, make note of the mount point, **%SystemDisk%ClusterStorage\<<volume>>**.



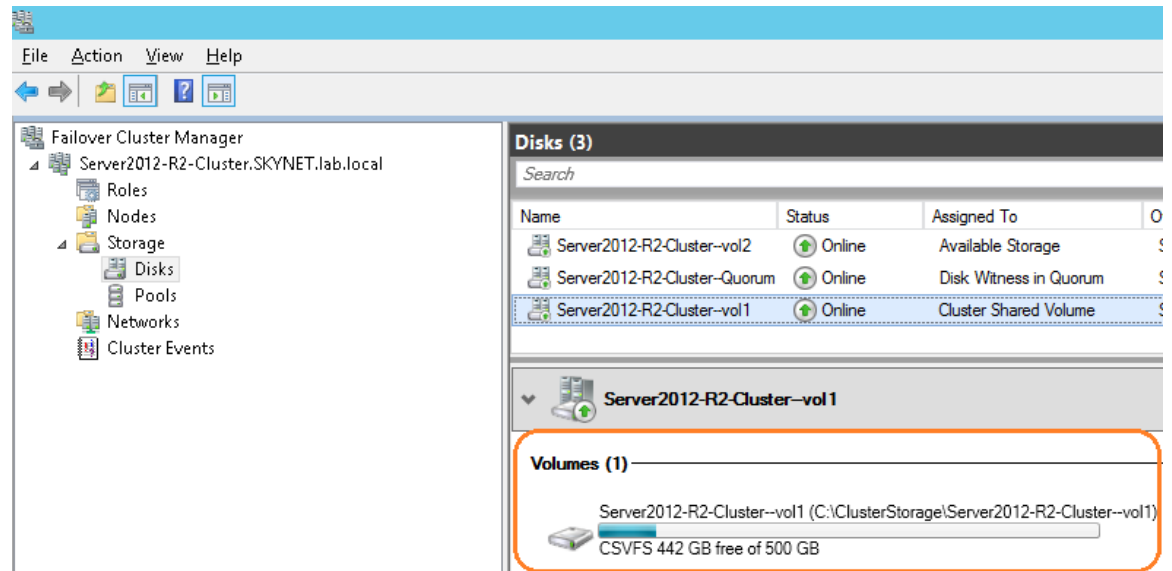
2. From Windows Explorer, navigate to the mount point folder.
 - a. Right-click on the folder, and select **Rename**.



- b. Provide a name for the mount point. For identification purposes, it is recommended to rename CSV mount points to match the corresponding cluster disk and NTFS volume names.



3. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to expand **Storage**.
 - c. Click to select **Disks**.
 - d. In the **Disks** pane, click to select the CSV.
 - e. In the **Volumes** section, make note of the newly renamed mount point. This is the path that the cluster will use to access resources on the CSV.



8 Hyper-V

Hyper-V enables you to create and manage a virtualized server environment. This virtualization capability maximizes the usage of physical hardware resources, such as CPU, network, storage and memory, by enabling those resources to be shared by multiple virtual machines. Hyper-V enables you to create virtual machines and manage their virtual resources. Each virtual machine runs an isolated instance of its own Operating System, referred to as a Guest Operating System.

Hyper-V can be installed on a single server or on multiple servers in a cluster to provide highly available resources, such as virtual machines, that can failover from one node to another in the event of failures. This level of availability is made possible by the usage of shared storage resources, such as SANs.

For more information on Hyper-V, refer to: <http://technet.microsoft.com/library/hh831531>

8.1 Hyper-V in a Failover cluster

Hyper-V Failover clustering steps:

1. Review [Failover clustering steps](#)
2. Ensure that Hardware-Assisted Virtualization and Data Execution Prevention are both enabled on the processor
3. [Install the Hyper-V role](#) on all cluster nodes
4. [Configure virtual networks](#)
5. [Create a virtual machine](#)
6. [Configure a virtual machine for high availability](#)
7. Install the Guest Operating System on the virtual machine
8. [Modify virtual machine settings](#)



8.2 Installing the Hyper-V role

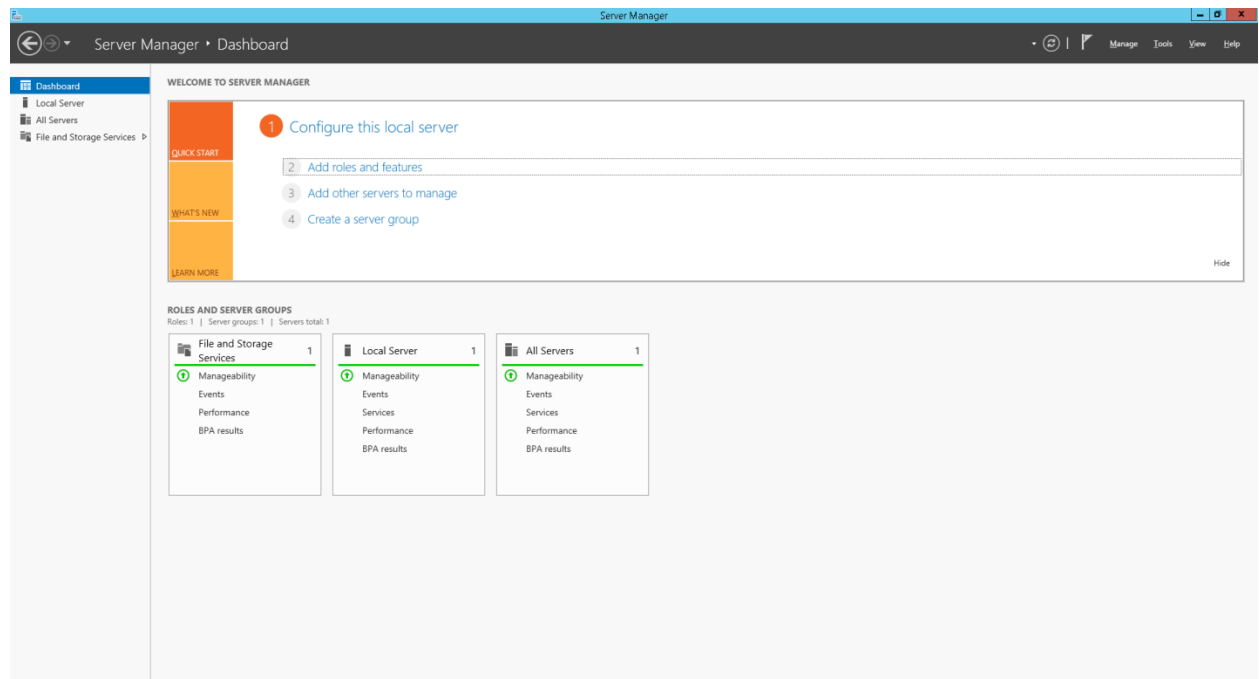
Before enabling the Hyper-V role in Windows, ensure that Hardware-Assisted Virtualization and Data Execution Prevention are both enabled on the processor. The setting for Intel is **XD execute disable** and the setting for AMD is **NX no execute**.

Installing the Hyper-V role includes the required components and optional management tools. The required components include The Hyper-V hypervisor, Virtual Machine Management Service, a WMI provider, and other components such as the VMBus, Virtualization Service Provider (VSP) and Virtual Infrastructure Driver (VID).

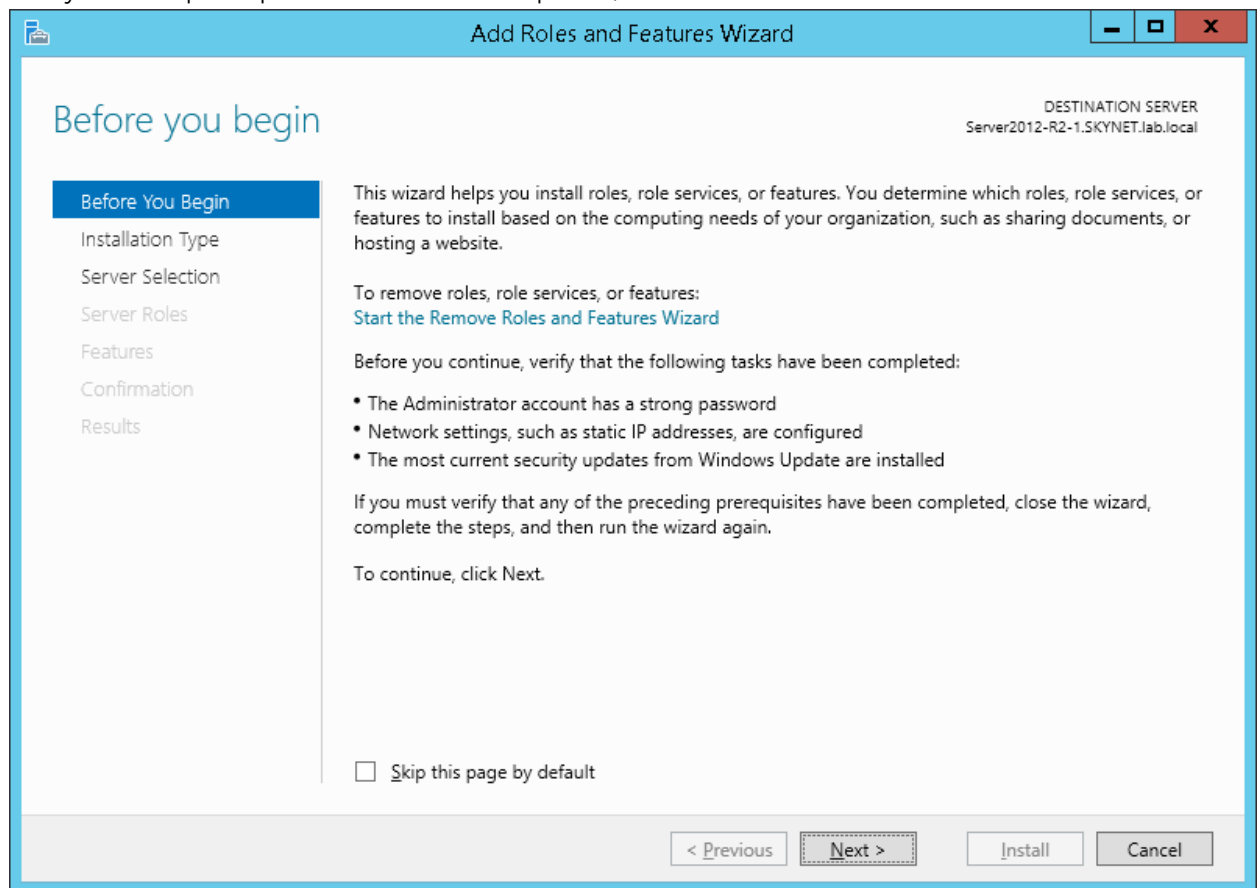
The management tools for Hyper-V are: Hyper-V Manager GUI, a Microsoft Management Console snap-in, Virtual Machine Connection Manager, and Hyper-V PowerShell cmdlets for optionally managing Hyper-V from a PowerShell interface.

The Hyper-V role must be added to each server in a Hyper-V Failover cluster.

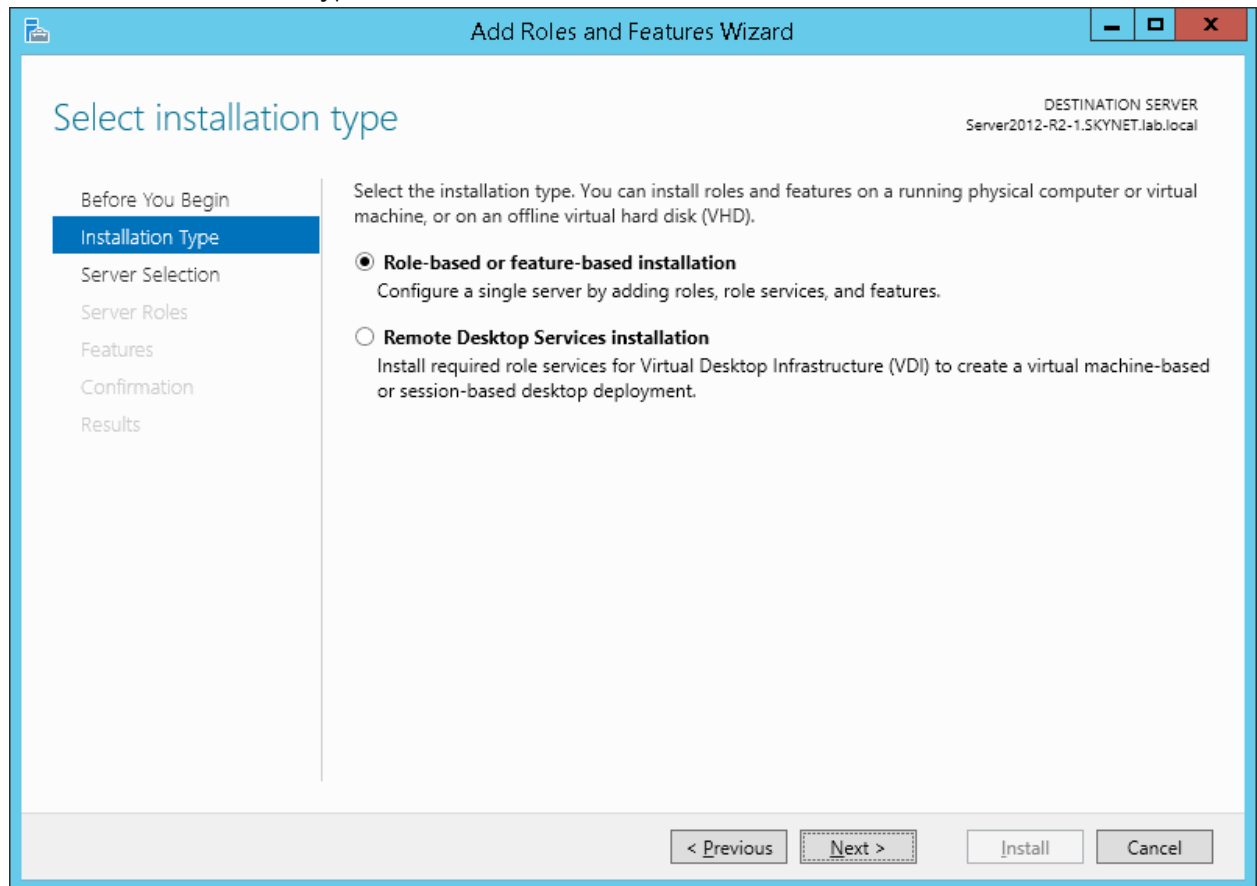
1. Launch **Server Manager**.
2. Click on **Add roles and features**.



3. Verify that the prerequisites have been completed, and click **Next** to continue.



4. To select the installation type, select **Role-based or feature-based installation** and click **Next**.



- To select the destination server, click **Select a server from the server pool**. Highlight the local server from the list, and click **Next**.

The screenshot shows the 'Add Roles and Features Wizard' window. The title bar reads 'Add Roles and Features Wizard'. The main heading is 'Select destination server'. In the top right corner, it says 'DESTINATION SERVER' and 'Server2012-R2-1.SKYNET.lab.local'. On the left, there is a navigation pane with the following items: 'Before You Begin', 'Installation Type', 'Server Selection' (which is highlighted), 'Server Roles', 'Features', 'Confirmation', and 'Results'. The main area contains the instruction 'Select a server or a virtual hard disk on which to install roles and features.' Below this, there are two radio buttons: 'Select a server from the server pool' (which is selected) and 'Select a virtual hard disk'. Under the 'Server Pool' section, there is a 'Filter:' text box. Below the filter is a table with three columns: 'Name', 'IP Address', and 'Operating System'. The table contains one row: 'Server2012-R2-1.SKYNET.lab.local', '10.10.6.20,10.1...', and 'Microsoft Windows Server 2012'. Below the table is a scrollbar. At the bottom of the main area, it says '1 Computer(s) found' and 'This page shows servers that are running Windows Server 2012, and that have been added by using the Add Servers command in Server Manager. Offline servers and newly-added servers from which data collection is still incomplete are not shown.' At the bottom of the window, there are four buttons: '< Previous', 'Next >', 'Install', and 'Cancel'.

DESTINATION SERVER
Server2012-R2-1.SKYNET.lab.local

Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results

Select a server or a virtual hard disk on which to install roles and features.

☒ Select a server from the server pool
☐ Select a virtual hard disk

Server Pool

Filter:

| Name | IP Address | Operating System |
|----------------------------------|--------------------|-------------------------------|
| Server2012-R2-1.SKYNET.lab.local | 10.10.6.20,10.1... | Microsoft Windows Server 2012 |

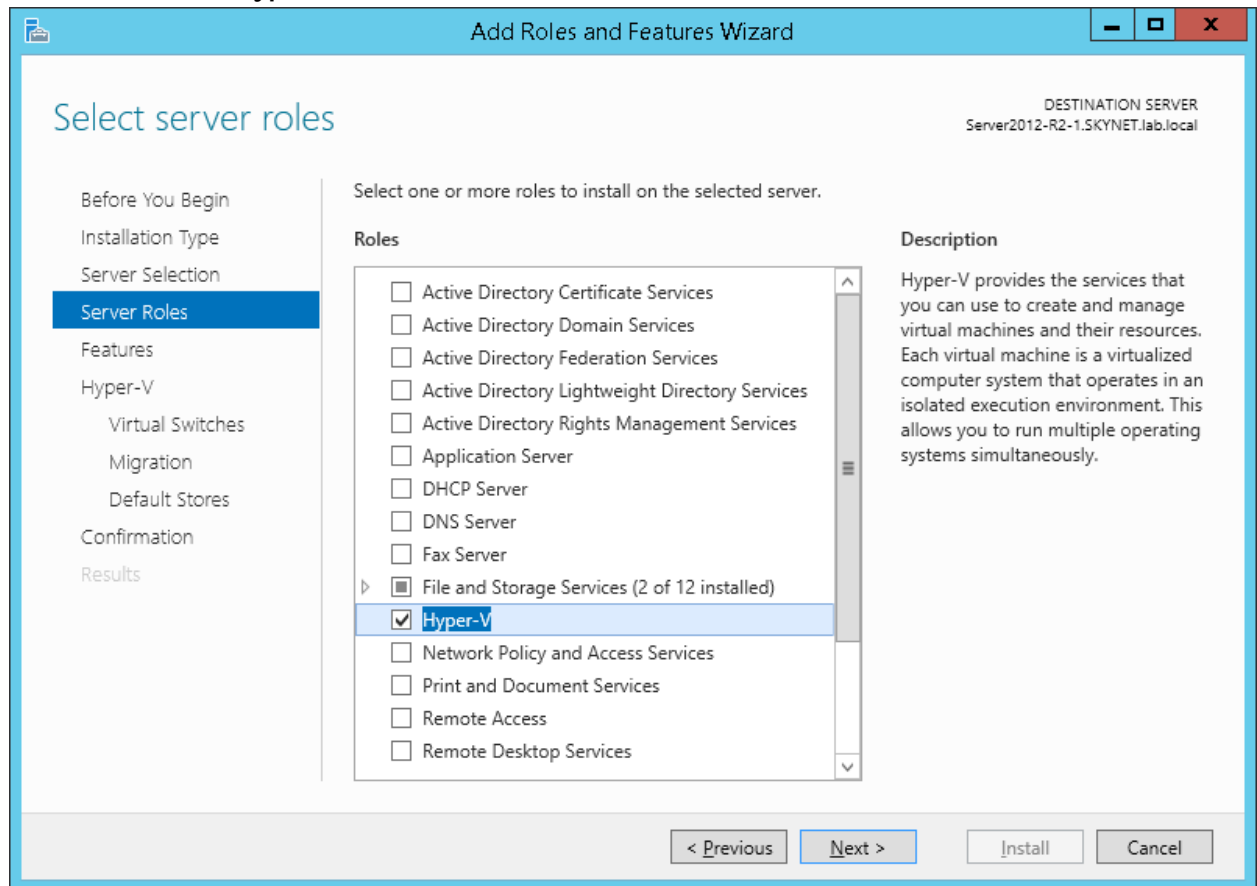
< ||| >

1 Computer(s) found

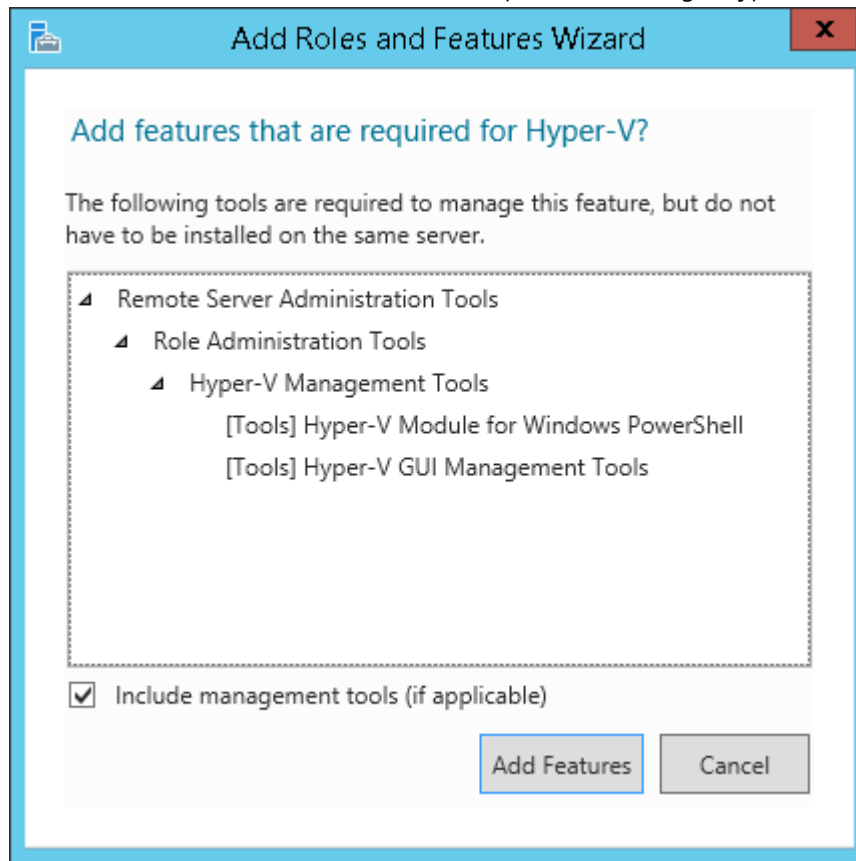
This page shows servers that are running Windows Server 2012, and that have been added by using the Add Servers command in Server Manager. Offline servers and newly-added servers from which data collection is still incomplete are not shown.

< Previous Next > Install Cancel

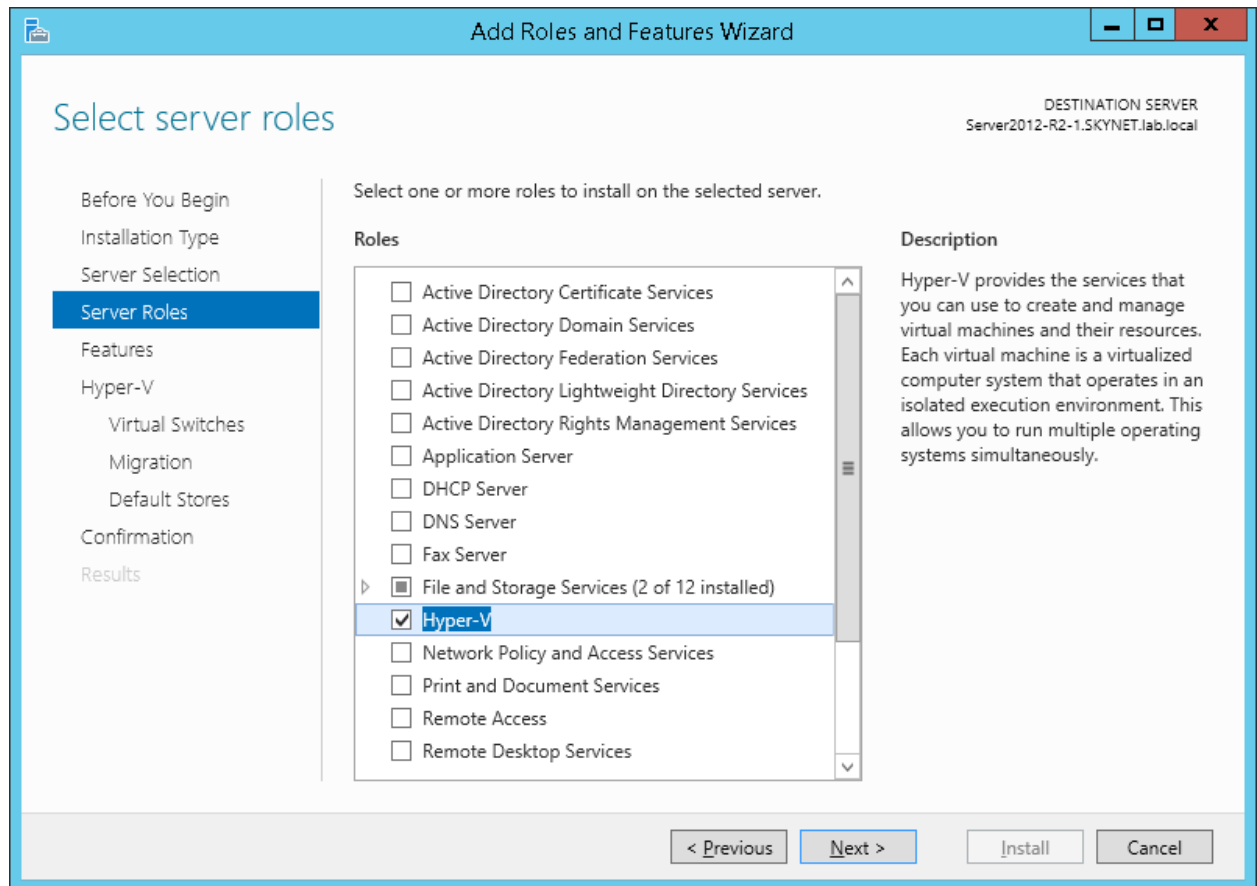
6. Click to select the **Hyper-V** role.



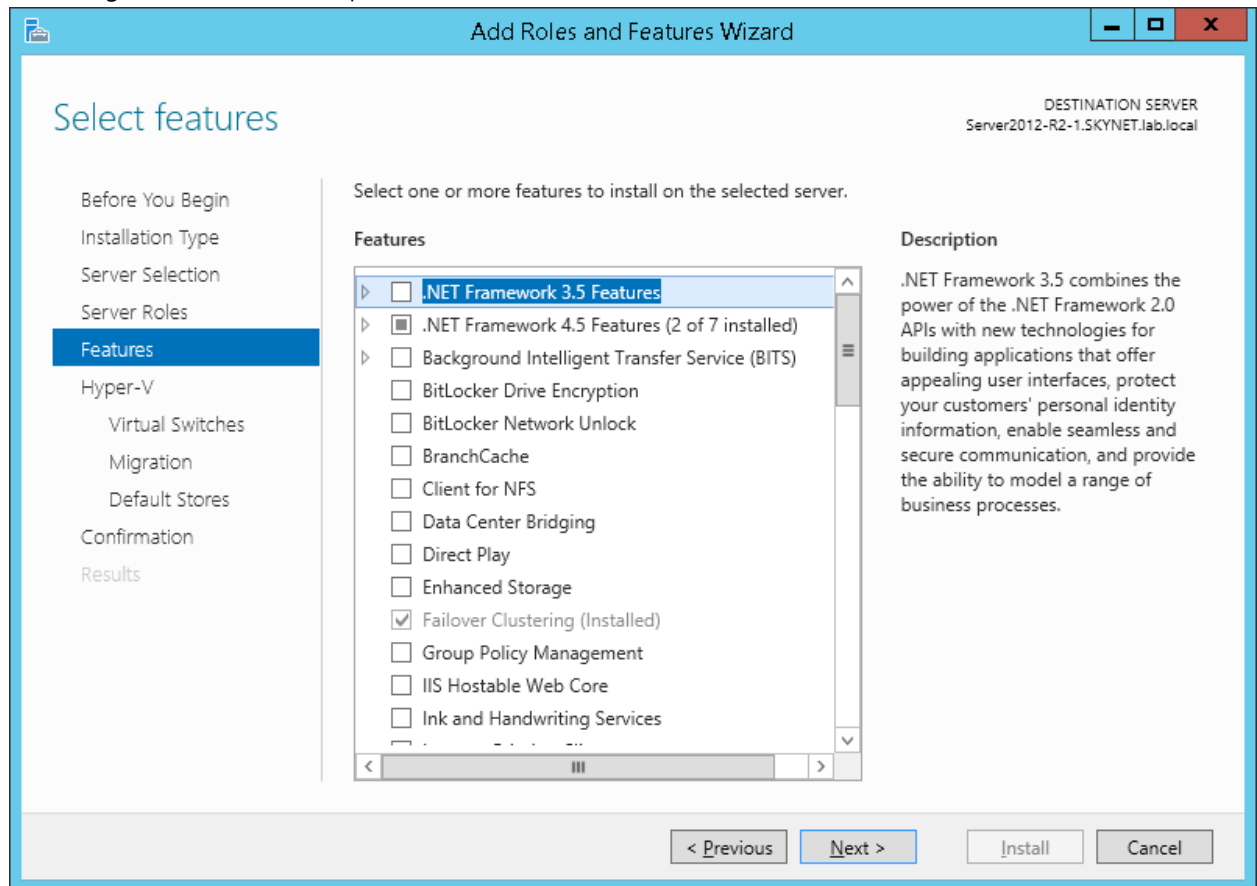
7. Click **Add Features** to select the tools required to manage Hyper-V.



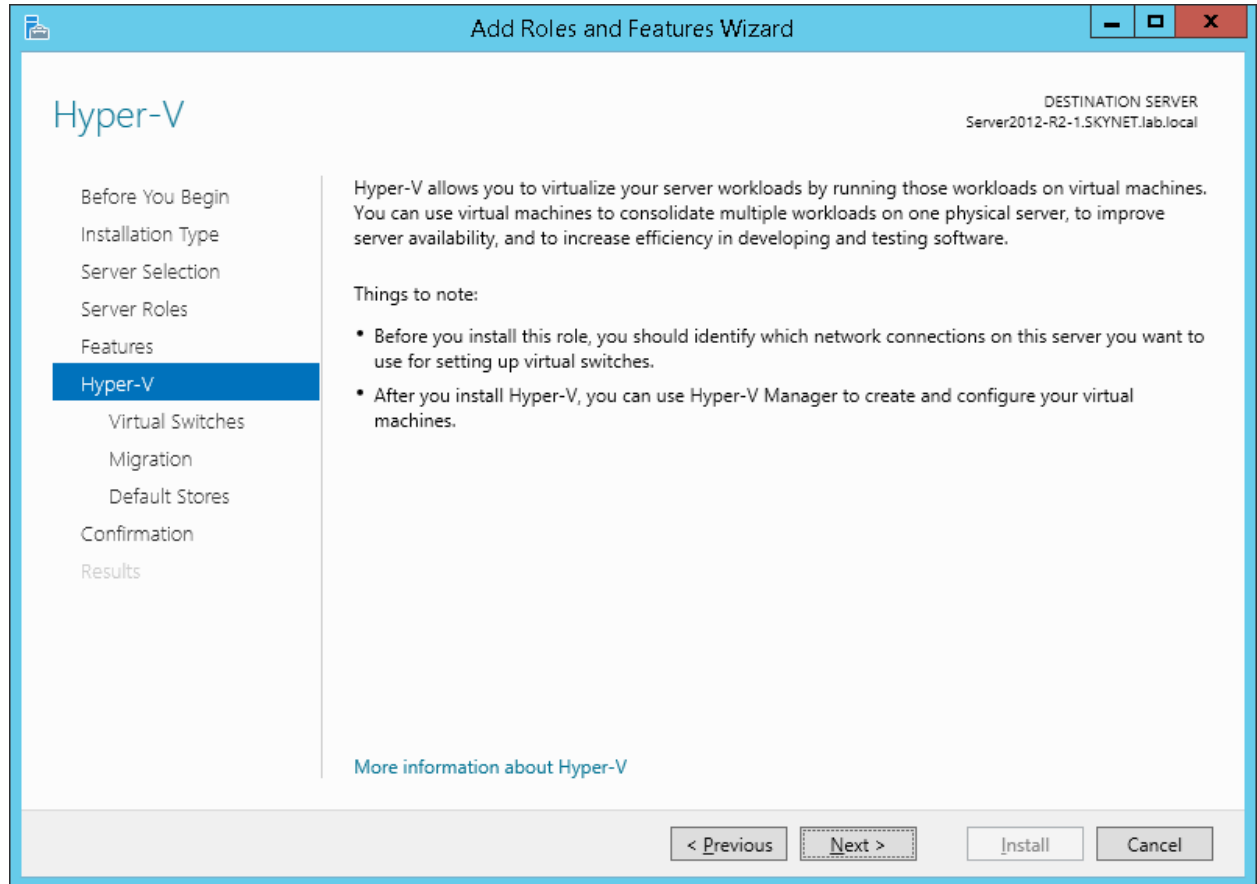
8. Click **Next**.



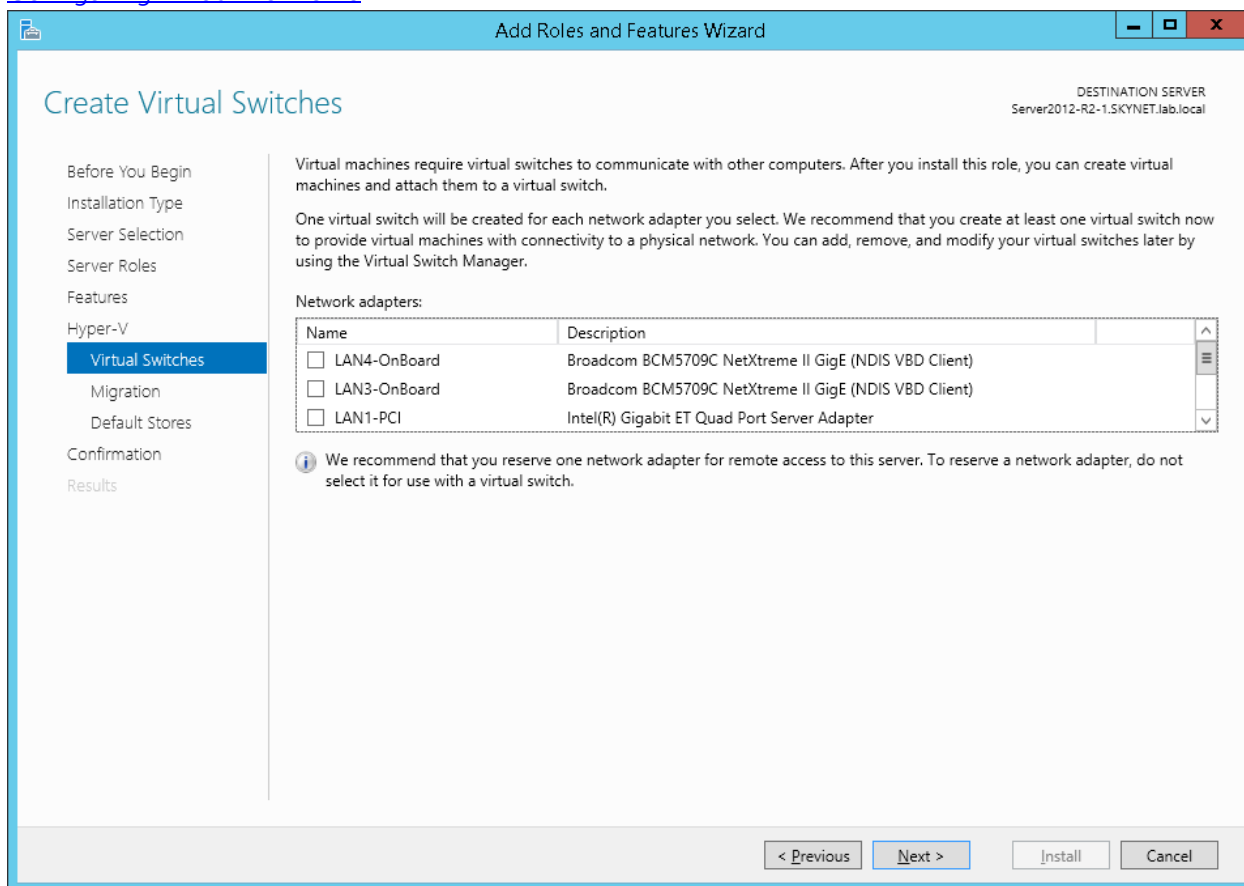
9. Selecting a feature is not required. Click **Next**.



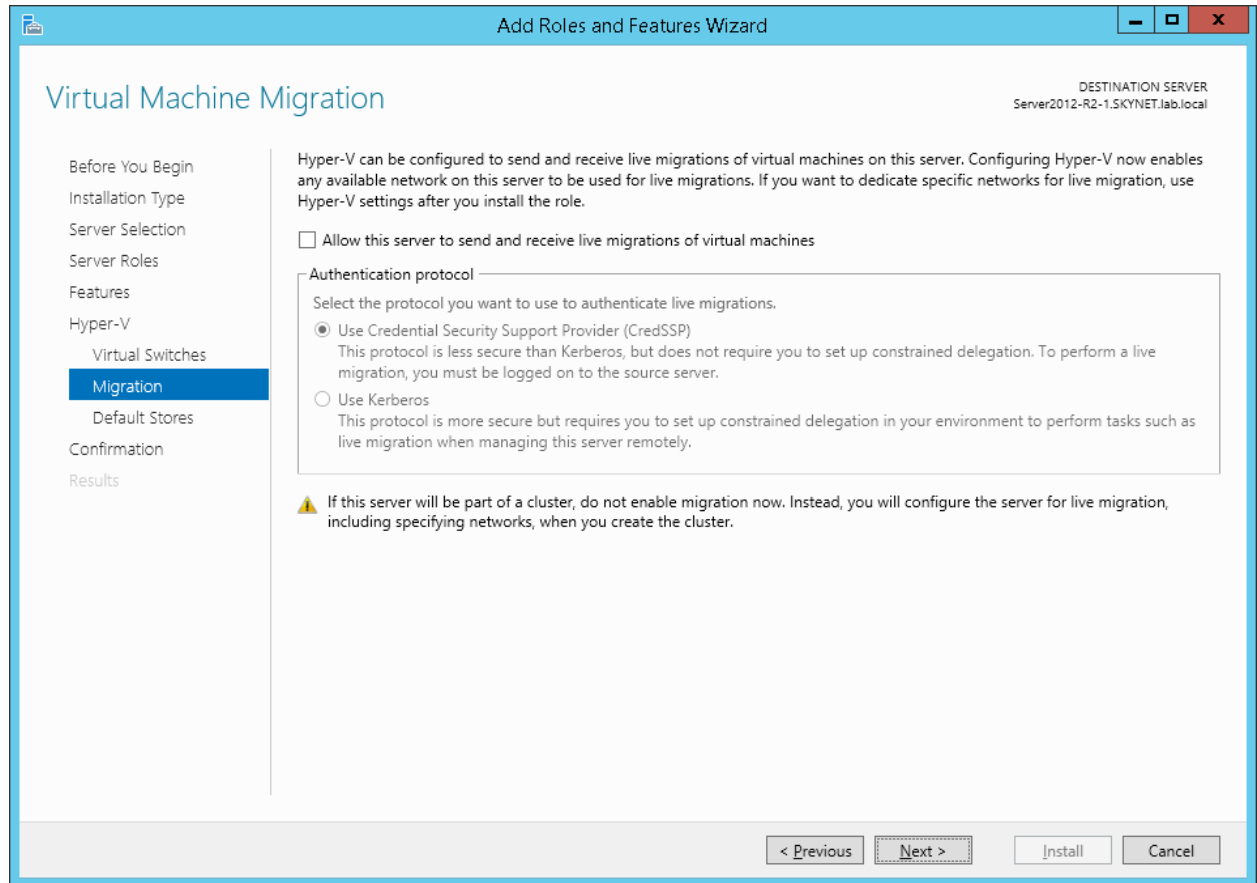
10. Before installing the role, identify the network connections on the server to be used for virtual switches. Click **Next**.



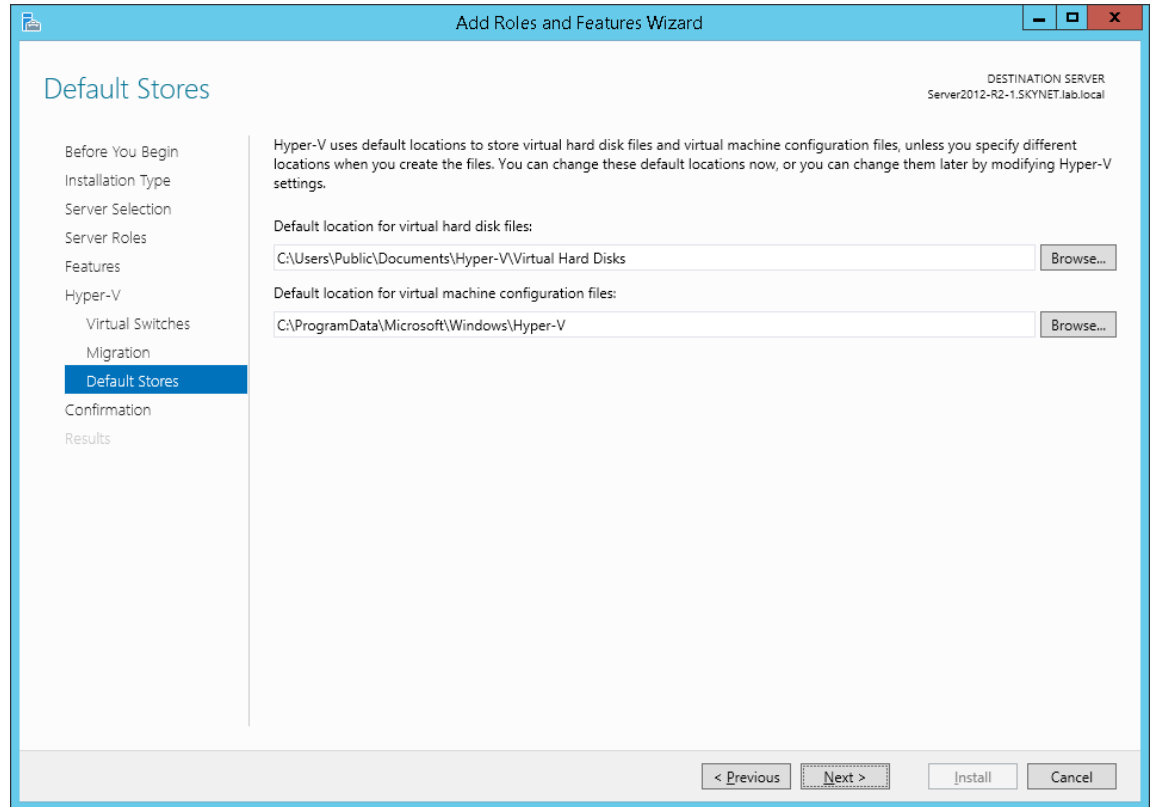
11. Virtual machines require virtual switches to access network resources. A virtual switch is created for each network adapter that is selected. Click to select the network adapters to use for virtual switches. You can also bypass this step now – and later add, remove and modify virtual switches by using Virtual Switch Manager. For additional information on creating virtual switches, refer to: [Configuring Virtual Networks](#).



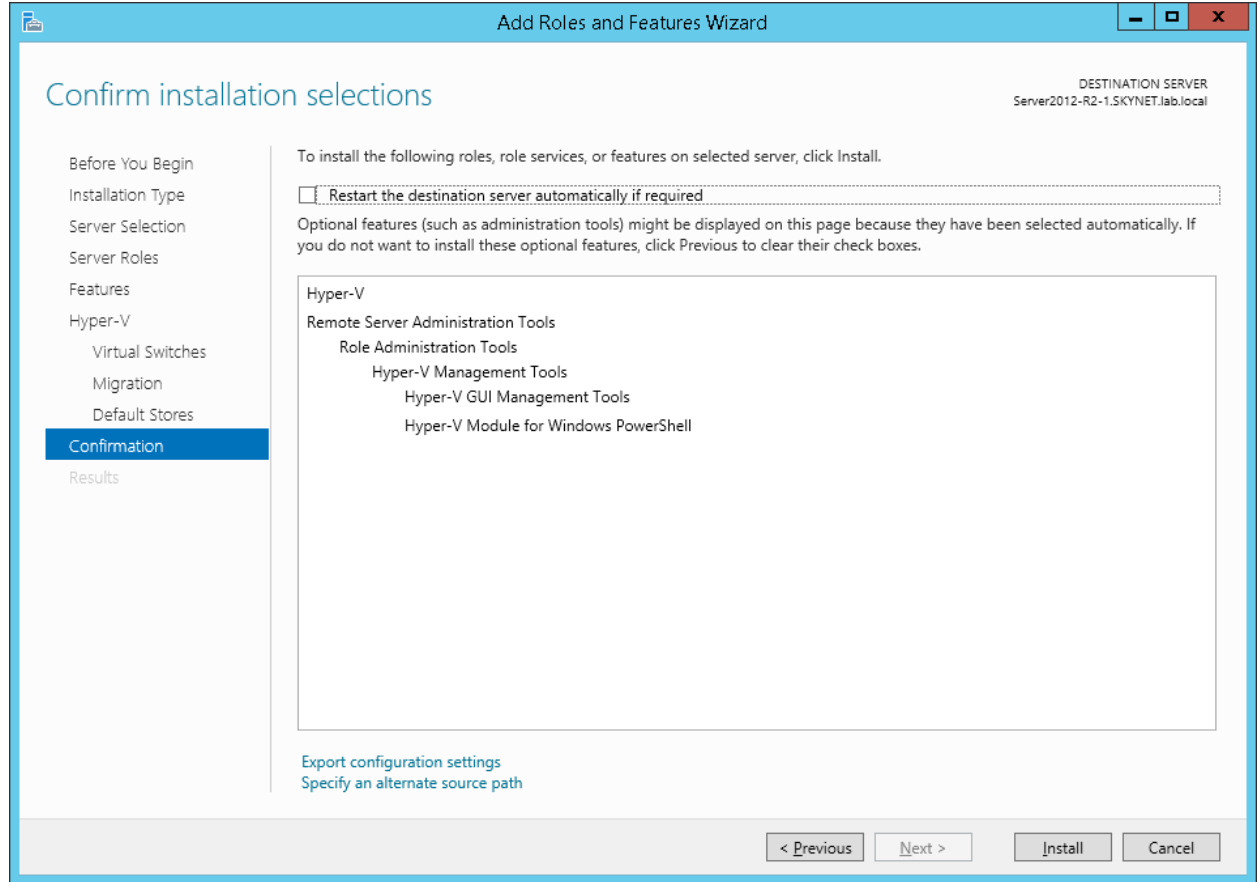
12. Because the server is part of a cluster, do not click to select **Allow this server to send and receive live migrations of Virtual Machines**. This step can be manually configured later using Failover Cluster Manager. Click **Next**.



13. Specify the default locations to store virtual hard disk and virtual machine configuration files.
 - a. To accept the defaults, click **Next**.
 - b. To specify an alternate location, such as an existing clustered volume, click **Browse**. If using a clustered volume, specify the volume as the location for the virtual machine VHD files, as well as the virtual machine configuration files.



14. Optionally, click to select **Restart the destination server automatically if required**. Confirm the installation selections, and click **Install**.



15. Review the summary, and click **Close**. A restart may be required.

8.3 Hyper-V cluster networking

In a Hyper-V cluster, plan for several varying types of network traffic. The different types of network traffic are summarized in the following table:

Table 4 Hyper-V cluster network traffic types

| Network traffic type | Description |
|------------------------|--|
| Management | Used to manage the Hyper-V Host Operating System and virtual machines |
| Cluster | Used for inter-node cluster communication, such as the cluster heartbeat |
| Live Migration | Used for virtual machine Live Migration between Hyper-V hosts |
| Storage | Used for iSCSI or SMB traffic |
| Virtual machine access | Used for virtual machine connectivity |

To simplify management and improve network security, isolate different types of network traffic. Refer to [Configuring Cluster Networking](#) for additional information on isolating network traffic, including the Storage network.

For additional network recommendations in a Hyper-V cluster in Windows Server 2012/R2, including optionally using Quality of Service (QoS) to converge multiple types of network traffic on network adapters, refer to: <http://technet.microsoft.com/en-us/library/dn550728.aspx>

8.3.1 Live Migration network

With Hyper-V Live Migration, virtual machines can move between Hyper-V hosts without experiencing downtime. Virtual machines can use Live Migration between nodes in the same cluster, between nodes in different clusters, or between a cluster and a stand-alone Hyper-V host. Thus, all Hyper-V hosts using Live Migration must be connected to a network that is configured to allow live migrations.

Live Migration traffic can saturate the network, so it is recommended to use a dedicated network for Live Migration.

Note: To use Live Migration in a Hyper-V cluster, it is recommended to use CSVs.

For additional information on Live Migration, refer to: <http://technet.microsoft.com/en-us/library/hh831435.aspx>



8.3.2 Configuring virtual networks

Hyper-V Manager can be used to configure virtual networks so that virtual machines can access network resources.

Similar to how a physical network switch provides network connectivity for physical devices, a Hyper-V virtual switch provides connectivity between virtual machines and the physical network.

There are three types of virtual switches:

Table 5 Virtual switch types

| Virtual switch type | Description |
|---------------------|--|
| External | <ul style="list-style-type: none">• Provides connectivity to the physical network for virtual machines• Binds to a physical network adapter on the Hyper-V host |
| Internal | <ul style="list-style-type: none">• Provides connectivity between virtual machines, and between the virtual machines and the Hyper-V host• Does not bind to a physical network adapter on the Hyper-V host.• No access to physical network |
| Private | <ul style="list-style-type: none">• Provides connectivity between virtual machines only• Does not bind to a physical network adapter on the Hyper-V host.• No access to physical network |

In a Hyper-V cluster, create identical virtual switches on each cluster node to ensure that the virtual switch configuration is identical on each node. Refer to Figure 7 for an example of a virtual machine configured with multiple virtual switches for the LAN and SAN.

Note: To use Dell EqualLogic MPIO in a Windows Guest Operating System, configure the virtual machine with access to at least two virtual switches that are bound to physical iSCSI SAN adapters on the Hyper-V host and install the DSM feature of Dell EqualLogic Host Integration Tools for Microsoft on all Hyper-V hosts and Windows Guest Operating Systems.

To provide load-balancing and fault tolerance for non-iSCSI networks, consider using NIC teaming.



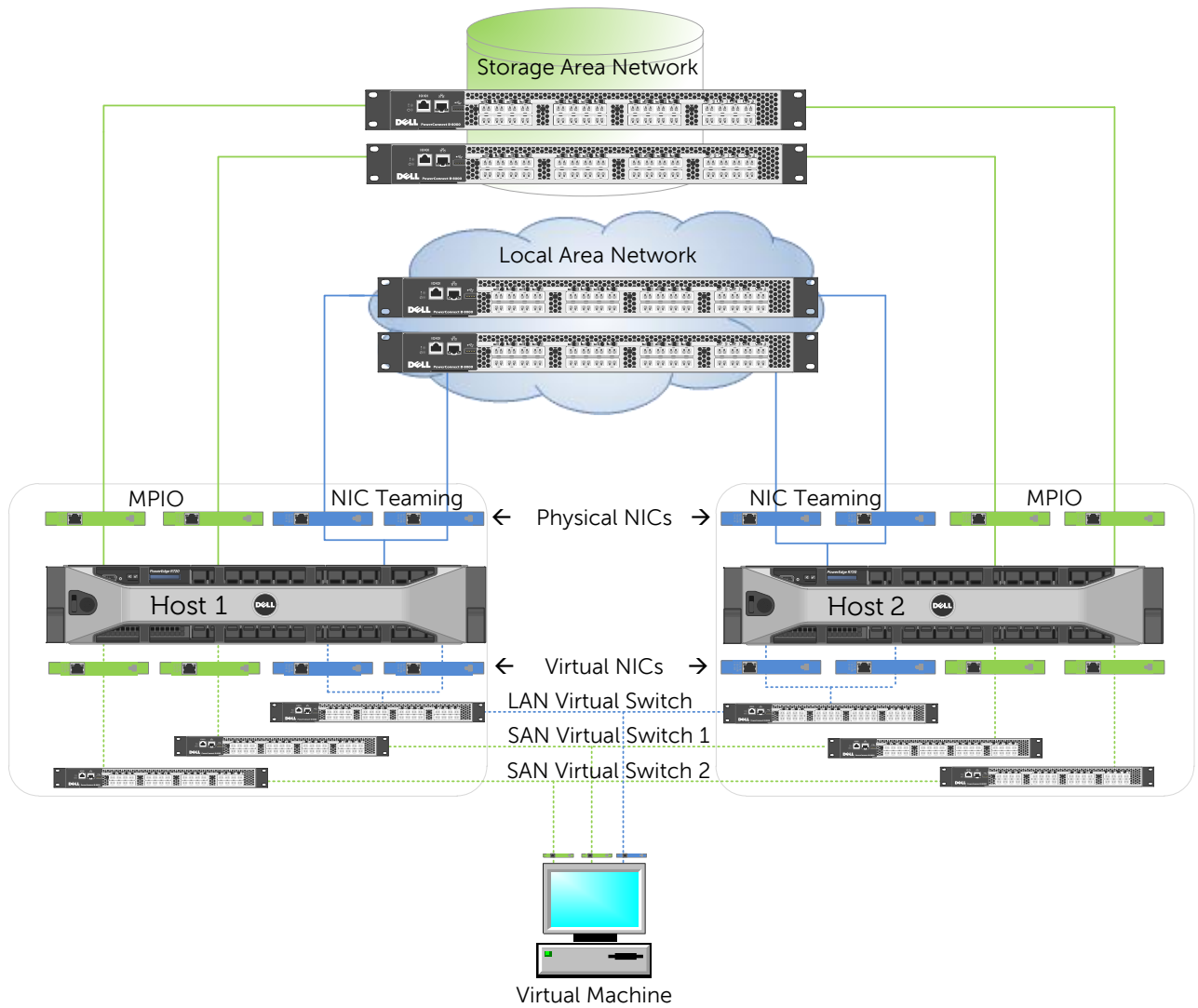
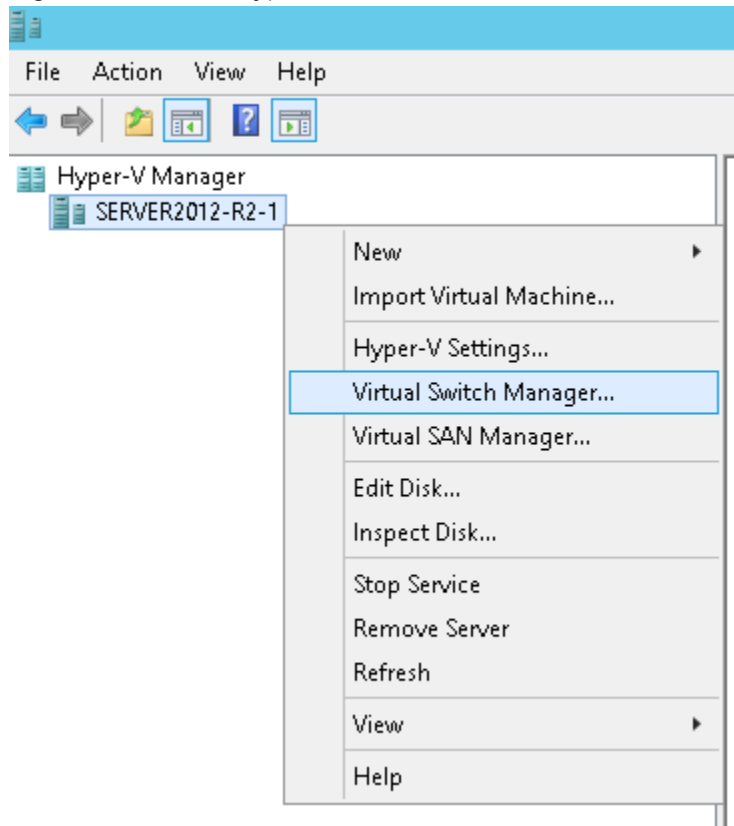


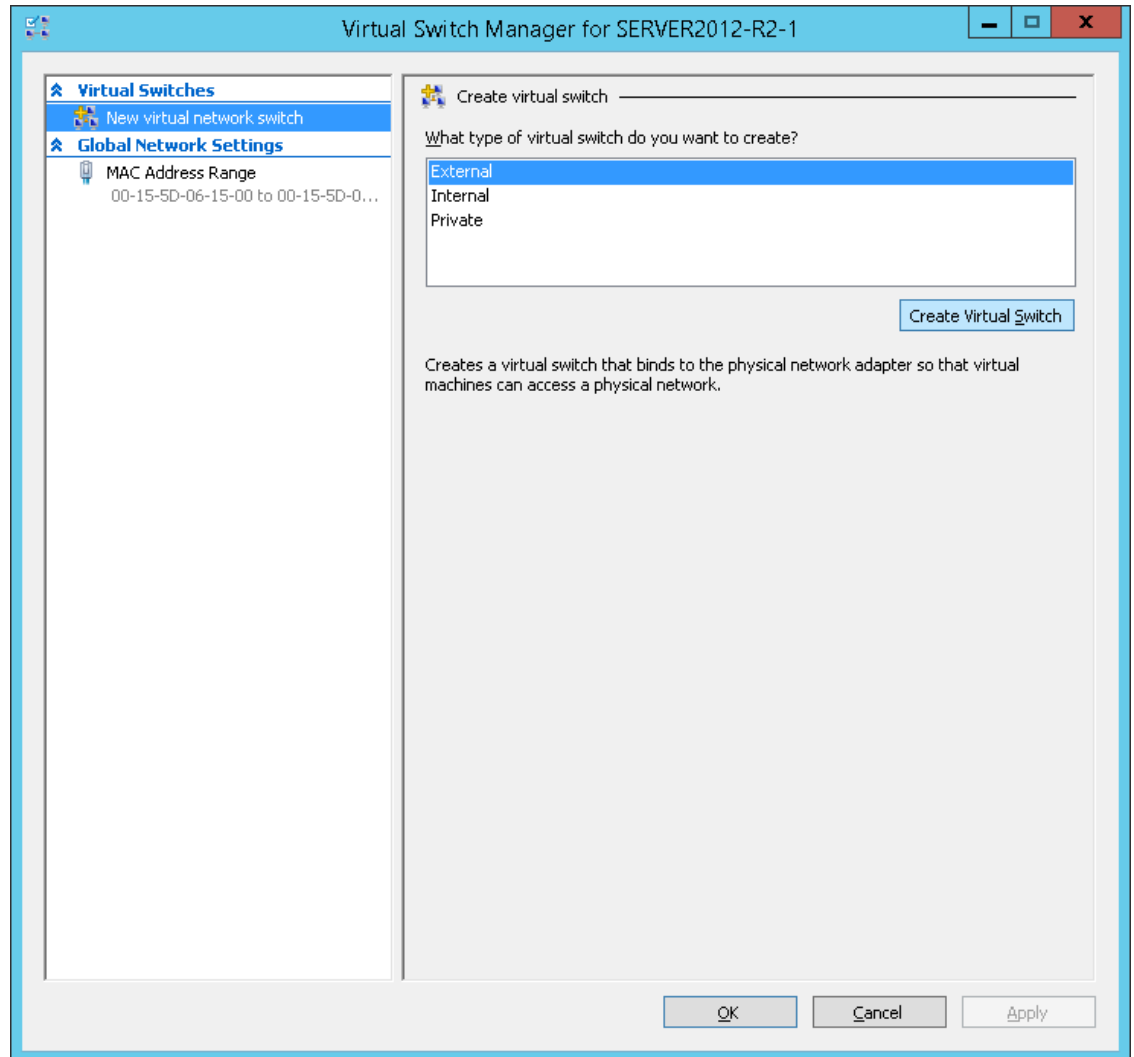
Figure 7 Hyper-V virtual machine configured with multiple virtual switches for LAN and SAN

To create an external Hyper-V virtual switch that will bind to a physical network adapter on the Hyper-V host:

1. Launch **Hyper-V Manager**.
2. If required, connect to the Hyper-V server.
3. Right-click on the Hyper-V server and select **Virtual Switch Manager**.

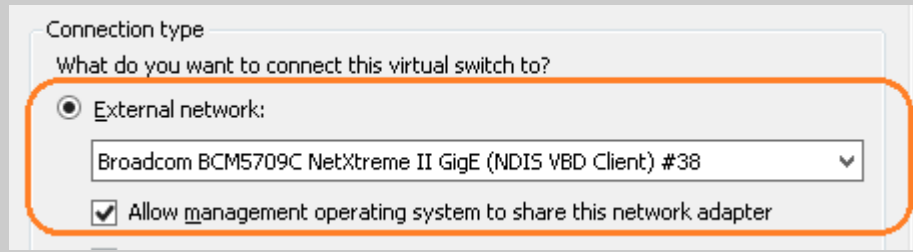


4. Click to highlight **New virtual network switch**.
 - a. Click to highlight **External**.
 - b. Click **Create Virtual Switch**.



5. Specify the name and click to select the physical network adapter that the External virtual switch will bind to.

Note: If the Hyper-V host only has one physical network adapter, to avoid losing network connectivity during creation of the virtual switch, click to select **Allow management Operating System to share this network adapter**.



Connection type

What do you want to connect this virtual switch to?

☒ External network:

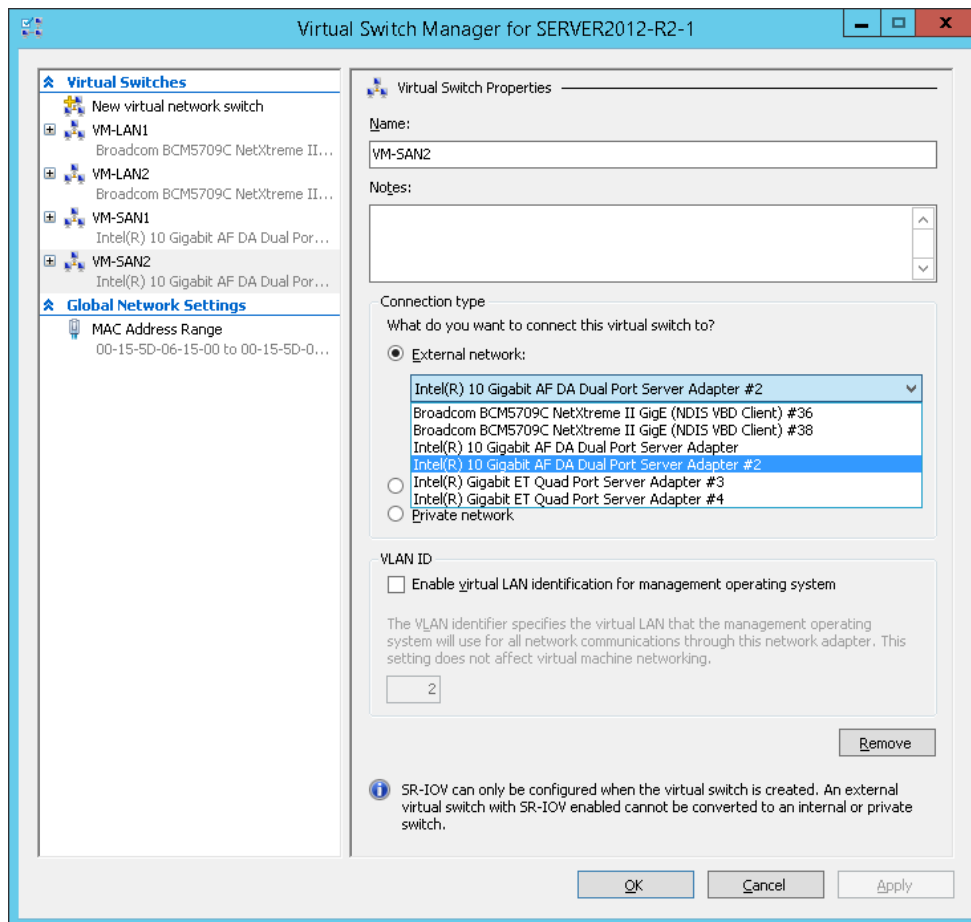
Broadcom BCM5709C NetXtreme II GigE (NDIS VBD Client) #38

☒ Allow management operating system to share this network adapter

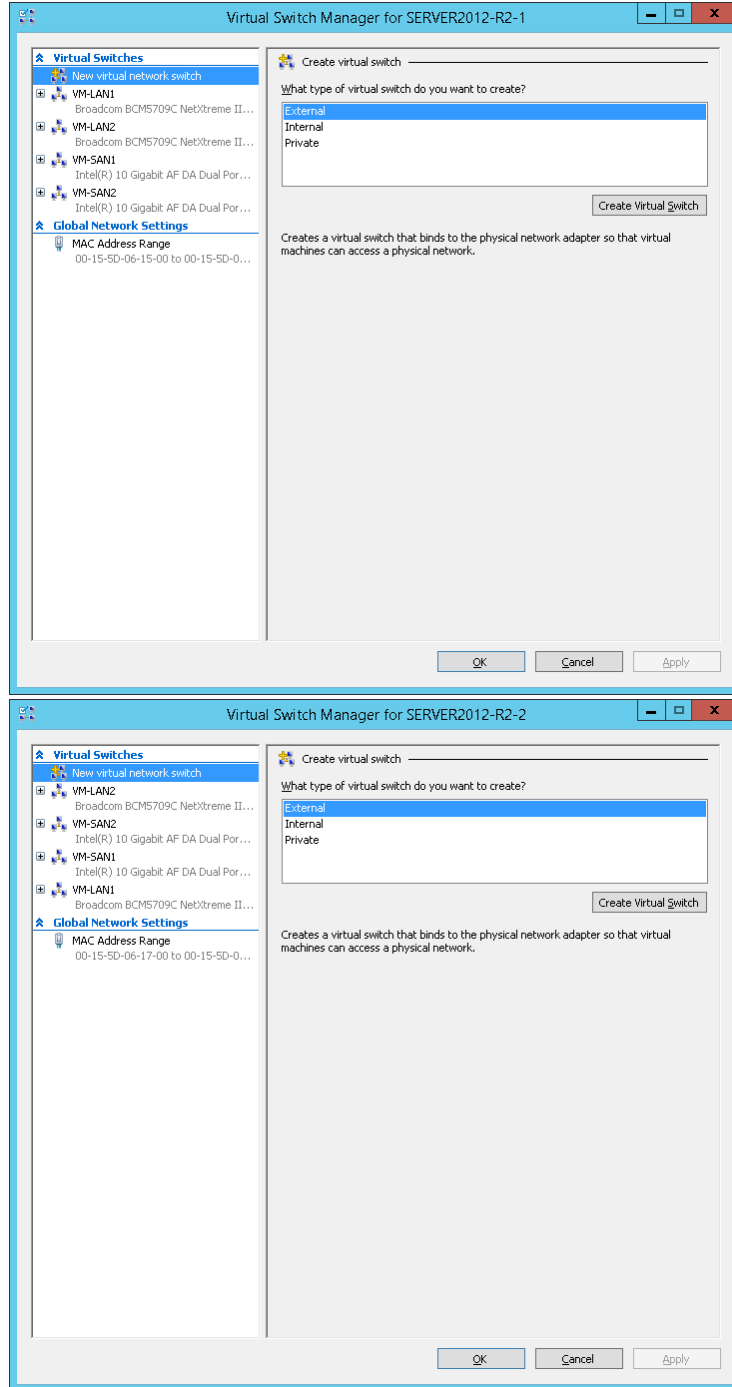
6. Create additional virtual switches, as required, to provide the virtual machine with connectivity to the networks used by the Hyper-V host. External virtual switches bind to physical network adapters on the Hyper-V host. To provide virtual machines with connectivity to the LAN and SAN for example, ensure that the correct adapters are selected for each virtual switch. If virtual machines will be using direct-attached storage by using the iSCSI initiator in the Guest Operating System, they will need access to virtual switches that are bound to the Hyper-V host's SAN adapters.

Note: To use Dell EqualLogic MPIO in a Windows Guest Operating System, create virtual switches for at least two SAN adapters on the Hyper-V host and install the DSM feature of Dell EqualLogic Host Integration Tools for Microsoft on all Hyper-V hosts and Windows Guest Operating Systems.

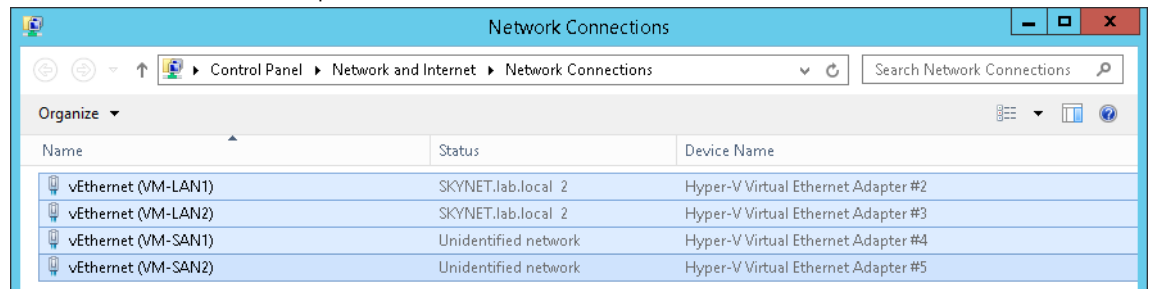
To provide load-balancing and fault tolerance for non-iSCSI networks, consider using NIC teaming.



7. In a Hyper-V cluster, create identical virtual switches on each cluster node and ensure that the virtual switch properties, including name and connection types, are identical.



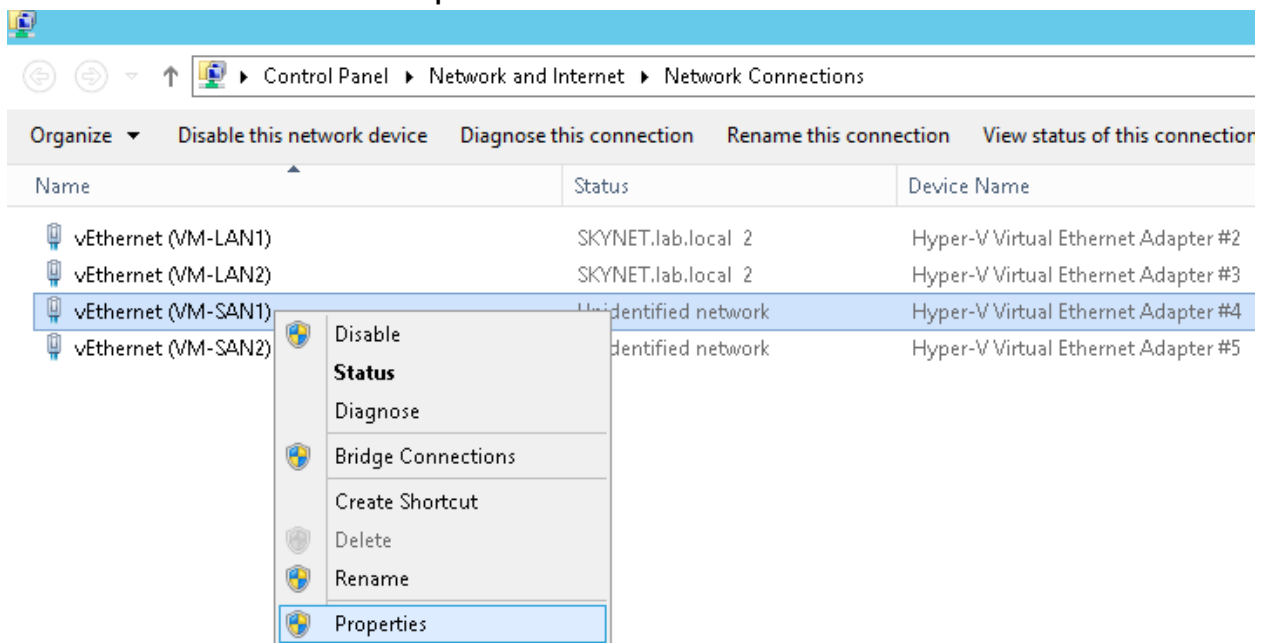
8. Upon creation of the Hyper-V virtual switches on the Hyper-V hosts, Virtual Ethernet Adapters are created for each virtual switch. To view the Virtual Ethernet Adapters used by the virtual switches:
 - a. Launch: **Control Panel\Network and Internet\Network Connections**.
 - b. Each Virtual Ethernet Adapter will include the virtual switch name.



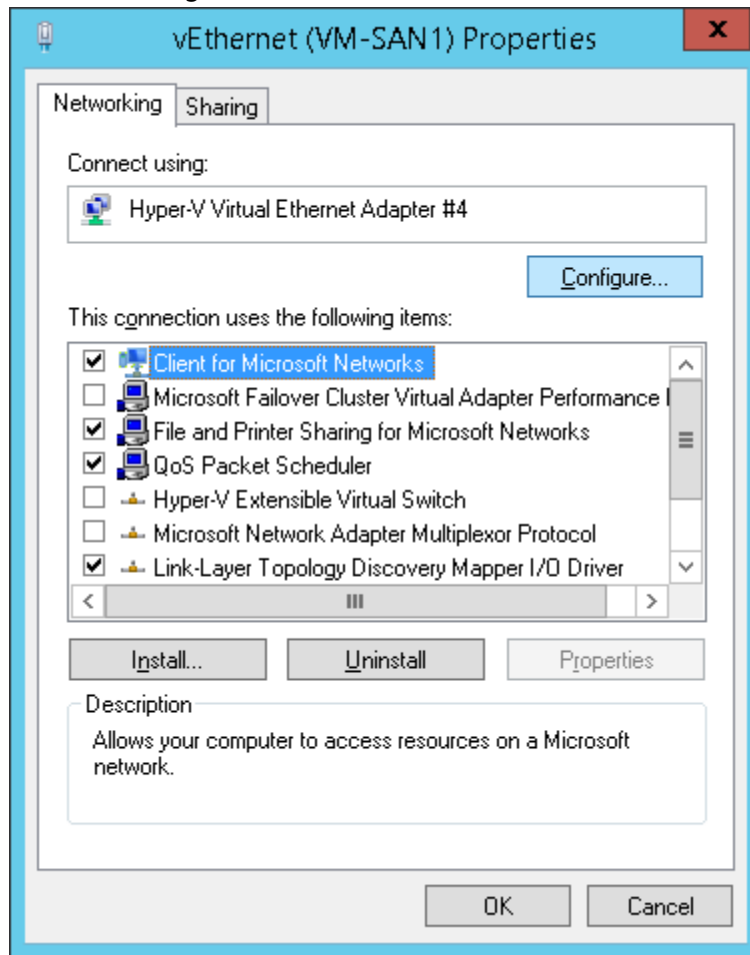
8.3.3 Enable Jumbo Frames

If using Jumbo Frames, enable it on all switches and NICS that use iSCSI traffic, including virtual switches and Virtual Ethernet Adapters. It is important to verify these settings on all nodes in a cluster, as well as in the Guest Operating System.

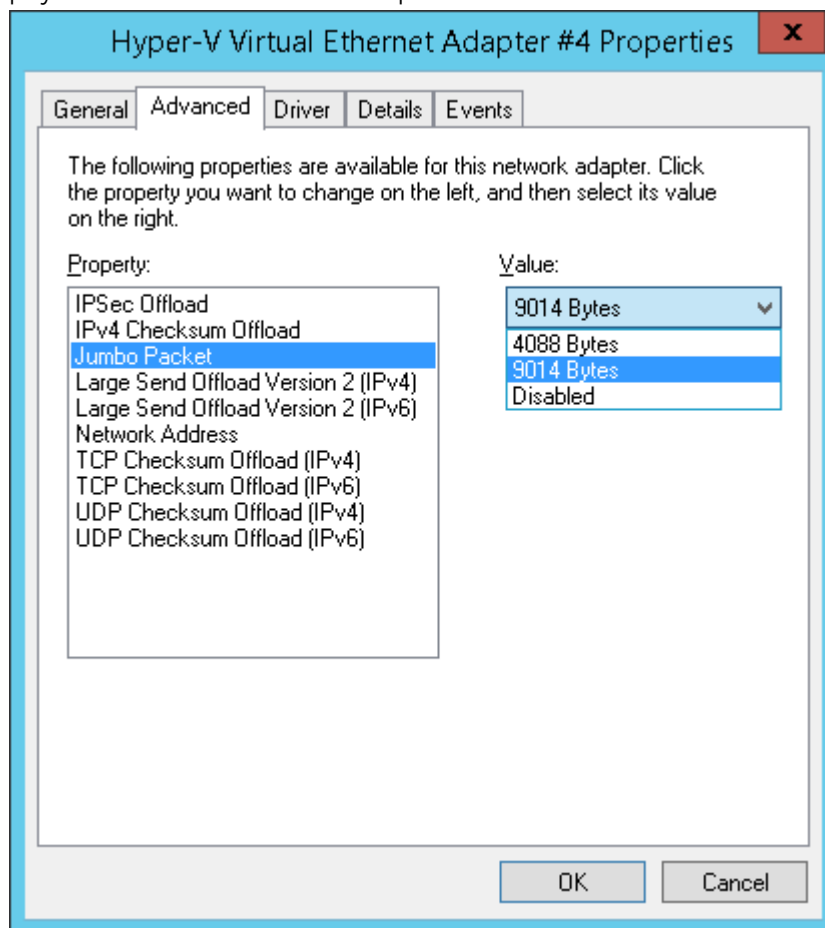
1. To enable Jumbo Frames on a physical or Virtual Ethernet Adapter, Right-click on the adapter used for iSCSI traffic and select **Properties**.



2. Click on **Configure**.

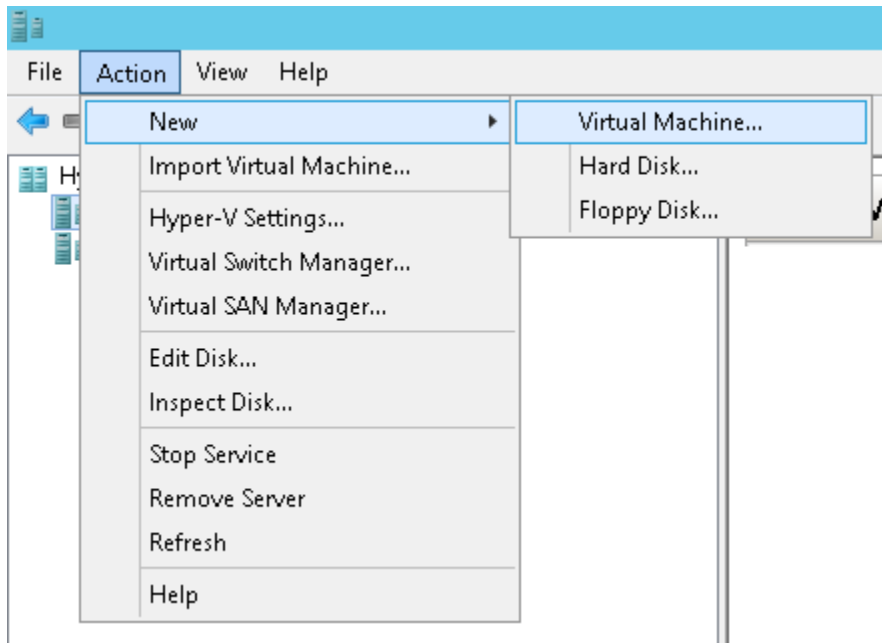


3. In the Advanced tab, verify that Jumbo Frames are enabled. This should be confirmed on all physical and virtual network adapters that are used for iSCSI traffic.



8.4 Creating a virtual machine

1. Launch Hyper-V Manager.
2. From the **Action** menu, select **New -> Virtual Machine**.



3. Specify the name and location for the virtual machine.
 - a. Use a descriptive name that helps you easily identify the virtual machine, such as the name of the Guest Operating System or application.
 - b. To store the virtual machine in a different location, such as shared SAN storage (recommended for High Availability), click to select **Store the Virtual Machine in a different location** and click **Browse** to specify the location. If using a clustered volume, specify the shared volume as the location for the virtual machine.

The screenshot shows the 'New Virtual Machine Wizard' window with the 'Specify Name and Location' step selected in the left-hand navigation pane. The main area contains the following text and controls:

Specify Name and Location

Choose a name and location for this virtual machine.


The name is displayed in Hyper-V Manager. We recommend that you use a name that helps you easily identify this virtual machine, such as the name of the guest operating system or workload.

Name:

You can create a folder or use an existing folder to store the virtual machine. If you don't select a folder, the virtual machine is stored in the default folder configured for this server.

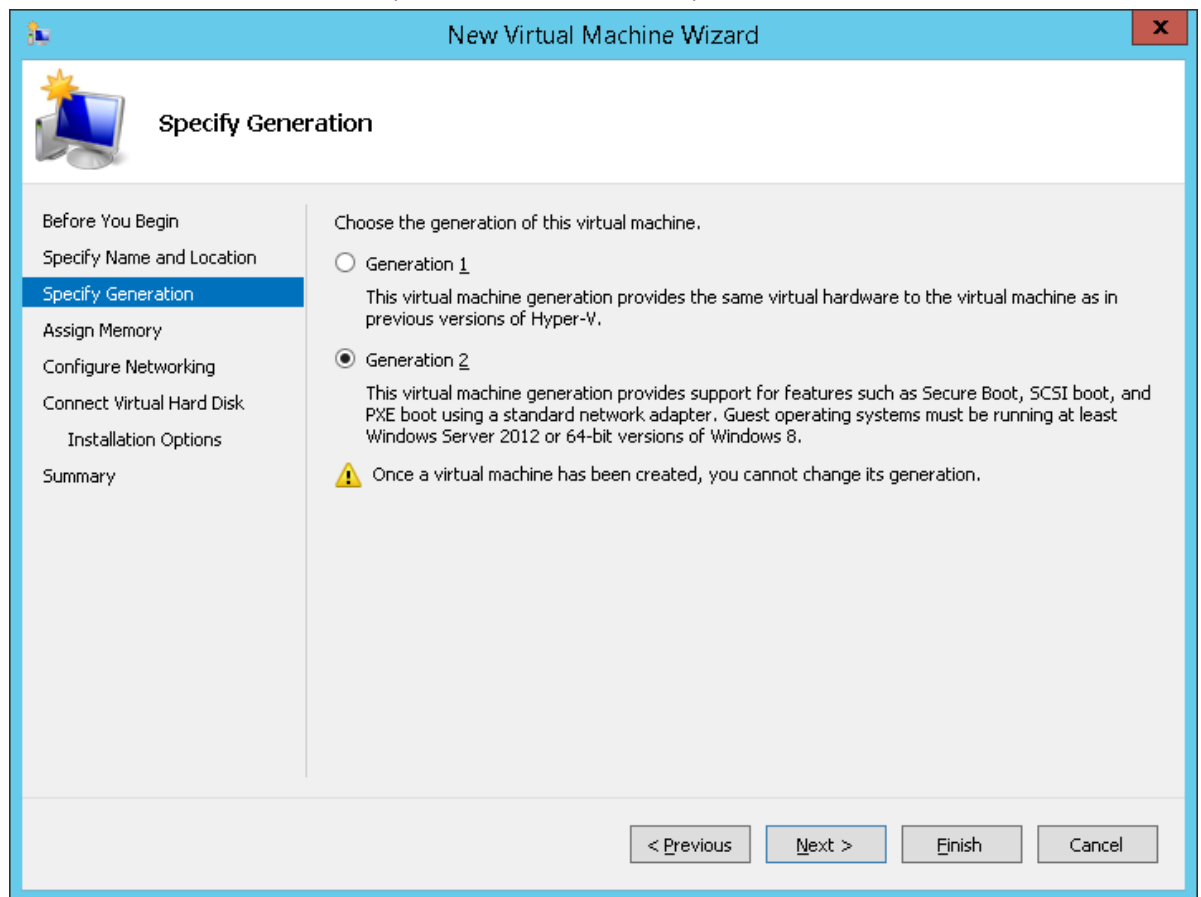
☒ Store the virtual machine in a different location

Location:

 If you plan to take checkpoints of this virtual machine, select a location that has enough free space. Checkpoints include virtual machine data and may require a large amount of space.

At the bottom of the window are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

- Specify the generation of the virtual machine. The generation of a virtual machine determines the hardware configuration that is available to the virtual machine. Once the virtual machine has been created, you cannot change its generation. There are two supported virtual machine generations: Generation 1 and Generation 2 (Server 2012 R2 and later).



Each Generation 1 virtual machine supports a maximum of four virtual IDE devices. Generation 1 virtual machines can boot to the virtual IDE controller using: VHD, VHDX, ISO files, Pass-through disk, physical CD/DVD drive, or SMB 3.0 file share. Generation 1 virtual machines also require virtual IDE to use CD/DVD drives or ISO images. The maximum size for a Generation 1 virtual machine boot volume is 2 TB.

Each Generation 1 virtual machine also supports up to four virtual SCSI controllers, with 64 devices per controller for a maximum of 256 devices. It is not possible to boot a Generation 1 virtual machine to the virtual SCSI controller. Generation 1 virtual machines also include support for virtual floppy controllers.

Generation 2 virtual machines no longer provide support for virtual IDE or floppy controllers. Each Generation 2 virtual machine supports up to four virtual SCSI controllers, with 64 devices per controller for a maximum of 256 devices. Generation 2 virtual machines can boot to the virtual SCSI controller using: VHDX, ISO files, Pass-through disk, physical CD/DVD drive, or SMB 3.0 file share. The maximum size for a Generation 2 virtual machine boot volume is 64 TB.

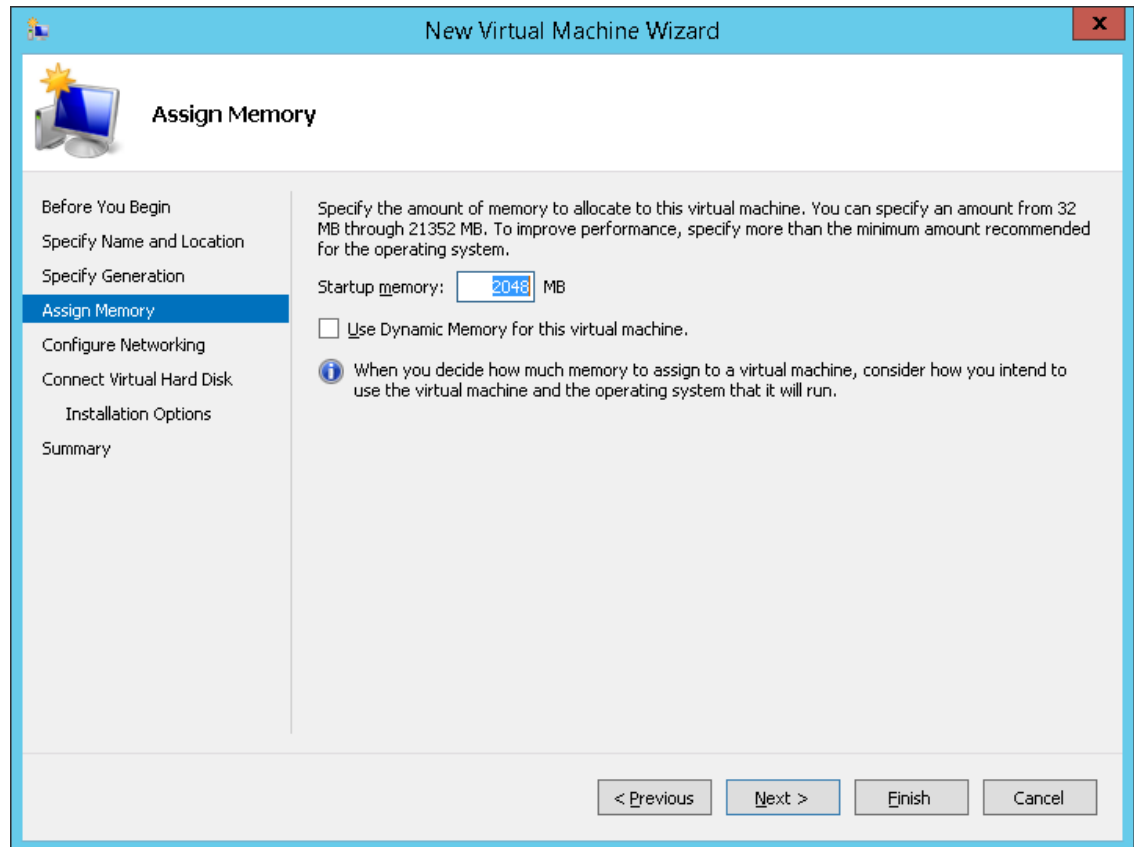
Generation 2 virtual machines support only VHDX files and do not support VHD.

For more information on virtual machine generations, refer to:

<http://technet.microsoft.com/en-us/library/dn282285.aspx>

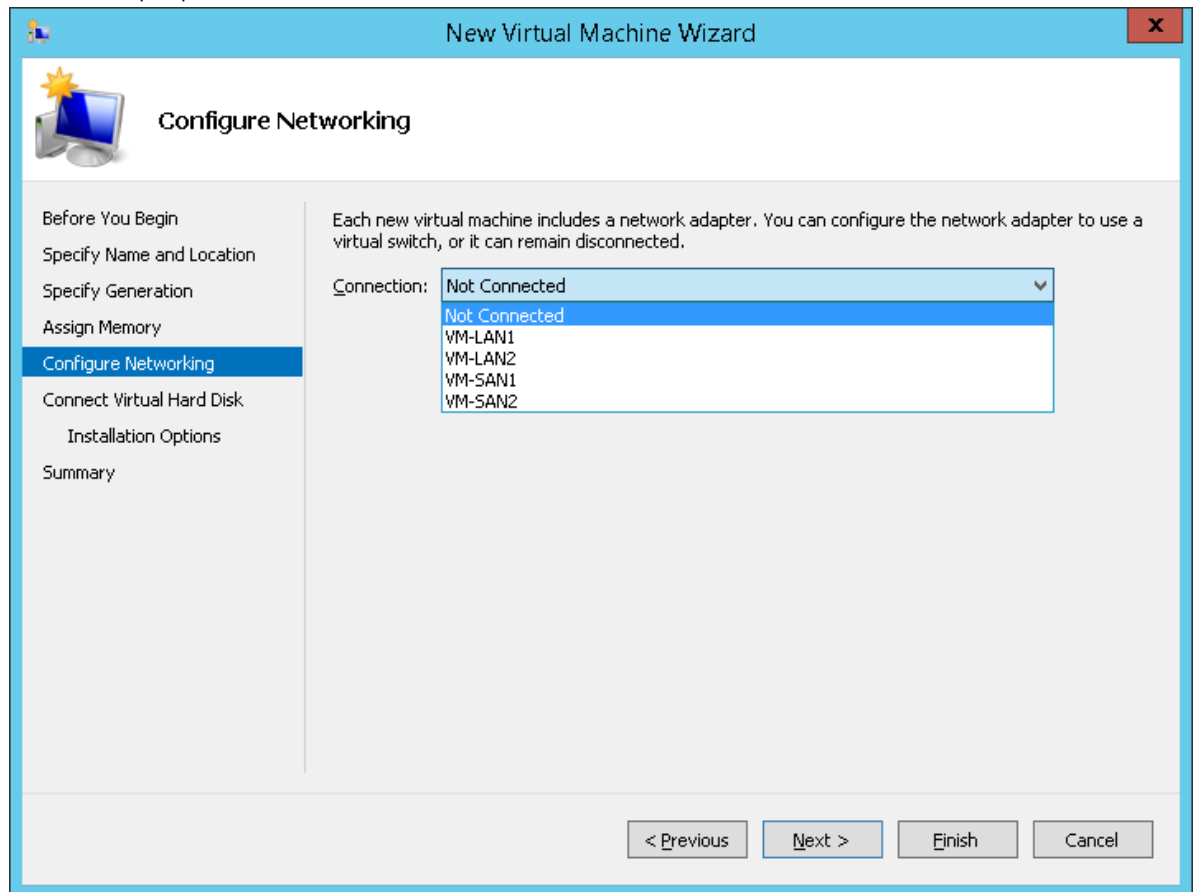


5. Specify the amount of memory to allocate to the virtual machine.
 - a. Optionally, click to select **Use Dynamic Memory for this Virtual Machine**. For additional information on Dynamic Memory, refer to:
<http://technet.microsoft.com/en-us/library/hh831766.aspx>
 - b. Click **Next**.



The screenshot shows the 'New Virtual Machine Wizard' window, specifically the 'Assign Memory' step. The window has a blue title bar with the text 'New Virtual Machine Wizard' and a close button (X) in the top right corner. On the left side, there is a vertical list of steps: 'Before You Begin', 'Specify Name and Location', 'Specify Generation', 'Assign Memory' (which is highlighted with a blue background), 'Configure Networking', 'Connect Virtual Hard Disk', 'Installation Options', and 'Summary'. The main area of the window is titled 'Assign Memory' and contains the following text: 'Specify the amount of memory to allocate to this virtual machine. You can specify an amount from 32 MB through 21352 MB. To improve performance, specify more than the minimum amount recommended for the operating system.' Below this text, there is a 'Startup memory:' label followed by a text box containing the value '2048' and the unit 'MB'. To the right of the text box is a checkbox labeled 'Use Dynamic Memory for this virtual machine.' which is currently unchecked. Below the checkbox, there is an information icon (i) followed by the text: 'When you decide how much memory to assign to a virtual machine, consider how you intend to use the virtual machine and the operating system that it will run.' At the bottom of the window, there are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'. The 'Next >' button is highlighted with a blue border.

6. To configure the virtual machine to connect to an existing virtual switch, click to select the virtual switch from the drop-down list. This can also be configured later by modifying the virtual machine's properties.



7. A virtual machine requires storage to install or run the Operating System and access data volumes. You can specify the storage during virtual machine creation or configure it later by modifying the virtual machine's properties.
 - a. To create a Virtual Hard Disk, click to select **Create a virtual hard disk**. Refer to [Creating a Virtual Hard Disk](#) for additional information.
 - b. To attach to an existing VHD, click to select **Use an existing virtual hard Disk**, and click **Browse** to specify the location of the existing VHD to attach to.
 - c. To connect the VHD later, click **Attach a virtual hard disk later**.
 - d. Click **Next**.

The screenshot shows the 'New Virtual Machine Wizard' window, specifically the 'Connect Virtual Hard Disk' step. The window has a blue title bar and a sidebar on the left with the following steps: 'Before You Begin', 'Specify Name and Location', 'Specify Generation', 'Assign Memory', 'Configure Networking', 'Connect Virtual Hard Disk' (which is highlighted), and 'Summary'. The main area contains the following text: 'A virtual machine requires storage so that you can install an operating system. You can specify the storage now or configure it later by modifying the virtual machine's properties.' There are three radio button options: 1. 'Create a virtual hard disk' (unselected): 'Use this option to create a VHDX dynamically expanding virtual hard disk.' Below this are fields for 'Name' (Windows Server 2012 - VM1.vhdx), 'Location' (C:\ClusterStorage\Volume1\Virtual Hard Disks\Windows Server 2012), and 'Size' (20 GB (Maximum: 64 TB)). 2. 'Use an existing virtual hard disk' (selected): 'Use this option to attach an existing VHDX virtual hard disk.' Below this is a 'Location' field containing 'ard Disks\Windows Server 2012 - VM1\SERVER2012-R2-VM1.VHDX' and a 'Browse...' button. 3. 'Attach a virtual hard disk later' (unselected): 'Use this option to skip this step now and attach an existing virtual hard disk later.' At the bottom right are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

8. Review the summary. To create the virtual machine and close the wizard, click **Finish**.

8.5 Creating a Virtual Hard Disk

1. To create a new VHD, click to select **Create a new Virtual Hard Disk** and specify the name, location and size.
 - a. To store the VHD in a specific location, such as shared SAN storage (recommended for High Availability), click **Browse** to specify the location. If using a clustered volume, specify the shared volume as the location for the VHD.
 - b. Size the VHD according to the requirements for the Guest Operating System that will be installed.
 - c. Click **Next**.

The screenshot shows the 'New Virtual Machine Wizard' window, specifically the 'Connect Virtual Hard Disk' step. The window has a blue title bar and a sidebar on the left with the following steps: 'Before You Begin', 'Specify Name and Location', 'Specify Generation', 'Assign Memory', 'Configure Networking', 'Connect Virtual Hard Disk' (highlighted), 'Installation Options', and 'Summary'. The main area contains the following text: 'A virtual machine requires storage so that you can install an operating system. You can specify the storage now or configure it later by modifying the virtual machine's properties.' There are three radio button options: 1. 'Create a virtual hard disk' (selected): 'Use this option to create a VHDX dynamically expanding virtual hard disk.' Below this are fields for 'Name' (Server 2012 - VM1.vhdx), 'Location' (C:\ClusterStorage\Volume1\Virtual Hard Disks\Windows Server 201), and 'Size' (20 GB (Maximum: 64 TB)). There is a 'Browse...' button next to the location field. 2. 'Use an existing virtual hard disk': 'Use this option to attach an existing VHDX virtual hard disk.' Below this is a 'Location' field (C:\Users\Public\Documents\Hyper-V\Virtual Hard Disks\...) and a 'Browse...' button. 3. 'Attach a virtual hard disk later': 'Use this option to skip this step now and attach an existing virtual hard disk later.' At the bottom right are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

2. You can install an Operating System during virtual machine creation, or you can install it later.
 - a. To install an Operating System later, click to select **Install an Operating System later**.
 - b. To install an Operating System from the network, click to select **Install an Operating System from a network-based installation server**. After the Virtual machine is created, you can start the virtual machine to boot to the network.
 - c. The Installation Options will vary depending on whether the virtual machine is Generation 1 or Generation 2. Refer to [Specify the generation of the virtual machine](#) for additional information.
 - i. Generation 1 virtual machine:
 - o To install an Operating System from a bootable CD/DVD attached to the Hyper-V host or to specify a bootable ISO file, click to select **Install an Operating System from a bootable CD/DVD-ROM** and select an option. After the virtual machine is created, you can start it to boot to the CD/DVD or ISO.
 - o To install an Operating System from a virtual floppy disk, click to select **Install an Operating System from a bootable floppy disk** and click **Browse** to specify a location. After the virtual machine is created, you can start it to boot to the virtual floppy disk.

New Virtual Machine Wizard

Installation Options

Before You Begin
Specify Name and Location
Specify Generation
Assign Memory
Configure Networking
Connect Virtual Hard Disk
Installation Options
Summary

You can install an operating system now if you have access to the setup media, or you can install it later.

☐ Install an operating system later

☒ Install an operating system from a bootable CD/DVD-ROM

Media

☒ Physical CD/DVD drive: Z: [v]

☐ Image file (.iso): er_2012_r2_with_update_x64_dvd_4065220.iso [Browse...]

☐ Install an operating system from a bootable floppy disk

Media

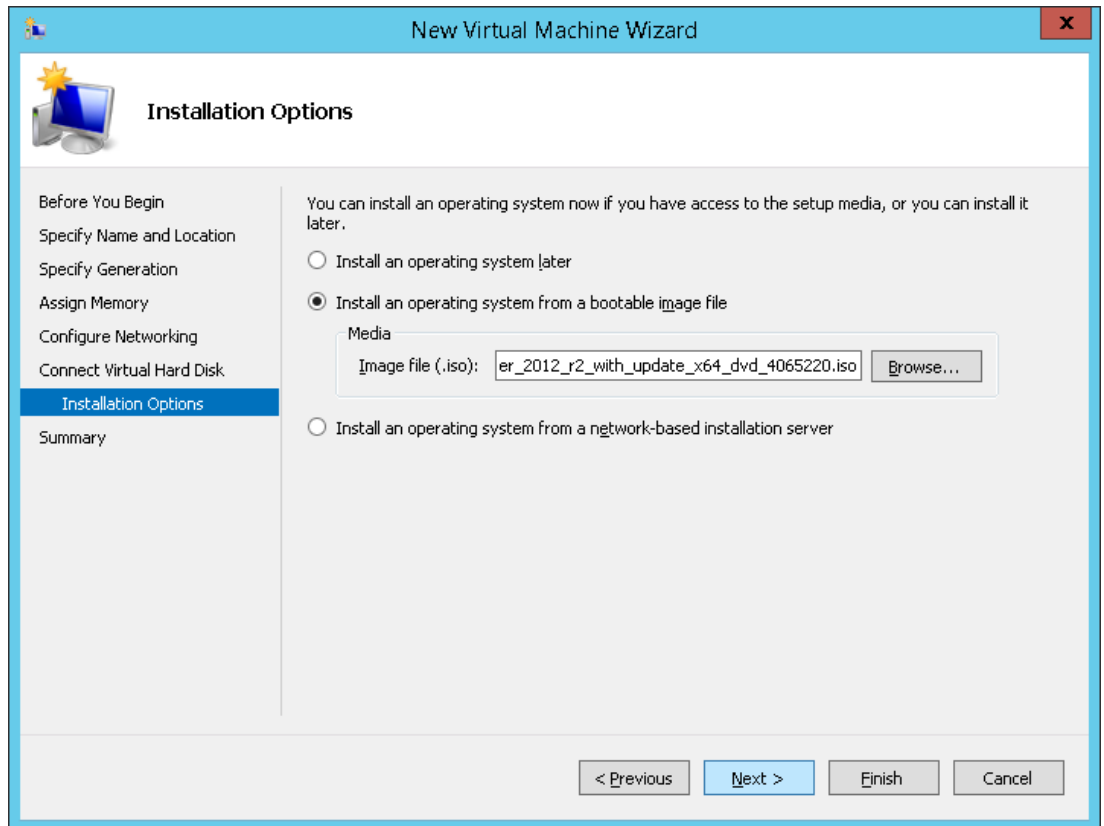
Virtual floppy disk (.vfd): [Browse...]

☐ Install an operating system from a network-based installation server

< Previous Next > Finish Cancel



- ii. Generation 2 virtual machine:
 - o To install an Operating System from a bootable ISO file, click to select **Install an Operating System from a bootable image file** and click **Browse** to specify the location of the ISO file. After the virtual machine is created, you can start the virtual machine to boot to the ISO.



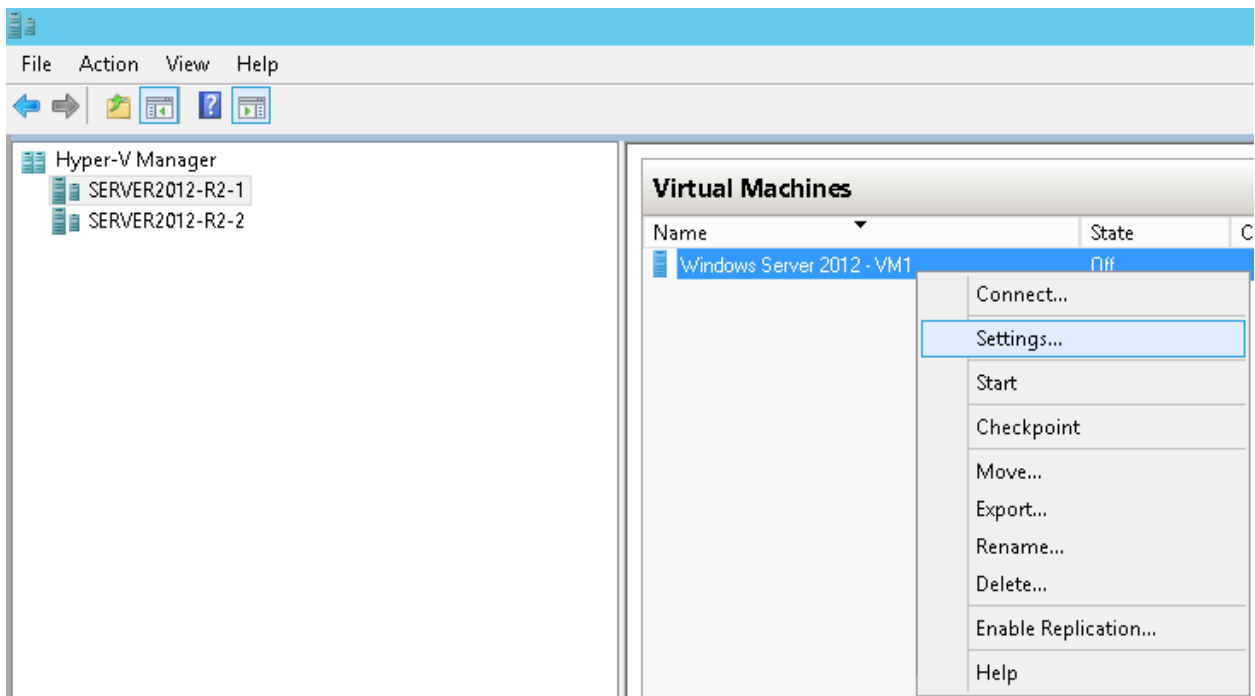
- d. Click **Next**.
3. Review the summary. To create the virtual machine and close the wizard, click **Finish**.

8.6 Modifying virtual machine settings

To view or modify virtual machine settings:

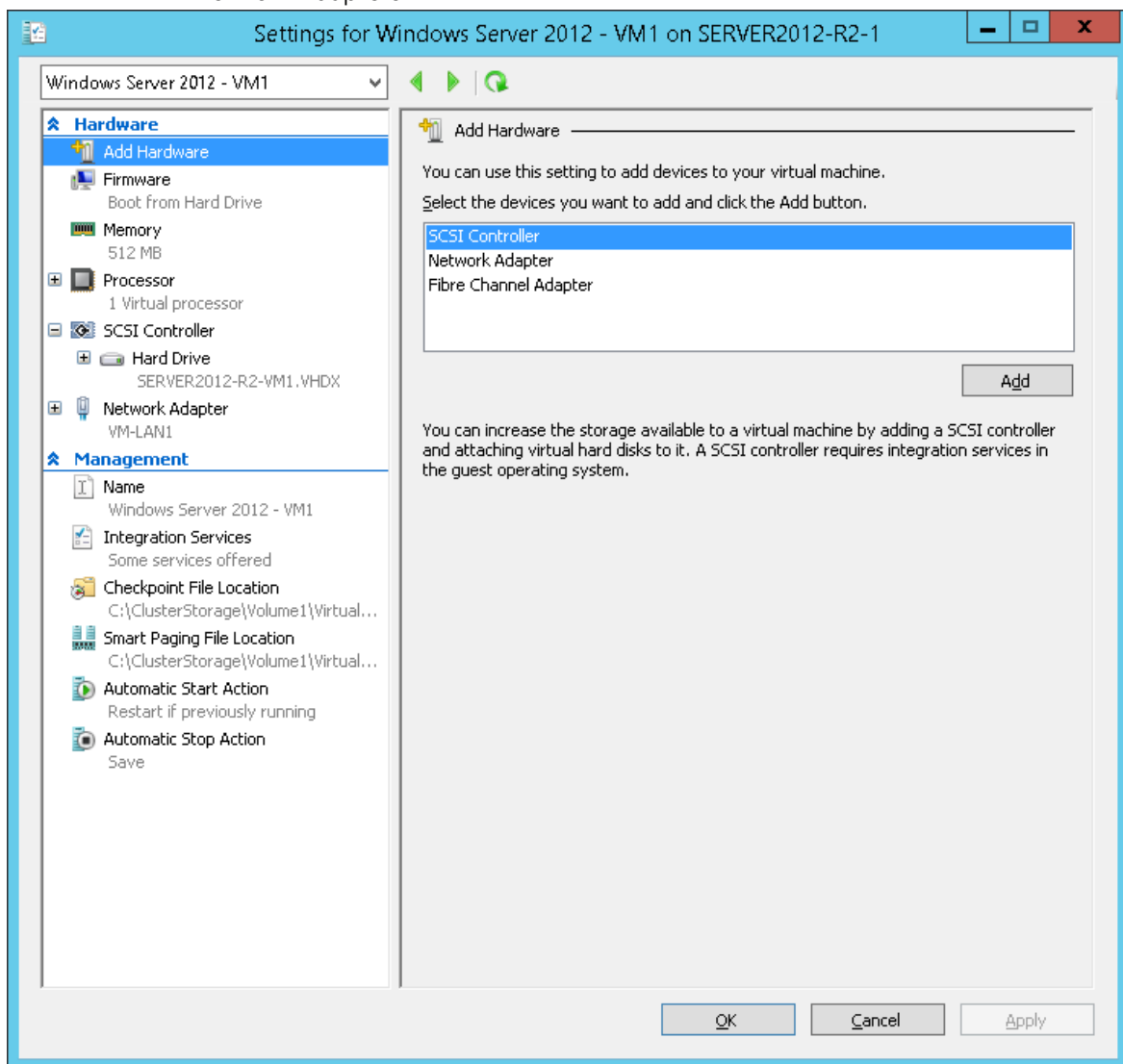
1. Launch **Hyper-V Manager**.
2. Right-click on the virtual machine and select **Settings**.

Note: Some settings can not be modified if the virtual machine is in the Running state. To modify a setting that is unavailable, first shut down the virtual machine. Also, some settings for clustered virtual machines must be modified through Failover Cluster Manager.



Note: If using a clustered virtual machine, specify the shared volume as the location for VHDs, Checkpoint File location, and Smart Paging File location.

3. Virtual machine configuration settings include:
 - a. Management Settings
 - Virtual machine name and description
 - Integration Services
 - Checkpoint File Location
 - Smart Paging File Location
 - Automatic Start/Stop Actions
 - b. Hardware Settings
 - Boot order
 - Memory
 - Processor
 - SCSI Controllers
 - Network Adapters



8.7 Virtual machine storage options

There are multiple disk storage options for a virtual machine:

- [VHDs](#)
- [Pass-through disks](#)
- [Direct-attached disks](#)
- [Server Message Block \(SMB\) file shares](#)

8.7.1 VHDs

VHDs are files that reside on a physical disk which represent virtual hard disk drives. VHDs can store partitions, file systems, and data – just like physical disks can. VHDs are commonly used as storage for virtual machines. From a virtual machine, a VHD appears as a physical disk. It is recommended to store VHDs in a secure location.

Refer to Figure 8 for an example of a virtual machine configured with VHDs for boot and data volumes. The virtual machine does not require access to the SAN to use a VHD.

VHDs in Hyper-V can be of the VHD or VHDX format (VHDX is available in Windows Server 2012 and later).

- VHD supports a maximum storage capacity of 2 TB.
- VHDX supports a maximum storage capacity of 64 TB.

There are three types of VHDs:

Table 6 Virtual Hard Disk types

| Type | Description |
|------------------------------|---|
| Fixed size | <ul style="list-style-type: none">• Provides the best performance• Recommended for applications with high disk activity• The VHD file uses the entire size of the VHD• The VHD file size is determined when the file is created and remains the same as data is written. |
| Dynamically expanding | <ul style="list-style-type: none">• Provides more efficient usage of physical storage space• Recommended for applications with lower disk activity• The VHD file size automatically increases as data is written |
| Differencing | <ul style="list-style-type: none">• Maintains a parent-child relationship with an existing parent disk• Parent disk remains in-tact• Differencing disks only contain the changes between itself (child) and the parent disk• The differencing VHD file size automatically increases as data is written. Changes can be merged to the parent disk |



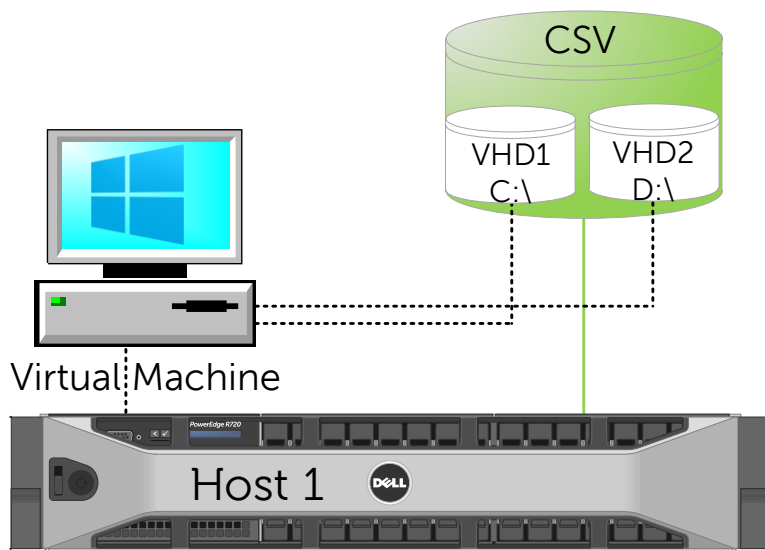


Figure 8 Hyper-V virtual machine configured with VHDs for boot and data volumes

Note: In Windows Server 2012 R2 and later, VHDs (VHDX only) can be shared by multiple virtual machines. A Shared VHDX can be used for clustering within the Guest Operating System. For additional information on VHD sharing, refer to: <http://technet.microsoft.com/en-us/library/dn281956.aspx>

8.7.2 Pass-through disks

A Pass-through disk is a physical hard disk (either locally or SAN-attached) on the Hyper-V host that is taken off-line and attached to from a virtual machine. Because the disk is offline on the Hyper-V host, a pass-through disk can only be accessed by the virtual machine. A CSV cannot be used as a Pass-through disk for a virtual machine.

Unlike VHDs, Pass-through disks cannot be dynamically expanding, and cannot use differencing disks or Hyper-V VHD snapshots. The virtual machine does not require access to the SAN to use a Pass-through disk.

Note: While VHDs have size limitations, (2 TB for VHD and 64 TB for VHDX), Pass-through disks and Direct-attached disks support sizes up to the maximum allowed by the Guest Operating System.

Refer to Figure 9 for an example of a virtual machine configured with a Pass-through disk. The disk is offline to the Hyper-V host and accessed directly from the virtual machine.

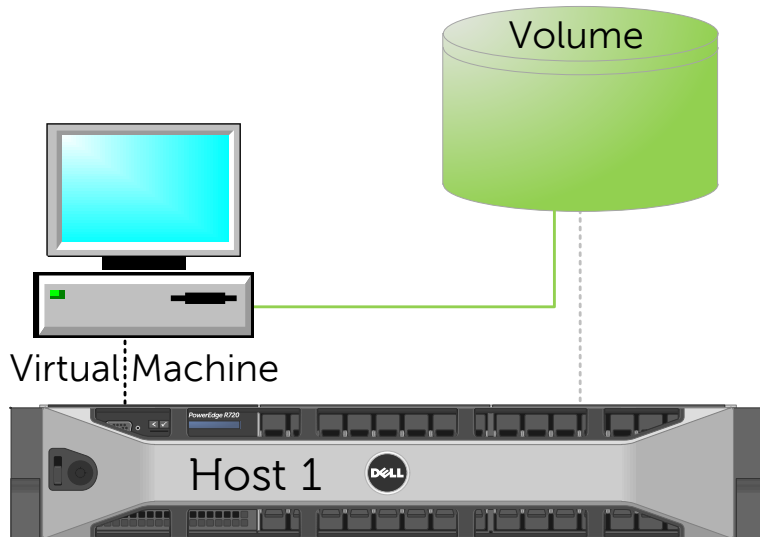


Figure 9 Hyper-V virtual machine configured with a Pass-through disk

8.7.3 Direct-attached disks

Direct-attached disks are iSCSI volumes that are connected to using an iSCSI initiator in the Guest Operating System. Direct-attached disks are not visible to the Hyper-V host and only accessible by the Guest Operating System running on the virtual machine.

Note: Windows Server 2012 and later also includes support for Direct-attached disks that use Virtual Fibre Channel, but this is unsupported for Dell EqualLogic iSCSI storage arrays.

Unlike VHDs, Direct-attached disks cannot be dynamically expanding, and cannot use differencing disks or Hyper-V VHD snapshots. VSS Hardware snapshots are supported for Direct-attached volumes in the Guest Operating System. The Dell EqualLogic Host Integration Tools for Microsoft includes a VSS Hardware Provider, as well as a VSS Requestor, Auto-Snapshot Manager/Microsoft Edition. For additional information, refer to: [Managing and Protecting a Windows Server Hyper-V Environment using Dell EqualLogic PS Series Storage Arrays and Tools](#)

Refer to Figure 10 for an example of a virtual machine configured with Direct-attached disks. The virtual machine accesses the volume directly and the volume is not visible to the Hyper-V host. The virtual machine requires access to the SAN Network to use a Direct-attached disk.



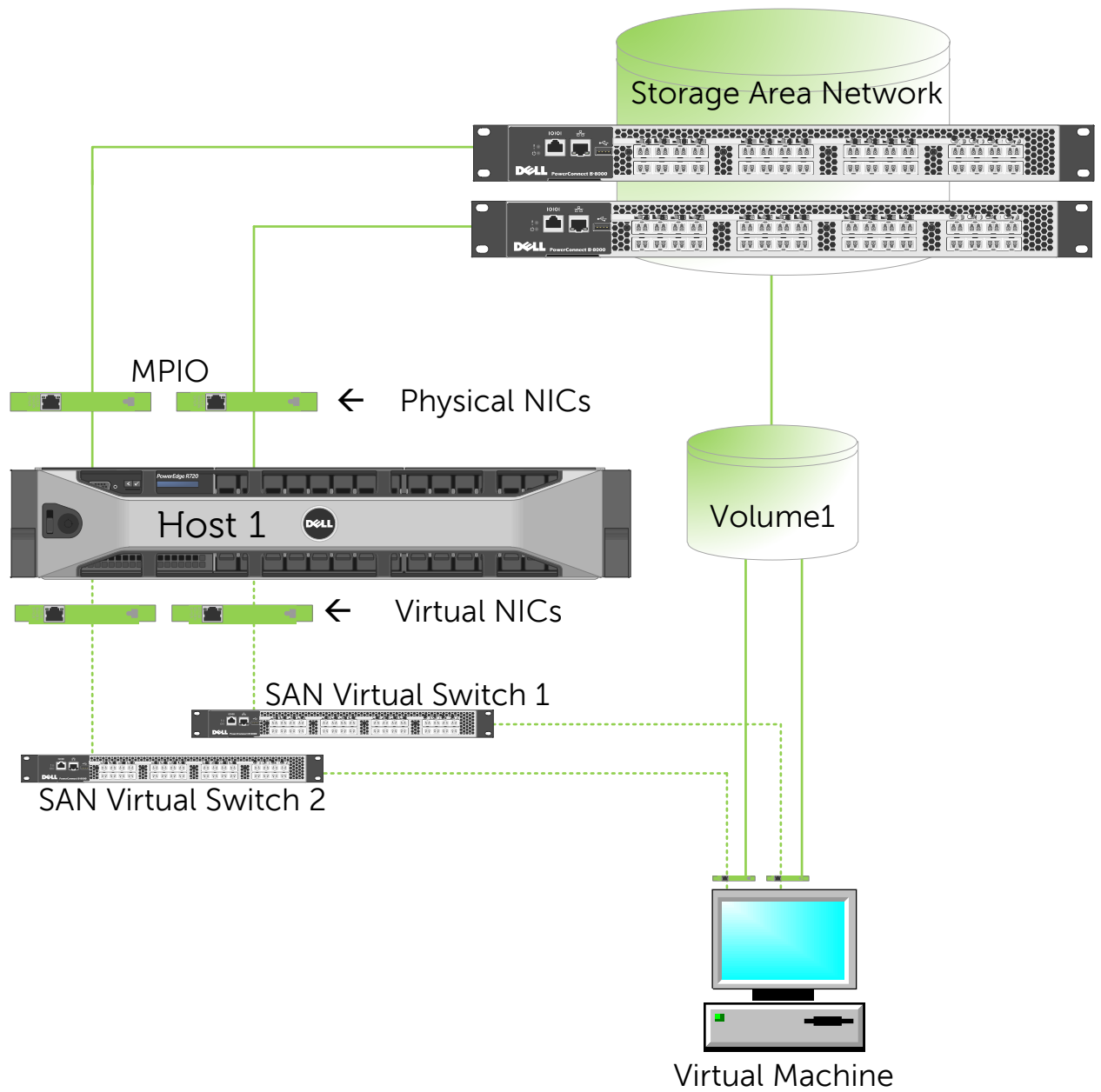


Figure 10 Hyper-V virtual machine configured with Direct-attached disks

8.7.4 Server Message Block (SMB) file shares

SMB is a network file sharing protocol that enables files or other resources to be created, accessed and modified on a remote server. Windows Server 2012 introduced version 3.0 of the SMB protocol. For additional information on SMB, refer to:

<http://technet.microsoft.com/en-us/library/hh831795.aspx>

Files shares in Windows Server 2012 and Windows Server 2012 R2 can be used as storage for Hyper-V, to store virtual machine files such as VHDs, configuration files, and snapshots.

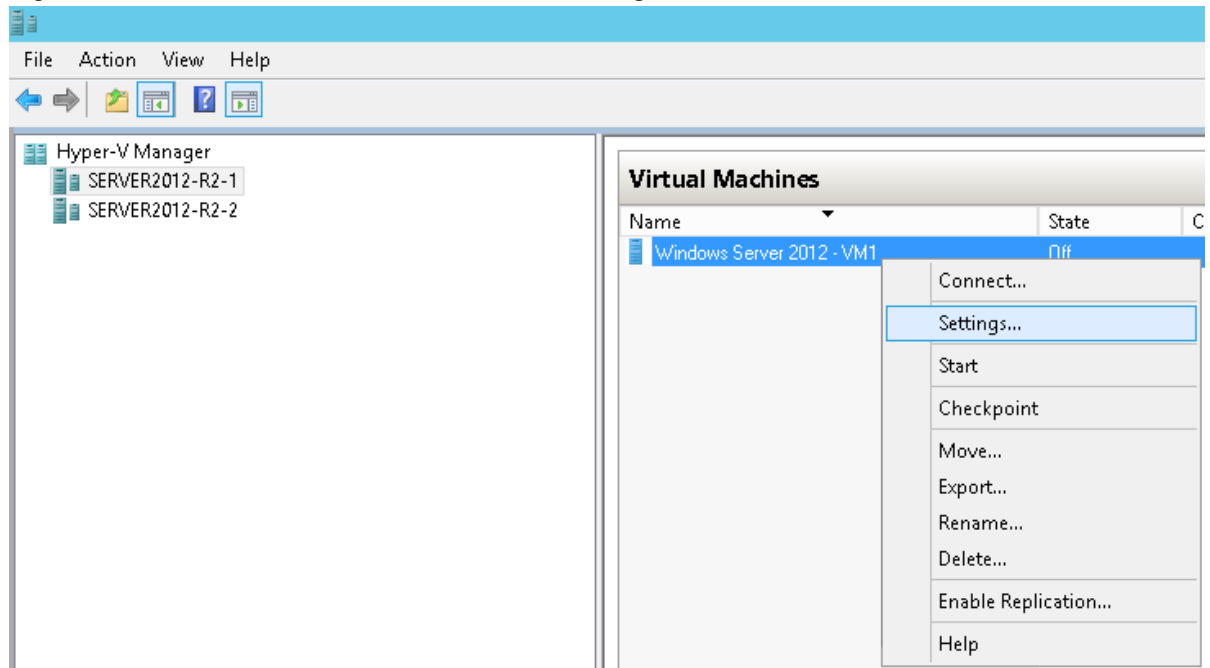
For additional information on deploying Hyper-V over SMB, refer to:

<http://technet.microsoft.com/en-us/library/jj134187.aspx>

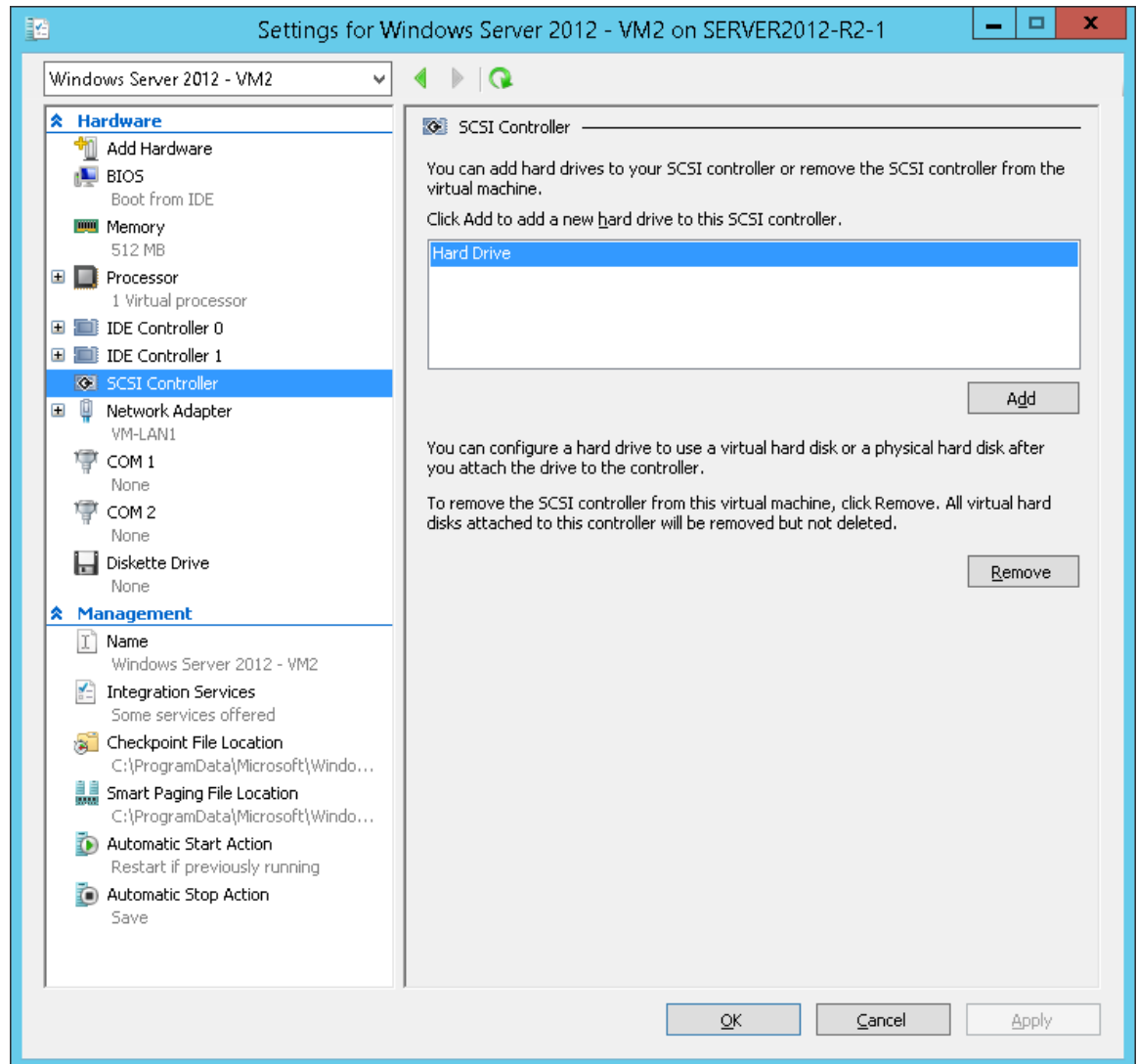


8.8 Attaching VHDs and Pass-through disks to virtual machines

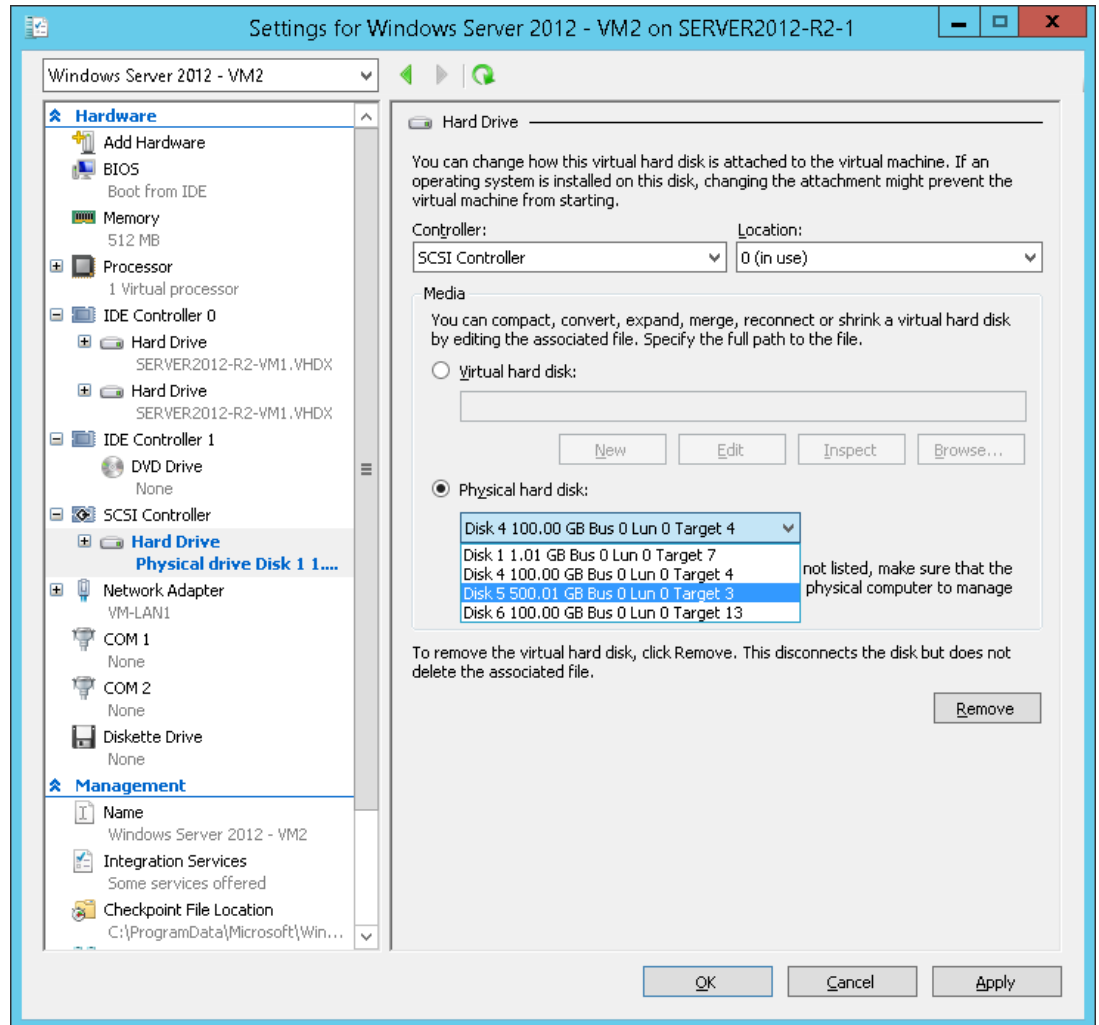
1. Launch Hyper-V Manager.
2. Right-click on the virtual machine and select **Settings**.



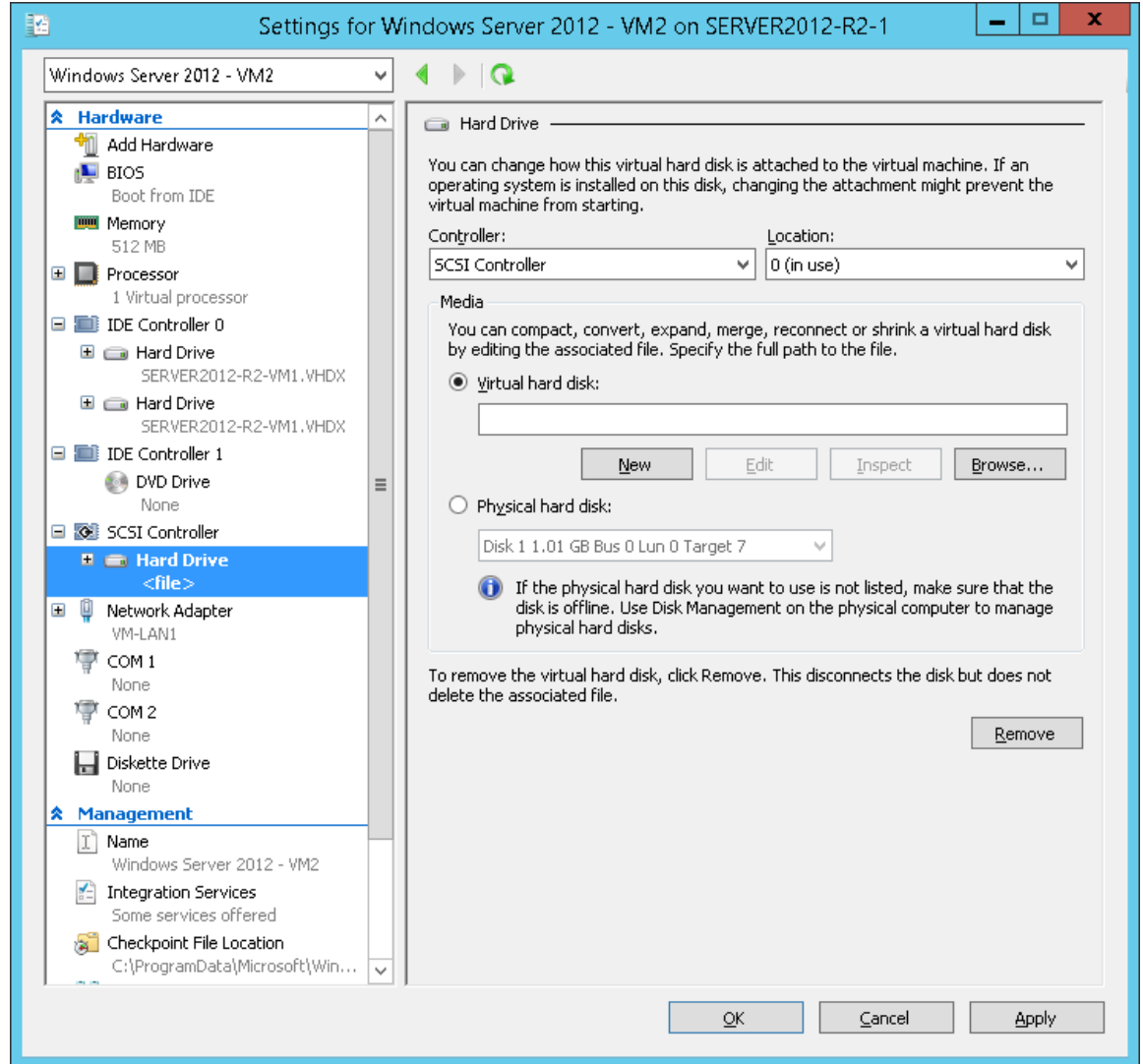
3. Click to highlight an IDE (Server 2012 or earlier only), or SCSI Controller.
 - a. Click to select **Hard Drive** and click **Add**.



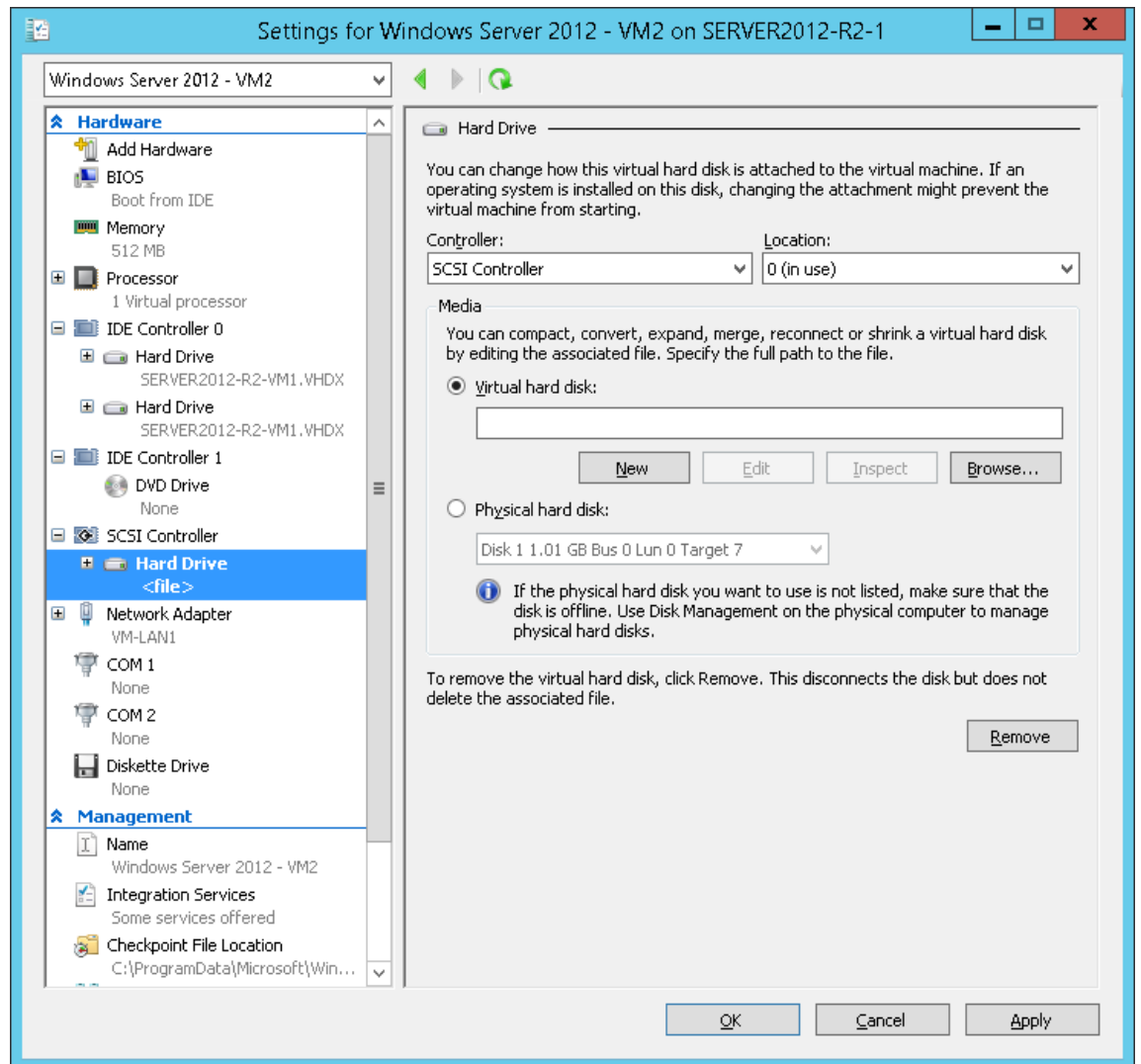
4. You can attach to a VHD or Physical hard disk on the Hyper-V host (Pass-through disk).
 - a. To attach to a physical disk on the Hyper-V host (Pass-through disk):
 - i. Click to select **Physical hard disk** and select a disk from the drop-down menu. If the physical hard disk is not listed, first make sure the disk is offline in Disk Manager.
 - ii. Click **Apply**. After the virtual machine is started, the Guest Operating System can store data on the disk.



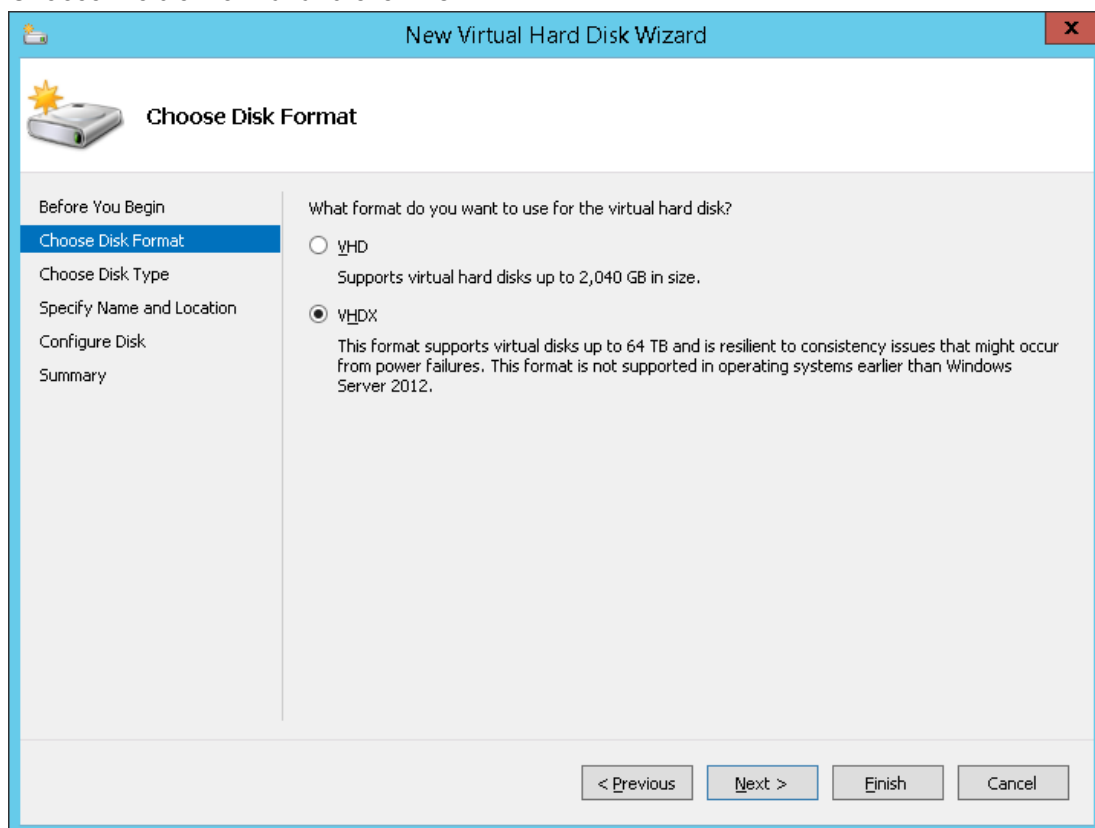
- b. To attach to an existing VHD, click to select **Virtual hard disk** and click **Browse** and specify the path.



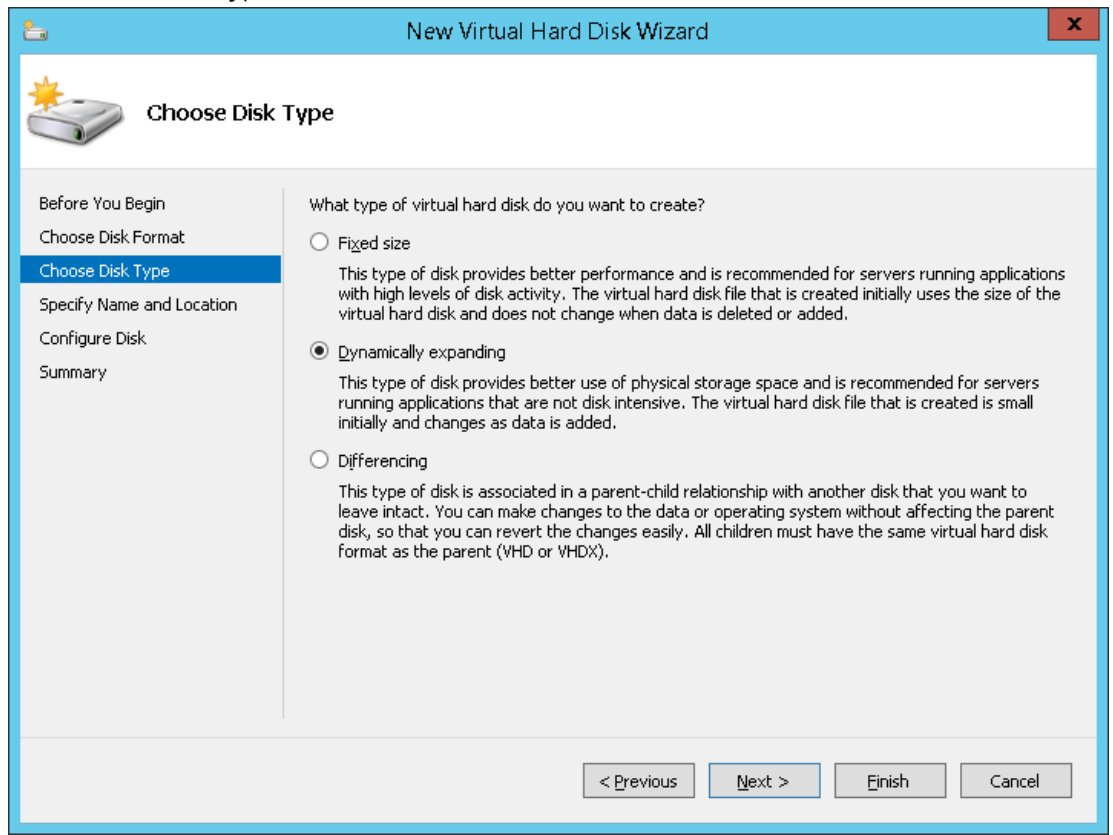
- c. To create a new VHD, click **New** to launch the New Virtual Hard Disk Wizard.



- i. Choose the disk format and click **Next**.



- ii. Choose the VHD type, and click **Next**.



- iii. Specify the name and location of the VHD, and click **Next**.
- iv. To store the VHD in a specific location, such as shared SAN storage (recommended for High Availability), click **Browse** to specify the location.
- v. Click **Next**.

The screenshot shows the 'New Virtual Hard Disk Wizard' window. The title bar is blue with the text 'New Virtual Hard Disk Wizard' and a close button. The main area has a light gray background. On the left, there is a vertical list of steps: 'Before You Begin', 'Choose Disk Format', 'Choose Disk Type', 'Specify Name and Location' (which is highlighted with a blue background), 'Configure Disk', and 'Summary'. Above this list is a small icon of a hard disk with a yellow star. The main content area is titled 'Specify Name and Location' and contains the text 'Specify the name and location of the virtual hard disk file.' Below this text are two input fields: 'Name:' with the value 'New Virtual Hard Disk.vhdx' and 'Location:' with the value 'Z:\ClusterStorage\Volume1\Virtual Hard Disks\Windows Server 2012 - VM2\'. To the right of the 'Location:' field is a 'Browse...' button. At the bottom of the window, there are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

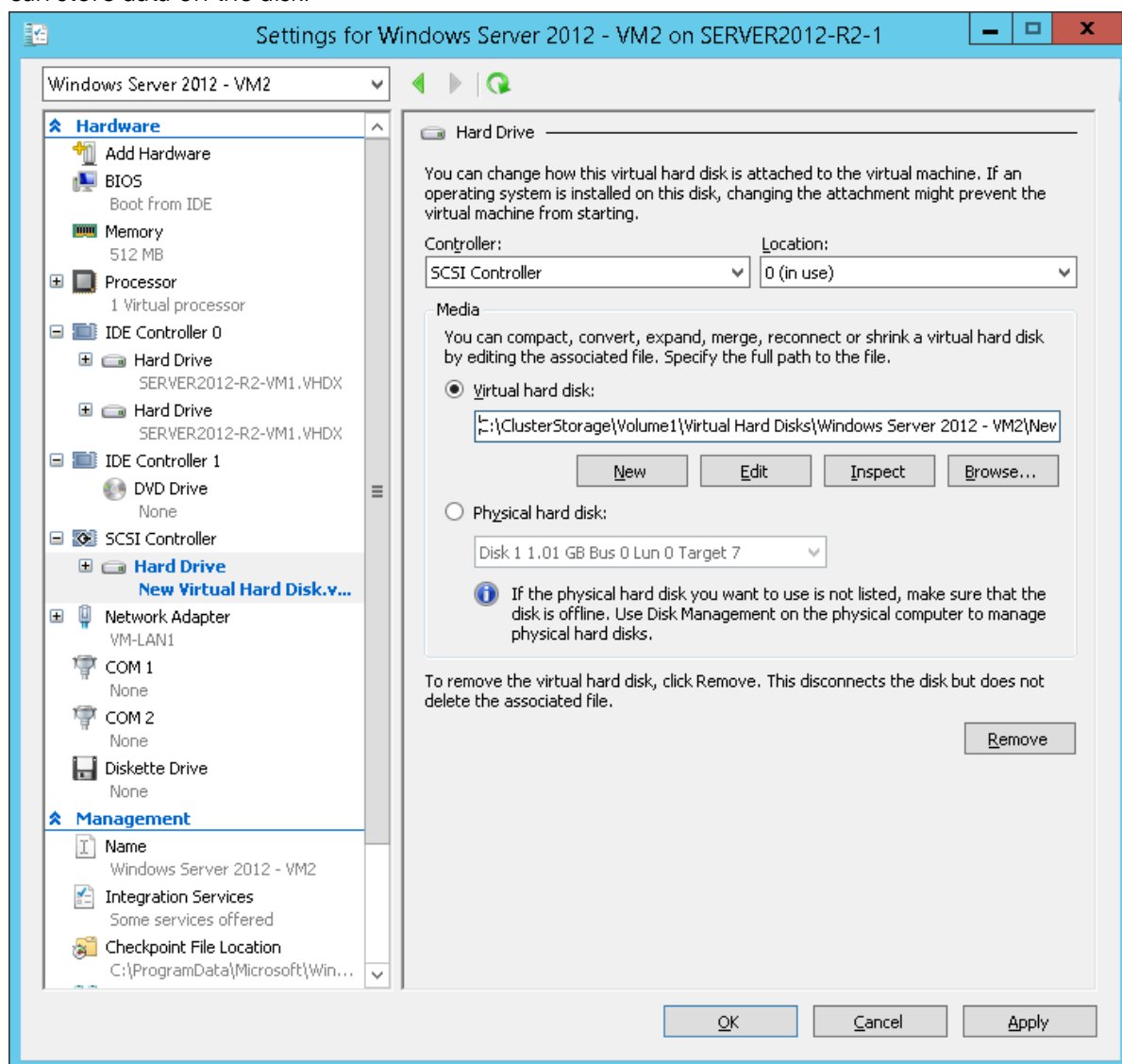
- vi. You can create a new blank VHD, copy the contents of an existing physical disk on the Hyper-V host, or copy the contents of an existing virtual hard disk. Select an option and click **Next**.

The screenshot shows the 'New Virtual Hard Disk Wizard' window, specifically the 'Configure Disk' step. The window has a blue title bar and a sidebar on the left with the following steps: 'Before You Begin', 'Choose Disk Format', 'Choose Disk Type', 'Specify Name and Location', 'Configure Disk' (which is highlighted), and 'Summary'. The main area contains the text 'You can create a blank virtual hard disk or copy the contents of an existing physical disk.' There are three radio button options: 'Create a new blank virtual hard disk' (selected), 'Copy the contents of the specified physical disk:', and 'Copy the contents of the specified virtual hard disk:'. The first option has a 'Size:' field set to '20' GB (Maximum: 64 TB). The second option is followed by a table of physical hard disks. The third option has a 'Path:' field with a file path and a 'Browse...' button. At the bottom are four buttons: '< Previous', 'Next >', 'Finish', and 'Cancel'.

| Physical Hard Disk | Size |
|--------------------|--------|
| \\.\PHYSICALDRIVE0 | 279 GB |
| \\.\PHYSICALDRIVE1 | 1 GB |
| \\.\PHYSICALDRIVE2 | 74 GB |
| \\.\PHYSICALDRIVE3 | 50 GB |
| \\.\PHYSICALDRIVE4 | 99 GB |
| \\.\PHYSICALDRIVE5 | 500 GB |
| \\.\PHYSICALDRIVE6 | 99 GB |

- vii. To create the VHD and close the wizard, click **Finish**.

5. To save the settings, click **Apply**. After the Virtual machine is started, the Guest Operating System can store data on the disk.

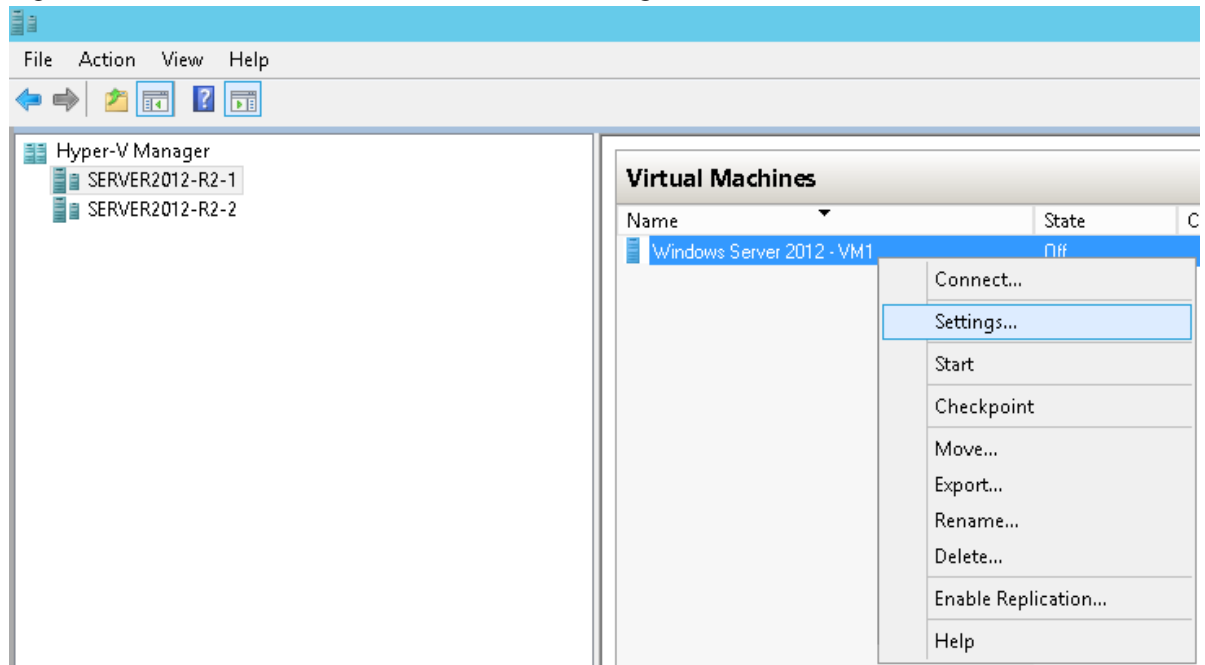


8.9 Using Direct-attached disks with virtual machines

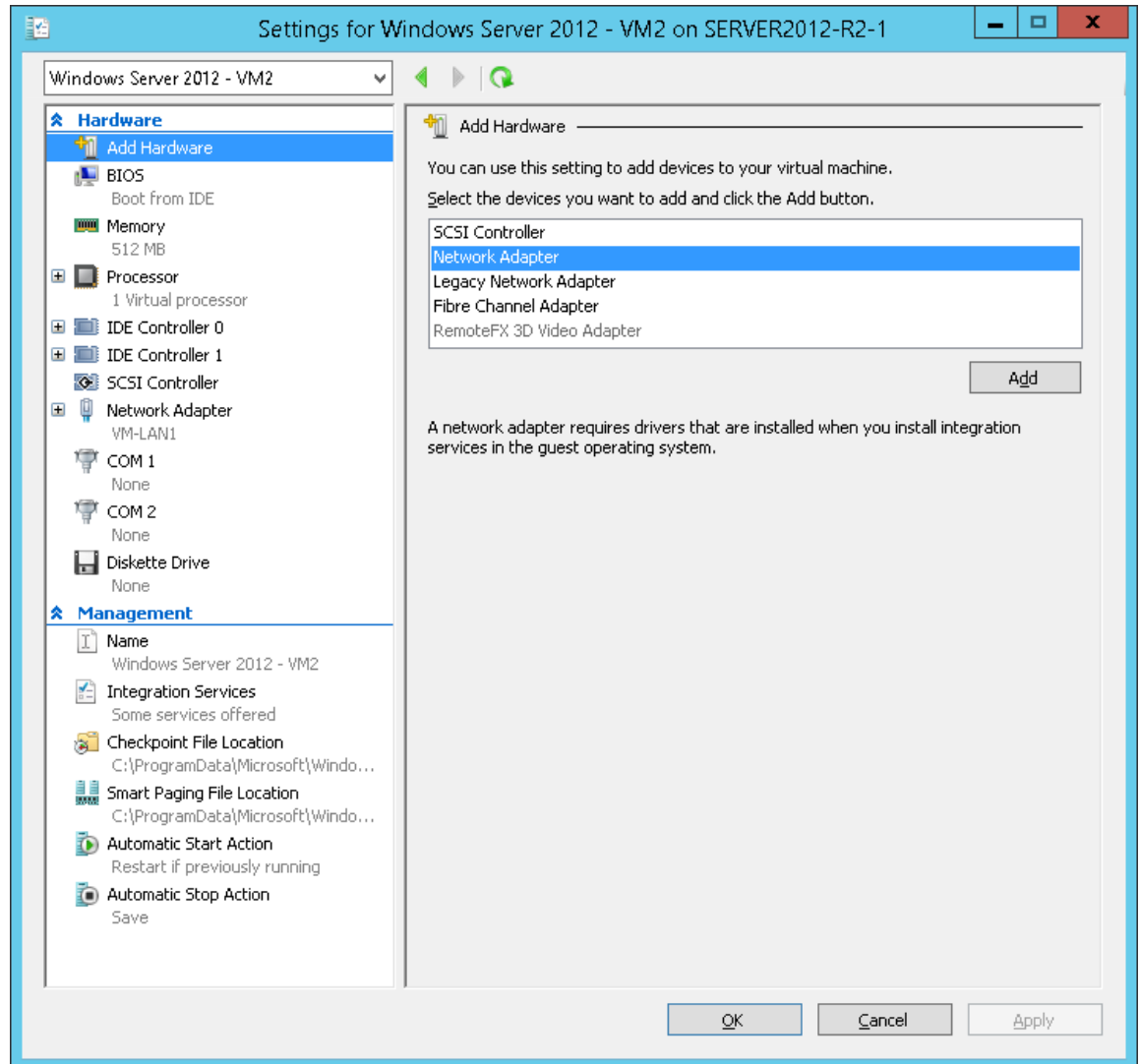
In order for a Guest Operating System to access the iSCSI SAN, the virtual machine must be configured with virtual network adapters for virtual switches that are bound to the physical SAN adapters on the Hyper-V host.

To configure a virtual machine with virtual network adapters:

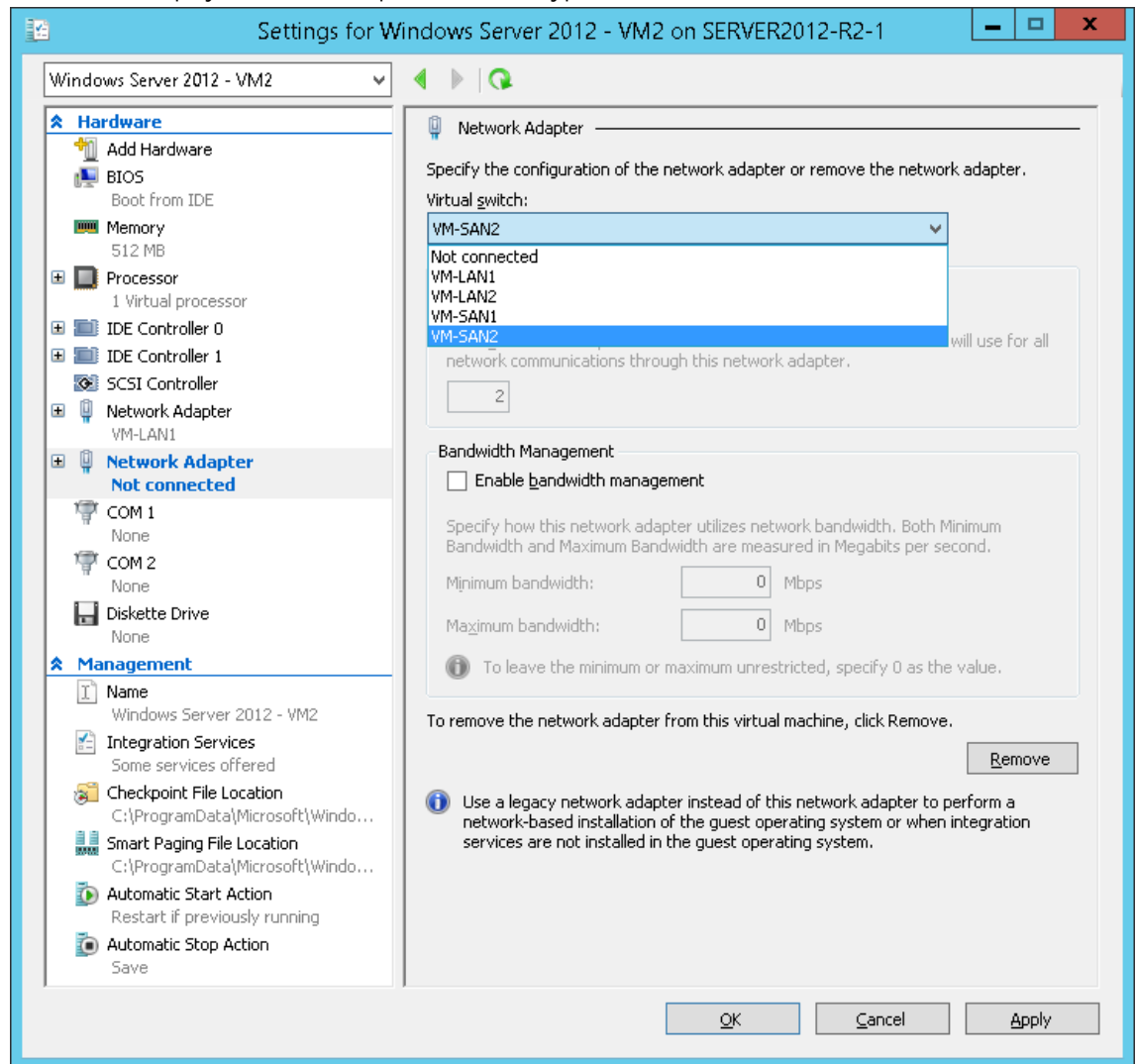
1. Launch Hyper-V Manager.
2. Right-click on the virtual machine, and select **Settings**.



3. Click **Add Hardware**.
 - a. Click to select **Network Adapter** or **Legacy Network Adapter** (Generation 1 virtual machine only), and click **Add**.



- b. Click to select a virtual switch that is bound to a physical adapter on the Hyper-V host and click **Apply**. In order for a virtual machine Guest Operating System to access the iSCSI SAN, the virtual machine must be configured with virtual network adapters for virtual switches that are bound to the physical SAN adapters on the Hyper-V host.



Note: To use Dell EqualLogic MPIO in a Windows Guest Operating System, configure the virtual machine with access to at least two virtual switches that are bound to physical SAN adapters on the Hyper-V host, and install the DSM feature of Dell EqualLogic Host Integration Tools for Microsoft on all Hyper-V hosts and Windows Guest Operating Systems.

To provide load-balancing and fault tolerance for non-iSCSI networks, consider using NIC teaming.

4. From the Guest Operating System, you can configure the network interfaces and connect directly to iSCSI EqualLogic volumes. If using Jumbo Frames, ensure that it is enabled on all switches and NICS that use iSCSI traffic, including virtual switches and virtual Ethernet adapters. It is important to verify these settings on all nodes in a cluster, as well as in the Guest Operating System. For additional information on Jumbo Frames, refer to the section [Enable Jumbo Frames](#).

Direct-attached volumes are not managed in Hyper-V Manager. From the Guest Operating System, Direct-attached iSCSI volumes are managed the same as if they were in a physical environment. For additional information on creating an EqualLogic volume and making it available to Windows, refer to [Appendix A](#).



8.10 Highly available virtual machines

In a cluster, virtual machines can be configured for High Availability so that they can failover or migrate to other nodes. Virtual machine High Availability is made possible by using shared storage. For shared storage, virtual machines can use CSVs, standard clustered disks, or SMB 3.0 File Shares (in Server 2012 and later).

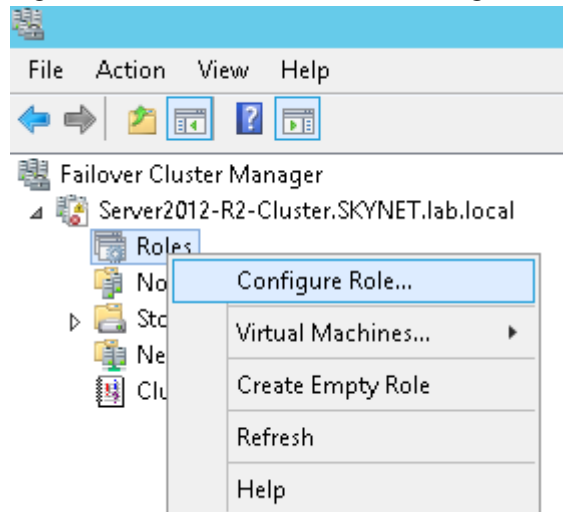
To ensure that a virtual machine can be clustered and highly available, all of its storage must first be present in the cluster. For additional information on adding disks to a cluster, including standard clustered disks and CSVs, refer to the section: [Adding disks to a cluster](#).

Note: Starting with Microsoft Windows Server 2012, Microsoft no longer supports the use of multiple virtual machines in a single clustered role. An example of this configuration would be a [standard clustered disk](#) (non-CSV) containing multiple virtual machines. Therefore, to ensure High Availability and gain improved virtual machine mobility between nodes, either use CSV's or maintain one virtual machine per standard cluster disk (non-CSV).

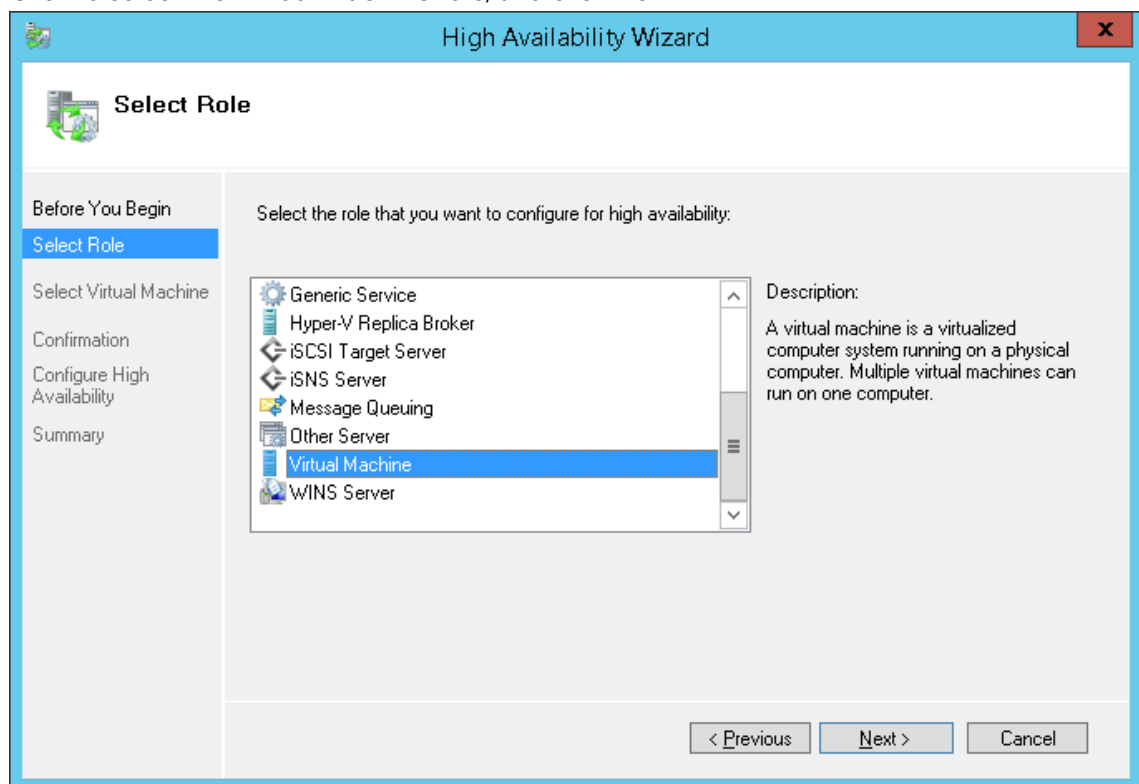


8.10.1 Creating virtual machine clustered roles

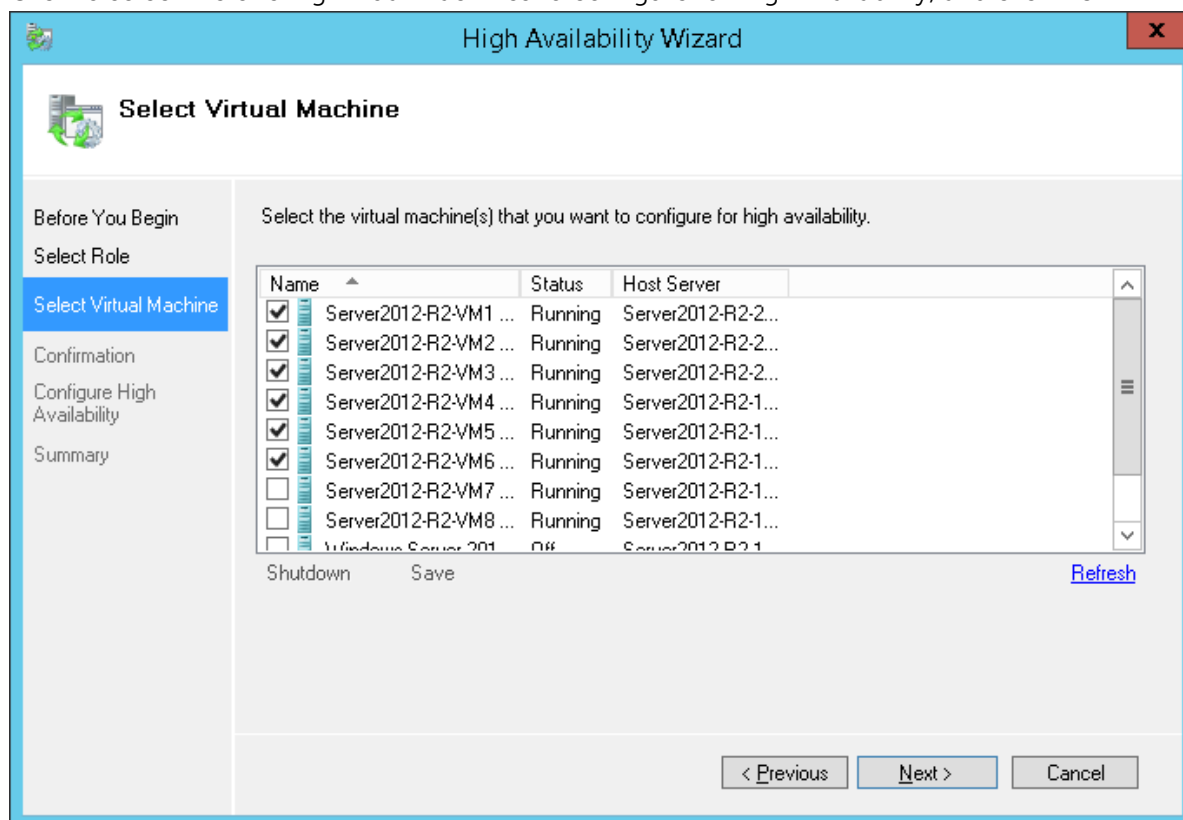
1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Right-click on **Roles**, and select **Configure Role**.



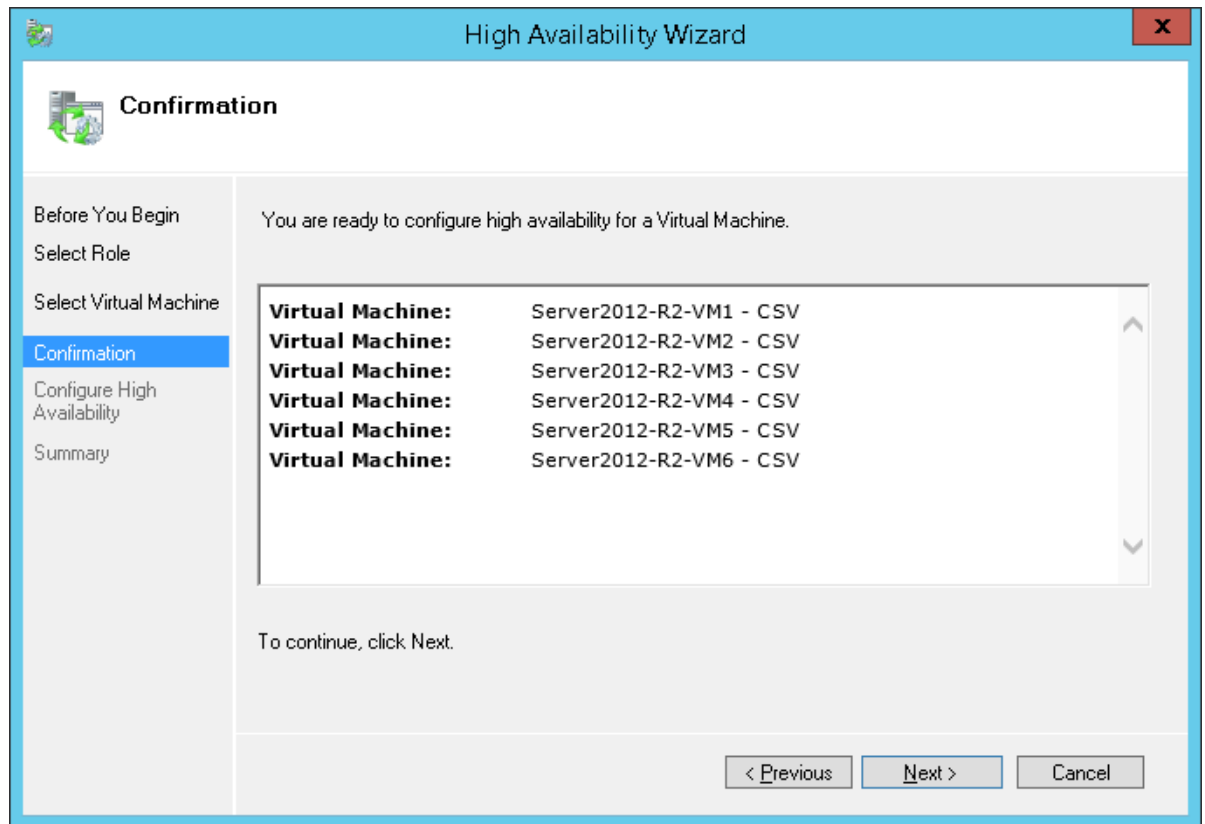
2. Click to select the **Virtual Machine** role, and click **Next**.



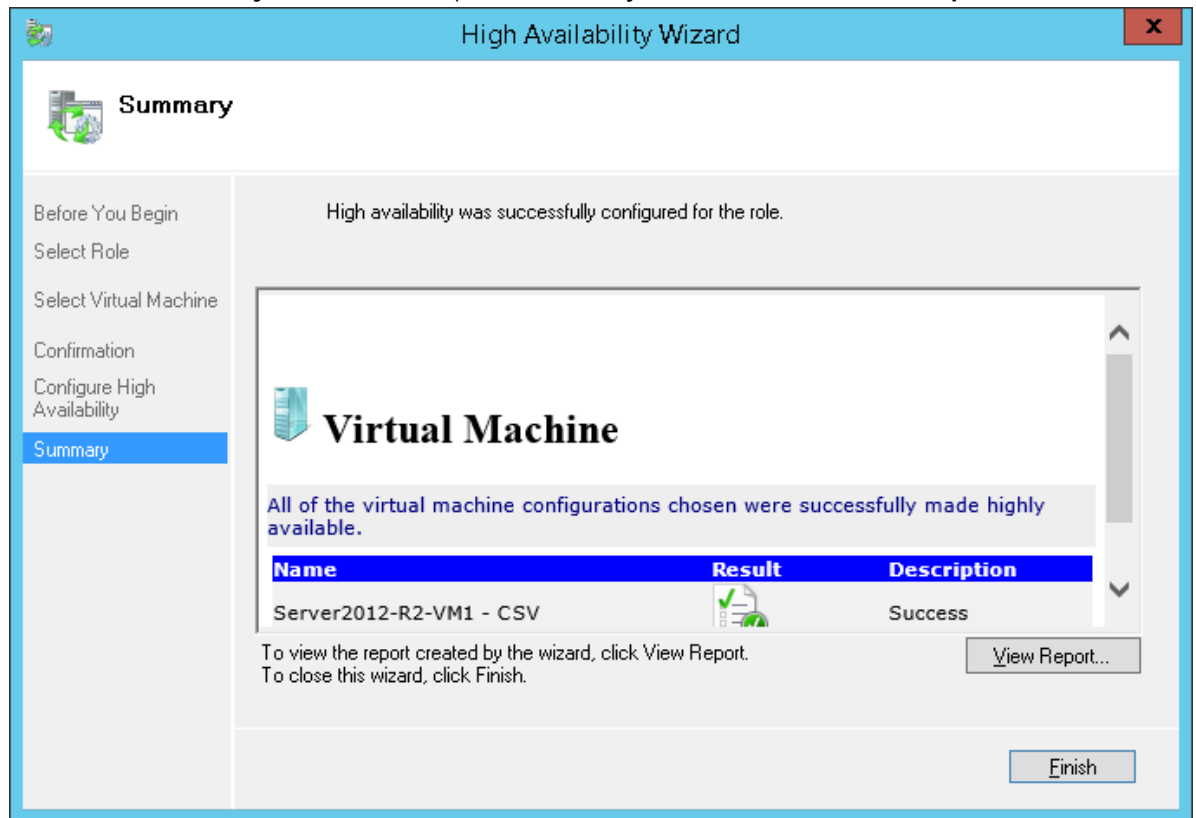
3. Click to select the existing virtual machines to configure for High Availability, and click **Next**.



4. To continue, click **Next**.

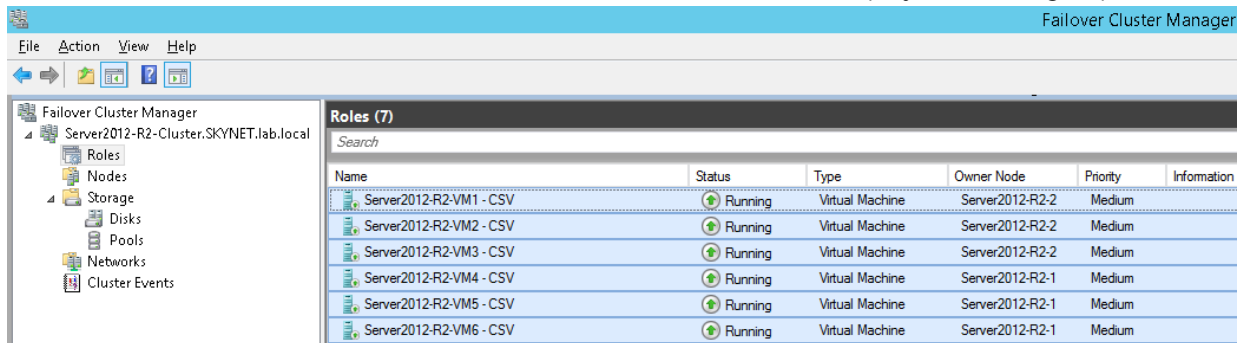


5. Review the **Summary**. To view the report created by the wizard, click **View Report** and click **Finish**.

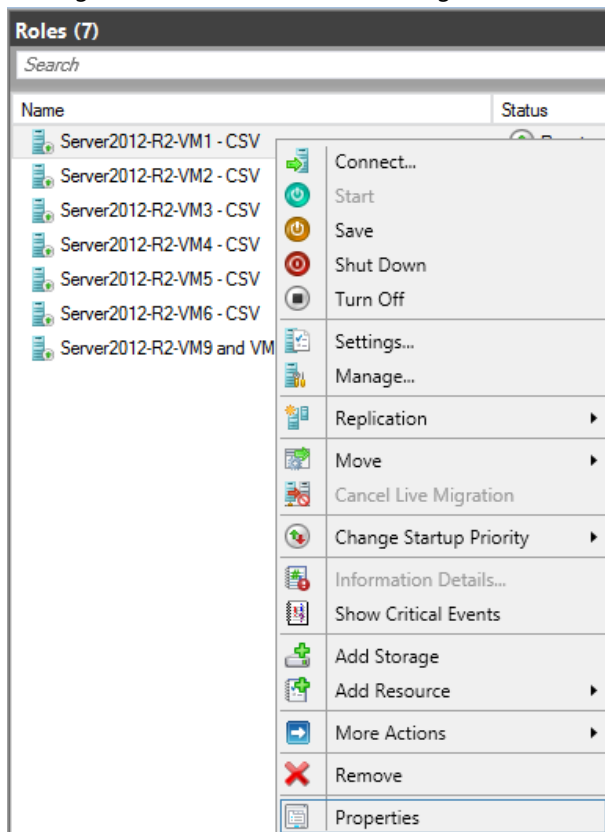


8.10.2 Managing virtual machine clustered roles

1. From the left pane of **Failover Cluster Manager**:
 - a. Click to expand the cluster.
 - b. Click to select **Roles**. Clustered virtual machine roles will be displayed in the right-pane.



2. Right-click on the clustered role to perform additional actions, including:
 - Connect to the virtual machine console
 - Start or Stop the virtual machine
 - Shutdown or Turn Off the virtual machine
 - Manage virtual machine Settings
 - Launch Hyper-V Manager
 - Enable Hyper-V Replication
 - Perform a Live Migration, Quick Migration or Storage Migration
 - **Live migration** – Move the virtual machine to another node without pausing
 - **Quick migration** - Pause the virtual machine, Move to another node, and start the virtual machine on the other node
 - **Storage migration** - Move only the virtual machine storage to another storage location
 - Change the Startup Priority
 - View Details
 - Show Critical Events
 - Add resources
 - Remove the clustered Role
 - Configure the Preferred Owners (cluster nodes) for the Role
 - Manage Failover and Failback settings



8.11 Protection and recovery of virtual machines

Dell EqualLogic Host Integration Tools for Microsoft enables application-consistent data protection and quick recovery of Hyper-V virtual machines. For additional information, refer to: [Managing and Protecting a Windows Server Hyper-V Environment using Dell EqualLogic PS Series Storage Arrays and Tools](#)

8.12 Guest clustering

Similar to a Failover cluster comprised of physical servers, virtual machines can be also be used to create a guest cluster for high availability of the workloads and roles running within the Guest Operating System.

There are multiple storage options for a guest cluster:

- **iSCSI:** From the Guest Operating System, Direct-attached iSCSI volumes are managed the same as if they were in a physical environment. Direct-attached disks are iSCSI volumes that are connected using an iSCSI initiator in the Guest Operating System. Direct-attached disks are not visible to the Hyper-V host and only accessible by the Guest Operating System running on the virtual machine. For additional information on creating an EqualLogic volume and making it available to Windows, refer to [Appendix A](#).
- **Shared VHD:** In Windows Server 2012 R2 and later, VHDs can be shared by multiple virtual machines. A Shared VHD can be used for clustering within the Guest Operating System. With Shared VHDs, guest clusters do not necessarily require direct access to the SAN, thus using Shared VHDs for guest clusters has an advantage over using direct-attached iSCSI volumes. The Shared VHD will not consume iSCSI sessions from the Guest Operating System. For additional information on deploying a guest cluster using a shared VHD, refer to: <http://technet.microsoft.com/library/dn265980.aspx>.
- **Virtual Fibre Channel:** Windows Server 2012 and later also include support for Direct-attached disks that use Virtual Fibre Channel, but this is unsupported for Dell EqualLogic iSCSI storage arrays.

For additional information on using Guest Clustering for High Availability, refer to: <http://technet.microsoft.com/en-us/library/dn440540.aspx>



8.13 Hyper-V Offloaded Data Transfer

Today's prevalence of server virtualization has resulted in increased demands for high-speed data transfers for storage and data migration. In the past, data transfers were traditionally performed through LAN networks. This legacy data transfer method burdened server capabilities and resulted in high utilization of server resources such as network, CPU and memory.

To maximize the full potential of intelligent storage arrays and high-speed SANs, Dell and other storage vendors collaborated with Microsoft to develop a new T10 Standard for SAN data transfers called Offloaded Data Transfers (ODX).

ODX provides the ability to automatically and quickly transfer large amounts of data, including virtual machines and file shares, directly between EqualLogic volumes without impacting valuable server performance. This reduces server resource usage such as CPU, memory and network by offloading the file transfers to a high-speed SAN.

ODX is a native feature of Windows Server 2012 and later and is on by default. Dell EqualLogic PS Series Firmware v6.0 and later includes support for ODX. ODX is supported on NTFS File systems.

Common Hyper-V storage operations involving large amounts of data, such as merging, moving, and compacting a VHD, use ODX and pass these operations to the Hyper-V host so that the workloads can take advantage of ODX as if they were running in a physical environment.

Note: VHDs attached to a virtual IDE controller do not support ODX.

For additional information on ODX with Dell EqualLogic and Hyper-V, refer to the following resources:

http://en.community.dell.com/techcenter/extras/m/white_papers/20437937.aspx

<http://technet.microsoft.com/en-us/library/hh831375.aspx>

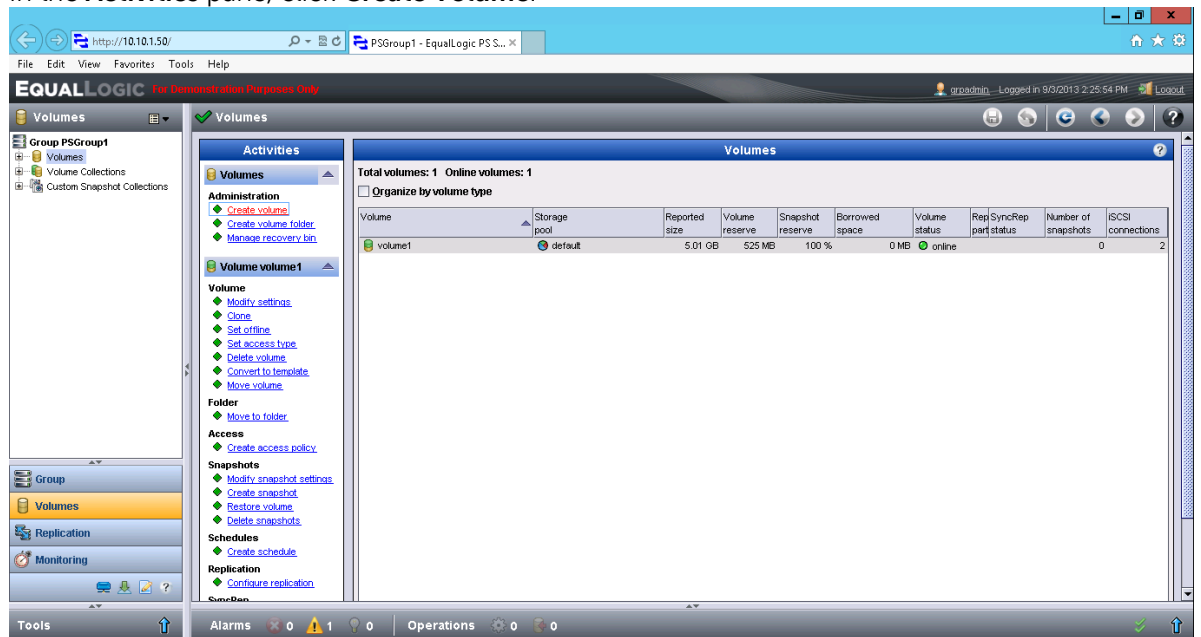


A Using Dell EqualLogic storage with Microsoft Windows

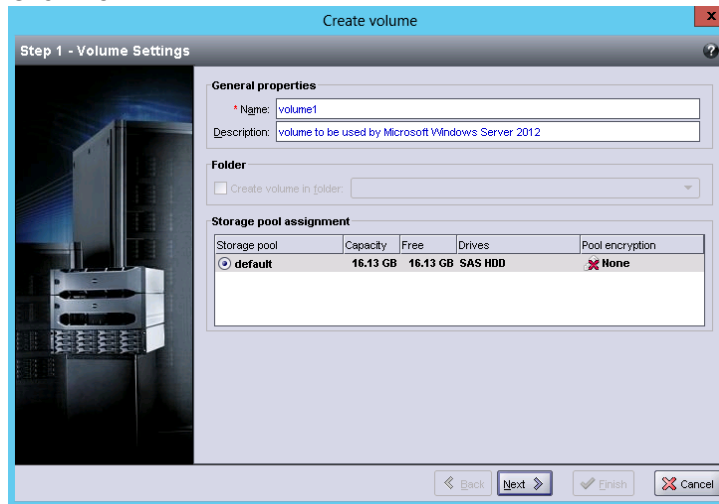
A.1 Creating a volume in an EqualLogic PS Series Group

Create volumes to access storage space in a pool, and modify volume size and attributes on-demand.

1. In the lower-left pane of the Group Manager GUI, click **Volumes**.
2. In the **Activities** pane, click **Create Volume**.



3. Specify General properties and Storage pool assignment.
 - a. Provide a **Name** and **Description** (optional) for the volume.
 - b. Select the storage pool to be used for the volume.
 - c. Click **Next**.



4. Specify Volume space and Snapshot space.
 - a. In the **Volume size** field, enter the desired volume size.
 - b. To optionally enable thin provisioning, click to select **Thin provisioned volume**. Use the sliders in the **Reported volume size** section to adjust settings. You can enable or disable thin provisioning on a volume at any time.
 - c. In the **Snapshot space** section, enter the desired percentage of the volume to be used for snapshots.
 - d. Click **Next**.

Volume space

* Volume size: 5 GB (max. 80.56 GB)

☒ Thin provisioned volume (use sliders below to adjust settings)

Snapshot space

Snapshot reserve (% of volume reserve): 100

Reported volume size 5.01 GB

Free 525 MB Unreserved 4.5 GB

Estimated changes in storage pool default

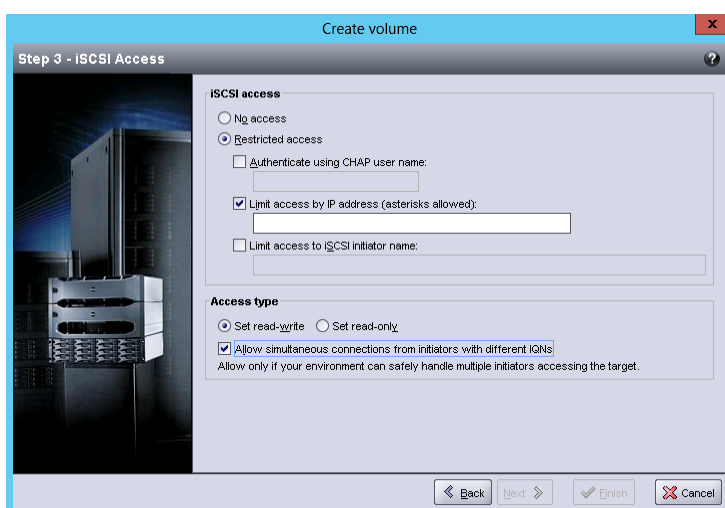
| Storage pool default | Current | New | Change |
|-------------------------|----------|----------|----------|
| Volume reserve | 0 MB | 525 MB | 525 MB |
| Snapshot reserve | 0 MB | 525 MB | 525 MB |
| Replication reserve | 0 MB | 0 MB | 0 MB |
| Delegated space | 0 MB | 0 MB | 0 MB |
| Free pool space | 16.13 GB | 15.1 GB | -1.03 GB |
| Available for borrowing | 16.13 GB | 15.62 GB | -525 MB |

Note: PS Series Groups use access control records to prevent unauthorized computer access to iSCSI targets (volumes or snapshots). To log in to a volume or snapshot, the server's iSCSI initiator must comply with conditions specified in the access control record. For additional information on access control records, refer to the *Dell EqualLogic Group Manager Administrator's Manual* at <http://eqsupport.dell.com>.

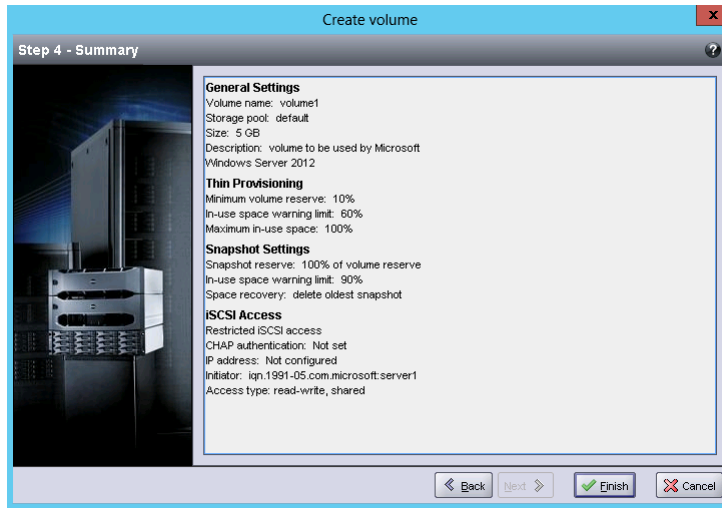
5. To enable multiple initiators to access the volume, as in a cluster configuration, optionally click to select **Allow simultaneous connections from initiators with different IQNs**.
6. Specify one or more of the following options and click **Next**.

Table 7 iSCSI access options

| Option | Description |
|--------------------------------------|---|
| Authenticate using CHAP user name | Restricts access to computers that supply the specified CHAP user name and its associated password (or "secret"). The credentials must match a local CHAP account or a CHAP account on an external RADIUS server. |
| Limit access by IP address | Restricts access to iSCSI initiators that match the specified IP address. |
| Limit access to iSCSI Initiator name | Restricts access to iSCSI initiators that match the specified name. |



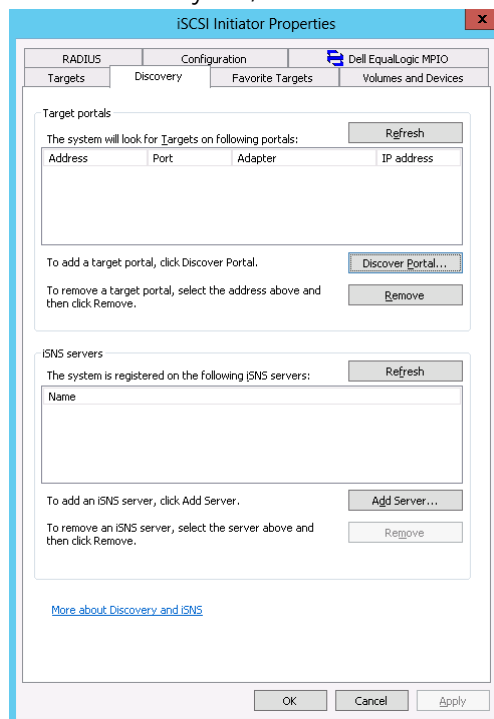
7. Review the summary, and click **Finish**.



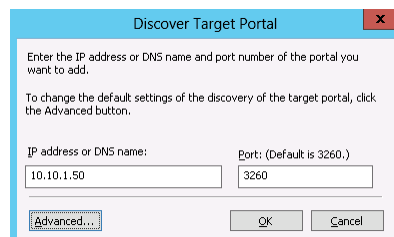
A.2 Connecting to an EqualLogic volume from Windows

The Microsoft iSCSI Initiator enables you to connect a Windows computer to EqualLogic iSCSI storage through the server's network adapters. Connecting to volumes with the Microsoft iSCSI Initiator will cause iSCSI SAN disks to appear as if they are locally attached to the server.

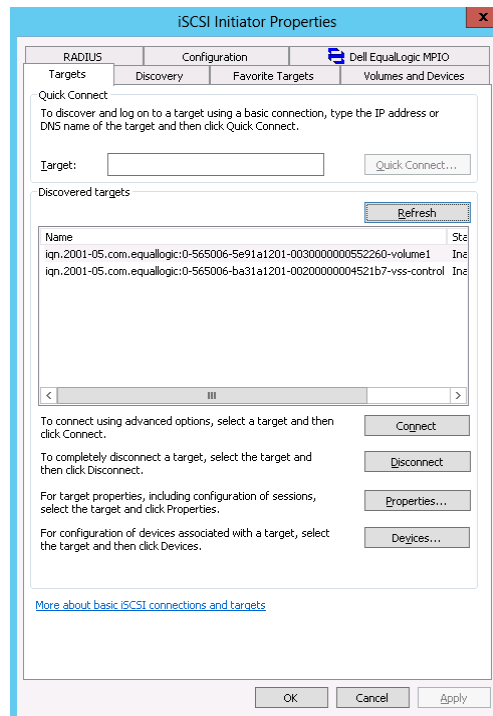
1. Launch iSCSI Initiator from Windows.
2. In the Discovery tab, click **Discover Portal**.



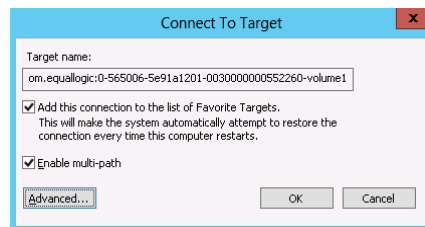
3. If required, specify the EqualLogic PS Series Group that you want to add.
 - a. In the IP address or DNS name field, enter the IP address or DNS name of the EqualLogic PS Series Group.
 - b. In the Port field, enter the network port number (Default is 3260).
 - c. To enable CHAP authentication, click **Advanced** and configure the required settings.
 - d. Click **OK**.



4. Discover all volumes that the server has access to.
 - a. Click the **Targets** tab, and then click **Refresh**. A list of discovered volumes is displayed.
 - b. Click to select the desired volume and click **Connect**.



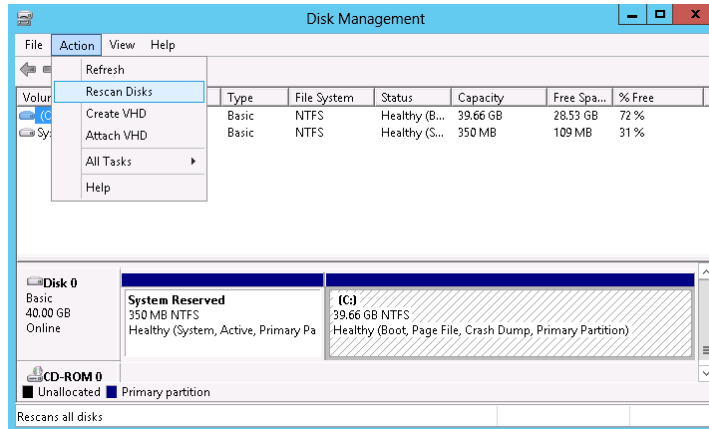
5. Connect to the Target.
 - a. To make the system automatically attempt to restore the connection to the volume upon reboot, click **Add this connection to the list of Favorite Targets**.
 - b. To enable multi-path, click **Enable multi-path**.
 - c. Click **OK**.



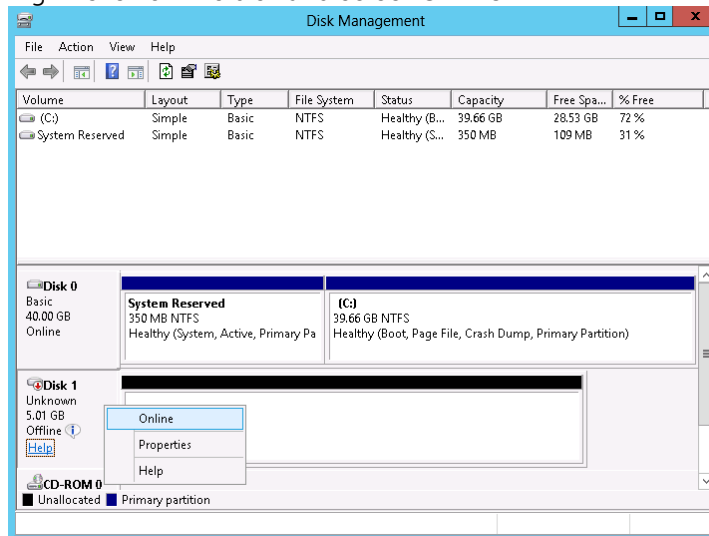
A.3 Making an EqualLogic volume available to Windows

After connecting to the iSCSI target, you can make the volume available to Windows so that it can be used to store data.

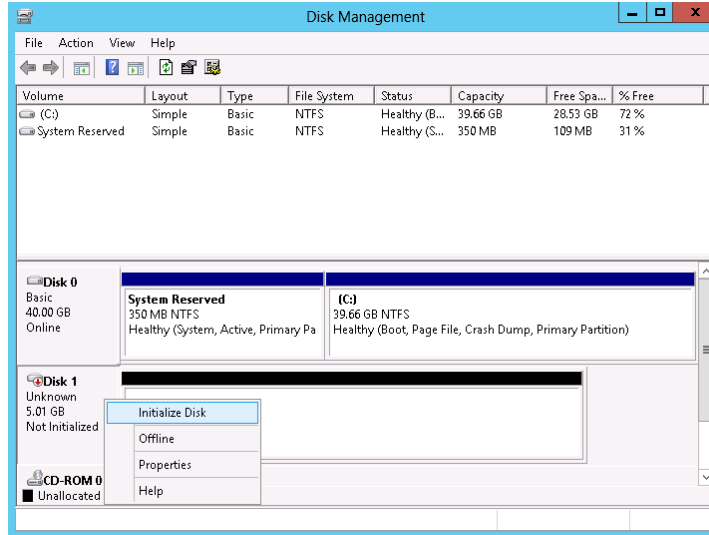
1. Launch the **Disk Management** Console in Windows Server 2012.
 - a. From the Action menu, select **Rescan disks**.



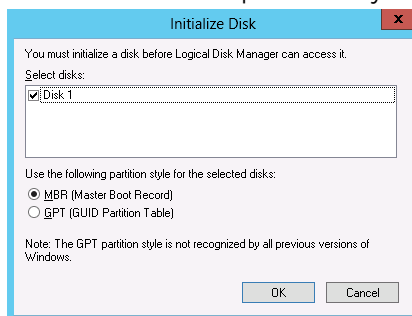
2. Bring the new disk online.
 - a. Right-click on the disk and select **Online**.



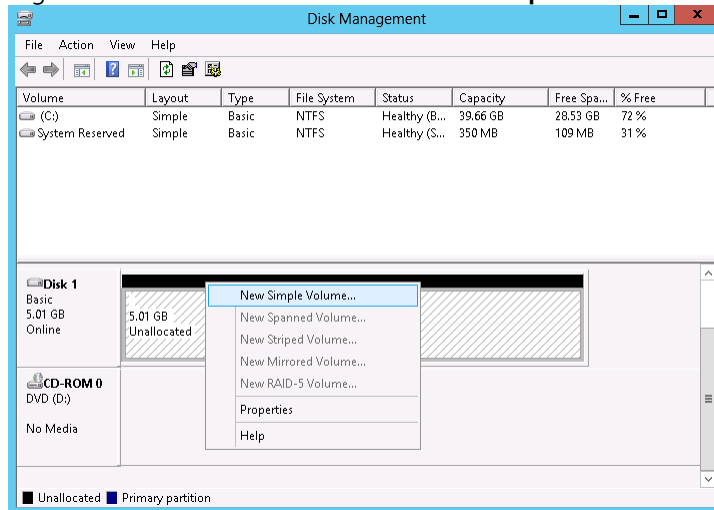
3. You must initialize a disk before Disk Manager can access it.
 - a. Right-click on the disk and select **Initialize Disk**.



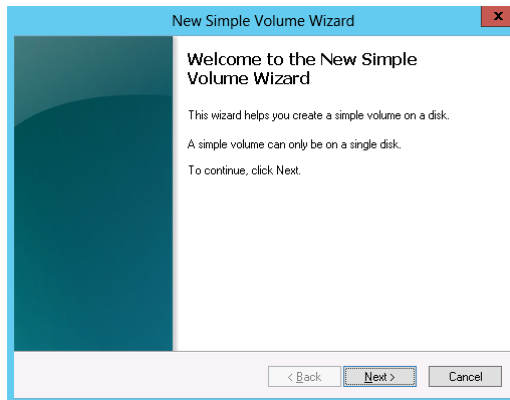
4. Select the disk and partition style and click **OK**.



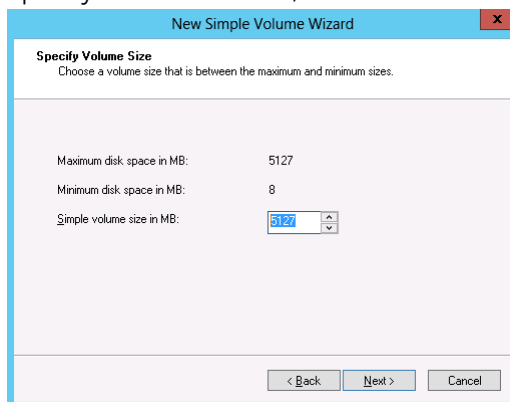
5. Create a Simple Volume on the disk.
 - b. Right-click on the disk and select **New Simple Volume**.



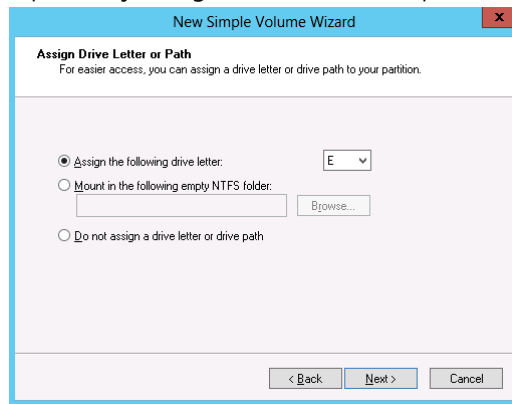
6. Click **Next**.



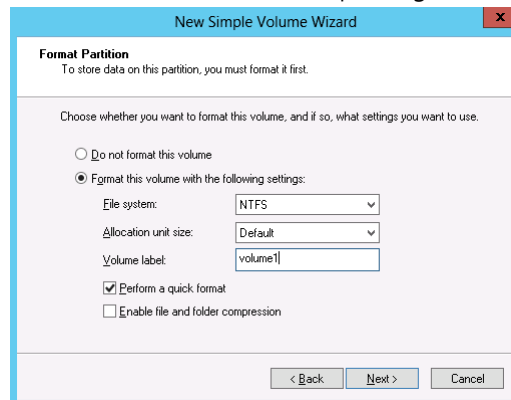
7. Specify the volume size, and click **Next**.



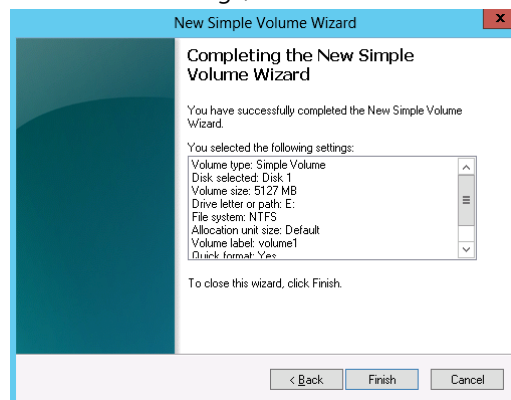
8. Optionally, assign a drive letter or path and click **Next**.



9. Format the partition by specifying **File system**, **Allocation unit size** and **Volume label** and click **Next**.
- a. For identification purposes, it recommended to specify a volume label that matches the volume name in the Dell EqualLogic Group.



10. The volume is now available to Windows and is ready to store data.
- a. Review the settings, and click **Finish**.



B Additional resources

Web resources

- [Dell EqualLogic Support Site](#) – Download Dell EqualLogic software and documentation
- [Dell EqualLogic Technical Content](#) - A collection of all EqualLogic technical content
- [Dell Storage Online Publications](#) - Storage solution best practices for enterprise application and data center environments.

Technical documents

- [Using Dell EqualLogic Storage with Microsoft Windows Server 2012](#)
- [Hyper-V Technology Overview](#)
- [Managing and Protecting a Windows Server Hyper-V Environment using Dell EqualLogic PS Series Storage Arrays and Tools](#)
- [Setup and Configuration of a Windows Server Core Hyper-V Host Using PowerShell and Dell EqualLogic Storage and Tools](#)
- [Deploying a dedicated Hyper-V management guest using PowerShell and Dell EqualLogic storage and tools](#)
- [Automation and Integration with MS System Center Virtual Machine Manager 2012 SP1 and Dell EqualLogic Storage](#)
- [Deploying and Configuring the Dell EqualLogic Multipath Device Specific Module with Microsoft Windows](#)

