Module 9

Implementing failover clustering with Windows Server 2016 Hyper-V

Module Overview

- Overview of the integration of Hyper-V Server 2016 with failover clustering
- Implementing Hyper-V VMs on failover clusters
- Key features for VMs in a clustered environment

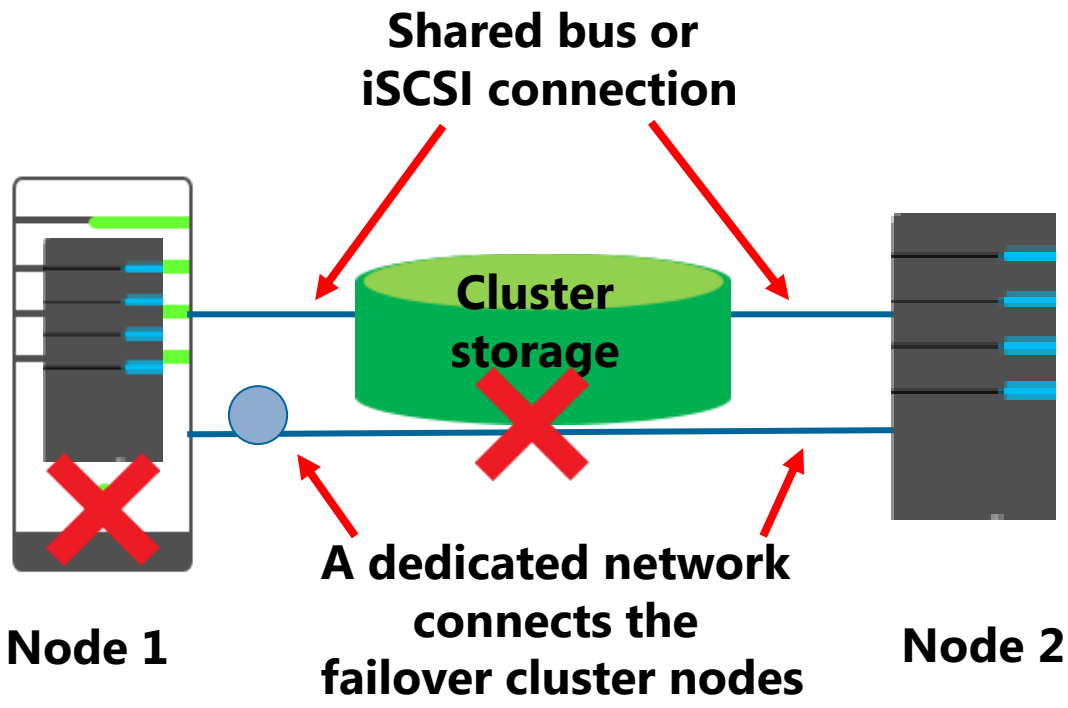
Lesson 1: Overview of the integration of Hyper-V Server 2016 with failover clustering

- Options for making application and services highly available
- How does a failover cluster work with Hyper-V nodes?
- Failover clustering with Windows Server 2016 Hyper-V features
- Best practices for implementing high availability in a virtual environment

Options for making application and services highly available

High availability options	Description
Host clustering	• VMs are highly available • Does not require VM operating system or application to be cluster-aware
Guest clustering	• VM are failover cluster nodes • VM applications must be cluster-aware • Requires iSCSI or virtual Fibre Channel interface for shared storage connections
NLB	• VM are NLB cluster nodes • Use for web-based applications

How does a failover cluster work with Hyper-V nodes?



Failover clustering with Windows Server 2016 Hyper-V features

Failover clustering with Windows 2016 Hyper-V features:

- Maximum nodes and VM support
  - Up to 64 nodes and 8,000 VMs per cluster
  - 1024 VMs per node
- File share storage:
  - Windows Server 2012 introduced the possibility of storing VMs on SMB file shares in a file server cluster.
  - To enable this feature, deploy a file server cluster role and select **Scale-Out File Server** for application data.
  - .vhdx (Windows 2012 R2 and Windows 2016 only)
  - .vhds (Windows Server 2016 only)

Failover clustering with Windows Server 2016 Hyper-V features

Failover clustering with Windows 2016 Hyper-V features:

- Shared virtual disk
  - Windows Server 2012 R2 introduced the ability to use a .vhdx as a **shared virtual disk** for guest clusters.
  - Windows Server 2016 introduced improved features to the shared disks and introduced a new disk format, .vhds (VHD Set)
- Rolling Hyper-V cluster upgrades
  - In Windows Server 2016, you can upgrade the nodes one at a time when upgrading from Windows Server 2012 R2. After upgrading all nodes in a Hyper-V cluster, you can upgrade the functional level of the entire cluster.
- VM configuration version
  - You can now manually update the VM configuration version.

Best practices for implementing high availability in a virtual environment

Best practices for implementing high availability in a virtual environment:

- Plan for failover scenarios
- Plan the network design for failover clustering
- Plan the shared storage for failover clustering
- Use the default failover cluster quorum mode
- Deploy standardized Hyper-V hosts
- Develop standard management practices

Lesson 2: Implementing Hyper-V VMs on failover clusters

- Components of Hyper-V clusters
- Prerequisites for implementing Hyper-V failover clusters
- Implementing Hyper-V VMs on a failover cluster
- Configuring CSVs
- Configuring a shared virtual hard disk
- Implementing Scale-Out File Servers for VMs
- Considerations for implementing Hyper-V clusters
- Maintaining and monitoring VMs in clusters
- Demonstration: Implementing failover clustering with Hyper-V

Components of Hyper-V clusters

Hyper-V cluster components include:

- Cluster nodes
- Cluster networks
- Virtual networks
- Storage for VMs
- VMs

Prerequisites for implementing Hyper-V failover clusters

- Hardware requirements for cluster nodes and storage include:
  - Server hardware
  - Network adapters
  - Storage adapters
  - Storage
- Software recommendations for cluster nodes include:
  - Running Windows Server 2016 Standard, Datacenter, or Hyper-V Server 2016 editions
  - Require the same software updates and service packs
  - Must be either a full installation or a Server Core installation
- Network infrastructure requirements include:
  - Network settings and IP addresses
  - Private networks
  - DNS
  - Domain role
  - Account for administering the cluster

Implementing Hyper-V VMs on a failover cluster

To implement a Hyper-V VM on a failover cluster:

1. Install and configure Windows Server 2016
2. Configure shared storage
3. Install the Hyper-V and Failover Clustering features
4. Validate the cluster configuration
5. Create the cluster
6. Create a VM on one of the cluster nodes
7. Make the VM highly available (for an existing VM)
8. Test the VM failover

Configuring CSVs

- CSVs in a Windows 2016 failover cluster allow multiple nodes in the cluster to have read-write access simultaneously to the same disk that you provision as an NTFS volume, and Windows 2016 failover cluster adds them as storage to the cluster.
- When you use CSVs, clustered roles can fail over from one node to another more quickly, and without requiring a change in drive ownership or dismounting and remounting a volume.
- Windows Server 2016 does not restrict CSVs to specific clustered workloads, but it only supports them for Hyper-V clusters and Scale-Out File Server clusters.
- When you implement a CSV, all added storage displays in the **\ClusterStorage** folder.
  - The **\ClusterStorage** folder is created on the cluster node's system folder, and you cannot move it.
  - This means that all Hyper-V hosts that are members of the cluster must use the same drive letter as their system drive, or VM failovers fail.

Configuring CSVs

- CSV benefits:
  - Fewer LUNs required
  - Better use of disk space
  - Virtual machine files are in a single logical location
  - No special hardware required
  - Increased resiliency
- To implement CSV:
  1. Create and format volumes on shared storage
  2. Add the disks to failover cluster storage
  3. Add the storage to the CSV

Configuring a shared virtual hard disk

- Failover cluster runs inside VMs: Guest Clustering
  - It is possible to share a virtual hard disk (in .vhdx or .vhds format only) between two or more VMs, and then use that virtual hard disk as a shared storage when building guest clusters. You can use the shared virtual hard disk as a witness disk or as a data disk in a cluster
- Shared virtual disk used as a shared storage:
  - VMs do not need access to iSCSI or failover clustering SAN
  - Presented as a virtual serial-attached SCSI disk
  - Can be used only for data
- Requirements for shared virtual hard disk:
  - Must be in .vhdx or .vhds format
  - Connected by using virtual SCSI adapter
  - Stored on a Scale-Out File Server or CSV
- Windows Server 2012 or later is the supported operating system in VM

Implementing Scale-Out File Servers for VMs

- In Windows Server 2016, you can store VM files on a SMB 3.0 file share
- File servers need to run Windows 2012 or later
- A file server cluster needs to be configured as a Scale-Out File Server for application data
  - **An ordinary file server cluster** serves the clients only by using one node at a time.
  - However, a Scale-Out File Server can engage all nodes simultaneously.
  - A Scale-Out File Server provides continuously available storage for file-based server applications.
  - It is now possible to store resources such as databases or VM hard disks on the folder shares hosted on the Scale-Out File Server.
- Use Hyper-V Manager to create or move VM files to a SMB file share

Implementing Scale-Out File Servers for VMs

- The key benefits of using a Scale-Out File Server are:
  - Active-active clustering
    - When all other failover clusters work in an active-passive mode, a Scale-Out File Server cluster works in a way that all nodes can accept and serve SMB client requests.
  - Increased bandwidth
    - Because of the active-active mode in the Scale-Out File Server cluster, you can have much higher bandwidth, which you can additionally increase by adding cluster nodes.

Implementing Scale-Out File Servers for VMs

- The key benefits of using a Scale-Out File Server are:
  - CSV Cache
    - Because the Scale-Out File Server clusters use CSVs, they also benefit from the use of the CSV Cache.
    - The CSV Cache is a feature that you can use to allocate system memory (RAM) as a writethrough cache.
    - The CSV Cache provides caching of read-only unbuffered I/O. This can improve performance for applications such as Hyper-V, which conducts unbuffered I/O when accessing a .vhd file.
    - With Windows Server 2012, you can allocate up to 20 percent of the total physical RAM for CSV write-through cache, and 80 percent with Windows Server 2012 R2 and Windows Server 2016.
    - The total physical RAM that a CSV write-through cache consumes is from nonpaged pool memory.

Considerations for implementing Hyper-V clusters

- Identify the following recommended failover clustering requirements:
  - Applications that require high availability
  - Application components that must be highly available
  - Application characteristics
  - Total capacity requirements
- Windows Server 2016 Hyper-V Live Migration considerations:
  - Verify basic requirements
  - Configure a dedicated network adapter or virtual network adapter
  - Use similar host hardware
  - Verify network configuration

Maintaining and monitoring VMs in clusters

In Windows Server 2016 failover clustering, you can implement the following technologies for VM maintenance and monitoring:

- Service and VM health monitoring
- Network health detection (Windows Server 2012 R2 and later only)
- Virtual machine drain on shutdown (Windows Server 2012 R2 and later only)

Demonstration: Implementing failover clustering with Hyper-V

In this demonstration, you will see how to:

- Move VM storage to the iSCSI target
- Configure the VM as highly available

Lesson 3: Key features for VMs in a clustered environment

- Overview of Network Health Protection
- Overview of actions taken on VMs when a host shuts down
- Overview of drain on shutdown
- Demonstration: Configure drain on shutdown

Overview of Network Health Protection

- Introduced in Windows Server 2012 R2 and available in Windows Server 2016
- Cluster resource checks availability of VM resources
- Network Health Protection controlled individually on each virtual network adapter

Overview of actions taken on VMs when a host shuts down

Automatic Stop Action options:

- Save the virtual machine state
- Turn off the virtual machine
- Shutdown the guest operating system

Overview of drain on shutdown

- A failover cluster node placed in a paused state uses live migration on VMs, removing downtime
- At shutdown a failover cluster node prior to Windows Server 2012 R2 uses quick migration, creating some downtime
- At shutdown a failover cluster node after Windows Server 2012 R2 uses live migration, removing downtime

Demonstration: Configure drain on shutdown

In this demonstration you will see how to:

- Live migrate a VM
- Configure drain on shutdown