

# **MCSA 70-740 Cert Guide: Installation, Storage, and Compute with Windows Server 2016**

Anthony Sequeira

**PEARSON**

800 East 96th Street  
Indianapolis, Indiana 46240 USA

## **MCSA 70-740 Cert Guide: Installation, Storage, and Compute with Windows Server 2016**

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## About the Author

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## Dedication

*This book is dedicated to all my fellow employees at CBT Nuggets. Thank you for your tireless efforts in enriching the lives of students all over the world.*

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## About the Technical Reviewer

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As the reader of this book, you are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

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# Introduction

Congratulations! If you are reading this, you have in your possession a powerful tool that can help you do the following:

- Install Windows Servers in host and compute environments
- Implement storage solutions
- Implement Hyper-V
- Implement Windows containers
- Implement high availability
- Maintain and monitor server environments
- Prepare for the Exam 70-740 Installation, Storage, and Compute with Windows Server 2016 certification exam from Microsoft

Whether you are preparing for the MCSA or MCSE certifications from Microsoft or changing careers to server administration, this book will help you gain the knowledge to get started and prepared.

This text covers every single objective the 70-740 exam has to offer and also provides the step-by-step guidance you need in production server environments.

The Exam 70-740 Installation, Storage, and Compute with Windows Server 2016 exam is required for the MCSA and MCSE certifications from Microsoft. This book covers all the topics listed in Microsoft's exam blueprint, and each chapter includes key topics and preparation tasks to assist you in mastering this information. Reviewing tables and practicing test questions will help you practice your knowledge in all subject areas.

## About the 70-740 Installation, Storage, and Compute with Windows Server 2016 Exam

This exam focuses primarily on the installation, storage, and compute features and functionality available in Windows Server 2016. It covers general installation tasks and considerations and the installation and configuration of Nano Server, in addition to the creation and management of images for deployment. It also covers local and server storage solutions, including the configuration of disks and volumes, data deduplication, high availability, disaster recovery, Storage Spaces Direct, and Failover Clustering solutions. The exam also covers Hyper-V and containers, along with the maintenance and monitoring of servers in physical and compute environments. For a complete review of the exam structure and types of questions you will face, visit [www.ajsnetworking.com/70-740-review](http://www.ajsnetworking.com/70-740-review).

You can take the exam at Pearson VUE testing centers. Register with VUE at [www.vue.com](http://www.vue.com).

## 70-740 Exam Topics

Table I-1 lists the topics of the 70-740 exam and indicates the chapter in the book where each is covered.

**Table I-1** 70-740 Exam Topics

<b>Exam Topic</b>	<b>Chapter</b>
<b>Install Windows Servers in host and compute environments</b>	
Install, upgrade, and migrate servers and workloads	Chapter 1
Install and configure Nano Server	Chapter 2
Create, manage, and maintain images for deployment	Chapter 3
<b>Implement storage solutions</b>	
Configure disks and volumes	Chapter 4
Implement server storage	Chapter 5
Implement data deduplication	Chapter 6
<b>Implement Hyper-V</b>	
Install and configure Hyper-V	Chapter 7
Configure virtual machine (VM) settings	Chapter 8
Configure Hyper-V storage	Chapter 9
Configure Hyper-V networking	Chapter 10
<b>Implement Windows Containers</b>	
Deploy Windows containers	Chapter 11
Manage Windows containers	Chapter 12
<b>Implement High Availability</b>	
Implement high availability and disaster recovery options in Hyper-V	Chapter 13
Implement failover clustering	Chapter 14
Manage failover clustering	Chapter 15
Implement Storage Spaces Direct	Chapter 16
Manage VM movement in clustered nodes	Chapter 17
Implement Network Load Balancing (NLB)	Chapter 18
<b>Maintain and Monitor Server Environments</b>	
Maintain server installations	Chapter 19
Monitor server installations	Chapter 20

## About the MCSA 70-740 Cert Guide

This book maps to the topic areas of the 70-740 exam and uses a number of features to help you understand the topics and prepare for the exam.

## Objectives and Methods

This book uses several key methodologies to help you discover for which exam topics you need more review, to help you fully understand and remember those details, and to help you prove to yourself that you have retained your knowledge of those topics. This book does not try to help you pass the exams only by memorization but by truly learning and understanding the topics. This book is designed to help you pass the 70-740 exam by using the following methods:

- Helping you discover which exam topics you have not yet mastered
- Providing explanations and information to fill in your knowledge gaps
- Supplying exercises that enhance your ability to recall and deduce the answers to test questions
- Providing practice exercises on the topics and the testing process via test questions on the companion website

## Book Features

To help you customize your study time using this book, the core chapters have several features that help you make the best use of your time:

- **“Do I Know This Already?” quiz:** Each chapter begins with a quiz that helps you determine how much time you need to spend studying that chapter.
- **Foundation Topics:** These are the core sections of each chapter. They explain the concepts for the topics in that chapter.
- **Exam Preparation Tasks:** After the “Foundation Topics” section of each chapter, the “Exam Preparation Tasks” section lists a series of study activities that you should do at the end of the chapter. Each chapter includes the activities that make the most sense for studying the topics in that chapter:
  - **Review All the Key Topics:** The Key Topic icon appears next to the most important items in the “Foundation Topics” section of the chapter. The Review All the Key Topics activity lists the key topics from the chapter, along with their page numbers. Although the contents of the entire chapter could be on the exam, you should definitely know the information listed in each key topic, so you should be sure to review these.

- **Complete the Tables and Lists from Memory:** To help you memorize some lists of facts, many of the most important lists and tables from the chapter are included in a document on the companion website. This document lists only partial information, allowing you to complete the table or list.
- **Define Key Terms:** Although the exam may be unlikely to ask a question such as “How do you define the term x?” the 70-740 exam does require that you learn and know a lot of networking terminology. This section lists the most important terms from the chapter, asking you to write a short definition and compare your answer against the glossary at the end of the book.
- **Q&A:** This section helps you confirm that you understand the content that you just covered.
- **Web-based practice exam:** The companion website includes the Pearson Test Prep practice test software, which allows you to take practice exam questions. Use them to prepare with a sample exam and to pinpoint topics for which you need more study.

## How This Book Is Organized

This book contains 20 core chapters:

- **Chapter 1, “Installing, Upgrading, and Migrating,”** covers installation requirements and methods as well as upgrade scenarios and migration approaches.
- **Chapter 2, “Installing and Configuring Nano,”** covers how to determine appropriate usage scenarios and requirements for Nano Server as well as how to install Nano Server, including the implementation of roles and features on Nano Server. The chapter also covers the management and configuration of Nano Server, including the use of Windows PowerShell.
- **Chapter 3, “Working with Images,”** covers the important planning and implementation steps involved in virtualization.
- **Chapter 4, “Disks and Volumes,”** covers basic and advanced disk and volume creation and management, including the use of NFS and SMB shares for a network.
- **Chapter 5, “Server Storage,”** covers more advanced storage topics such as storage pools and Storage Area Network (SAN)-related topics.
- **Chapter 6, “Data Deduplication,”** covers implementation of data deduplication.
- **Chapter 7, “Installing Hyper-V,”** covers requirements for Hyper-V as well as its implementation and management.
- **Chapter 8, “Working with Virtual Machines,”** covers advanced topics in VM creation and management.

- **Chapter 9, “Hyper-V Storage,”** covers the ins and outs of VHDs and VHDX files.
- **Chapter 10, “Hyper-V Networking,”** covers networking concepts from virtual NICs to RDMA.
- **Chapter 11, “Deploying Containers,”** covers container basics and their creation.
- **Chapter 12, “Managing Containers,”** covers container management, including the use of Docker in the Windows Server 2016 environment.
- **Chapter 13, “High Availability in Hyper-V,”** covers important high-availability topics such as Hyper-V Replica, live migration, and shared-nothing live migration.
- **Chapter 14, “Failover Clustering,”** covers the creation of various Failover Clustering models that are possible in Windows Server 2016.
- **Chapter 15, “Managing Failover Clustering,”** moves deeper into the subject of failover cluster management, including advanced topics such as VM monitoring and node fairness.
- **Chapter 16, “Storage Spaces Direct,”** includes a discussion of deployment scenarios and step-by-step instructions for implementation.
- **Chapter 17, “Managing VM Movement,”** includes features such as Live Migration; Quick Migration; Storage Migration; importing, exporting, and copying; and VM Network Health Protection, and Drain on Shutdown.
- **Chapter 18, “Network Load Balancing (NLB),”** details NLB design and implementation and provides step-by-step instructions and management guidelines.
- **Chapter 19, “Maintaining Servers,”** covers WSUS and Windows Defender.
- **Chapter 20, “Monitoring Servers,”** focuses on properly monitoring a server using Resource Monitor and Performance Monitor.

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**This chapter covers the following subjects:**

- **Storage Spaces:** Windows Server 2016 makes it simple to combine multiple physical disks into whatever logical storage scheme you might need. The industry term for this is storage virtualization. Of course, this section details this technology for you.
- **Storage Area Networks:** Windows Server 2016 can integrate very well with Fibre Channel and related Storage Area Network (SAN) technologies. This part of the chapter covers topics like the creation of iSCSI targets and initiators as well as advanced topics like DCB and MPIO.
- **Storage Replica:** A great new feature of Windows Server 2016 is the replication of data between storage locations. This section describes the various options available, and when they are right for your design.

# Server Storage

Microsoft offers many rich storage features in Windows Server 2016. This chapter covers some of the most important ones, including Storage Spaces, Storage Area Network (SAN) features, and Storage Replica capabilities.

## “Do I Know This Already?” Quiz

The “Do I Know This Already?” quiz allows you to assess whether you should read the entire chapter. Table 5-1 lists the major headings in this chapter and the “Do I Know This Already?” quiz questions covering the material in those headings so you can assess your knowledge of these specific areas. The answers to the “Do I Know This Already?” quiz appear in Appendix A, “Answers to the ‘Do I Know This Already?’ Quizzes and Q&A Questions.”

**Table 5-1** “Do I Know This Already?” Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions
Storage Spaces	1, 2
Storage Area Networks	3, 4
Storage Replica	5, 6

**CAUTION** The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark your answer as incorrect for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. What Storage Spaces layout choice is similar to RAID 5?
  - a. Simple
  - b. Three-way mirror
  - c. Parity
  - d. Two-way mirror
2. How many disks are needed for three-way mirroring?
  - a. Two
  - b. Three
  - c. Four
  - d. Five
3. What SAN technology is critical for lossless connectivity in a converged network?
  - a. iSNS
  - b. DCB
  - c. MPIO
  - d. MCS
4. What SAN technology is critical for resiliency for the connectivity of iSCSI targets?
  - a. DCB
  - b. iSNS
  - c. MPIO
  - d. FC
5. In what scenarios could Storage Replica be critical? Choose two.
  - a. File Server
  - b. SYSVOL
  - c. SQL Server
  - d. Microsoft Exchange
6. What PowerShell cmdlet do you use to configure Storage Replica?
  - a. **New-Replica**
  - b. **New-SRPartnership**
  - c. **New-SReplica**
  - d. **New-SReplicaPeer**

## Foundation Topics

### Storage Spaces

Storage Spaces offers a nice alternative to a potentially expensive and complex Storage Area Network (SAN). Storage Spaces allows you to use multiple physical disks attached to a Windows Server 2016 system and present them to users in a flexible manner. For example, you can pool together physical disks with Storage Spaces and present them to users as one large logical disk.

**NOTE** The Datacenter Edition of Windows Server 2016 offers a new feature called Storage Spaces Direct. This feature can use local, unshared storage to create highly available storage for hosting virtual machine files. Chapter 16, “Storage Spaces Direct,” discusses this feature.

### Configuring Storage Pools and Storage Spaces

Storage Spaces storage virtualization technology in Windows Server 2016 consists of two components:

- **Storage Pools:** A collection of physical disks presented as logical disks (for example, one large logical disk).
- **Storage Spaces:** Virtual disks created from free space in a Storage Pool. These virtual disks are like LUNs (logical unit numbers) in a Storage Area Network (SAN) environment.

Storage management is extremely flexible and offers many options, including the following:

- The Windows Storage Management API (Application Programming Interface) in Windows Management Instrumentation (WMI)
- PowerShell
- The File and Storage Services role in Server Manager

You can format your Storage Spaces virtual disk as either of the following:

- NTFS
- ReFS

Remember, as discussed in Chapter 4, “Disks and Volumes,” that various needs often dictate your choice of formatting. For example, data deduplication needs NTFS as the file system technology.

To configure Storage Spaces, you need to consider the following:

- **Disk-sector size:** If you can use only 512 and/or 512e drives, your pool defaults to 512e; remember that the 512e disks use 4096-byte sectors that emulate 512-byte sectors. If there is one or more 4K drives, the pool defaults to 4K. You can define the sector size for Storage Spaces, but remember that it forces you into the type of disks that you can add.
- **Drive allocation:** This dictates how a pool distributes drives; options include automatic by the OS (the default), manual, or hot spare.
- **Provisioning scheme:** Options are thin provisioned or fixed provisioning space.

### Implementing Simple, Mirror, and Parity Storage Layout Options for Disks or Enclosures

#### Key Topic

Storage layout is obviously a critical choice for Storage Spaces. Valid options include the following:

- **Simple:** Simple features striping but no parity for resiliency; remember that striping means segments of data are written across multiple physical disks. Why would you choose Simple? The answer lies in performance improvements.
- **Two-way and three-way mirrors:** These spaces support two- or three-way copies of the data they host; note that mirror spaces also stripe data across multiple physical disks.
- **Parity:** This Storage Spaces technology is like RAID 5: Data is striped, along with parity information, across multiple physical drives; the parity information permits resiliency.

**NOTE** You can use Storage Spaces with Failover Clustering, as described in Chapter 14, “Failover Clustering.”

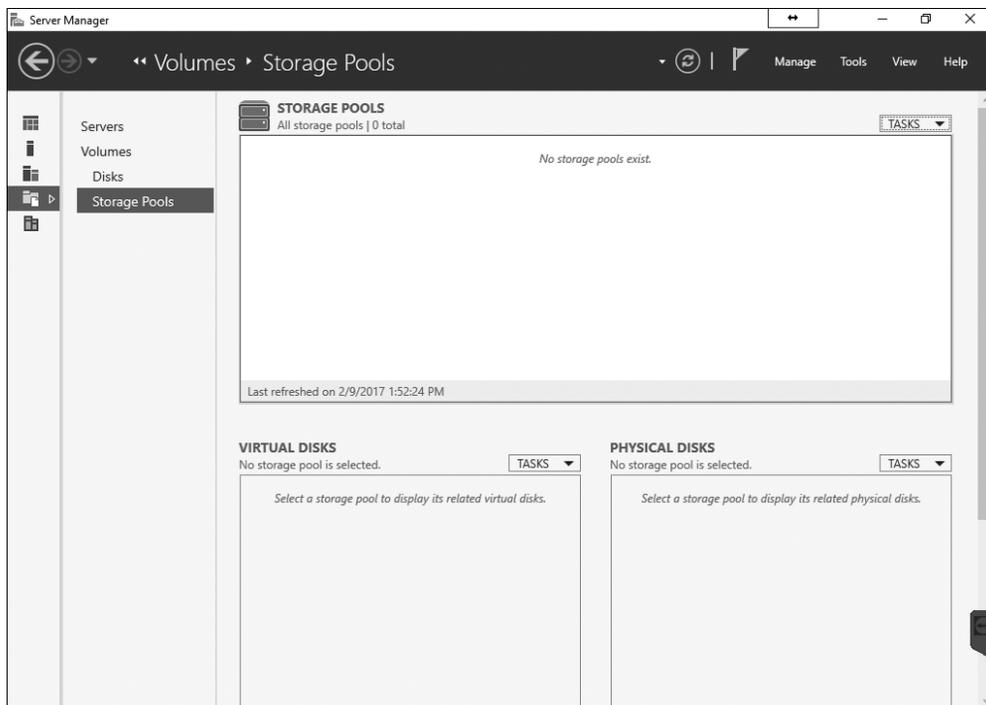
It is critical to remember these rules regarding the physical disks of your Storage Spaces configuration:

- To create a storage pool, you need at least one physical disk.
- If you want to create a resilient mirror virtual disk, you need a minimum of two physical disks.

- To create a resilient virtual disk with parity, you need a minimum of three physical disks.
- For three-way mirroring resiliency, you need at least five physical disks.
- Your disks must be blank and unformatted, with no volumes on any disk.
- Failover Clustering cannot use SATA, USB, or SCSI disks.

Follow these steps to configure the Storage Spaces functionality in various configurations:

- Step 1.** In Server Manager, select **File and Storage Services** and then **Storage Pools**, as shown in Figure 5-1.



**Figure 5-1** Configuring a New Storage Pool

- Step 2.** Create a new Storage Pool by using the Tasks drop-down menu.
- Step 3.** Provide values for **Storage Pool Name** and **Available Disk Group**, and choose **Physical Disks** for the pool.

**Step 4.** Create a new virtual disk and specify the following values:

- Storage Pool
- Virtual Disk Name
- Enclosure Awareness
- Storage Layout
- Resiliency Settings
- Provisioning Type
- Size of the Virtual Disk

**Step 5.** When the virtual disk is created, select **Create a volume when this wizard closes**.

**Step 6.** In the **New Volume Wizard**, complete the following:

- Virtual Disk
- Volume Size
- Drive Letter
- File System
- Volume Label

## Expanding Storage Pools



Expanding a Storage Pool is simple. Follow these steps:

**Step 1.** Add a new virtual disk by navigating to **iSCSI** in Server Manager.

**Step 2.** Create a new iSCSI virtual disk by specifying the following values:

- Storage location
- Disk name
- Size
- iSCSI target

**Step 3.** In Server Manager, click the **Refresh** button and wait for all the panes to refresh.

**Step 4.** In the **STORAGE POOLS** pane, right-click your **Storage Pool** and then add the new physical disk to the Storage Pool.

**Step 5.** In the **VIRTUAL DISKS** pane, right-click **Mirrored vDisk** and then extend your virtual disk to the desired size.

## Configuring Tiered Storage

Tiered Storage Spaces is an exciting feature in Windows Server 2016. It allows you to mix the types of disks you use in a Storage Space and use them efficiently. For example, you might use slow, large mechanical disks in conjunction with small, fast SSD (solid state drive) disks. Windows Server can dynamically move data based on the frequency of access.

When you add HDDs and SSDs to a Storage Space, Windows Server 2016 registers each type of disk and automatically creates two tiers. By default, each night at 1 a.m., optimization of the disks can occur.



To manually run the optimization, use the following PowerShell command:

```
Get-ScheduledTask -TaskName "Storage Tiers Optimization" |  
Start-ScheduledTask
```

You can pin files to certain tiers by using the PowerShell cmdlet **Set-FileStorageTier**. Here is the complete syntax for this cmdlet:

```
Set-FileStorageTier -DesiredStorageTierFriendlyName <String>  
-FilePath <String> [-CimSession <CimSession[]> ] [-ThrottleLimit  
<Int32> ] [-Confirm] [-WhatIf] [ <CommonParameters> ] [  
<WorkflowParameters>]
```

## Storage Area Networks

Storage Area Network (SAN) technologies now integrate with Windows Server 2016 more seamlessly than ever before. The sections that follow detail this integration.

### Configuring iSCSI Target and Initiator

iSCSI storage provides an inexpensive and simple way to configure a connection to remote disks. An iSCSI SAN implementation typically includes the following:

- **An IP network:** IP is the glue holding the various parts of the datacenter together
- **iSCSI targets:** iSCSI targets advertise storage, just like controllers for hard disk drives of locally attached storage.
- **iSCSI initiators:** iSCSI targets display storage to the iSCSI initiator.
- **iSCSI qualified name (IQN):** IQNs are unique identifiers that iSCSI uses to address initiators and targets on an iSCSI network.

The iSCSI Target Server role service supports a software-based and hardware-independent iSCSI disk subsystem. You can use the iSCSI Target Server to create iSCSI targets and iSCSI virtual disks, and then you can use Server Manager to manage your iSCSI targets and virtual disks. In Windows Server 2016, the iSCSI Target Server is available as a role service under the File and Storage Services role in Server Manager.

**Key  
Topic**

The following Windows PowerShell cmdlets exist for managing the iSCSI Target Server:

```
Install-WindowsFeature FS-iSCSITarget-Server
```

```
New-IscsiVirtualDisk [-Path] <String> [-SizeBytes] <UInt64>
[-BlockSizeBytes <UInt32> ] [-ComputerName <String> ] [-Credential
<PSCredential> ] [-Description <String> ] [-LogicalSectorSizeBytes
<UInt32> ] [-PhysicalSectorSizeBytes <UInt32> ] [
<CommonParameters>]
```

```
New-IscsiServerTarget [-TargetName] <String> [-ClusterGroupName
<String> ] [-ComputerName <String> ] [-Credential <PSCredential> ]
[-InitiatorIds <InitiatorId[]> ] [ <CommonParameters>]
```

```
Add-IscsiVirtualDiskTargetMapping [-TargetName] <String> [-Path]
<String> [-ComputerName <String> ] [-Credential <PSCredential> ]
[-Lun <Int32> ] [ <CommonParameters>]
```

Windows Server 2016 installs the iSCSI initiator by default. To connect your computer to an iSCSI target, you only need to start the service and configure it. The following Windows PowerShell cmdlets allow management of the iSCSI initiator:

```
Start-Service msiscsi
```

```
Set-Service msiscsi -StartupType "Automatic"
```

```
New-IscsiTargetPortal -TargetPortalAddress <String>
[-AuthenticationType <String> ] [-ChapSecret <String> ]
[-ChapUsername <String> ] [-CimSession <CimSession[]> ]
[-InitiatorInstanceName <String> ] [-InitiatorPortalAddress
<String> ] [-IsDataDigest <Boolean> ] [-IsHeaderDigest <Boolean>
] [-TargetPortalPortNumber <UInt16> ] [-ThrottleLimit <Int32> ] [
<CommonParameters>] [ <WorkflowParameters>]
```

```
Connect-IscsiTarget -NodeAddress <String> [-AuthenticationType
<String> ] [-ChapSecret <String> ] [-ChapUsername <String>
] [-CimSession <CimSession[]> ] [-InitiatorInstanceName
<String> ] [-InitiatorPortalAddress <String> ] [-IsDataDigest
<Boolean> ] [-IsHeaderDigest <Boolean> ] [-IsMultipathEnabled
<Boolean> ] [-IsPersistent <Boolean> ] [-ReportToPnP <Boolean>
```

```

] [-TargetPortalAddress <String> ] [-TargetPortalPortNumber
<UInt16> ] [-ThrottleLimit <Int32> ] [ <CommonParameters>] [
<WorkflowParameters>]

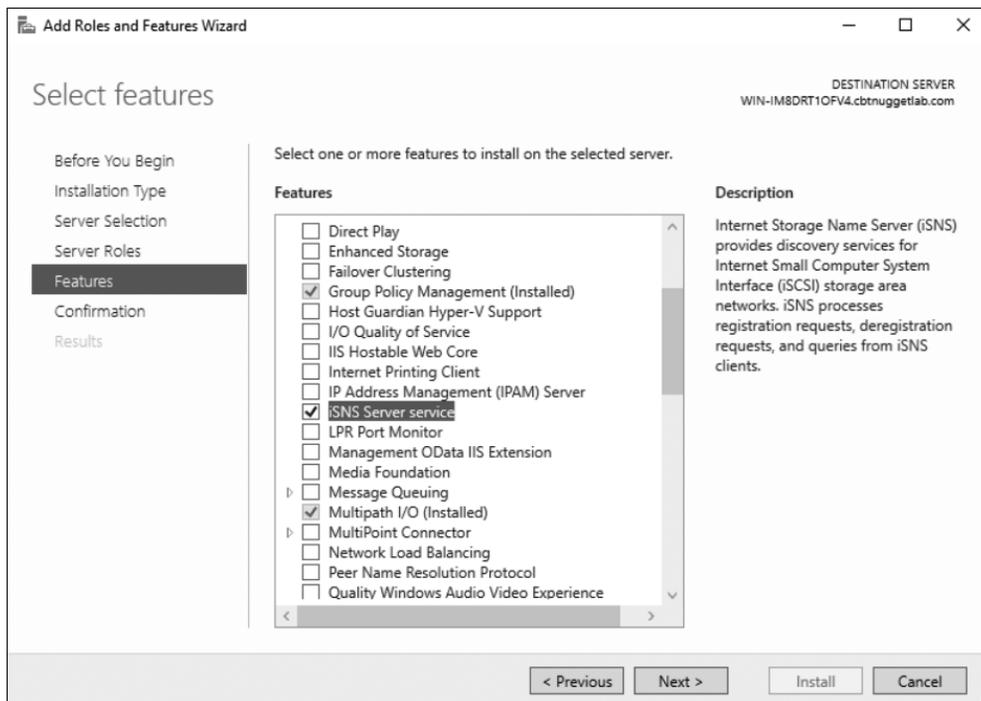
```

## Configuring iSNS

You use the Internet Storage Name Service (iSNS) protocol for interaction between iSNS servers and iSNS clients. iSNS clients are initiators that are trying to discover targets on an Ethernet network. iSNS eases automated discovery, management, and configuration of iSCSI and Fibre Channel devices (using iFCP gateways) on a TCP/IP network.

**NOTE** Windows Server 2016 only supports the discovery of iSCSI devices, not Fibre Channel devices.

Adding iSNS simply installs as a feature in Server 2016, as shown in Figure 5-2.



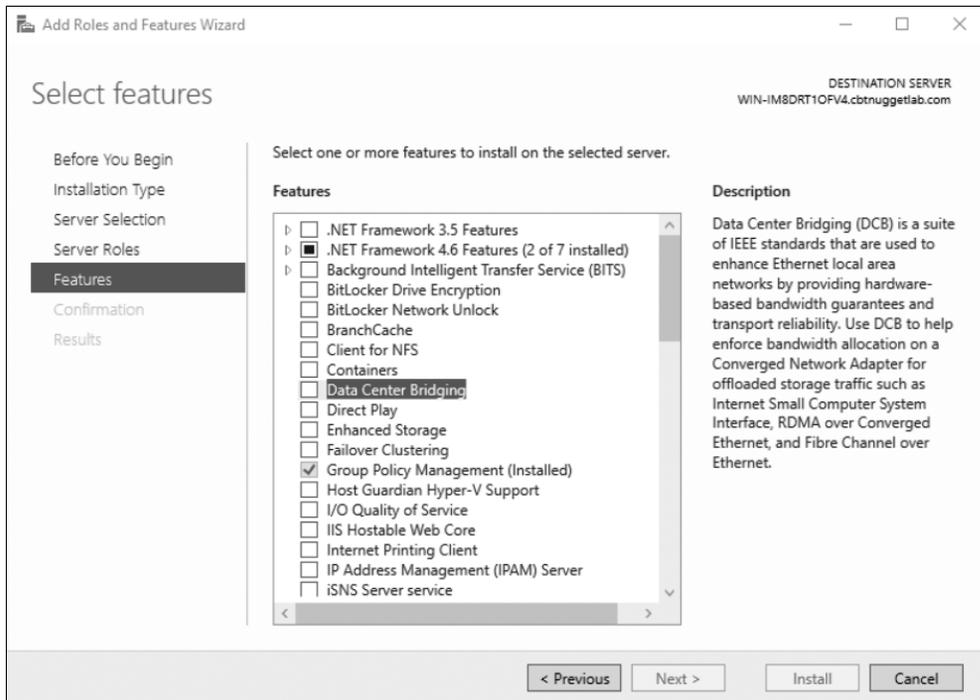
**Figure 5-2** Installing the iSNS Feature

## Configuring Datacenter Bridging (DCB)

Data Center Bridging (DCB) is a suite of Institute of Electrical and Electronics Engineers (IEEE) standards that enables Converged Fabrics in the data center. This is an environment where storage, data networking, cluster IPC, and management traffic all share the same Ethernet network infrastructure.

DCB offers hardware-based bandwidth allocation to a specific type of traffic and enhances Ethernet transport reliability with the use of priority-based flow control. Hardware-based bandwidth allocation is essential if traffic bypasses the operating system and offloads to a converged network adapter. This adapter might support Internet Small Computer System Interface (iSCSI), Remote Direct Memory Access (RDMA) over Converged Ethernet, or Fiber Channel over Ethernet (FCoE). Priority-based flow control is essential if the upper-layer protocol, such as Fiber Channel, assumes a lossless underlying transport.

You install DCB as a feature in a Windows Server 2016 system as shown in Figure 5-3.



**Figure 5-3** Installing DCB

## Configuring Multipath IO (MPIO)

Creating a single connection to iSCSI storage makes that storage available. There is an issue, however, because this configuration does not make the storage highly available. If iSCSI loses the connection, the server loses access to its storage. Therefore, you should make most iSCSI storage connections redundant through one of two high-availability technologies—Multiple Connected Session (MCS) and Multipath I/O (MPIO).

MCS is an iSCSI protocol feature that does the following:

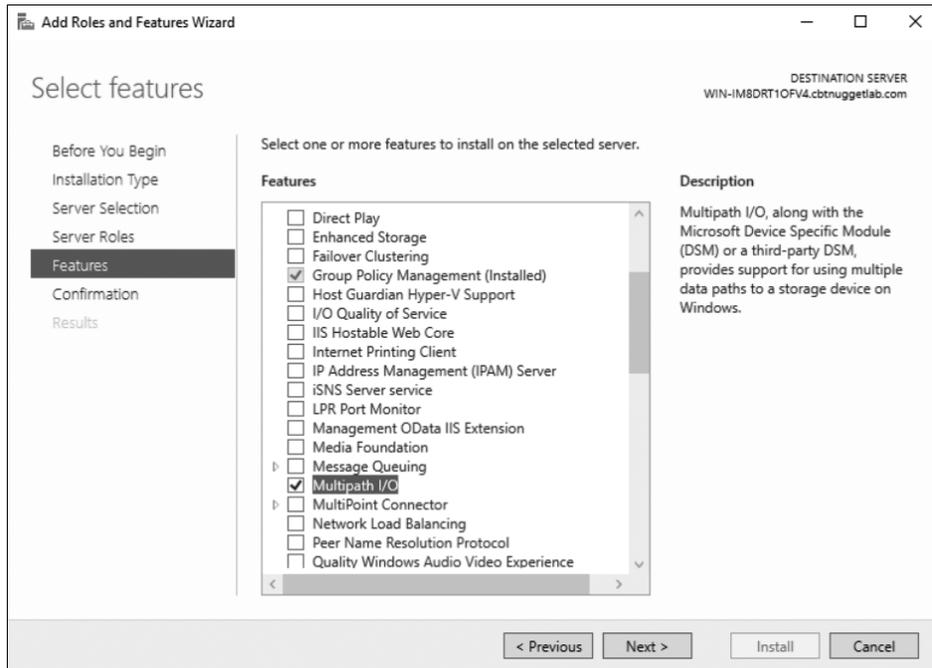
- Enables multiple TCP/IP connections from the initiator to the target for the same iSCSI session
- Supports automatic failover
- Needs explicit support by iSCSI SAN devices

MPIO offers redundancy in a different fashion:

- If you have multiple network interface cards in an iSCSI initiator and iSCSI Target Server, you can use MPIO to provide failover redundancy during network outages.
- MPIO needs a device-specific module (DSM) if you want to connect to a third-party SAN device connected to the iSCSI initiator.
- MPIO is widely supported.
- MPIO is more complex to configure and is not as fully automated during failover as MCS.

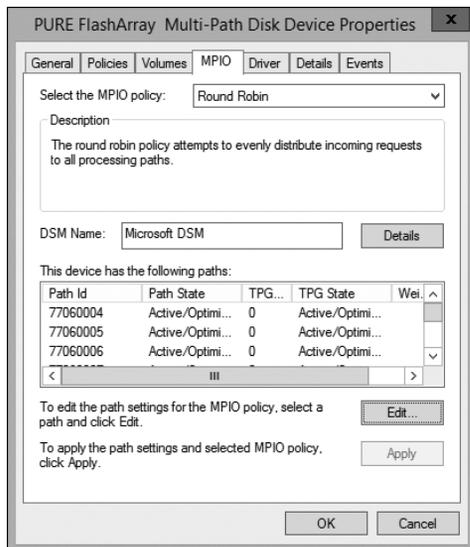
**NOTE** Our exam blueprint requires knowledge of the MPIO approach to SAN redundancy. This text presents MCS here for the sake of completeness.

You install MPIO in the Add Roles and Features Wizard, as shown in Figure 5-4.



**Figure 5-4** Installing MPIO

You can then carry out MPIO policy in the Properties dialog of your storage device (see Figure 5-5).



**Figure 5-5** Configuring MPIO Policy

## Storage Replica

Another exciting new data storage feature in Windows Server 2016 is Storage Replica. This technology permits storage and agnostic data replication between clusters or servers.

### Key Topic

Remember these key points about Storage Replica:

- Synchronous and asynchronous replication choices exist; as the administrator, you can choose based on network latency and geographic distances.
- Storage Replica requires the Datacenter Edition of Windows Server 2016.
- Storage Replica requires GPT initialized disks.
- Supported replication scenarios include Server-to-Server, Cluster-to-Cluster, and Stretch Cluster.
- Only one-to-one replication is supported; a third replica is not an option.
- Storage Replica performs replication at the block level, and therefore you should not consider it for branch office scenarios with slow WAN links.
- Storage Replica can replicate data involving open files.

### Determining Usage Scenarios for Storage Replica

While Storage Replica is not application specific, you should note that some replication technologies are better suited for some implementations. Table 5-2 shows appropriate usage scenarios for the Storage Replica feature. Note that this table also helps you determine the appropriate application-specific replication technology.

**Table 5-2** Determining Usage Scenarios for Storage Replica

	<b>Virtual Machine</b>	<b>SYSVOL</b>	<b>File Server</b>	<b>Microsoft Exchange</b>	<b>SQL Server</b>
<b>Hyper-V Replica</b>	Yes	Not applicable	Yes (VMs)	No	Yes (VMs)
<b>Storage Replica</b>	Yes	No	Yes	No	Yes
<b>SQL Server AlwaysOn Failover Cluster Instance</b>	No	Not applicable	Not applicable	Not applicable	Yes
<b>SQL Server AlwaysOn Availability Groups</b>	No	Not applicable	Not applicable	Not applicable	Yes
<b>Microsoft Exchange Database Availability Groups</b>	No	Not applicable	Not applicable	Yes	Not applicable
<b>Distributed File System Replication</b>	No	Yes	Yes	No	No

## Implementing Storage Replica for Server-to-Server, Cluster-to-Cluster, and Stretch Cluster Scenarios

As described earlier in this section, there are three scenarios available with Storage Replica:

- Server-to-Server
- Cluster-to-Cluster
- Stretch Cluster

### Server-to-Server

You use PowerShell to implement Server-to-Server replication, which involves the following requirements:

- The servers must be participants in a domain.
- Each storage set must have two volumes—one for data and one for logs. The two data volumes must be the same size, and their sector size must also be the same.
- Each file server needs at least a 1 GB connection.
- You need 4 GB of RAM in each server with at least two CPU cores.
- Firewalls must allow ICMP, SMB, and WS-MAN bidirectional traffic.
- You need a network between servers of at least 1 Gbps and 5 ms round-trip latency.
- Both server nodes must have local admin permissions.

Here is sample syntax for a PowerShell configuration:

```
New-SRPartnership -SourceComputerName SVR1 -SourceRGName RepGroup01
-SourceVolumeName
F: -SourceLogVolumeName G: -DestinationComputerName SVR2
-DestinationRGName RepGroup02
-DestinationVolumeName F: -DestinationLogVolumeName G:
-LogSizeInBytes 8GB
```

Here is the complete cmdlet syntax:

```
New-SRPartnership [[-SourceComputerName] <String> ] [-SourceRGName]
<String> [-DestinationComputerName] <String> [-DestinationRGName]
<String> [[-ReplicationMode] <ReplicationMode> {Synchronous |
Asynchronous} ] [[-PreventReplication]] [[-Seeded]] [[-AsyncRPO]
<UInt32> ] [[-EnableEncryption]] [[-Force]] [-CimSession
<CimSession[]> ] [-ThrottleLimit <Int32> ] [ <CommonParameters>] [
<WorkflowParameters>]
```

## Cluster-to-Cluster

You use PowerShell to implement Cluster-to-Cluster replication. The requirements for Cluster-to-Cluster replication are identical to those for Server-to-Server.

Here are the steps for PowerShell Cluster-to-Cluster configuration:

- Step 1.** Grant the first cluster full access to the other cluster by running the **Grant-ClusterAccess** cmdlet on any node in the first cluster or remotely:

```
Grant-SRAccess -ComputerName SRV01 -Cluster SRVCLUSB
```

- Step 2.** Grant the second cluster full access to the other cluster by running the **Grant-ClusterAccess** cmdlet on any node in the second cluster or remotely:

```
Grant-SRAccess -ComputerName SRV03 -Cluster SRVCLUSA
```

- Step 3.** Configure the Cluster-to-Cluster replication, specifying the source and destination disks, the source and destination logs, the source and destination cluster names, and the log size. You can perform this command locally on the server or using a remote management computer:

```
New-SRPartnership -SourceComputerName SRVCLUSA -SourceRGName rg01  
-SourceVolumeName c:\ClusterStorage\Volume2  
-SourceLogVolumeName f: -DestinationComputerName SRVCLUSB  
-DestinationRGName rg02 -DestinationVolumeName c:\  
ClusterStorage\Volume2 -DestinationLogVolumeName f:
```

## Stretch Cluster

Stretch Cluster is a configuration that features one Hyper-V cluster with nodes in two locations and storage in both locations. It allows failover of virtual machines from one cluster to the other. Requirements are identical to those for Server-to-Server and Cluster-to-Cluster.

You configure Stretch Cluster using Failover Cluster Manager or Windows PowerShell. To use the Failover Cluster Manager, follow these steps:

- Step 1.** Add a source data disk to a role or CSV.
- Step 2.** Enable replication on that source data disk.
- Step 3.** Select a destination data disk.
- Step 4.** Select a source log disk.
- Step 5.** Select a destination log disk.

To use PowerShell, follow these steps:

- Step 1.** Add the source data storage only to the cluster as CSV. To get the size, partition, and volume layout of the available disks, use the following commands:

```
Move-ClusterGroup -Name "available storage" -Node sr-srv01

$DiskResources = Get-ClusterResource | Where-Object {
$_.ResourceType -eq 'Physical Disk' -and $_.State -eq 'Online' }
$DiskResources | foreach {
    $resource = $_
    $DiskGuidValue = $resource | Get-ClusterParameter DiskIdGuid

    Get-Disk | where { $_.Guid -eq $DiskGuidValue.Value } |
    Get-Partition | Get-Volume |
        Select @{N="Name"; E={$resource.Name}}, @{N="Status";
E={$resource.State}}, DriveLetter, FileSystemLabel, Size,
SizeRemaining
} | FT -AutoSize
```

```
Move-ClusterGroup -Name "available storage" -Node sr-srv03

$DiskResources = Get-ClusterResource | Where-Object {
$_.ResourceType -eq 'Physical Disk' -and $_.State -eq 'Online' }
$DiskResources | foreach {
    $resource = $_
    $DiskGuidValue = $resource | Get-ClusterParameter DiskIdGuid

    Get-Disk | where { $_.Guid -eq $DiskGuidValue.Value } | Get-
Partition | Get-Volume |
        Select @{N="Name"; E={$resource.Name}}, @{N="Status";
E={$resource.State}}, DriveLetter, FileSystemLabel, Size,
SizeRemaining
} | FT -AutoSize
```

- Step 2.** Set the correct disk to CSV:

```
Add-ClusterSharedVolume -Name "Cluster Disk 4"
Get-ClusterSharedVolume
Move-ClusterSharedVolume -Name "Cluster Disk 4" -Node sr-srv01
```

- Step 3.** Configure the Stretch Cluster, as in this example:

```
New-SRPartnership -SourceComputerName sr-srv01
-SourceRGName rg01 -SourceVolumeName "C:\ClusterStorage\
Volume1" -SourceLogVolumeName e: -DestinationComputerName
sr-srv03 -DestinationRGName rg02 -DestinationVolumeName d:
-DestinationLogVolumeName e:
```

## Exam Preparation Tasks

As mentioned in the section “How to Use This Book” in the Introduction, you have a couple choices for exam preparation: the exercises here, Chapter 21, “Final Preparation,” and the exam simulation questions in the Pearson Test Prep Software Online.

## Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 5-3 lists these key topics and the page number on which each is found.

**Table 5-3** Key Topics for Chapter 5

Key Topic Element	Description	Page Number
List	Storage layout options	86
Steps	Storage Pool expansion	88
Command	Manually optimizing tiered storage	89
List	PowerShell cmdlets for iSCSI targets	90
List	Storage Replica key points	95

## Complete Tables and Lists from Memory

Print a copy of Appendix B, “Memory Tables” (found on the book website), or at least the section for this chapter, and complete the tables and lists from memory. Appendix C, “Memory Tables Answer Key,” also on the website, includes completed tables and lists you can use to check your work.

## Define Key Terms

Define the following key terms from this chapter and check your answers against the glossary:

Storage Spaces, Storage Pool, Tiered Storage, iSCSI Target, iSCSI Initiator, iSNS, DCB, MPIO, Storage Replica

## Q&A

The answers to these questions appear in Appendix A. For more practice with exam format questions, use the Pearson Test Prep Software Online.

1. What two tiers of disk types are used with tiering inside Storage Spaces?
2. What PowerShell command can you use to connect an iSCSI target in a Windows Server 2016 environment?
3. What type of partition system does Storage Replica require on disks? What edition of Windows Server 2016 does it require?





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