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# 20743B

**Upgrading Your Skills to MCSA: Windows  
Server 2016**

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Product Number: 20743B

Released: 02/2017

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Revised July 2013

# Module 1

## Installing and configuring Windows Server 2016

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## Lesson 1

# Introducing Windows Server 2016

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Question and Answers

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## Question and Answers

**Question:** Docker is a container that enables you to run an app in an isolated and portable operating environment.

True

False

**Answer:**

True

False

**Feedback:**

Docker is a management tool that you can use to manage Windows and Hyper-V container images.

## Lesson 2

# Installing Windows Server 2016

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## Question and Answers

**Question:** Which of the following tools can you use to locally manage an installation of Windows Server 2016 Nano Server?

- PowerShell.exe
- Sconfig.cmd
- Taskmgr.exe
- All of the above
- None of the above

**Answer:**

- PowerShell.exe
- Sconfig.cmd
- Taskmgr.exe
- All of the above
- None of the above

**Feedback:**

Nano Server does not provide for local management by using any of the preceding tools. You can use the Nano Server Recovery Console to do basic configuration of the Windows Firewall rules and network settings.

## Discussion: Selecting a suitable Windows Server edition and installation type

**Question:** Your customer, a small legal firm, has a requirement for a single server that the firm wants you to deploy at their only office. Which Windows Server 2016 installation option would be the most suitable?

**Answer:** Deploying Windows Server 2016 with Desktop Experience offers the best solution here. It provides for the most roles and features, and it enables you to perform local management.

**Question:** One of your enterprise customers has a new branch office. You must deploy Windows Server 2016 to support the local users at this new branch. The server will be managed remotely from IT staff located in the head office. The server will support the DNS, DHCP, and AD DS server roles. Your customer wants to minimize resource consumption on the server. Which Windows Server 2016 installation option would be best?

**Answer:** Although Nano Server would be a good choice in terms of remote management, it does not support the required roles, except for DNS. Therefore, the logical choice is Server Core.

**Question:** Your customer wants to run a web server based on IIS. The server must use as few hardware resources as possible. Which Windows Server 2016 installation option would be best?

**Answer:** Of the available installation options for Windows Server 2016, Nano Server uses the fewest hardware resources. It also supports the IIS role, so this would be the logical choice.

## Demonstration: Installing Nano Server

### Demonstration Steps

1. Switch to **LON-DC1**.
2. Right-click **Start**, and then click **Windows PowerShell (Admin)**.

3. In the **Windows PowerShell** window, type **cd\**, and then press Enter.
4. In the **Windows PowerShell** window, type **md Nano**, and then press Enter.
5. In the **Windows PowerShell** window, type the following command, and then press Enter.

```
copy d:\NanoServer\NanoServerImageGenerator\*.ps* c:\nano
```

6. In the **Windows PowerShell** window, type the following command, and then press Enter.

```
Import-Module c:\nano\NanoServerImageGenerator.psm1
```

7. In the **Windows PowerShell** window, type the following command, and then press Enter.

```
new-NanoServerImage -Edition Standard -mediapath D:\ -Basepath c:\nano -targetpath  
c:\nano\nano-svr1.vhdx -DeploymentType Guest -computername NANO-SVR1 -storage -  
package Microsoft-NanoServer-IIS-Package
```

8. At the **AdministratorPassword** prompt, type **Pa55w.rd**, and then press Enter.
9. When the process is completed, on the taskbar, click **File Explorer**, navigate to **C:\Nano**, and then examine the files listed.
10. Switch to NANO-SVR1.
11. In the **User name** box, type **Administrator**, and then press the Tab key.
12. In the **Password** box, type **Pa55w.rd**, and then press Enter.
13. In the **Nano Server Recovery Console**, observe that the computer name is Nano-SVR1 and that the computer belongs to a workgroup. Press the Tab key until **Networking** is selected, and then press Enter.
14. Press Enter on the **Ethernet** adapter. In **Network Adapter Settings**, notice that Dynamic Host Configuration Protocol (DHCP) is obtaining the IP configuration.
15. Make a note of the IP address. You will need this in a later demonstration.
16. Press **Esc** twice.

## Lesson 3

# Configuring Windows Server 2016

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## Question and Answers

**Question:** Which of the following commands do you use to initiate remote Windows PowerShell management?

- ( ) **Enter-PSSession -Name**
- ( ) **Enter-PSRemote -Name**
- ( ) **Enter-PSSession -ComputerName**
- ( ) **Enter-PSRemote -ComputerName**

**Answer:**

- ( ) **Enter-PSSession -Name**
- ( ) **Enter-PSRemote -Name**
- (√) **Enter-PSSession -ComputerName**
- ( ) **Enter-PSRemote -ComputerName**

**Feedback:**

Use the **Enter-PSSession -ComputerName** cmdlet to initiate remote Windows PowerShell.

## Demonstration: Configuring Nano Server

### Demonstration Steps

#### Add Nano Server to a domain

1. Switch to **LON-DC1**.
2. Switch to the **Administrator: Windows PowerShell** window.
3. At the command prompt, type the following cmdlet, and then press Enter.

```
djoin.exe /provision /domain adatum /machine nano-svr1 /savefile .\odjblob
```



**Note:** Replace the IP address 172.16.0.X in the following commands with the IP address you recorded earlier from your Nano Server installation.

4. At the command prompt, type the following cmdlet, and then press Enter.

```
Set-Item WSMAN:\localhost\Client\TrustedHosts "172.16.0.X"
```



**Note:** Your IP address might be different.

5. Type **Y**, and, when you receive a prompt, press Enter.
6. At the command prompt, type the following cmdlet, and then press Enter. Your IP address might be different.

```
$ip = "172.16.0.X"
```

7. At the command prompt, type the following cmdlet, and then press Enter.

```
Enter-PSSession -ComputerName $ip -Credential $ip\Administrator
```

- In the **Windows PowerShell credential request** dialog box, in the **Password** box, type **Pa55w.rd**, and then click **OK**.

- At the command prompt, type the following cmdlet, and then press Enter.

```
netsh advfirewall firewall set rule group="File and Printer Sharing" new enable=yes
```

- At the command prompt, type the following cmdlet, and then press Enter.

```
Exit-PSSession
```

- At the command prompt, type the following command, and then press Enter. Your IP address might be different.

```
net use z: \\172.16.0.X\c$
```

- At the command prompt, type **Z:**, and then press Enter.

- At the command prompt, type the following command, and then press Enter.

```
copy c:odjblob
```

- At the command prompt, type the following cmdlet, and then press Enter.

```
Enter-PSSession -ComputerName $ip -Credential $ip\Administrator
```

- In the **Windows PowerShell credential request** dialog box, in the **Password** box, type **Pa55w.rd**, and then click **OK**.

- At the command prompt, type **cd\**, and then press Enter.

- At the command prompt, type the following cmdlet, and then press Enter.

```
djoin /requestodj /loadfile c:\odjblob /windowspath c:\windows /localos
```

- At the command prompt, type the following cmdlet, and then press Enter. Nano Server restarts.

```
shutdown /r /t 5
```

- Switch to NANO-SVR1.

- In the **User name** box, type **Administrator**, and then press the Tab key.

- In the **Password** box, type **Pa55w.rd**, and then press the Tab key.

- In the **Domain** box, type **Adatum**, and then press Enter.

- In the **Nano Server Recovery Console**, observe that the computer is in the Adatum.com domain.

### Configure Nano Server from the command line

- Switch to **LON-DC1**, and then close Windows PowerShell.

- Right-click **Start**, and then click **Windows PowerShell (Admin)**.

- At the command prompt, type the following cmdlet, and then press Enter.

```
get-windowsfeature -comp Nano-svr1
```

- At the command prompt, type the following cmdlet, and then press Enter.

```
install-windowsfeature Fs-fileserver -comp Nano-svr1
```



**Note:** If you see error "Warning: Failed to start automatic updating for installed components. Error: 0x80040154" you can ignore this.

- At the command prompt, type the following cmdlet, and then press Enter.

```
get-windowsfeature -comp Nano-svr1
```

- At the command prompt, type the following cmdlet, and then press Enter. Your IP address might be different.

```
$ip = "172.16.0.X"
```

- At the command prompt, type the following cmdlet, and then press Enter.

```
Enter-PSSession -ComputerName $ip -Credential $ip\Administrator
```

- In the **Windows PowerShell credential request** dialog box, in the **Password** box, type **Pa55w.rd**, and then click **OK**.

- At the command prompt, type the following cmdlet, and then press Enter.

```
get-netipaddress
```

- At the command prompt, type the following command, and then press Enter.

```
bcdedit /enum
```

- At the command prompt, type the following command, and then press Enter.

```
net share
```

### Configure Nano Server by using Server Manager

- In **Server Manager**, in the navigation pane, select and then right-click **All Servers**, and then click **Add Servers**.
- In the **Add Servers** dialog box, in the **Name (CN):** box, type **Nano-SVR1**, and then click **Find Now**.
- In the **Name** list, click **Nano-svr1**, and then to add the computer to the **Computer** list, click the Right Arrow.
- Click **OK**.
- In **Server Manager**, expand **File and Storage Services**.
- Click **Shares**, and then in the **TASKS** list, click **New Share**.
- In the **New Share Wizard**, click **SMB Share - Quick**, and then click **Next**.
- On the **Select the server and path for this share** page, in the **Server** list, click **nano-svr1**, and then click **Next**.
- On the **Specify share name** page, in the **Share name** box, type **Data**, and then click **Next**.
- To complete the wizard, click **Next** twice, and then click **Create**.
- Click **Close**.

## Lesson 4

# Preparing for upgrades and migrations

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## Question and Answers

**Question:** How does virtualization help in server role consolidation?

**Answer:** Virtualization allows you to take advantage of separating roles onto different servers. For example, by using virtualization, you can more easily troubleshoot issues and better manage service uptime. At the same time, you also gain the advantage of consolidating multiple roles onto fewer computers. You must ensure that the hardware resources on the virtualization hosts are sufficient to handle the various workloads.

## Resources

### In-place upgrades vs. server migration

 **Additional Reading:** For more information on migration, refer to "Install, Use, and Remove Windows Server Migration Tools" at: <http://aka.ms/Drjq4b>

### Using solution accelerators

 **Additional Reading:** For more information about using the MDT as part of a complete deployment solution, refer to "Automate and manage Windows operating system deployments" at: <http://aka.ms/Ofwaxa>

For more information about the MDT, including the latest updates, refer to "Microsoft Deployment Toolkit" at: <http://aka.ms/Gqaxp8>

 **Reference Links:** For more information about the Microsoft Assessment and Planning (MAP) Toolkit, refer to: <http://aka.ms/vjfbdj>

 **Additional Reading:** For more information about the Windows Server Migration Tools and migration guides for specific roles and features, refer to "Migrate Roles and Features to Windows Server" at: <http://aka.ms/H31ibv>

## Demonstration: Using MAP

### Demonstration Steps

#### Review the MAP options

1. On **LON-CL1**, click **Start**, expand **Microsoft Assessment and Planning Toolkit**, and then click **Microsoft Assessment and Planning Toolkit**.
2. In the **Microsoft Assessment and Planning Toolkit** console, the **Microsoft Assessment and Planning Toolkit** dialog box appears. Click **Cancel**.
3. In the **Microsoft Assessment and Planning Toolkit** console, review the default window that displays the **Overview** page.
4. In the **Microsoft Assessment and Planning Toolkit** console, in the left pane, click **Cloud**, and then review the readiness information for the different cloud scenarios.
5. In the **Microsoft Assessment and Planning Toolkit** console, in the left pane, click **Desktop**, and then review the readiness information for the different desktop scenarios.
6. Repeat step 5 for all remaining items in the left pane: **Server**, **Desktop Virtualization**, **Server Virtualization**, **Database**, **Usage Tracking**, and **Environment**.

## Perform inventory

1. On **LON-CL1**, in the **Microsoft Assessment and Planning Toolkit** console, in the left pane, click **Overview**, and then, in the **Overview** page, click **Create/Select database**.
2. In the **Microsoft Assessment and Planning Toolkit** dialog box, ensure that **Create an inventory database** is selected, then in the **Name** box type **INVENTORY**, and then click **OK**.
3. On the **Overview** page, click **Perform an inventory**.
4. In the **Inventory and Assessment Wizard**, perform the following steps:
  - a. On the **Inventory Scenarios** page, select the following check boxes, and then click **Next**:
    - **Windows computers**
    - **Exchange Server**
    - **Lync Server**
    - **SQL Server**
    - **Windows Azure Platform Migration**
  - b. On the **Discovery Methods** page, select **Use Active Directory Domain Services**, and **Scan an IP address range**, and then click **Next**.
  - c. On the **Active Directory Credentials** page, in the **Domain** field, type **Adatum.com**, and then, in the **Domain account** field, type **Adatum\Administrator**. In the **Password** field, type **Pa55w.rd**, and then click **Next**.
  - d. On the **Active Directory Options** page, click **Next**.
  - e. On the **Scan an IP Address Range** page, in the **IP address ranges** table, click in the cell under **Starting Address**, and then type **172.16.0.1**. Click in the cell under **Ending Address**, and then type **172.16.0.100**. Click **Next**.
  - f. On the **All Computers Credentials** page, click **Next**, and then, on the **Credentials Order** page, click **Next**.
  - g. On the **Connection Properties** page, click **Next**.
  - h. On the **Summary** page, review the inventory options, click **Cancel**, and then click **Yes**.



**Note:** You cancel the inventory procedure because the lab does not contain an environment with older operating systems for MAP to discover. In the next step, you review the test inventory that you import from the sample database in MAP.

## Review the MAP inventory from a sample database

1. In the **Microsoft Assessment and Planning Toolkit** console, click **File**, and then click **Manage Databases**.
2. In the **Microsoft Assessment and Planning Toolkit** dialog box, click **Import**, and then click **Browse**.
3. In the **Microsoft Assessment and Planning Toolkit** dialog box, in the left pane, expand **C:\Program Files\Microsoft Assessment and Planning Toolkit\Sample**, and then, in the right pane, click **MAP\_SampleDB.bak**, and then click **Open**.
4. In the **Microsoft Assessment and Planning Toolkit** dialog box, in the **Database Name** box, type **MAPDEMO**, and then click **OK**.
5. When the dialog box displays a message that the database has been successfully imported, click **OK**, and then click **Close**.

6. In **Microsoft Assessment and Planning Toolkit** window, click **File**, and then click **Create/Select Database**.
7. In **Microsoft Assessment and Planning Toolkit** dialog box, ensure that **Use an existing database** is selected, select **MAPDEMO**, and then click **OK**.
8. In the **Microsoft Assessment and Planning Toolkit** console, review the default window that displays the **Overview** page that includes inventory information loaded from the sample database. Refresh the **Overview** page window, if necessary.
9. In the **Microsoft Assessment and Planning Toolkit** console, in the left pane, click **Cloud**, and then review the readiness information for the different cloud scenarios that displays with inventory information from the sample database.
10. In the **Microsoft Assessment and Planning Toolkit console**, in the left pane, click **Desktop**, and then review the readiness information for the different desktop scenarios that displays with inventory information from the sample database.
11. Repeat step 10 for all remaining items in the left pane: **Server**, **Desktop Virtualization**, **Server Virtualization**, **Database**, **Usage Tracking**, and **Environment**.

## Lesson 5

# Migrating server roles and workloads

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## Question and Answers

**Question:** What are some reasons that you would do a cross-forest migration instead of a migration within the same domain?

**Answer:** You might want to migrate to a new forest as part of reorganizing your AD DS structure. This is an opportunity to optimize and reduce complexity.

A cross-forest migration might also be necessary because of a business merger or acquisition.

By performing a cross-forest migration, both the new and old structures will exist at the same time, which will allow you to roll back to the previous structure if problems arise during migration.

## Resources

### Migrating server roles within a domain



**Additional Reading:** For more information about determining which roles and features to migrate, refer to the migration guides for Windows Server 2016 in “Migrate Roles and Features to Windows Server” at: <http://aka.ms/H31ibv>

## Lesson 6

# Windows Server activation models

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## Question and Answers

### Discussion: Planning volume activation

**Question:** Your organization's IT infrastructure consists of personal computers and servers that are running different editions of Windows client operating systems and Windows Server operating systems. Next month, your organization plans to deploy 500 Windows 10 client computers and 20 Windows Server 2016 servers. Because of a legacy application in the finance department, you must deploy 10 client computers that are running Windows 8.1 and two servers that are running Windows Server 2012 R2. What type of volume activation should you implement?

**Answer:** You should implement volume licensing based on KMS. This is because your organization deploys different editions of Windows client operating systems and Windows Server operating systems.

**Question:** Your organization's IT infrastructure was upgraded from different editions of Windows client operating systems and Windows Server operating systems to Windows 10 and Windows Server 2016, respectively. What type of volume activation should you implement?

**Answer:** You should implement volume licensing based on Active Directory-based activation. This is because your organization deploys Windows 10 and Windows Server 2016 operating systems, and AD DS-based activation is supported only when the computers are running Windows Server 2016 or Windows 10.

## Resources

### Windows Server 2016 licensing and activation



**Reference Links:** For more information on VAMT, refer to "Introduction to VAMT" at: <http://aka.ms/I0cdnd>

# Module Review and Takeaways

## Review Questions

**Question:** When creating a virtual hard disk for Nano Server by using the Windows PowerShell cmdlet **New-NanoServerImage**, when do you use the **-Guestdrivers** switch?

**Answer:** You see the **-Guestdrivers** switch when you intend to run Nano Server as a virtual machine under Hyper-V.

**Question:** When using the Nano Server Recovery Console, which two fundamental components can you configure?

**Answer:** You can configure only networking and firewall settings on Nano Server by using the Nano Server Recovery Console.

**Question:** Which role can you use to manage KMS?

**Answer:** You can use the Volume Activation Services role to manage KMS.

# Lab Review Questions and Answers

## Lab: Installing and configuring Nano Server

### Question and Answers

**Question:** In the lab, you used a virtual machine to run Nano Server. Having created your virtual hard disk, if you want to run Nano Server on a physical host, what commands do you use to configure the startup environment?

**Answer:** To modify the startup settings of a physical computer to use the virtual hard disk for Nano Server:

1. In an elevated command prompt, copy the current boot loader entry on the computer where Nano Server will be running, and then use that to create a new entry with the **bcdedit /copy {current} /d "Nano Server"** command.
2. Type **bcdedit** again, and then copy the GUID, including the braces ({ }), that appear in the **ID** field of the newly copied boot loader entry.
3. Run these commands, replacing *{GUID}* with the copied GUID, including the braces:
  - a. **bcdedit /set {GUID} device vhd=C:\NanoServer\NanoServer.vhd**
  - b. **bcdedit /set {GUID} osdevice vhd= C:\NanoServer\NanoServer.vhd**
  - c. **bcdedit /set {GUID} path \windows\system32\boot\winload.exe**
4. Verify the setting is correct by going to **System Properties**. Select **Startup and Recovery settings**. You should see that **System startup** lists **Nano Server**.
5. Alternatively, mount the NanoServer.vhd file in the file system by using drive G, and then run **bcdboot G:\Windows**.

# Module 2

## Overview of storage in Windows Server 2016

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## Lesson 1

# Overview of storage in Windows Server 2016

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## Question and Answers

**Question:** You can use Windows PowerShell scripts to change the file-classification properties.

True

False

**Answer:**

True

False

**Feedback:**

In addition to folder classifier and string classifier, you can also use the Windows PowerShell classifier to change the file-classification properties.

## Resources

### File classification



**Additional Reading:** For more information about the syntax for creating regular expression, refer to "Regular Expression Syntax" at: <http://aka.ms/lf9d2u>

## Demonstration: Using FSRM to manage quotas, file screens, and storage reports

### Demonstration Steps

#### Create a quota

1. On **LON-SVR1**, click **Start**, and then click **Server Manager**.
2. In **Server Manager**, click **Add roles and features**.
3. In the **Add Roles and Features Wizard**, click **Next**.
4. Confirm that **Role-based or feature-based installation** is selected, and then click **Next**.
5. Confirm that **LON-SVR1.Adatum.com** is selected, and then click **Next**.
6. On the **Select server roles** page, expand **File and Storage Services (2 of 12 Installed)**, expand **File and iSCSI Services (1 of 11 Installed)**, and then select the **File Server Resource Manager** check box.
7. In the **Add role and features Wizard** dialog box, click **Add Features**.
8. Click **Next** twice to confirm the role service and feature selection.
9. On the **Confirm installation selections** page, click **Install**.
10. When the installation completes, click **Close**.
11. In **Server Manager**, click **Tools**, and then click **File Server Resource Manager**.
12. In the **File Server Resource Manager** window, expand the **Quota Management** node, and then click **Quota Templates**.
13. Right-click the **100 MB Limit** template, and then click **Create Quota from Template**.
14. In the **Create Quota** window, click **Browse**.

15. In the **Browse for Folder** window, expand **Allfiles (D:)**, expand **Labfiles**, click **Mod02**, and then click **OK**.
16. In the **Create Quota** window, click **Create**.
17. In the **File Server Resource Manager** window, click **Quotas** to view the newly created quota.

### Test a quota

1. Click **Start**, and then click **Windows PowerShell**.
2. In the **Windows PowerShell** window, type the following two commands, pressing Enter after each command:

```
cd D:\labfiles\Mod02
Fsutil file createnew largefile.txt 123456789
```

3. Notice that the following message displays: "Error: There is not enough space on the disk."
4. Close the **Windows PowerShell** window.

### Create a file screen

1. In the **File Server Resource Manager** window, expand the **File Screening Management** node, and then click **File Screen Templates**.
2. Right-click the **Block Image Files** template, and then click **Create File Screen from Template**.
3. In the **Create File Screen** window, click **Browse**.
4. In the **Browse for Folder** window, expand **Allfiles (D:)**, expand **Labfiles**, click **Mod02**, and then click **OK**.
5. In the **Create File Screen** window, click **Create**.

### Test a file screen

1. Open **File Explorer**.
2. In the **File Explorer** window, expand **This PC**, expand **Allfiles (D:)**, and then expand **Labfiles**.
3. In **File Explorer**, click the **Home** tab, click **New Item**, and then click **Bitmap image**.
4. Type **testimage**, and then press Enter.
5. Confirm that the file was created successfully.
6. Right-click **testimage**, and then click **Copy**.
7. Right-click **Mod02**, and then click **Paste**.
8. When you receive a message that you need permission to perform this action, click **Cancel**.

### Generate a storage report

1. In **File Explorer**, double-click **Mod02**.
2. Double-click **CreateDemoFiles.cmd**.
3. Close **File Explorer**.
4. In the **File Server Resource Manager** window, in the navigation pane, click and right-click **Storage Reports Management**, and then click **Generate Reports Now**.
5. In the **Storage Reports Task Properties** window, select the **Large Files** check box.
6. Click the **Scope** tab, and then click **Add**.

7. In the **Browse for Folder** window, expand **Allfiles (D:)**, click **Labfiles**, and then click **OK**.
8. In the **Storage Reports Task Properties** window, click **OK**.
9. In the **Generate Storage Reports** window, click **OK** to generate the report.
10. In the window that displays, right-click the html file, click **Open with**, and in the **How do you want to open this file?** dialog box, click **Internet Explorer**, and then click **OK**.
11. Examine the report.
12. Close the report window.
13. Close the **Interactive** window.
14. Close the **File Server Resource Manager** window.

## Demonstration: Configuring file classification

### Demonstration Steps

#### Create a classification property

1. On **LON-SVR1**, in the **Server Manager** window, click **Tools**, and then click **File Server Resource Manager**.
2. In the **File Server Resource Manager** window, expand the **Classification Management** node, and then click **Classification Properties**.
3. Right-click **Classification Properties**, and then click **Create Local Property**.
4. In the **Create Local Classification Property** dialog box, in the **Name** text box, type **Confidential**. In the **Description** text box, type **Assigns a confidentiality value of Yes or No**.
5. Under **Property type**, click the drop-down list box, and then click **Yes/No**.
6. In the **Create Local Classification Property** dialog box, click **OK**.

#### Create a classification rule

1. In the **File Server Resource Manager** window, click the **Classification Rules** node.
2. Right-click the **Classification Rules** node, and then click **Create Classification Rule**.
3. In the **Rule name** text box, type **Confidential Payroll Documents**.
4. In the **Description** text box, type **Classify documents containing the word payroll as confidential**, and then click the **Scope** tab.
5. In the **Scope** section, click **Add**.
6. In the **Browse for Folder** dialog box, expand **This PC**, expand **Allfiles (D:)**, expand **Labfiles**, click **Mod02**, and then click **OK**.
7. In the **Create Classification Rule** dialog box, click the **Classification** tab.
8. In the **Classification method** section, click the drop-down list box, and then click **Content Classifier**.
9. In the **Property** section, click **Confidential** as the property name, click **Yes** as the property value, and then click **Configure**.
10. On the **Parameters** tab, below the **Expression Type** column, click the drop-down list box, and then click **String**.
11. Click the **Expression** column, type **payroll**, and then click **OK**.
12. In the **Create Classification Rule** dialog box, click **OK**.

### **Modify the classification schedule**

1. Right-click the **Classification Rules** node, and then click **Configure Classification Schedule**.
2. In the **File Server Resource Manager Options** window, ensure that the **Automatic Classification** tab is selected.
3. In the **Schedule** section, select the **Enable fixed schedule** check box.
4. In the **Run at** text box, type **8:30 AM**, select **Sunday**, and then click **OK**.
5. Right-click the **Classification Rules** node, and then click **Run Classification With All Rules Now**.
6. In the **Run Classification** window, select the **Wait for classification to complete** option, and then click **OK**.
7. If an **Internet Explorer 11** dialog box opens, click **Close**.
8. View the report, and ensure that **Document1.txt** and **Document2.txt** are listed at the bottom of the report.
9. Close all open windows, except **Server Manager** on **LON-SVR1**.

## Lesson 2

# Implementing Data Deduplication

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## Question and Answers

**Question:** Can you enable Data Deduplication on ReFS formatted drives?

**Answer:** Yes.

**Feedback:** Yes, Data Deduplication is supported on NTFS and ReFS.

**Question:** Can you enable Data Deduplication on volumes where virtual machines are running, and apply it to those virtual machines?

**Answer:** Yes.

**Feedback:** Yes, you will achieve the same level of optimization with running virtual machines, as with virtual machines that are not running. You will experience no degradation in performance.

**Question:** Which features of Data Deduplication are present in Windows Server 2016? (Select all that apply.)

- Deduplication of volumes up to 64 TB
- Deduplication of volumes larger than 64 TB
- Support for virtualized backup storage
- Support for storage on Hyper-V virtual machines
- Support for Nano Server

**Answer:**

- Deduplication of volumes up to 64 TB
- Deduplication of volumes larger than 64 TB
- Support for virtualized backup storage
- Support for storage on Hyper-V virtual machines
- Support for Nano Server

**Feedback:**

Standard Hyper-V virtual machines do not support Data Deduplication. Only virtual machines that you use for VDI deployments will support it. Also, because of a limit in Volume Shadow Copy Service (VSS), volumes that you use for Data Deduplication cannot exceed 64 terabytes (TB).

## Demonstration: Implementing Data Deduplication

### Demonstration Steps

#### Install the Data Deduplication role service

1. On **LON-SVR1**, in **Server Manager**, click **Add roles and features**.
2. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.
3. On the **Select installation type** page, click **Next**.
4. On the **Select destination server** page, click **Next**.
5. On the **Select server roles** page, in the **Roles** list, expand **File and Storage Services (3 of 12 installed)**.
6. Expand **File and iSCSI Services (2 of 11 installed)**.
7. Select the **Data Deduplication** check box, and then click **Next**.

8. On the **Select features** page, click **Next**.
9. On the **Confirm installation selections** page, click **Install**.
10. When the installation is complete, on the **Installation progress** page, click **Close**.

### Enable Data Deduplication

1. In **Server Manager**, in the navigation pane, click **File and Storage Services**, and then click **Disks**.
2. In the **Disks** pane, click **1**.
3. Under **VOLUMES**, click **D**.
4. Right-click **D**, and then click **Configure Data Deduplication**.
5. In the **Allfiles (D:) Deduplication Settings** dialog box, in the **Data deduplication** list, click **General purpose file server**.
6. In the **Deduplicate files older than (in days)** text box, type **5**.
7. Click **Set Deduplication Schedule**.
8. In the **LON-SVR1 Deduplication Schedule** dialog box, select the **Enable throughput optimization** check box, and then click **OK**.
9. In the **Allfiles (D:) Deduplication Settings** dialog box, click **OK**.

### Check the status of Data Deduplication

1. Click **Start**, and then click **Windows PowerShell**.
2. At the Windows PowerShell command prompt, type the following command, and then press Enter:

```
Get-DedupStatus
```

3. Type the following command, and then press Enter:

```
Get-DedupStatus | fl
```

4. Type the following command, and then press Enter:

```
Get-DedupVolume
```

5. Type the following command, and then press Enter:

```
Get-DedupVolume | fl
```

6. Type the following command, and then press Enter:

```
Start-DedupJob D: -Type Optimization -Memory 50
```

7. Repeat steps 2 and 4. If you repeat these steps, you will notice the available space increasing. Notice also that the number of optimized files increases.



**Note:** It might take a few minutes for you to see the available space increasing.

8. Close all open windows.

## Lesson 3

# Configuring iSCSI storage

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## Question and Answers

**Question:** What are the required components of an iSCSI solution? (Select all that apply.)

- IP network
- iSCSI targets
- iSCSI initiators
- iSCSI qualified name
- Domain Name System (DNS)

**Answer:**

- IP network
- iSCSI targets
- iSCSI initiators
- iSCSI qualified name
- Domain Name System (DNS)

**Feedback:**

If you access the iSCSI target through IP addresses, DNS is not a required part of an iSCSI solution. iSCSI has its own name service called Internet Storage Name Service (iSNS). DNS is required only if you want to use fully qualified domain names (FQDN) to access your iSCSI storage.

**Question:** You can use **Server Manager** to configure both the iSCSI Target Server and the iSCSI initiator.

- True
- False

**Answer:**

- True
- False

**Feedback:**

You can configure the iSCSI Target Server by using **Server Manager** and Windows PowerShell. However, you cannot configure the iSCSI initiator by using **Server Manager**; you can configure the iSCSI initiator only through its own interface, or through Windows PowerShell.

## Resources

### Components of iSCSI

 **Additional Reading:** For more information on iSCSI Target Server scalability limits, refer to "iSCSI Target Server Scalability Limits" at: <http://aka.ms/dfxgja>

 **Additional Reading:** For more information, refer to "iSCSI Target Cmdlets in Windows PowerShell" at: <http://aka.ms/j1iomo>

 **Additional Reading:** For more information, refer to "Introduction of iSCSI Target in Windows Server 2012" at: <http://aka.ms/ygfqwd>

## Managing iSCSI targets



**Additional Reading:** For more information, refer to “iSCSI Target Cmdlets in Windows PowerShell” at: <http://aka.ms/j1iomo>

### Demonstration: Configuring the iSCSI target

#### Demonstration Steps

##### Add an iSCSI Target Server role service

1. On **LON-DC1**, on the taskbar, click the **Windows** button, and then click **Windows PowerShell**.
2. In the **Administrator: Windows PowerShell** window, type the following command, and then press Enter:

```
Install-Windowsfeature FS-iSCSITarget-Server -IncludeManagementTools
```

3. Close the Windows PowerShell window.

##### Create two iSCSI virtual disks and an iSCSI target on LON-DC1

1. On **LON-DC1**, in **Server Manager**, click the refresh button.
2. In the navigation pane, click **File and Storage Services**.
3. In the **File and Storage Services** pane, click **iSCSI**.
4. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then in the **TASKS** drop-down list box, click **New iSCSI Virtual Disk**.
5. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click **C:**, and then click **Next**.
6. On the **Specify iSCSI virtual disk name** page, in the **Name** text box, type **iSCSIDisk1**, and then click **Next**.
7. On the **Specify iSCSI virtual disk size** page, in the **Size** text box, type **5**.
8. Ensure that **GB** is selected in the drop-down list box, ensure that **Dynamically expanding** is selected as an option, and then click **Next**.
9. On the **Assign iSCSI target** page, click **New iSCSI target**, and then click **Next**.
10. On the **Specify target name** page, in the **Name** text box, type **FileServer**, and then click **Next**.
11. On the **Specify access servers** page, click **Add**.
12. In the **Select a method to identify the initiator** dialog box, click **Enter a value for the selected type**. In the **Type** drop-down list box, click **IP Address**, in the **Value** text box, type **172.16.0.11**, and then click **OK**.
13. On the **Specify access servers** page, click **Next**.
14. On the **Enable Authentication** page, click **Next**.
15. On the **Confirm selections** page, click **Create**.
16. On the **View results** page, wait until the creation process completes, and then click **Close**.
17. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then in the **TASKS** drop-down list box, click **New iSCSI Virtual Disk**.

18. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click **C:**, and then click **Next**.
19. On the **Specify iSCSI virtual disk name** page, in the **Name** text box, type **iSCSIDisk2**, and then click **Next**.
20. On the **Specify iSCSI virtual disk size** page, in the **Size** text box, type **5**.
21. Ensure that **GB** is selected in the drop-down list box, ensure that **Dynamically expanding** is selected as an option, and then click **Next**.
22. On the **Assign iSCSI target** page, click **fileserver**, and then click **Next**.
23. On the **Confirm selections** page, click **Create**.
24. On the **View results** page, wait until the creation process completes, and then click **Close**.

## Demonstration: Configuring iSCSI storage

### Demonstration Steps

#### Connect LON-SVR1 to the iSCSI target

1. On **LON-SVR1**, in **Server Manager**, click **Tools**, and then click **iSCSI Initiator**.
2. In the **Microsoft iSCSI** message box, click **Yes**.
3. In the **iSCSI Initiator Properties** dialog box, on the **Targets** tab, in the **Target** text box, type **LON-DC1**, and then click **Quick Connect**.
4. In the **Quick Connect** window, in the **Discovered targets** section, click **iqn.1991-05.com.microsoft:lon-dc1-fileserver-target**, and then click **Done**.
5. In the **iSCSI Initiator Properties** dialog box, click **OK**.

#### Verify the presence of the iSCSI disks

1. In **Server Manager**, in the tree pane, click **File and Storage Services**, and then click **Disks**.
2. In **Server Manager**, in the content pane, point out the two new 5-GB disks that are offline. Point out that the bus type is iSCSI. (If you are in the **File and Storage Services** section of **Server Manager**, you might need to click the refresh button to see the two new disks.)

## Lesson 4

# Configuring the Storage Spaces feature in Windows Server 2016

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## Question and Answers

**Question:** Which resiliency types can you configure in the Storage Spaces feature? (Select all that apply.)

- Simple
- Advanced
- Two-way mirror
- Three-way mirror
- Parity

**Answer:**

- Simple
- Advanced
- Two-way mirror
- Three-way mirror
- Parity

**Feedback:**

There is no advanced resiliency type in the Storage Spaces feature.

## Resources

### Redundancy in storage spaces



**Additional Reading:** For more information, refer to "Deploy Clustered Storage Spaces" at: <http://aka.ms/k5vwda>

### Monitoring Storage Spaces



**Additional Reading:** To download the Microsoft System Center Operations Manager Management Pack for Windows Server Storage Spaces, refer to: <http://aka.ms/Uzb16z>

## Module Review and Takeaways

### Review Questions

**Question:** Is the Storage Spaces feature also available in Windows 10?

**Answer:** Yes, you can use the Storage Spaces feature in both Windows Server 2016 and Windows 10.

**Question:** Can you configure Data Deduplication on a boot volume?

**Answer:** No, you cannot configure Data Deduplication on a boot volume. You can configure Data Deduplication only on volumes that are not system or boot volumes.

**Question:** Can you use both local and shared storage with the Storage Spaces Direct feature?

**Answer:** No. Storage Spaces Direct can use only local storage. A standard storage space can use shared storage.

# Lab Review Questions and Answers

## Lab A: Implementing and managing storage

### Question and Answers

**Question:** Why would you implement MPIO with iSCSI? What problem does this solve?

**Answer:** You must have a Multipath I/O (MPIO) to create a second network route to the iSCSI target. This is useful when you lose a connection to the iSCSI target because of a loss in a network adapter. When you configure an MPIO, you ensure that if a network adapter fails another network adapter can take over.

**Question:** What is the purpose of the iSCSI initiator component?

**Answer:** The iSCSI initiator component is the client component that allows iSCSI to connect to an iSCSI target. Windows Vista, Windows Server 2008, and newer Windows client and Windows Server operating systems have this component preinstalled as a service. You only have to start them to use them.

## Lab B: Implementing and managing advanced storage solutions

### Question and Answers

**Question:** How many disk failures can you have while remaining functional with a three-way mirrored storage space?

**Answer:** A three-way mirrored storage space can accommodate two disk failures.

**Question:** How many servers do you need as a minimum to set up the Storage Spaces Direct feature?

**Answer:** The Storage Spaces Direct feature requires a minimum of four servers.

# Module 3

## Implementing directory services

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## Lesson 1

# Deploying Active Directory domain controllers

### Contents:

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Demonstration: Deploying an RODC	3

## Question and Answers

**Question:** Which of the following commands would you use to promote Windows Server 2016 Server Core to a domain controller?

- Adprep /forestprep**
- Adprep /domainprep**
- Install-ADDSDomainController –domainname “Adatum.com”**
- Install-WindowsFeature –name AD-Domain-Services**

**Answer:**

- Adprep /forestprep**
- Adprep /domainprep**
- Install-ADDSDomainController –domainname “Adatum.com”**
- Install-WindowsFeature –name AD-Domain-Services**

**Feedback:**

You can install the binaries by using the **Install-WindowsFeature –name AD-Domain-Services** cmdlet followed by the **Install-ADDSDomainController –domainname “Adatum.com”** cmdlet to promote a domain controller.

## Resources

### What’s new in AD DS on Windows Server 2016?



**Additional Reading:** For more information on PAM for AD DS, refer to: <http://aka.ms/dav4pu>

### Deploying Active Directory domain controllers on Server Core



**Additional Reading:**

- For more information on using the **Install-ADDSDomainController** Windows PowerShell cmdlet, refer to: <http://aka.ms/mvkc3u>
- For more information, refer to: <http://aka.ms/WivzdV>

### Deploying Active Directory domain controllers by using the Install from Media method



**Additional Reading:** For more information on the steps that are necessary to install AD DS, refer to Install Active Directory Domain Services (Level 100): <http://aka.ms/nmus1d>

## Demonstration: Deploying an RODC

### Demonstration Steps

#### Add a server to manage

1. Switch to **LON-DC1**.

2. In **Server Manager**, click **Add other servers to manage**.
3. In the **Add Servers** dialog box, in the **Name (CN)** text box, type **LON-SVR3**, and then click **Find Now**.
4. In the search results, select **LON-SVR3**, click the arrow to move it to the **Selected** pane, and then click **OK**.

### **Create a new server group**

1. In **Server Manager**, click **Create a server group**.
2. In the **Create Server Group** dialog box, in the **Server group name** text box, type **DCs**.
3. Select both **LON-SVR3** and **LON-DC1**, click the arrow to move them to the **Selected** pane, and then click **OK**.

### **Install the RODC role remotely**

1. In **Server Manager**, click **Add roles and features**.
2. In the **Add Roles and Features Wizard**, click **Next**.
3. On the **Select installation type** page, click **Next**.
4. On the **Select destination server** page, select **LON-SVR3.Adatum.com**, and then click **Next**.
5. On the **Select server roles** page, select the **Active Directory Domain Services** check box.
6. In the **Add features that are required for Active Directory Domain Services** dialog box, click **Add Features**, and then click **Next**.
7. On the **Select features** page, click **Next**.
8. On the **Active Directory Domain Services** page, click **Next**.
9. On the **Confirm installation selections** page, select the **Restart the destination server automatically if required** check box, and then click **Install**.
10. When installation completes, click **Close**.
11. In the **Server Manager** dashboard, on the menu bar, click the notification icon (the flag icon or yellow triangle).
12. Locate the **Post-deployment Configuration** task, and then click **Promote this server to a domain controller**.
13. In the **Active Directory Domain Services Configuration Wizard**, ensure that **Add a domain controller to an existing domain** is selected.
14. In the **Supply the credentials to perform this operation** section, click **Change**.
15. In the **Windows Security** dialog box, in the **User name** text box, type **Adatum\Administrator**, and then in the **password** text box, type **Pa55w.rd**. Click **OK**, and then click **Next**.
16. On the **Domain Controller Options** page, ensure that the **Domain Name System (DNS) Server** and the **Global Catalog (GC)** check boxes are selected, and then select the **Read only domain controller (RODC)** check box.
17. Type and confirm the **Directory Services Restore Mode (DSRM) password** to be **Pa55w.rd**, and then click **Next**.
18. On the **RODC Options** page, click **Next**.
19. On the **Additional Options** page, click **Next**.
20. On the **Paths** page, click **Next**.

21. On the **Review Options** page, click **Next**.
22. On the **Prerequisites Check** page, click **Install**.
23. When the promotion completes, click **Close**. Note that **LON-SVR3** restarts.

### **Configure the password replication policy**

1. On **LON-DC1**, in **Server Manager**, on the **Tools** menu, click **Active Directory Users and Computers**.
2. If necessary, expand **Adatum.com**, and then click **Domain Controllers**.
3. In the **details** pane, right-click **LON-SVR3**, and then click **Properties**.
4. In the **LON-SVR3 Properties** dialog box, click the **Password Replication Policy** tab, and then click **Add**.
5. In the **Add Groups, Users and Computers** dialog box, click **Allow passwords for the account to replicate to this RODC**, and then click **OK**.
6. In the **Select Users, Computers, Services Accounts, or Groups** dialog box, type **Managers**, and then click **OK**.
7. Click the **Managed By** tab, and then click **Change**.
8. In the **Select User or Group** dialog box, type **IT**, and then click **OK**.
9. In the **LON-SVR3 Properties** dialog box, click **OK**.
10. Close **Active Directory Users and Computers**.

## Lesson 2

# Implementing service accounts

### Contents:

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Demonstration: Configuring managed service accounts	7

## Question and Answers

**Question:** You can only configure and administer group managed service accounts on computers that run Windows Server 2008 R2 or later.

- ( ) True
- ( ) False

**Answer:**

- ( ) True
- (v) False

**Feedback:**

You can only configure and administer group managed service accounts on computers that run Windows Server 2012 or later.

## Demonstration: Configuring managed service accounts

### Demonstration Steps

1. On LON-DC1, right-click **Start**, and then click **Windows PowerShell (Admin)**.
2. At the Windows PowerShell command prompt, type the following command, and then press Enter:

```
Add-KdsRootKey -EffectiveTime ((get-date).addhours(-10))
```

3. At the Windows PowerShell command prompt, type the following command, and then press Enter:

```
New-ADServiceAccount -Name Webservice -DNSHostName LON-DC1 -  
PrincipalsAllowedToRetrieveManagedPassword LON-DC1$
```

4. At the Windows PowerShell command prompt, type the following command, and then press Enter:

```
Add-ADComputerServiceAccount -identity LON-DC1 -ServiceAccount Webservice
```

5. At the Windows PowerShell command prompt, type the following command, and then press Enter:

```
Get-ADServiceAccount -Filter *
```

6. Note the output of the command.
7. Close Windows PowerShell.

## Lesson 3

# Azure AD

### Contents:

Question and Answers

9

## Question and Answers

**Question:** Do you think that your organization might use Azure AD? In what capacity will your organization implement it?

**Answer:** Answers will vary based on students' organizational needs.

## Module Review and Takeaways

### Review Questions

**Question:** To implement Microsoft Passport, which operating systems must be on users' devices?

**Answer:** To implement Microsoft Passport, users' devices must run Windows 10 Pro or Windows 10 Enterprise.

**Question:** To enable Kerberos delegation, what requirements must be met?

**Answer:** To enable Kerberos delegation:

- The user object must not have the Account is sensitive and cannot be delegated option enabled.
- SPNs must be registered for the application service accounts.
- The application service account must be trusted for delegation. This enables the account to act on behalf of another user.

**Question:** What are the benefits of implementing Azure AD?

**Answer:** Azure AD provides the following benefits:

- High availability. Azure AD is generally more highly available than most organizations can provide on-premises.
- Scalable. The Azure environment can scale to meet very large workloads on demand.
- Disaster recovery. Azure AD provides built-in disaster recovery and the ability to be a disaster recovery site for on-premises AD DS.
- Integration with on-premises AD DS, including directory synchronization and SSO. This includes the ability to limit the data that syncs to Azure AD.
- APIs. The Azure Service Management representational state transfer (REST) API provides developers the ability to perform management portal tasks programmatically. The Graph API allows developers to query directory data from their applications.

# Lab Review Questions and Answers

## Lab: Implementing and managing AD DS

### Question and Answers

**Question:** What are two benefits of using managed service accounts in Windows Server 2016?

**Answer:** The benefits are:

- Automatic password management. A managed service account automatically maintains its own password, including password changes. This can better isolate services from other services on a computer.
- Simplified service principal name (SPN) management. If the **samAccountName** property of a computer changes, or if the DNS host name property is modified, the managed service account SPN automatically changes from the old name to the new name for all managed service accounts on the computer.

# Module 4

## Implementing AD FS

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## Lesson 1

# Overview of AD FS

### Contents:

Question and Answers

3

## Question and Answers

**Question:** A federated trust is the same as a forest trust that organizations can configure between AD DS forests.

True

False

**Answer:**

True

False

**Feedback:**

A federated trust is not the same as a forest trust that organizations can configure between AD DS forests. In a federated trust, the AD FS servers in two organizations never have to communicate directly with each other. In addition, all communication in a federation deployment occurs over Hypertext Transfer Protocol over Secure Sockets Layer (HTTPS), so you do not need to open multiple ports on any firewalls to enable federation.

## Lesson 2

# Deploying AD FS

### Contents:

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Demonstration: Installing the AD FS server role	5

## Question and Answers

**Question:** In Windows Server 2016, the federation server proxy functionality is part of the Web Application Proxy role.

- ( ) True  
( ) False

**Answer:**

- (√) True  
( ) False

**Feedback:**

The federation server proxy is an optional component that you usually deploy in a perimeter network. It does not add any functionality to the AD FS deployment but is deployed to provide a layer of security for connections from the Internet to the federation server. In Windows Server 2016, the federation server proxy functionality is part of Web Application Proxy.

## Demonstration: Installing the AD FS server role

### Demonstration Steps

#### Install AD FS

1. On **LON-SVR2**, open **Server Manager**, click **Manage**, and then click **Add Roles and Features**.
2. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.
3. On the **Select installation type** page, click **Role-based or feature-based installation**, and then click **Next**.
4. On the **Select destination server** page, click **LON-SVR2.Adatum.com**, and then click **Next**.
5. On the **Select server roles** page, select the **Active Directory Federation Services** check box, and then click **Next**.
6. On the **Select features** page, click **Next**.
7. On the **Active Directory Federation Services (AD FS)** page, click **Next**.
8. On the **Confirm installation selections** page, click **Install**.
9. Wait until installation is complete, and then click **Close**.

#### Add a DNS record for AD FS

1. On **LON-DC1**, in **Server Manager**, click **Tools**, and then click **DNS**.
2. In **DNS Manager**, expand **LON-DC1**, expand **Forward Lookup Zones**, and then click **Adatum.com**.
3. Right-click **Adatum.com**, and then click **New Host (A or AAAA)**.
4. In the **New Host** window, in the **Name** box, type **adfs**.
5. In the **IP address** box, type **172.16.0.12**, and then click **Add Host**.
6. In the **DNS** window, click **OK**, and then click **Done**.
7. Close **DNS Manager**.

#### Configure AD FS

1. On **LON-SVR2**, in **Server Manager**, click the **Notifications** icon, and then click **Configure the federation service on this server**.

2. In the **Active Directory Federation Services Configuration Wizard**, on the **Welcome** page, click **Create the first federation server in a federation server farm**, and then click **Next**.
3. On the **Connect to Active Directory Domain Services** page, click **Next** to use **Adatum\Administrator** to perform the configuration.
4. On the **Specify Service Properties** page, in the **SSL Certificate** box, select **adfs.adatum.com**.
5. In the **Federation Service Display Name** box, type **A. Datum Corporation**, and then click **Next**.
6. On the **Specify Service Account** page, click **Create a Group Managed Service Account**.
7. In the **Account Name** box, type **ADFS**, and then click **Next**.
8. On the **Specify Configuration Database** page, click **Create a database on this server using Windows Internal Database**, and then click **Next**.
9. On the **Review Options** page, click **Next**.
10. On the **Pre-requisite Checks** page, click **Configure**.
11. On the **Results** page, click **Close**.



**Note:** If you receive a timeout error that the configuration failed, repeat steps 1 through 11.

12. Restart LON-SVR2 and sign in as **Adatum\Administrator** with the password **Pa55w.rd**.

## Lesson 3

# Implementing AD FS for a single organization

### Contents:

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Demonstration: Configuring claims provider and relying party trusts	8

## Question and Answers

**Question:** What are claim rules? What can you use claim rules for?

**Answer:** Claim rules define send and consume claims from AD FS servers. Claim rules define the business logic that is applied to claims that are provided by claims providers, and to claims that are accepted by the relying parties. You can use claim rules to:

- Define which incoming claims are accepted from one or more claims providers.
- Define which outbound claims are provided to one or more relying parties.
- Apply authorization rules to enable access to a specific relying party for one or more users or groups of users.

## Demonstration: Configuring claims provider and relying party trusts

### Demonstration Steps

#### Configure a claims provider trust

1. On **LON-SVR2**, click **Start**, and then click **Server Manager**.
2. In **Server Manager**, click **Tools**, and then click **AD FS Management**.
3. In the **AD FS Management** console, click **Claims Provider Trusts**.
4. Right-click **Active Directory**, and then click **Edit Claim Rules**.
5. In the **Edit Claim Rules for Active Directory** dialog box, on the **Acceptance Transform Rules** tab, click **Add Rule**.
6. In the **Add Transform Claim Rule Wizard**, on the **Select Rule Template** page, in the **Claim rule template** list, click **Send LDAP Attributes as Claims**, and then click **Next**.
7. On the **Configure Rule** page, in the **Claim rule name** box, type **Outbound LDAP Attributes Rule**.
8. In the **Attribute store** list, click **Active Directory**.
9. In the **Mapping of LDAP attributes to outgoing claim types** section, select the following values for the LDAP Attribute and the Outgoing Claim Type:
  - E-Mail-Addresses: **E-Mail Address**
  - User-Principal-Name: **UPN**
10. Click **Finish**, and then click **OK**.

#### Configure a WIF application for AD FS

1. On **LON-SVR1**, open **Server Manager**, click **Tools**, and then click **Windows Identity Foundation Federation Utility**.
2. On the **Welcome to the Federation Utility Wizard** page, in the **Application configuration location** box, type **C:\inetpub\wwwroot\AdatumTestApp\web.config** for the location of the sample Web.config file.
3. In the **Application URI** box, type **https://lon-svr1.adatum.com/AdatumTestApp/** to indicate the path to the sample application that will trust the incoming claims from the federation server, and then click **Next** to continue.
4. On the **Security Token Service** page, click **Use an existing STS**, in the **STS WS-Federation metadata document location** box, type **https://adfs.adatum.com/federationmetadata/2007-06/federationmetadata.xml**, and then click **Next** to continue.

5. On the **STS signing certificate chain validation error** page, click **Disable certificate chain validation**, and then click **Next**.
6. On the **Security token encryption** page, click **No encryption**, and then click **Next**.
7. On the **Offered claims** page, review the claims that will be offered by the federation server, and then click **Next**.
8. On the **Summary** page, review the changes that will be made to the sample application by the **Federation Utility Wizard**, scroll through the items to understand what each item is doing, and then click **Finish**.
9. In the **Success** window, click **OK**.

### Configure a relying party trust

1. On **LON-SVR2**, right-click **Start** and then click **Windows PowerShell (Admin)**.
2. In the **Administrator: Windows PowerShell** command prompt, type the following command and then press Enter:

```
Add-ADFSRelyingPartyTrust -Name 'A. Datum Test App' -MetadataURL 'https://lon-svr1.adatum.com/AdatumTestApp/federationmetadata/2007-06/federationmetadata.xml'
```



**Note:** This command is necessary due to a bug in the AD FS console. This is likely to be fixed when this course releases.

3. On **LON-SVR2**, in the **AD FS** console, click **Relying Party Trusts**.
4. In the details pane, right-click **A. Datum Test App**, and then click **Edit Access Control Policy**.
5. In the **Edit Access Control Policy for Adatum Test App** dialog box, in the **Name** list, click **Permit everyone**, and then click **OK**.
6. Right-click **A. Datum Test App**, and then click **Edit Claims Issuance Policy**.
7. In the **Edit Claim Issuance Policy for A. Datum Test App** dialog box, on the **Issuance Transform Rules** tab, click **Add Rule**.
8. In the **Claim rule template** box, select **Pass Through or Filter an Incoming Claim**, and then click **Next**.
9. In the **Claim rule name** box, type **Pass through Windows account name**.
10. In the **Incoming claim type** drop-down list, click **Windows account name**, and then click **Finish**.
11. On the **Issuance Transform Rules** tab, click **Add Rule**.
12. In the **Claim rule template** box, select **Pass Through or Filter an Incoming Claim**, and then click **Next**.
13. In the **Claim rule name** box, type **Pass through E-Mail Address**.
14. In the **Incoming claim type** drop-down list, click **E-Mail Address**, and then click **Finish**.
15. On the **Issuance Transform Rules** tab, click **Add Rule**.
16. In the **Claim rule template** box, select **Pass Through or Filter an Incoming Claim**, and then click **Next**.
17. In the **Claim rule name** box, type **Pass through UPN**.
18. In the **Incoming claim type** drop-down list, click **UPN**, and then click **Finish**.

19. On the **Issuance Transform Rules** tab, click **Add Rule**.
20. In the **Claim rule template** box, select **Pass Through or Filter an Incoming Claim**, and then click **Next**.
21. In the **Claim rule name** box, type **Pass through Name**.
22. In the **Incoming claim type** drop-down list, click **Name**, and then click **Finish**.
23. On the **Issuance Transform Rules** tab, click **OK**.

## Lesson 4

# Implementing Web Application Proxy

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## Question and Answers

**Question:** Which of the following statements about configuring Web Application Proxy is true? (Choose all that apply.)

- ( ) To install Web Application Proxy, you must have implemented AD FS in your organization.
- ( ) To install Web Application Proxy, you need not have implemented AD FS in your organization.
- ( ) For each application that you publish, you must configure an external URL and an internal server URL.
- ( ) When you define the external URL, you must also select a certificate that contains the host name in the internal URL.
- ( ) When you define the external URL, you must also select a certificate that contains the host name in the external URL.

**Answer:**

- (√) To install Web Application Proxy, you must have implemented AD FS in your organization.
- ( ) To install Web Application Proxy, you need not have implemented AD FS in your organization.
- (√) For each application that you publish, you must configure an external URL and an internal server URL.
- ( ) When you define the external URL, you must also select a certificate that contains the host name in the internal URL.
- (√) When you define the external URL, you must also select a certificate that contains the host name in the external URL.

**Feedback:**

Option 4 is incorrect. The certificate must contain the host name of the external URL.

Option 2 is incorrect. To install Web Application Proxy, AD FS must be implemented in your organization already.

## Demonstration: Installing and configuring Web Application Proxy

### Demonstration Steps

#### Install Web Application Proxy

1. On **LON-SVR3**, open **Server Manager**, click **Manage**, and then click **Add Roles and Features**.
2. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.
3. On the **Select installation type** page, click **Role-based or feature-based installation**, and then click **Next**.
4. On the **Select destination server** page, click **LON-SVR3.Adatum.com**, and then click **Next**.
5. On the **Select server roles** page, select the **Remote Access** check box, and then click **Next**.
6. On the **Select features** page, click **Next**.
7. On the **Remote Access** page, click **Next**.
8. On the **Select role services** page, select the **Web Application Proxy** check box.
9. In the **Add Roles and Features Wizard**, click **Add Features**.
10. On the **Select role services** page, click **Next**.

11. On the **Confirm installation selections** page, click **Install**.
12. On the **Installation progress** page, click **Close**.

### **Export the adfs.adatum.com certificate from LON-SVR2**

1. On **LON-SVR2**, click **Start**, type **mmc**, and then press Enter.
2. In the **Microsoft Management** console, click **File**, and then click **Add/Remove Snap-in**.
3. In the **Add or Remove Snap-ins** window, in the **Available snap-ins** column, double-click **Certificates**.
4. In the **Certificates snap-in** window, click **Computer account**, and then click **Next**.
5. In the **Select Computer** window, click **Local Computer (the computer this console is running on)**, and then click **Finish**.
6. In the **Add or Remove Snap-ins** window, click **OK**.
7. In the **Microsoft Management** console, expand **Certificates (Local Computer)**, expand **Personal**, and then click **Certificates**.
8. Right-click **adfs.adatum.com**, point to **All Tasks**, and then click **Export**.
9. In the **Certificate Export Wizard**, click **Next**.
10. On the **Export Private Key** page, click **Yes, export the private key**, and then click **Next**.
11. On the **Export File Format** page, click **Next**.
12. On the **Security** page, select the **Password** check box.
13. In the **Password** and **Confirm password** boxes, type **Pa55w.rd**, and then click **Next**.
14. On the **File to Export** page, in the **File name** box, type **C:\adfs.pfx**, and then click **Next**.
15. On the **Completing the Certificate Export Wizard** page, click **Finish**, and then, to close the success message, click **OK**.
16. Close the **Microsoft Management** console, and do not save the changes.

### **Import the adfs.adatum.com certificate on LON-SVR3**

1. On **LON-SVR3**, click **Start**, type **mmc**, and then press Enter.
2. In the **Microsoft Management** console, click **File**, and then click **Add/Remove Snap-in**.
3. In the **Add or Remove Snap-ins** window, in the **Available snap-ins** column, double-click **Certificates**.
4. In the **Certificates snap-in** window, click **Computer account**, and then click **Next**.
5. In the **Select Computer** window, click **Local Computer (the computer this console is running on)**, and then click **Finish**.
6. In the **Add or remove Snap-ins** window, click **OK**.
7. In the **Microsoft Management** console, expand **Certificates (Local Computer)**, and then click **Personal**.
8. Right-click **Personal**, point to **All Tasks**, and then click **Import**.
9. In the **Certificate Import Wizard**, click **Next**.
10. On the **File to Import** page, in the **File name** box, type **\\LON-SVR2\c\$\adfs.pfx**, and then click **Next**.

11. On the **Private key protection** page, in the **Password** box, type **Pa55w.rd**.
12. Select the **Mark this key as exportable. This will allow you to back up or transport your keys at a later time** check box, and then click **Next**.
13. On the **Certificate Store** page, click **Place all certificates in the following store**.
14. In the **Certificate store** box, select **Personal**, and then click **Next**.
15. On the **Completing the Certificate Import Wizard** page, click **Finish**.
16. To clear the success message, click **OK**.
17. Close the **Microsoft Management** console, and do not save the changes.

### **Configure Web Application Proxy**

1. On **LON-SVR3**, in **Server Manager**, click the **Notifications** icon, and then click **Open the Web Application Proxy Wizard**.
2. In the **Web Application Proxy Configuration Wizard**, on the **Welcome** page, click **Next**.
3. On the **Federation Server** page, enter the following, and then click **Next**:
  - o Federation service name: **adfs.adatum.com**
  - o User name: **Adatum\Administrator**
  - o Password: **Pa55w.rd**
4. On the **AD FS Proxy Certificate** page, in the **Select a certificate to be used by the AD FS proxy** box, select **adfs.adatum.com**, and then click **Next**.
5. On the **Confirmation** page, click **Configure**.
6. On the **Results** page, click **Close**.

## Lesson 5

# Implementing SSO with Microsoft online services

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## Question and Answers

**Question:** How will your organization implement SSO with online services, such as Microsoft Office 365?

**Answer:** Answers will vary depending on the students' organizations' needs.

## Resources

### Configuring SSO for integration with Microsoft online services



**Additional Reading:** For additional guidance on these steps, refer to Checklist: Use AD FS to implement and manage single sign-on: <http://aka.ms/Dxonts>

# Module Review and Takeaways

## Review Questions

**Question:** Your organization is planning to implement AD FS. In the short term, only internal clients will use AD FS to access internal applications. However, later you will provide access to web-based applications that are secured by AD FS to users at home. How many certificates should you obtain from a third-party CA?

**Answer:** You require only a single certificate from a third-party because the only AD FS certificate that needs to be trusted is the service communication certificate. You can leave the token signing and token decrypting certificates as self-signed.

**Question:** Your organization has implemented a single AD FS server and a single Web Application Proxy successfully. Initially, AD FS was used for only a single application, but now it is used for several business-critical applications. AD FS must be configured to be highly available.

During the installation of AD FS, you selected to use the Windows Internal Database. Can you use this database in a highly available configuration?

**Answer:** Yes, you can use the Windows Internal Database to support up to five AD FS servers. The first AD FS server is the primary server where all configuration changes take place. Changes in the primary server are replicated to the other AD FS servers.

## Lab Review Questions and Answers

### Lab A: Implementing AD FS

#### Question and Answers

**Question:** Why is it important to configure adfs.adatum.com to use as a host name for the AD FS service?

**Answer:** If you use the host name of an existing server for the AD FS server, you will not be able to add additional servers to your server farm. All servers in the server farm must share the same host name when providing AD FS services. AD FS proxy servers also use the host name for AD FS.

**Question:** How can you test whether AD FS is functioning properly?

**Answer:** If you can successfully access <https://hostname/federationmetadata/2007-06/federationmetadata.xml> on the AD FS server, then AD FS is functioning properly.

### Lab B: Implementing Web Application Proxy

#### Question and Answers

**Question:** In the lab, you received a certificate error when connecting from **LON-CL3** to the A. Datum Test App. Why did this error occur, and what can you do to avoid this?

**Answer:** The error occurs because the client computer does not trust the Adatum CA that issued the web server certificates used by the A. Datum Test App. You could either add the root certificate of the CA to the Trusted Root Certification Authorities on **LON-CL3**, or use certificates from an authority that **LON-CL3** already trusts, such as an external CA.

# Module 5

## Implementing network services

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## Lesson 1

# Overview of networking enhancements

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## Question and Answers

**Question:** Which of the following options are new or different in Windows Server 2016? (Select all that apply.)

- DNS policies
- DHCP failover
- IPv6 root hints in DNS
- Hyper-V virtualized networking
- No DHCP server support for NAP

**Answer:**

- DNS policies
- DHCP failover
- IPv6 root hints in DNS
- Hyper-V virtualized networking
- No DHCP server support for NAP

**Feedback:**

Windows Server 2012 introduced the DHCP failover and Hyper-V virtualized networking features.

**Question:** You need more physical NICs when you configure converged networking on a Hyper-V host.

- True
- False

**Answer:**

- True
- False

**Feedback:**

Converged networking means to configure the Hyper-V host with fewer physical NICs and to create virtual NICs rather than more physical NICs.

## Resources

### What is converged networking?

 **Additional Reading:** For more information, refer to Remote Direct Memory Access (RDMA) and Switch Embedded Teaming (SET): <http://aka.ms/Kjbew7>

### New DNS features in Windows Server 2016

 **Additional Reading:** For more information, refer to What's New in DNS Server in Windows Server 2012 R2: <http://aka.ms/q8slci>

## DNS policies



**Additional Reading:** For more information, refer to DNS Policies Overview:  
<http://aka.ms/lm8s95>

## Changes in DHCP features in Windows Server 2016



**Additional Reading:** For more information, refer to What's New in DHCP in Windows Server 2016: <http://aka.ms/lyimjo>



**Reference Links:** For more information, refer to Windows PowerShell for DHCP server:  
<http://aka.ms/Pj3sjc>

## Demonstration: Configuring DNS policies

### Demonstration Steps

1. On **TREY-DC1**, in **Server Manager**, click **Tools**, and then click **DNS**.
2. In the **DNS** console, expand **TREY-DC1**, and then click **Conditional Forwarders**.
3. Right-click **Conditional Forwarders**, and then click **New Conditional Forwarder**.
4. In the **New Conditional Forwarder** dialog box, in the **DNS Domain** text box, type **Adatum.com**, and, in the **IP addresses of the master servers** list, click **<Click here to add an IP Address or DNS Name>**, type **172.16.0.10**, press Enter, and then click **OK**.
5. Click **Start**, and then click **Windows PowerShell**.
6. In the **Windows PowerShell** window, type the following three commands, pressing Enter after each command:

```
Clear-DnsClientCache
Clear-DnsServerCache
Resolve-DnsName LON-DC1.Adatum.com
```

7. When you receive a prompt, press **Y**, and then press Enter. Verify that the name resolves to an IP address. If the last command returns an error, repeat the last command.
8. Switch to **LON-DC1**.
9. On **LON-DC1**, click **Start**, and then click **Windows PowerShell**.
10. In the **Windows PowerShell** window, type the following two commands, pressing Enter after each command:

```
Add-DnsServerClientSubnet -Name "TreyResearchSubnet" -IPv4Subnet 172.16.10.0/24 -
PassThru
Add-DnsServerQueryResolutionPolicy -Name "BlackholePolicyTreyResearch" -Action IGNORE
-ClientSubnet "EQ,TreyResearchSubnet" -PassThru
```

11. Switch to **TREY-DC1**.
12. On **TREY-DC1**, in the **Windows PowerShell** window, type the following three commands, pressing Enter after each command:

```
Clear-DnsClientCache
Clear-DnsServerCache
Resolve-DnsName LON-DC1.Adatum.com
```

13. When you receive a prompt, press **Y**, and then press Enter. Verify that the last command returns an error because the DNS policy no longer allows **TREY-DC1** to do name resolution on **LON-DC1**.

## Demonstration: Configuring DHCP failover

### Demonstration Steps

#### Configure a DHCP failover relationship

1. On **LON-SVR1**, open **Server Manager**.
2. Click **Tools** and then click **DHCP**.
3. In the **DHCP** console, right-click **DHCP**, and then click **Add Server**.
4. In the **Add Server** dialog box, click the **This authorized DHCP server** option, click **lon-dc1.adatum.com**, and then click **OK**.
5. In the **DHCP** console, expand **lon-dc1**, select and then right-click **IPv4**, and then click **Configure Failover**.
6. In **Configure Failover Wizard**, click **Next**.
7. On the **Specify the partner server to use for failover** page, in the **Partner Server** field, type **172.16.0.11**, and then click **Next**.
8. On the **Create a new failover relationship** page, in the **Relationship Name** field, type **Adatum**.
9. In the **Maximum Client Lead Time** field, in the **hours** text box, type **0**, and then, in the **minutes** text box, type **15**.
10. Ensure that the **Mode** field is set to **Load balance**.
11. Ensure that the **Load Balance Percentage** is set to **50%**.
12. Select the **State Switchover Interval** check box. Do not change the default value of **60 minutes**.
13. In the **Enable Message Authentication Shared Secret** field, type **Pa55w.rd**, and then click **Next**.
14. Click **Finish**, and then click **Close**.
15. In the **lon-svr1.adatum.com** node, click **IPv4**, and then press F5.
16. Expand the **IPv4** node, and then expand **Scope [172.16.0.0] Adatum**.
17. Click **Address Pool**. Notice that the address pool is configured.
18. Click **Scope Options**. Notice that the scope options are configured.
19. Close the **DHCP** console.

## Lesson 2

# Implementing IPAM

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## Question and Answers

**Question:** Which of the following statements are true? (Choose all that apply.)

- You can install IPAM on an AD DS domain controller.
- You can install IPAM on a domain-joined server.
- IPAM can manage servers that are running Windows Server 2012 and newer only.
- IPAM can manage servers that are running Windows Server 2008 and newer only.
- You must install SQL Server locally on the IPAM server.

**Answer:**

- You can install IPAM on an AD DS domain controller.
- You can install IPAM on a domain-joined server.
- IPAM can manage servers that are running Windows Server 2012 and newer only.
- IPAM can manage servers that are running Windows Server 2008 and newer only.
- You must install SQL Server locally on the IPAM server.

**Feedback:**

You cannot install IPAM on a domain controller. However, you still need to join the server to a domain. IPAM can manage Windows Server 2008, if you install the correct management tools. You can use both Windows Internal Database (WID) and supported versions of Microsoft SQL Server to store the IPAM database. IPAM does not require that you install SQL Server locally.

## Demonstration: Implementing IPAM

### Demonstration Steps

#### Install IPAM

1. On **LON-SVR2**, click **Start**, and then click **Server Manager**.
2. In the **Server Manager** console, click **Add roles and features**.
3. In **Add Roles and Features Wizard**, click **Next**.
4. On the **Select installation type** page, click **Next**.
5. On the **Select destination server** page, click **Next**.
6. On the **Select server roles** page, click **Next**.
7. On the **Select features** page, select the **IP Address Management (IPAM) Server** check box.
8. In the **Add Roles and Features Wizard** dialog box, click **Add Features**, and then click **Next**.
9. On the **Confirm installation selections** page, click **Install**.
10. When **Add Roles and Features Wizard** completes, click **Close**.

#### Configure IPAM

1. In the **Server Manager** navigation pane, click **IPAM**.
2. In the **IPAM Overview** content pane, verify that in the **Connect to IPAM server** section, IPAM is connected to **LON-SVR2.ADATUM.COM** as **Adatum\Administrator**.
3. Click **Provision the IPAM server**.
4. In **Provision IPAM Wizard**, click **Next**.

5. On the **Configure database** page, click **Next**.
6. On the **Select provisioning method** page, ensure that **Group Policy Based** is selected. In the **GPO name prefix** text box, type **IPAM**, and then click **Next**.
7. On the **Summary** page, click **Apply**. Provisioning will take a few minutes to complete.
8. When provisioning has completed, click **Close**.
9. In the **IPAM Overview** content pane, click **Configure server discovery**.
10. In the **Configure Server Discovery** dialog box, click **Get forests**, and then in the **Configure Server Discovery** dialog box, click **OK**. Click **Cancel**. The yellow status bar indicates when discovery is complete.
11. In the **IPAM Overview** content pane, click **Configure server discovery**.
12. Click **Add** to add the **Adatum.com** domain, and then click **OK**.
13. In the **IPAM Overview** content pane, click **Start server discovery**. Discovery might take 5 to 10 minutes to run. The yellow status bar indicates when discovery is complete.
14. In the **IPAM Overview** content pane, click **Select or add servers to manage and verify IPAM access**. Notice that the **IPAM Access Status** is blocked for **LON-DC1**. Scroll down to the **Details** view, and notice the status report.
15. In the taskbar, click **Start**, and then click **Windows PowerShell**.
16. In the **Windows PowerShell** window, type the following command, and then press Enter:

```
Invoke-IPAMGpoProvisioning -Domain Adatum.com -GpoPrefixName IPAM -IpamServerFqdn LON-SVR2.adatum.com -DelegatedGpoUser Administrator
```

17. When you receive a prompt to confirm the action, type **Y**, and then press Enter. The command will take a few minutes to complete.
18. Close the **Windows PowerShell** window.
19. Switch to **LON-DC1**.
20. In **LON-DC1**, in the **Server Manager** console, click **Tools**, and then click **Group Policy Management**.
21. In the **Group Policy Management** console, expand **Forest: Adatum.com**, expand **Domains**, and then expand **Adatum.com**.
22. Verify that three Group Policy Objects (GPOs) starting with **IPAM\_** are linked to the **Adatum.com** domain.
23. In the navigation pane, click the **IPAM\_DNS** GPO.
24. In the **Group Policy Management Console** dialog box, click **OK**.
25. Verify that the **Security Filtering** section is empty.
26. Switch to **LON-SVR2**.
27. In **LON-SVR2**, switch to **Server Manager**. In the **IPv4** content pane, right-click the line with **LON-DC1**, and then click **Edit Server**.
28. In the **Add or Edit Server** dialog box, set the **Manageability status** field to **Managed**, and then click **OK**.
29. Switch to **LON-DC1**.
30. In **LON-DC1**, in the **Group Policy Management** console, press F5.

31. In the **Group Policy Management Console** dialog box, click **OK**.
32. Verify that the **Security Filtering** section no longer is empty. **LON-DC1\$** is now listed.
33. Click **Start**, type **cmd**, and then press Enter.
34. In the command prompt window, type **Gpupdate /force**, and then press Enter.
35. Wait for the Gpupdate process to complete, and then close the command prompt.
36. Switch to **LON-SVR2**.
37. In **LON-SVR2**, in the **Server Manager** window, right-click the line with **LON-DC1**, and then click **Refresh Server Access Status**. Discovery might take 5 to 10 minutes to run. The yellow status bar indicates when discovery is complete.
38. After discovery is complete, refresh IPv4 by clicking the **Refresh** icon. It might take up to 5 minutes for the status to change. Verify that the **IPAM Access Status** for **LON-DC1** is now Unblocked.
39. In the **IPAM** navigation pane, click **Overview**.
40. In the **IPAM Overview** content pane, click **Retrieve data from managed servers**. This action will take a few minutes to complete.

## Lesson 3

# Managing IP address spaces with IPAM

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## Resources

### Using IPAM to manage IP addressing

 **Additional Reading:** For more information, refer to REGIONAL INTERNET REGISTRIES: <http://aka.ms/s8hoes>

### Administering IPAM

 **Additional Reading:** For more information, refer to Manage IPAM: <http://aka.ms/sjmpco>

## Module Review and Takeaways

### Review Questions

**Question:** How many DHCP servers can you configure as part of a DHCP failover relationship?

**Answer:** Each DHCP failover relationship can only contain two DHCP servers. However, each DHCP server can be a part of multiple relationships, as long as the relationship names are unique.

**Question:** Describe a limitation of IPAM.

**Answer:** IPAM is not able to manage non-Windows devices, such as network devices. You can use the **Network Controller** role in Windows Server 2016 to manage network devices.

### Real-world Issues and Scenarios

**Scenario:** What are some scenarios in which you would use DNS policies?

**Answer:** You can use DNS policies to configure split-brain DNS, DNS load balancing, and DNS responses based on criteria such as time of day, client IP address, DNS server IP address, and query type.

**Scenario:** What are some methods that you can use to guard against DHCP failures?

**Answer:** You can use DHCP failover protection, a DHCP split-scope solution, or you can cluster the DHCP servers.

### Tools

The following table includes the tools that are needed for this module:

Tool	Use	Where to find it
The <b>DNS management</b> console	Configure all aspects of DNS.	In Server Manager, in the <b>Tools</b> drop-down list box.
The <b>DHCP</b> console	Configure all aspects of DHCP.	In Server Manager, in the <b>Tools</b> drop-down list box.
The <b>IPAM</b> console	Configure IP address management.	In Server Manager.

# Lab Review Questions and Answers

## Lab: Implementing network services

### Question and Answers

**Question:** Will you be implementing DNS policies in your DNS infrastructure? Discuss your answers with the rest of the students.

**Answer:** Answers will vary but might include split-brain DNS, block malicious attempts, and application load balancing.

**Question:** What is the difference between a centralized and a distributed IPAM topology?

**Answer:** In a centralized topology, there is only one IPAM server. In a distributed topology, there is an IPAM server in every site. IPAM servers do not communicate with each other in a distributed topology. You configure each IPAM server independently.

# Module 6

## Implementing Hyper-V

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## Lesson 1

# Configure the Hyper-V role in Windows Server 2016

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Demonstration: Installing and configuring the Hyper-V role	4

## Question and Answers

**Question:** In a scenario where you are limited to only one physical server, how can you build a test or development environment with multiple hosts and virtual machines on those hosts?

**Answer:** Answers might vary but should include:

1. Ensure that the host is running Windows Server 2016.
2. Build a virtual machine with a minimum of 4 gigabytes (GB) of static memory.
3. Enable nested virtualization.
4. Install the Hyper-V role and create the build by using new virtual machines on a nested virtualization host.

**Question:** When you are configuring a Hyper-V host, what are some best practice guidelines to follow? Select all that apply.

- Use Generation 2 virtual machines if the guest operating system supports them.
- Manage Hyper-V locally.
- Run Hyper-V by using the Server Core or Nano configuration.
- Do not collocate other server roles.
- Provision the host with adequate hardware.

**Answer:**

- Use Generation 2 virtual machines if the guest operating system supports them.
- Manage Hyper-V locally.
- Run Hyper-V by using the Server Core or Nano configuration.
- Do not collocate other server roles.
- Provision the host with adequate hardware.

**Feedback:**

All the options are best practices except for managing Hyper-V locally. You should always manage Hyper-V remotely by using **Hyper-V Manager**, **Failover Cluster Manager**, or Microsoft System Center 2012 R2 Virtual Machine Manager.

## Resources

### New features in Windows Server 2012 R2 Hyper-V

 **Additional Reading:** For more information, refer to: "What's New in Hyper-V for Windows Server 2012 R2" at: <http://aka.ms/y3gvwz>

### New features in Windows Server 2016 Hyper-V

 **Additional Reading:** For more information, refer to: "What's new in Hyper-V on Windows Server 2016" at: <https://aka.ms/rpjomy>

## Best practices for configuring Hyper-V hosts



**Additional Reading:** For more information, refer to: “Tip: 6 Best Practices for Physical Servers Hosting Hyper-V Roles” at: <http://aka.ms/aquwzd>

## Demonstration: Installing and configuring the Hyper-V role

### Demonstration Steps

1. Sign in to **LON-HOST1** as **Adatum\Administrator** with the password **Pa55w.rd**.
2. Open **Server Manager**, and then on the **Tools** menu, click **Hyper-V Manager**.
3. In the navigation pane, right-click **LON-HOST1**, and then click **Hyper-V Settings**.
4. Click **Virtual Hard Disks**. Show where to change the location of the default virtual hard disks folder.
5. Click **Virtual Machines**. Show where to change the location of the default virtual machine configuration files folder.
6. Click **Physical GPUs**. Explain that the Remote Desktop Virtualization Host role service must be installed before you can enable Microsoft RemoteFX and GPU management.
7. Click **NUMA Spanning**. Explain that when you enable NUMA spanning, servers take advantage of Non-Uniform Memory Access (NUMA) performance optimizations.



**Note:** Mention that Module 12: “Implementing Failover Clustering with Windows Server 2016 Hyper-V,” discusses live migrations, storage migrations, and replication configuration.

## Lesson 2

**Configuring Hyper-V storage****Contents:**

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## Question and Answers

**Question:** You want to create a guest cluster for which you can manage and resize the shared storage through Hyper-V while the servers are online. What requirement must you consider?

**Answer:** Answers might vary but should include:

- Host and guests should be running Windows Server 2016.
- The storage should be a shared .vhdx or .vhds file that is created on a Cluster Shared Volume (CSV) if in a cluster or SMB 3.0 if the guests are not on clustered hosts.

**Question:** When you configure a virtual hard disk, which of the following options are available? Select all that apply.

- Pass-through
- Dynamic
- Differencing
- Fixed

**Answer:**

- Pass-through
- Dynamic
- Differencing
- Fixed

**Feedback:**

All of the options are available except pass-through.

## Resources

### Virtual hard disk file formats



**Additional Reading:** For more information, refer to: "Hyper-V Virtual Hard Disk Format Overview" at: <http://aka.ms/gsfjsjo>



**Additional Reading:** For more information, refer to: "Ask Premier Field Engineering (PFE) Platforms" at: <http://aka.ms/ag3wyd>

### Fibre Channel support in Hyper-V



**Additional Reading:** For more information, refer to: "Hyper-V Virtual Fibre Channel Overview" at: <http://aka.ms/gpv90h>

### Storing virtual machines on SMB 3.0 file shares



**Additional Reading:** For more information, refer to: "Server Message Block Overview" at: <http://aka.ms/obyww0>

## Demonstration: Managing virtual hard disks in Hyper-V

### Demonstration Steps

1. On **LON-HOST1**, on the taskbar, click **File Explorer**.
2. Click **This PC**, and then go to **D:\Program Files\Microsoft Learning\Base**.



**Note:** The drive letter might depend on the number of drives on the physical host machine.

3. Verify that the **Base17C-WS16-1607.vhd** hard disk image file is present.
4. Go to **E:\Program Files\Microsoft Learning\20743\Drives**, click the **Home** tab, and then click the **New Folder** icon twice to create two new folders. Right-click each folder and rename them:
  - o **LON-GUEST1**
  - o **LON-GUEST2**
5. Run the **CreateVirtualSwitches.ps1** and **LON-HOST1\_VM-Pre-Import-20743B.ps1** scripts.
6. Close File Explorer.
7. Switch to **Hyper-V Manager**.
8. In the **Actions** pane, click **New**, and then click **Hard Disk**.
9. On the **Before You Begin** page of the **New Virtual Hard Disk** wizard, click **Next**.
10. On the **Choose Disk Format** page, select **VHD**, and then click **Next**.
11. On the **Choose Disk Type** page, select **Differencing**, and then click **Next**.
12. On the **Specify Name and Location** page, specify the following details, and then click **Next**:
  - o Name: **LON-GUEST1.vhd**
  - o Location: **E:\Program Files\Microsoft Learning\20743\Drives\LON-GUEST1\**
13. On the **Configure Disk** page, type **D:\Program Files\Microsoft Learning\Base\Base17C-WS16-1607.vhd** as the location, and then click **Finish**.
14. Click the **Start** button, and then click the **Windows PowerShell** icon.
15. At the command prompt in the Windows PowerShell command-line interface, type the following command to create a new differencing disk to use with **LON-GUEST2**, and then press Enter:
 

```
New-VHD "E:\Program Files\Microsoft Learning\20743\Drives\LON-GUEST2\LON-GUEST2.vhd"
-ParentPath "D:\Program Files\Microsoft Learning\Base\Base17C-WS16-1607.vhd"
```
16. Close the Windows PowerShell window.
17. In the **Actions** pane of the **Hyper-V Manager** console, click **Inspect Disk**.
18. In the **Open** dialog box, go to **E:\Program Files\Microsoft Learning\20743\Drives\LON-GUEST2\**, click **LON-GUEST2.vhd**, and then click **Open**.
19. In the **Virtual Hard Disk Properties** dialog box, verify that **LON-GUEST2.vhd** is configured as a differencing virtual hard disk with **D:\Program Files\Microsoft Learning\Base\Base17C-WS16-1607.vhd** as a parent, and then click **Close**.

## Lesson 3

# Configuring Hyper-V networking

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## Question and Answers

**Question:** When configuring a Hyper-V host with multiple network adapters on the same network, what should you do to provide redundancy and performance?

**Answer:** Answers might vary but should include:

- Create a team.
- Create a Switch Independent or Link Aggregation Control Protocol (LACP) team, depending on switch requirements.
- If the host is Windows Server 2016, creating a software embedded team is also acceptable.

## Resources

### New Hyper-V networking features in Windows Server 2012 R2

 **Additional Reading:** For more information, refer to: "What's New in Hyper-V Virtual Switch in Windows Server 2012 R2" at: <http://aka.ms/gd08pi>

### New Hyper-V networking features in Windows Server 2016

 **Additional Reading:** For more information about the improvements in Windows Server 2016, refer to: "What's New in Networking" at: <http://aka.ms/u2v17v>

### Types of Hyper-V networks

 **Additional Reading:** For more information, refer to: "Hyper-V Virtual Switch Overview" at: <http://aka.ms/jqu2uq>

### Hyper-V virtual networking

 **Additional Reading:** For more information, refer to Hyper-V Network Virtualization Overview" at: <http://aka.ms/vfku5o>

## Demonstration: Creating Hyper-V network types

### Demonstration Steps

1. In **Hyper-V Manager**, in the **Actions** pane, click **Virtual Switch Manager**.
2. In the **Virtual Switch Manager** dialog box, select **New virtual network switch**. Ensure that **External** is selected, and then click **Create Virtual Switch**.
3. In the **Virtual Switch Properties** area of the **Virtual Switch Manager** dialog box, specify the following information, and then click **OK**:
  - Name: **Corporate Network2**
  - Connection type: **External Network**: mapped to the host computer's physical network adapter. Varies depending on the host computer.

4. In the **Apply Networking Changes** dialog box, review the warning, but do not click **Yes**. Explain to students that this type of network is already created earlier.
5. In **Hyper-V Manager**, in the **Actions** pane, click **Virtual Switch Manager**.
6. Under **Virtual Switches**, select **New virtual network switch**.
7. Under **Create virtual switch**, select **Internal**, and then click **Create Virtual Switch**.
8. In the **Virtual Switch Properties** section, configure the following settings, and then click **OK**:
  - o Name: **Internal Network2**
  - o Connection type: **Internal network**

## Lesson 4

## Configuring Hyper-V virtual machines

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## Question and Answers

**Question:** When building a guest virtual machine running Windows Server 2016 that will require the ability to expand the startup .vhdx file while the server is running, what generation version should you use?

**Answer:** You should use Generation 2 virtual machines to build a Windows Server 2016 virtual machine.

**Question:** You need to build a virtual machine guest that has static memory that you can resize while the server is online. What requirements should you keep in mind?

**Answer:** Answers might vary, but they should include the following at minimum:

- The host must run Windows Server 2016.
- The guest virtual machine configuration version must upgrade to Windows Server 2016.

**Question:** You need to run guest virtual machines on both Windows Server 2012 R2 and Windows Server 2016 servers. What should you avoid doing until you no longer need to run these virtual machines on Windows Server 2012 R2?

**Answer:** You should avoid upgrading the virtual machine configuration version until you no longer need to run the guest virtual machines on Windows Server 2012 R2.

## Resources

### How memory works in Hyper-V



**Additional Reading:** For more information, refer to: "Hyper-V Dynamic Memory Overview" at: <http://aka.ms/rb0nbx>

## Demonstration: Creating a virtual machine

### Demonstration Steps

1. In **Hyper-V Manager**, in the **Actions** pane, click **New**, and then click **Virtual Machine**.
2. On the **Before You Begin** page of the **New Virtual Machine** wizard, click **Next**.
3. On the **Specify Name and Location** page of the **New Virtual Machine** wizard, select **Store the virtual machine in a different location**, enter the following values, and then click **Next**:
  - o Name: **LON-GUEST1**
  - o Location: **E:\Program Files\Microsoft Learning\20743\Drives\LON-GUEST1\**
4. On the **Specify Generation** page, click **Next**.
5. On the **Assign Memory** page of the **New Virtual Machine** wizard, enter a value of **1024 MB**, select the **Use Dynamic Memory for this virtual machine** option, and then click **Next**.
6. On the **Configure Networking** page of the **New Virtual Machine** wizard, select **Private Network**, and then click **Next**.
7. On the **Connect Virtual Hard Disk** page, choose **Use an existing virtual hard disk**.
8. Click **Browse**, and then go to **E:\Program Files\Microsoft Learning\20743B\Drives\LON-GUEST1\lon-guest1.vhd**.
9. Click **Open**, and then click **Finish**.

10. Click the **Start** button, and then click the **Windows PowerShell** icon.
11. At the Windows PowerShell command prompt, enter the following command to create a new virtual machine named **LON-GUEST2**:

```
New-VM -Name LON-GUEST2 -MemoryStartupBytes 1024MB -VHDPATH "E:\Program
Files\Microsoft Learning\20743\Drives\LON-GUEST2\LON-GUEST2.vhd" -SwitchName "Private
Network"
```

12. Close the Windows PowerShell window.
13. In **Hyper-V Manager**, click **LON-GUEST2**.
14. In the **Actions** pane, under **LON-GUEST2**, click **Settings**.
15. In the **Settings for the LON-GUEST2** dialog box, click **Automatic Start Action**, and then set the **Automatic Start Action** setting to **Nothing**.
16. In the **Settings for the LON-GUEST2** dialog box, click **Automatic Stop Action**, and then set the **Automatic Stop Action** setting to **Shut down the guest operating system**.
17. Click **OK** to close the **Settings for the LON-GUEST2** dialog box.

## Demonstration: Creating checkpoints

### Demonstration Steps

1. In **Hyper-V Manager**, click **LON-GUEST1**.
2. In the **Actions** pane, click **Settings**, and then under **Management**, click **Checkpoints**.
3. Ensure that checkpoints are enabled and that **Checkpoint Type** is set to **Production Checkpoints**, and then click **OK**.
4. To create a production checkpoint, in the **Actions** pane, click **Checkpoint**.



**Note:** The checkpoint should now be visible in the **Checkpoints** pane.

5. Click **LON-Guest1**, in the **Actions** pane, click **Settings**, and then under **Management**, click **Checkpoints**.
6. Change **Checkpoint Type** to **Standard Checkpoints**, and then click **OK**.
7. To create a standard checkpoint, in the **Actions** pane, click **Checkpoint**.
8. Click **LON-GUEST1**, and then in the **Checkpoints** pane, select the top checkpoint.
9. In the **Actions** pane, click **Delete Checkpoint Subtree**, and then click **Delete** when prompted to delete and merge all of the previous checkpoints.

## Demonstration: Using Windows PowerShell Direct to restart a virtual machine

### Demonstration Steps

1. In **Hyper-V Manager**, click **LON-GUEST1**.
2. In the **Actions** pane, click **Start**, and then click **Connect**. Wait until the virtual machine completes the startup process.
3. On the **Hi there** page, click **Next**.
4. On the **Licenses Terms** page, click **Accept**.

5. On the **Customize settings** page, in the **Password** and re-enter password text boxes, type **Pa55w.rd**, and then click **Finish**.
6. In **Hyper-V Manager**, click **LON-GUEST1**.
7. In the **Actions** pane, click **Settings**, and then click **Network Adapter**.
8. Change the **Virtual switch** to **Not connected**, and then click **OK**.
9. On **LON-HOST1**, open Windows PowerShell as an administrator.
10. Enter the following command, and then press Enter:

```
Enter-PSSession -Vmname "LON-GUEST1"
```

11. When prompted for credentials, use **Administrator** with the password **Pa55w.rd**. This should enter you into a PSSession with **LON-GUEST1**.
12. Enter the following command, and then press Enter, after which **LON-GUEST1** should restart:

```
Restart-Computer
```

13. In **Hyper-V Manager**, click **LON-GUEST1**, and then click **Settings**.
14. In the navigation pane on the left, click **Network Adapter**.
15. Change the virtual switch to **Private Network**, and then click **OK**.
16. Shut down **LON-GUEST1**.

# Module Review and Takeaways

## Review Questions

**Question:** In which situations should you use static memory allocation rather than dynamic memory?

**Answer:** You should use fixed memory allocation in the following situations:

- When the guest operating system or application does not support dynamic memory.
- When the host operating system has limited memory resources and you need to ensure that operating systems receive a fair allocation of memory.

**Question:** In which situations must you use virtual hard disks in .vhdx format rather than virtual hard disks in .vhd format?

**Answer:** You should use the .vhdx format rather than the .vhd format in the following situations:

- You need to support virtual hard disks larger than 2 terabytes (TB); .vhdx files can be a maximum of 64 TB in size.
- You need to protect against data corruption caused by power failures. An unexpected power failure is less likely to corrupt the .vhdx format because of the way the file format processes updates.
- You need to deploy a virtual hard disk to a large-sector disk.

**Question:** You want to deploy a Hyper-V virtual machine's virtual hard disk on a file share. What operating system must the file server be running to support this configuration?

**Answer:** You can deploy virtual hard disks only to file shares that support SMB 3.0. The Windows Server 2016 operating system supports hosting SMB 3.0 file shares.

## Real-world Issues and Scenarios

You need to ensure that you provision a virtual machine host with adequate RAM. Having multiple virtual machines paging a hard disk drive because they are provisioned with inadequate memory will decrease performance for all virtual machines on the Hyper-V host.

Additionally, you should monitor virtual machine performance carefully. One virtual machine that uses a disproportionate amount of server resources can adversely affect the performance of all other virtual machines that the Hyper-V server hosts.

## Tools

The following table includes the tools that are needed for this module.

Tool	Used for	Where to find it
Sysinternals Disk2vhd	Converts physical hard disks to .vhd format	 <b>Additional Reading:</b> For more information, refer to "Sysinternals Suite" at: <a href="http://aka.ms/kx5ojf">http://aka.ms/kx5ojf</a>
System Center 2012 R2 Virtual Machine Manager	<ul style="list-style-type: none"> <li>• Manages virtual machines across multiple Hyper-V servers</li> <li>• Performs online physical-to-virtual conversions, but does not support physical-to-virtual conversions</li> </ul>	 <b>Additional Reading:</b> For more information, refer to "Virtual Machine Manager" at: <a href="http://aka.ms/qc0v35">http://aka.ms/qc0v35</a>

## Lab Review Questions and Answers

### Lab: Implementing server virtualization with Hyper-V

#### Question and Answers

**Question:** What type of virtual network switch would you create if you want to allow a virtual machine to communicate with a LAN that is connected to the Hyper-V host?

**Answer:** You would create an external virtual network switch if you want to allow a virtual machine to communicate with a LAN that is connected to the Hyper-V host.

**Question:** How can you ensure that a single virtual machine does not use all of the available bandwidth that a Hyper-V host provides?

**Answer:** To ensure that a single virtual machine does not use all of the available bandwidth that a Hyper-V host provides, you must configure minimum and maximum bandwidth settings on the virtual network adapters.

**Question:** What dynamic memory configuration task can you perform on a virtual machine that is hosted on Windows Server 2012 Hyper-V or later?

**Answer:** You can modify dynamic memory settings while a virtual machine is running on Windows Server 2012 Hyper-V or later. This was not possible in previous versions of Hyper-V.

# Module 7

## Configuring advanced networking features

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## Lesson 1

# Overview of high-performance networking features

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Demonstration: Implementing NIC Teaming	4

## Question and Answers

### Categorize Activity

**Question:** Categorize each item into the appropriate category. Indicate your answer by writing the category number to the right of each item.

Items	
1	This allows you to combine up to 32 network adapters and then use them as a single network interface.
2	This is a collection of technologies that allow you to meet the service requirements of a workload.
3	You can configure this through Device Manager or Windows PowerShell
4	This configuration can be deployed with only one network adapter but does not offer fault tolerance.
5	This can help you to implement bandwidth management.
6	You can implement this by allocating a virtual machine's multiple cores through the advanced network.
7	To use this, the host must have at least two external virtual switches.
8	You can use this to prioritize traffic such as voice or video streaming.
9	To use this, you must configure a virtual machine to use multiple CPU cores.

Category 1	Category 2	Category 3
NIC Teaming	QoS	RSS

**Answer:**

Category 1	Category 2	Category 3
NIC Teaming	QoS	RSS
<p>This allows you to combine up to 32 network adapters and then use them as a single network interface.</p> <p>This configuration can be deployed with only one network adapter but does not offer fault tolerance.</p> <p>To use this, the host must have at least two external virtual switches.</p>	<p>This is a collection of technologies that allow you to meet the service requirements of a workload.</p> <p>This can help you to implement bandwidth management.</p> <p>You can use this to prioritize traffic such as voice or video streaming.</p>	<p>You can configure this through Device Manager or Windows PowerShell</p> <p>You can implement this by allocating a virtual machine's multiple cores through the advanced network.</p> <p>To use this, you must configure a virtual machine to use multiple CPU cores.</p>

## Resources

### Implementing SMB 3.1.1 shared folders

**Additional Reading:**

For more information, refer to Server Message Block Overview: <http://aka.ms/obyww0>

### What is RSC?

**Additional Reading:**

For more information on the preceding Windows PowerShell cmdlets, refer to Network Adapter Cmdlets in Windows PowerShell: <http://aka.ms/Owijj>

## Demonstration: Implementing NIC Teaming

### Demonstration Steps

1. On LON-HOST1, open Server Manager, click the Tools menu, and then click Computer Management.
2. In the Computer Management Console tree, under the **System Tools** node, select **Device Manager**.
3. In Device Manager, in the details pane, right-click **LON-HOST1**, and then select **Add legacy hardware**.
4. In the **Welcome to the Add Hardware Wizard** window, click **Next**.
5. On **The wizard can help you install other hardware** page, select the **Install the hardware that I manually select from a list (Advanced)** option, and then click **Next**.
6. On the **From the list below, select the type of hardware you are installing** page, scroll down and select **Network adapters**, and then click **Next**.
7. On the **Select the device driver you want to install for this hardware** page, in the **Manufacturer** pane, select **Microsoft**, in the **Model** pane, select **Microsoft KM-TEST Loopback Adapter**, and then click **Next**.
8. On **The Wizard is ready to install your hardware** page, click **Next**.
9. On the **Completing the Add Hardware Wizard** page, click **Finish**.
10. In Server Manager, in the console tree, click the **Local Server** node.
11. In the **Properties details** pane, next to the **NIC Teaming** item, click the **Disabled** hyperlink.
12. In the **NIC Teaming** dialog box, in the **Adapters and Interfaces** pane, click **Ethernet 3**, click **Tasks**, and then select **Add to new team**.
13. In the **NIC Teaming** dialog box, in the **Team name** box, type **Host NIC Team**, and then click **OK**.
14. In the **NIC Teaming** dialog box, in the **Teams** pane, note the following details:
  - a. Team: **Host NIC Team**
  - b. Status: **OK**
  - c. Teaming Mode: **Switch Independent**

- d. Load Balancing: **Dynamic**
- e. Adapters: **1**



**Note:** Explain that as previously mentioned, you have created a NIC team with only one adapter, which is not fault tolerant but allows for the separation of network traffic when you are also using VLANs.

## Lesson 2

# Configuring advanced Hyper-V networking features

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## Question and Answers

**Question:** What is the ping-pong effect?

- ( ) The ping-pong effect occurs when multiple physical network adapters from the host are matched to several virtual network adapters. They continuously swap physical addresses.
- ( ) The ping-pong effect occurs when a virtual switch extension applies network forwarding. It bypasses the default forwarding, which causes network packets to loop back and forth to the router.
- ( ) The ping-pong effect results from a rare circumstance that can occur in dynamic VMQ when a CPU core is being used, and the processing happens to generate a large amount of inbound traffic. Because of this, another, less-busy CPU core is dynamically selected, and because the traffic load has not changed, it jumps back to the original or another CPU core. This process continues.
- ( ) When you use Remote Direct Memory Access (RDMA), a network adapter can switch repeatedly between Switch Embedded Teaming (SET) and RDMA functionality.
- ( ) The ping-pong effect occurs when a NIC team switches repeatedly among team member adapters.

**Answer:**

- ( ) The ping-pong effect occurs when multiple physical network adapters from the host are matched to several virtual network adapters. They continuously swap physical addresses.
- ( ) The ping-pong effect occurs when a virtual switch extension applies network forwarding. It bypasses the default forwarding, which causes network packets to loop back and forth to the router.
- (v) The ping-pong effect results from a rare circumstance that can occur in dynamic VMQ when a CPU core is being used, and the processing happens to generate a large amount of inbound traffic. Because of this, another, less-busy CPU core is dynamically selected, and because the traffic load has not changed, it jumps back to the original or another CPU core. This process continues.
- ( ) When you use Remote Direct Memory Access (RDMA), a network adapter can switch repeatedly between Switch Embedded Teaming (SET) and RDMA functionality.
- ( ) The ping-pong effect occurs when a NIC team switches repeatedly among team member adapters.

## Demonstration: Configuring network adapter advanced features

### Demonstration Steps

#### Use Windows PowerShell to enable DHCP guarding

1. On **LON-HOST1**, click **Start**, and then click **Windows PowerShell**.
2. At the Windows PowerShell command prompt, type the following commands to prevent **LON-DC1** from issuing a DHCP lease, and then press Enter.

```
Set-VMNetworkAdapter -VMName 20743B-LON-DC1-B -DhcpGuard On
```

#### Turn off DHCP guarding

- On the physical host computer, at the Windows PowerShell command prompt, type the following command, and then press Enter.

```
Set-VMNetworkAdapter -VMName 20743B-LON-DC1-B -DhcpGuard Off
```

## Module Review and Takeaways

### Best Practices

When implementing advanced networking features for Hyper-V, use the following best practices:

- Deploy multiple network adapters to a Hyper-V physical host, and then configure those adapters as part of a team. This helps to ensure that network connectivity will be retained if individual network adapters fail. Configure multiple teams with network adapters that are connected to different switches to help ensure that connectivity will remain if a hardware switch fails.
- Use bandwidth management to allocate a minimum and a maximum bandwidth allocation on a per-virtual network adapter basis. You should configure bandwidth allocation to help guarantee that each virtual machine will have a minimum bandwidth allocation. This helps to ensure that if another virtual machine that is physically hosted on the same Hyper-V server experiences a traffic spike, other virtual machines will be able to communicate normally with the network.
- Provision a Hyper-V physical host with an adapter that supports VMQ. VMQ uses hardware packet filtering to deliver network traffic directly to a virtual machine. This helps to improve performance because the packet does not need to be copied from the physical host operating system to the virtual machine. When you do not configure virtual machines to support VMQ, the physical host operating system can become a bottleneck when it processes large amounts of network traffic.
- If you are physically hosting large numbers of virtual machines and need to isolate them, use network virtualization rather than VLANs. Network virtualization is complicated to configure, but it has an advantage over VLAN—it is not necessary to configure VLANs on all the switches that are connected to the Hyper-V physical host. You can perform all the necessary configurations when you need to isolate servers on a Hyper-V physical host without needing to involve the network team.

### Review Question

**Question:** You want to deploy a Windows Server 2016 Hyper-V virtual machine's virtual hard disk on a file share. What operating system must the file server be running to support this configuration?

**Answer:** You can deploy virtual hard disks only to file shares that support at least SMB 3.0, and only the Windows Server 2012 and Windows Server 2016 operating systems support the physical hosting of SMB 3.0 and SMB 3.1.1 file shares.

# Lab Review Questions and Answers

## Lab: Configuring advanced Hyper-V networking features

### Question and Answers

**Question:** In the “NIC Teaming” task, you created **LON-GUEST2 NIC Team**. Is this fault tolerant?

**Answer:** Yes it is, you included two network adapters and if one fails, the other will still provide functionality.

**Question:** In the task named “Create virtual network adapters,” you the **LON-GUEST2** virtual machine was shut down. Why?

**Answer:** You were adding hardware—specifically, a network adapter. This cannot be done while a virtual machine is running.

# Module 8

## Implementing Software Defined Networking

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## Lesson 1

# Overview of SDN

### Contents:

Question and Answers

3

## Question and Answers

**Question:** In Software Defined Networking, each physical compute host must be assigned at least one IP address from the Management logical network. You can use DHCP for this assignment.

True

False

**Answer:**

True

False

**Question:** Does the complexity of your organization's network infrastructure suggest the need for Software Defined Networking?

**Answer:** Answers will vary based on students' experiences and their organization's network infrastructure.

## Lesson 2

# Implementing network virtualization

### Contents:

Question and Answers

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## Question and Answers

**Question:** Does a virtual machine CA change when you move the virtual machine between Hyper-V hosts?

**Answer:** When you move a virtual machine, its CA stays the same. The only thing that changes is its PA, which is the address of the Hyper-V host on which it is running. You must update the network virtualization configuration on the Hyper-V hosts so that Hyper-V hosts are aware of the move.

**Question:** Why are network virtualization policies necessary when using network virtualization?

**Answer:** Network virtualization policies define the Hyper-V host on which the virtual machines are running. Hyper-V consults network virtualization policies when it needs to form an NVGRE-encapsulated packet and send it on a physical network.

## Lesson 3

# Implementing Network Controller

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## Question and Answers

**Question:** What does Network Controller use the Northbound and Southbound APIs for?

**Answer:** Network Controller uses the Southbound API to communicate with network devices, services, and components. With the Southbound API, Network Controller can:

- Discover network devices.
- Detect service configurations.
- Gather all of the information you need about the network.
- Send information to the network infrastructure: for example, configuration changes that you have made.

The Network Controller Northbound API enables you to configure, monitor, troubleshoot, and deploy new devices on the network by using:

- Windows PowerShell
- Representational state transfer (REST) application programming interface (API)
- A management application with a GUI, for example, System Center Virtual Machine Manager

## Resources

### The procedure for deploying Network Controller

 **Additional Reading:** For more information on the syntax of these cmdlets, refer to “Deploy Network Controller using Windows PowerShell: Create a node object” at: <http://aka.ms/A6mp6v>

 **Additional Reading:** For more information on the syntax of this cmdlet, refer to “Deploy Network Controller using Windows PowerShell: Configure the Network Controller application” at: <http://aka.ms/bktmqo>

### Software Load Balancing

 **Additional Reading:** You also can use Windows PowerShell cmdlets. For more information on the Windows PowerShell cmdlets that you can use to manage Network Controller, refer to “Network Controller Cmdlets” at: <http://aka.ms/Wct3o3>

## Demonstration: Preparing to deploy Network Controller

### Demonstration Steps

#### Create Active Directory security groups

1. Switch to LON-DC1.
2. In **Server Manager**, click **Tools**, and then click **Active Directory Users and Computers**.
3. In **Active Directory Users and Computers**, expand **Adatum.com**, and then click **IT**.
4. Right-click **IT**, click **New**, and then click **Group**.
5. In the **New Object – Group** dialog box, in the **Group name** text box, type **Network Controller Admins**, and then click **OK**.
6. In the details pane, double-click **Network Controller Admins**.

7. In the **Network Controller Admins Properties** dialog box, on the **Members** tab, click **Add**.
8. In the **Select Users, Contacts, Computers, Service Accounts, or Groups** dialog box, in the **Enter the object names to select (examples)** text box, type **administrator; Beth**, and then click **OK** twice.
9. Right-click **IT**, click **New**, and then click **Group**.
10. In the **New Object – Group** dialog box, in the **Group name** text box, type **Network Controller Ops**, and then click **OK**.
11. In the details pane, double-click **Network Controller Ops**.
12. In the **Network Controller Ops Properties** dialog box, on the **Members** tab, click **Add**.
13. In the **Select Users, Contacts, Computers, Service Accounts, or Groups** dialog box, in the **Enter the object names to select (examples)** text box, type **administrator; Beth**, and then click **OK** twice.
14. Close **Active Directory Users and Computers**.

### Request a certificate

1. Switch to LON-SVR2.
2. Right-click **Start**, and then click **Run**.
3. In the **Run** dialog box, type **mmc.exe**, and then press Enter.
4. In the **Console1 – [Console Root]** window, click **File**, and then click **Add/Remove Snap-in**.
5. In the **Add or Remove Snap-ins** dialog box, in the **Snap-in** list, double-click **Certificates**.
6. Click **Computer account**, click **Next**, click **Finish**, and then click **OK**.
7. In the navigation pane, expand **Certificates**, and then expand **Personal**.
8. Right-click **Personal**, click **All Tasks**, and then click **Request New Certificate**.
9. In the **Certificate Enrollment** dialog box, on the **Before you Begin** page, click **Next**.
10. On the **Select Certificate Enrollment Policy** page, click **Next**.
11. Select the **Computer** check box, click **Enroll**, and then click **Finish**.
12. Close the management console, and do not save the changes.

## Demonstration: Deploying Network Controller

### Demonstration Steps

#### Add the Network Controller role

1. On LON-SVR2, click **Start**, and then click **Server Manager**.
2. In **Server Manager**, in the details pane, click **Add roles and features**.
3. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.
4. On the **Select installation type** page, click **Next**.
5. On the **Select destination server** page, click **Next**.
6. On the **Select server roles** page, in the **Roles** list, select the **Network Controller** check box.
7. Click **Add Features**, and then click **Next**.
8. On the **Select features** page, click **Next**.
9. On the **Network Controller** page, click **Next**.

10. On the **Confirm installation selections** page, click **Install**.
11. When the role is installed, click **Close**.
12. Right-click **Start**, point to **Shut down or sign out**, and then click **Restart**.
13. In the **Choose a reason that best describes why you want to shut down this computer** dialog box, click **Continue**.
14. After **LON-SVR2** has restarted, sign in as **Adatum\administrator** with the password **Pa55w.rd**.

### Configure the Network Controller cluster

1. On **LON-SVR2**, right-click **Start**, and then click **Windows PowerShell (Admin)**.
2. At the Windows PowerShell (Admin) command prompt, type the following command, and then press Enter:

```
$node=New-NetworkControllerNodeObject -Name "Node1" -Server "LON-SVR2.Adatum.com" -
FaultDomain "fd:/rack1/host1" -RestInterface "Ethernet"
```

3. At the command prompt, type the following command, and then press Enter:

```
$Certificate = Get-Item Cert:\LocalMachine\My | Get-ChildItem | where {$_.Subject -
imatch "LON-SVR2" }
```

4. At the command prompt, type the following command, and then press Enter:

```
Install-NetworkControllerCluster -Node $node -ClusterAuthentication Kerberos -
ManagementSecurityGroup "Adatum\Network Controller Admins" -
CredentialEncryptionCertificate $Certificate
```

### Configure the Network Controller application

- At the command prompt, type the following command, and then press Enter:

```
Install-NetworkController -Node $node -ClientAuthentication Kerberos -
ClientSecurityGroup "Adatum\Network Controller Ops" -RestIpAddress "172.16.0.99/24" -
ServerCertificate $Certificate
```



**Note:** This command can take quite a while to complete.

### Validate the deployment

1. At the command prompt, type the following command, and then press Enter:

```
$cred=New-Object Microsoft.Windows.Networkcontroller.credentialproperties
```

2. At the command prompt, type the following command, and then press Enter:

```
$cred.type="usernamepassword"
```

3. At the command prompt, type the following command, and then press Enter:

```
$cred.username="admin"
```

4. At the command prompt, type the following command, and then press Enter:

```
$cred.value="abcd"
```

5. At the command prompt, type the following command, and then press Enter:

```
New-NetworkControllerCredential -ConnectionUri https://LON-SVR2.Adatum.com -  
Properties $cred -ResourceId cred1
```

6. Press **Y**, and then press Enter when prompted. If you receive an error, repeat steps 5 and 6.
7. At the command prompt, type the following command, and then press Enter:

```
Get-NetworkControllerCredential -ConnectionUri https://LON-SVR2.Adatum.com -  
ResourceId cred1
```

# Module Review and Takeaways

## Review Questions

**Question:** You decide to deploy Network Controller in your Active Directory domain environment. What steps must you take to prepare for the deployment?

**Answer:** The deployment requirements in a domain environment are as follows:

- You can only deploy Network Controller to the Windows Server 2016 Datacenter edition.
- The management client you use must be installed on a computer or virtual machine running Windows 10, Windows 8.1, or Windows 8.
- You must configure dynamic DNS registration to enable registration of required Domain Name System (DNS) records for Network Controller.
- If the computers or virtual machines running Network Controller or the management client for Network Controller are joined to a domain, you must:
  - Create a security group that holds all the users that have permission to configure Network Controller.
  - Create a security group that holds all the users that have permission to configure and manage the network by using Network Controller.

**Question:** What are the reasons to consider implementing Software Defined Networking with Windows Server 2016?

**Answer:** SDN provides for network resources that are:

- Flexible. You can move traffic from your on-premises infrastructure to your private or public cloud infrastructure.
- Efficient. You can abstract the hardware components of your network infrastructure with software components.
- Scalable. Your on-premises infrastructure has a finite capacity. Your cloud-based infrastructure has far broader limits enabling you to scale up your infrastructure when necessary.

**Question:** How do you install the Network Controller feature in Windows Server 2016 by using Windows PowerShell?

**Answer:** To deploy Network Controller with Windows PowerShell, install the feature by running the following cmdlet:

**Install-WindowsFeature -Name NetworkController –IncludeManagementTools**

# Lab Review Questions and Answers

## Lab: Deploying Network Controller

### Question and Answers

**Question:** In the lab, you used Windows PowerShell to manage Network Controller. What other tools could you use?

**Answer:** You also could use System Center Virtual Machine Manager and non-Microsoft management tools to manage Network Controller.

**Question:** In the lab, you deployed Network Controller in a domain environment. In a non-domain environment, what steps must you take to provide for authentication?

**Answer:** In a non-domain environment, certificates provide authentication. Therefore, you must configure certificate-based authentication by:

- Creating a certificate for use on the management client. The Network Controller must trust this certificate.
- Creating a certificate on the Network Controller for computer authentication.

# Module 9

## Implementing remote access

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## Lesson 1

# Remote access overview

### Contents:

Question and Answers

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## Question and Answers

**Question:** What is the main benefit from using DirectAccess over a VPN? (Choose two answers.)

- Faster
- A user does not have to initiate a connection
- DirectAccess requires more user configuration
- With DirectAccess, a user does not have to remember one connection for an internal connection and another for an external connection
- VPNs provide internal and external connectivity

**Answer:**

- Faster
- A user does not have to initiate a connection
- DirectAccess requires more user configuration
- With DirectAccess, a user does not have to remember one connection for an internal connection and another for an external connection
- VPNs provide internal and external connectivity

## Lesson 2

# Implementing DirectAccess

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Demonstration: Configuring DirectAccess with the Getting Started Wizard	5

## Question and Answers

**Question:** How do you configure DirectAccess clients?

**Answer:** To configure DirectAccess clients, use Group Policy. When you use the Configure Remote Access Wizard to configure DirectAccess, it creates two GPOs, one of which is linked to the client computers in the domain. This client GPO defines DirectAccess-related settings and is applied to DirectAccess clients.

**Question:** How does the DirectAccess client determine if it is connected to the intranet or the Internet?

**Answer:** When the DirectAccess client computer tries to locate the NLS server, if the DirectAccess client computer can contact the NLS server, the DirectAccess client computer assumes it is on the internal network. If the DirectAccess client computer cannot contact the NLS server, the DirectAccess client computer assumes it is on the Internet. In organizations where DirectAccess is a business-critical solution, the NLS should be a highly-available web server, because NLS server availability is important for DirectAccess client computers to determine if they are located on an internal network or the Internet.

## Demonstration: Configuring DirectAccess with the Getting Started Wizard

### Demonstration Steps

1. Switch to **LON-RTR**.
2. Open Server Manager, click **Tools**, and then select **Remote Access Management**.
3. In the Remote Access Management console, under Configuration, click **DirectAccess and VPN**, and then click **Run the Getting Started Wizard**.
4. On the **Configure Remote Access** page, click **Deploy DirectAccess only**.
5. Verify that **Edge** is selected, and in the **Type the public name or IPv4 address used by clients to connect to the Remote Access server** text box, type **131.107.0.200**, and then click **Next**.
6. On the **Configure Remote Access** page, click the **here** link.
7. On the **Remote Access Review** page, verify that two Group Policy Objects (GPOs) have been created:
  - o DirectAccess Server Settings
  - o DirectAccess Client Settings
8. Next to Remote Clients, click **Change**.
9. In the Remote Access Setup window, click **Domain Computers (ADATUM\Domain Computers)**, click **Remove**, and then click **Add**.
10. In the Select Groups window, type **DA\_Clients**, and then click **OK**.
11. Clear the **Enable DirectAccess for mobile computers only** check box, and click **Next**.
12. On the **DirectAccess Client Setup** page, in the **DirectAccess connection name** text box, type **Windows 10 Workplace Connection**, and then click **Finish**.
13. On the **Remote Access Review** page, click **OK**.
14. On the **Configure Remote Access** page, to finish the DirectAccess wizard, click **Finish**.
15. In the **Applying Getting Started Wizard Settings** dialog box, click **Close**.
16. Click **Start**, and then click **Windows PowerShell**.
17. At the command prompt in the Windows PowerShell command-line interface, type the following cmdlet, and then press Enter:

```
Restart-Computer
```

18. Switch to **LON-CL1**. When you configured the DirectAccess server, the wizard created two Group Policies and linked them to the domain. To apply them, restart **LON-CL1**, and then sign in as **Adatum\Administrator** with the password **Pa55w.rd**.
19. On **LON-CL1**, right-click the **Start** button, and then click **Command Prompt**.
20. At the command prompt, type the following command, and then press Enter:

```
gpupdate /force
```

 **Note:** If you receive a Group Policy processing error, disable and then enable the Ethernet network connection and repeat step 20.

21. At the command prompt, type the following command, and then press Enter:

```
gpresult /R
```

22. Look through the resulting output that the command generated. Under the Computer Settings section, verify that the DirectAccess Client Settings GPO is applied.

 **Note:** If the DirectAccess Client Settings GPO is not applied, restart **LON-CL1**, and then repeat steps 18-22 on **LON-CL1**.

23. At the command prompt, type the following command, and then press Enter:

```
netsh name show effectivepolicy
```

24. Verify that the "DNS Effective Name Resolution Policy Table Settings" message appears.

## Lesson 3

# Implementing VPN

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## Question and Answers

**Question:** The SSTP VPN tunneling protocol supports VPN Reconnect.

- ( ) True  
( ) False

**Answer:**

- ( ) True  
(√) False

**Feedback:**

The IKEv2 VPN tunneling protocol is required to support VPN Reconnect.

## Demonstration: Configuring VPNs

### Demonstration Steps

#### Configure a VPN server

1. Switch to **LON-RTR**.
2. Open Server Manager, click the **Tools** menu, and then select **Remote Access Management**.
3. In the **Configuration** pane, click **DirectAccess and VPN**.
4. In the details pane, under Configure Remote Access, click the **Run the Getting Started Wizard** link.
5. On the **Configure Remote Access** page, click **Deploy VPN only**. This will bring up a separate **Routing and Remote Access Console**.
6. In the **Routing and Remote Access Console**, right-click **LON-RTR**, and then select **Configure and Enable Routing and Remote Access**.
7. In the Routing and Remote Access Server Setup Wizard, click **Next**.
8. On the **Configuration** page, ensure that **Remote access (dial-up or VPN)** is selected, and then click **Next**.
9. On the **Remote Access** page, click the **VPN** check box, and then click **Next**.
10. On the **VPN Connection** page, highlight the Network Interface value that has the 131.107.0.200 address, and then click **Next**.
11. On the **IP Address Assignment** page, click **Next**.
12. On the **Managing Multiple Remote Access Servers** page, click **Next**, and then click **Finish**.
13. In the Routing and Remote Access window, click **OK**.
14. Click **OK** at the second prompt.
15. From Server Manager, click the **Tools** menu item, and then open the **Network Policy Server**.
16. Expand **Policies**, and click **Network Policies**.
17. Right-click **Connections to Microsoft Routing and Remote Access server**, and click **Properties**.
18. In the Access Permission section, click **Grant access**, and then click **OK**.
19. Close all open windows.
20. Click **Start** and then click the **Windows PowerShell** icon.

21. At the command prompt in the Windows PowerShell command-line interface, type the following cmdlet, and then press Enter:

```
Restart-Computer
```

22. Sign in to **LON-RTR** as **Adatum\Administrator** with the password of **Pa55w.rd**.

### Configure a VPN client

1. Switch to **LON-CL1**, right-click **Start**, and then click **Network Connections**.
2. Right-click **Ethernet**, and click **Disable**.
3. Right-click **Ethernet 2**, and click **Enable**.
4. Right-click **Ethernet 2**, and click **Properties**.
5. In the **Ethernet 2 Properties** dialog box, double-click **Internet Protocol Version 4 (TCP/IPv4)**.
6. In the **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog box, ensure that the following displays, and then click **OK**:
  - o IP address: **131.107.0.2**
  - o Subnet mask: **255.255.0.0**If no changes are required, then in the **Internet Protocol Version 4 (TCP/IPv4) Properties** dialog box, click **Cancel**.
7. In the **Ethernet 2 Properties** dialog box, click **OK**.
8. Close Network Connections.
9. On **LON-CL1**, on the **Start** menu, click **Settings**.
10. In the **Settings** app, click the **Network & Internet** category.
11. In the **Network & Internet** console tree, click the **VPN** tab.
12. In the details pane, click the **Add a VPN connection** plus sign (+).
13. In the **Add a VPN connection** window, provide the following values, and then click **Save**:
  - a. VPN provider: **Windows (built-in)**
  - b. Connection name: **Adatum HQ VPN**
  - c. Server name or address: **131.107.0.200**

### Test a VPN connection

1. In the Network & Internet Settings app, click **Adatum HQ VPN**, and then click **Connect**.
2. Sign in as **Adatum\Administrator** with the password **Pa55w.rd**, and then click **OK**.
3. In the NETWORK & INTERNET Settings app, the **Adatum HQ VPN** should show a status of Connected.
4. Click **Disconnect**.

## Module Review and Takeaways

### Review Questions

**Question:** Users are complaining that they are unable to connect to the corporate network by using VPNs following recent firewall configuration changes. The team responsible for implementing security policies has determined that only TCP port 443 is allowed through into the internal network. Which tunneling protocol supports this restriction?

**Answer:** SSTP uses HTTPS over TCP port 443.

**Question:** What are the main benefits of using DirectAccess for providing remote connectivity?

**Answer:** You can deploy the following remote access solutions: DirectAccess, VPN, and Web Application Proxy.

**Question:** What are the main benefits of using DirectAccess for providing remote connectivity?

**Answer:** The main benefits of using DirectAccess for providing remote connectivity are as follows:

- Always-on connectivity. When the user is connected to the Internet, the user is also connected to the intranet.
- Seamless user experience. Same user experience regardless of whether connected locally or remotely.
- Bidirectional access. When the client computer is accessing the intranet, the computer is also connected and managed.
- Improved security. Administrators can set and control the intranet resources that are accessible through DirectAccess.

# Lab Review Questions and Answers

## Lab: Implementing DirectAccess

### Question and Answers

**Question:** Your organization requires only selected computers to be able to connect from the Internet to the corporate network resources using DirectAccess. How will you configure the DirectAccess settings to meet the organization's requirements?

**Answer:** If only selected computers need to be provided with secure remote access from the Internet to the corporate network resources, you can create computer groups and then configure appropriate membership for the clients that need secure remote access. After you configure group membership, you should configure DirectAccess to allow remote access for the computer group that you created.

**Question:** In the lab, you used the Getting Started Wizard to configure DirectAccess. In what situations is using the wizard inappropriate?

**Answer:** The Getting Started Wizard is not suited for large deployments that need to support multisite access, that require a highly-available infrastructure, or that require support for computers running Windows 7 in a DirectAccess scenario.

# Module 10

## Deploying and managing Windows and Hyper-V containers

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## Lesson 1

# Overview of containers in Windows Server 2016

### Contents:

Question and Answers

3

## Question and Answers

**Question:** In Windows Server 2016 containers, which of the following statements best describes a sandbox?

- ( ) A sandbox is a computer that is configured with containers. This can be a physical computer or a virtual computer.
- ( ) A sandbox is the first layer of the container hierarchy.
- ( ) All changes that are made to a running container are stored in the sandbox.
- ( ) A sandbox is a management tool that you can use instead of the Windows PowerShell command-line interface to manage your containers.

**Answer:**

- ( ) A sandbox is a computer that is configured with containers. This can be a physical computer or a virtual computer.
- ( ) A sandbox is the first layer of the container hierarchy.
- (✓) All changes that are made to a running container are stored in the sandbox.
- ( ) A sandbox is a management tool that you can use instead of the Windows PowerShell command-line interface to manage your containers.

## Lesson 3

# Installing, configuring, and managing containers by using Docker

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## Question and Answers

**Question:** Docker is a graphical management tool that you can use to manage Hyper-V containers in Windows Server 2016.

( ) True

( ) False

**Answer:**

( ) True

(v) False

**Feedback:**

You can use Docker at the command line to manage both Hyper-V and Windows Server containers in Windows Server 2016.

## Resources

### Overview of management with Docker

-  **Additional Reading:** For more information on other examples of **Dockerfiles** for the Windows operating system, go to the Dockerfile for Windows repository at: <http://aka.ms/sqic5n>
-  **Additional Reading:** For more information on the complete list of **Dockerfile** instructions, refer to: "Dockerfile reference" at: <http://aka.ms/Ncu9g5>
-  **Additional Reading:** For more information on **docker build**, including a list of all build options, refer to: "docker build" at: <http://aka.ms/Qmswzf>
-  **Additional Reading:** You can use several methods to optimize the Docker build process and the resulting Docker images. For more information on how the Docker build process operates and the tactics that you can use for optimal image creation with Windows containers, refer to: "Optimize Windows Dockerfiles" at: <http://aka.ms/f29xln>
-  **Additional Reading:** For more information about administering containers on Windows Server by using Docker, refer to "Windows Containers Quick Start" at: <https://aka.ms/vuwy1t>
-  **Additional Reading:** For more information on using the **docker run** command to define a container's resources at runtime, refer to: "Docker run reference" at: <http://aka.ms/S2oofi>

### Overview of Docker Hub

-  **Additional Reading:** For more information on registering a Docker ID, refer to: "Docker ID accounts" at: <https://aka.ms/y7ev6l>
-  **Additional Reading:** For more information about the Docker repositories that Docker Hub supports and promotes, refer to: "Official Repositories on Docker Hub" at: <http://aka.ms/wyoi4>
-  **Additional Reading:** For more information about pushing a repository to the Docker Hub registry, refer to: "Build your own image" at: <https://aka.ms/tkiow>
-  **Additional Reading:** For more information about creating organizations and teams so that you can delegate access to colleagues for shared image repositories, refer to: "Organizations and teams in Docker Hub" at: <http://aka.ms/Vr7xie>

## Docker with Azure

 **Additional Reading:** For more information on using Docker Machine to create new Docker host VMs in Azure for your Linux containers, refer to: "Use Docker Machine with the Azure Driver" at: <http://aka.ms/Qdpt98>

 **Additional Reading:** For more information, refer to: "Azure Resource Manager overview" at: <http://aka.ms/ltdpqs>

 **Additional Reading:** For more information on using the Azure Container Service to deploy Docker Swarm clusters, refer to: "Deploy an Azure Container Service cluster" at: <http://aka.ms/Yz210g>

## Demonstration: Deploying containers by using Docker

### Demonstration Steps

#### Install the NuGet provider

1. On **LON-NVHOST2**, click **Start**, and then click **Windows PowerShell**.
2. At the Windows PowerShell command prompt, type the following command to install the NuGet provider, and then press Enter:

```
Install-PackageProvider -Name NuGet -Force
```

#### Install Docker

1. At the Windows PowerShell command prompt, type the following command to install Docker, and then press Enter:

```
Install-Module -Name DockerMsftProvider -Repository PSGallery -Force
```

2. If the "Do you want PowerShellGet to install and import the NuGet provider now" notification appears, type **Y**, and then press Enter.
3. At the Windows PowerShell command prompt, type the following command to install Docker, and then press Enter:

```
Install-Package -Name Docker -ProviderName DockerMsftProvider
```

4. At the "Are you sure you want to install software from 'DockerDefault'" notification, type **Y**, and then press Enter.
5. Type the following command to restart the computer, and then press Enter:

```
Restart-Computer -Force
```

#### Download an image

1. After the virtual machine restarts, sign in to **LON-NVHOST2**.
2. Click **Start**, and then click **Windows PowerShell**.
3. At the Windows PowerShell command prompt, type the following command, and then press Enter to view the images that are available on Docker Hub:

```
docker search Microsoft
```

4. At the Windows PowerShell command prompt, type the following command to download the sample Internet Information Services (IIS) image, and then press Enter:

```
docker pull microsoft/iis:windowsservercore
```

The download process may take a considerable amount of time to complete.

5. At the **Windows PowerShell** command prompt, type the following command to verify the downloaded image, and then press Enter:

```
docker images
```

### Deploy a new container

1. On **LON-NVHOST2**, at the Windows PowerShell command prompt, type the following command to deploy the IIS container, and then press Enter:

```
docker run -d -p 80:80 microsoft/iis:windowsservercore cmd
```



**Note:** This command runs the IIS image as a background service (-d) and configures networking such that port 80 of the container host maps to port 80 of the container.

2. Type the following command to retrieve the IP address information of the container host:

```
ipconfig
```

3. Note the IPv4 address of the Ethernet adapter named vEthernet (HNS Internal NIC). This is the address of the new container. Also, note the IPv4 address of the Ethernet adapter named Ethernet. This is the IP address of the container host.
4. On **LON-HOST1**, open Internet Explorer.
5. In the address bar, type the following, and then press Enter:

```
http://<ContainerhostIP>
```



**Note:** Replace <ContainerhostIP> with the IP address that you noted earlier.

6. Observe the default IIS page.

### Manage the container

1. On **LON-NVHOST2**, at the Windows PowerShell command prompt, type the following command to view the running containers, and then press Enter:

```
docker ps
```

2. Note the container ID.
3. Type the following command to stop the container, and then press Enter:

```
docker stop <ContainerID>
```



**Note:** Replace <ContainerID> with the container ID that you noted in the previous step.

4. On **LON-HOST1**, open Internet Explorer.
5. In the address bar, type the following, and then press Enter:

```
http://<ContainerhostIP>
```

Observe that the default IIS page is no longer accessible. This is because the container is not running.

6. On **LON-NVHOST2**, at the Windows PowerShell command prompt, type the following command to delete the container, and then press Enter:

```
docker rm <ContainerID>
```



**Note:** Replace <ContainerID> with the container ID that you noted earlier.

## Module Review and Takeaways

### Review Questions

**Question:** When creating a virtual hard disk for Nano Server by using the **New-NanoServerImage** Windows PowerShell cmdlet, when do you use the **-Guestdrivers** switch?

**Answer:** Use the **-Guestdrivers** switch when you intend to run Nano Server as a VM in Hyper-V.

**Question:** When configuring Windows Server containers, what Docker commands can you use to create a container?

**Answer:** To create a container, you can use the **docker run** and **docker build** commands.

**Question:** When planning to deploy Windows containers, what are the advantages of choosing Server Core or Nano Server?

**Answer:** Nano Server can host containers with less disk space, sets up significantly faster, and requires fewer updates and restarts than Server Core. Alternatively, Server Core can host Server Core and Nano Server containers and can host more apps than Nano Server.

### Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
<p>Unable to download package providers. Some error messages such as "bits transfers failed" display.</p>	<ul style="list-style-type: none"> <li>• Verify that the container host is able to connect to the Internet.</li> <li>• Software updates to providers might require software updates to the container host. Run Windows Update to ensure that the host is up-to-date.</li> <li>• Because most of the online repositories use Secure Sockets Layer (SSL) encryption, verify that the user who is running the commands can verify the SSL certificates. Ensure that any Group Policy with the <b>Turn off Automatic Root Certificates Update</b> setting turned on has been disabled.</li> </ul>

## Lab Review Questions and Answers

### Lab: Installing and configuring containers

#### Question and Answers

**Question:** When using the **Nano Server Recovery Console**, which two fundamental components can you configure?

**Answer:** You can configure only networking and firewall settings on a Nano Server by using the **Nano Server Recovery Console**.

# Module 11

## Implementing failover clustering

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## Lesson 1

# Overview of failover clustering

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## Question and Answers

**Question:** What are some of the improvements to failover clustering in Windows Server 2016?

**Answer:** The new features in Windows Server 2016 include:

- Cluster Operating System Rolling Upgrade
- Storage Replica
- Azure Cloud Witness
- VM resiliency
- Site-aware clusters
- Workgroup and multiple-domain clusters

**Question:** What quorum configuration is a best practice for Windows Server 2016 failover clusters?

**Answer:** The answers might vary but should include dynamic quorum mode and dynamic witness. These provide the highest level of scalability for the cluster in most standard configurations.

## Resources

### Failover cluster storage



**Reference Links:** For more information, refer to Deploy Clustered Storage Spaces: <http://aka.ms/b5cjdj>



**Reference Links:** For more information, refer to Failover Clustering Hardware Requirements and Storage Options: <http://aka.ms/kr8ahr>

### What are CSVs?



**Additional Reading:**

- For more information, refer to Server Message Block Overview: <http://aka.ms/rep0rf>
- For more information, refer to Storage Spaces Overview: <http://aka.ms/txzql4>

## Lesson 2

# Implementing a failover cluster

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Demonstration: Validating and configuring a failover cluster	5

## Question and Answers

**Question:** Does Windows Server 2016 require all nodes to be in the same domain?

**Answer:** No, Windows Server 2016 does not require all nodes to be in the same domain. However, we recommend having all nodes in the same domain.

**Question:** Can a node that runs Windows Server 2016 and one that runs Windows Server 2012 R2 both run in the same cluster?

**Answer:** Yes, this is part of the Cluster Operating System Rolling Upgrade feature that is new in Windows Server 2016. It is a best practice to move toward having the cluster run the same operating system and not run in mixed mode for an extended period.

## Demonstration: Validating and configuring a failover cluster

### Demonstration Steps

1. On **LON-SVR2**, in Server Manager, click **Tools**, and then click **Failover Cluster Manager**.
2. In the Failover Cluster Manager, in the console tree, ensure that **Failover Cluster Manager** is selected.
3. Under **Management**, click **Validate Configuration**, and then click **Next**.
4. In the **Enter name** box, type **LON-SVR2**, and then click **Add**.
5. In the **Enter name** box, type **LON-SVR3**, click **Add**, and then click **Next**.
6. Verify that **Run all tests (recommended)** is selected, and then click **Next**.
7. In the **Confirmation** window, click **Next**.
8. Wait for the validation tests to finish, and then in the **Summary** window, click **View Report**. Review the results of the validation, discuss any warnings, and then explain why they displayed.
9. Close the report window, clear the **Create the cluster now using the validated nodes** check box, and then click **Finish**.
10. On **LON-SVR2**, in the Failover Cluster Manager, in the **Actions** section, click **Create Cluster**.
11. Read the **Before You Begin** page, and then click **Next**.
12. Type **LON-SVR2**, and then click **Add**. Type **LON-SVR3**, and then click **Add**.
13. Verify the entries, and then click **Next**.
14. In the **Access Point for Administering the Cluster** section, type **Cluster1** as the **Cluster Name**.
15. Under **Address**, type **172.16.0.125** as the **IP address**, and then click **Next**.
16. On the **Confirmation** page, verify the information, and then click **Next**.
17. On the **Summary** page, click **Finish** to return to the Failover Cluster Manager.

## Lesson 3

# Configuring highly available applications and services on a failover cluster

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## Question and Answers

**Question:** In the **Failover Cluster Manager** console, what are some of the Microsoft roles you can configure?

**Answer:** File Services, Dynamic Host Configuration Protocol (DHCP), and Microsoft Hyper-V

### Sequencing Activity

**Question:** The following are the steps for clustering server roles. Arrange them in the correct order by numbering each step.

	Steps
	Install the Failover Clustering feature. Use Server Manager or Windows PowerShell to install the Failover Clustering feature on all computers that will be cluster members.
	Verify the configuration, and create a cluster with the appropriate nodes. Use the Failover Cluster Management snap-in to first validate a configuration and to then create a cluster with selected nodes.
	Configure the application. Configure the options on the application that is used in the cluster.
	Install the role on all the cluster nodes. Use Server Manager to install the server role that you want to use in the cluster.
	Test the failover. Use the Failover Cluster Management snap-in to test the failover by intentionally moving the service from one node to another.
	Create a clustered application by using the Failover Clustering Management snap-in.

**Answer:**

	Steps
1	Install the Failover Clustering feature. Use Server Manager or Windows PowerShell to install the Failover Clustering feature on all computers that will be cluster members.
2	Verify the configuration, and create a cluster with the appropriate nodes. Use the Failover Cluster Management snap-in to first validate a configuration and to then create a cluster with selected nodes.
3	Configure the application. Configure the options on the application that is used in the cluster.
4	Install the role on all the cluster nodes. Use Server Manager to install the server role that you want to use in the cluster.
5	Test the failover. Use the Failover Cluster Management snap-in to test the failover by intentionally moving the service from one node to another.
6	Create a clustered application by using the Failover Clustering Management snap-in.

## Demonstration: Clustering a file server role

### Demonstration Steps

1. On **LON-SVR2**, open the Failover Cluster Manager.
2. Expand **Cluster1.adatum.com**, expand **Storage**, and then click **Disks**.
3. Verify that three cluster disks are available.

4. Right-click **Roles**, and then click **Configure Role**.
5. In the **Configure Role Wizard**, on the **Before You Begin** page, click **Next**.
6. On the **Select Role** page, click **File Server**, and then click **Next**.
7. On the **File Server Type** page, click **Scale-Out File Server for application data**, and then click **Next**.
8. On the **Client Access Point** page, in the **Name** box, type **AdatumFS**, and then click **Next**.
9. On the **Confirmation** page, click **Next**.
10. On the **Summary** page, click **Finish**.

## Lesson 4

# Maintaining a failover cluster

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## Question and Answers

**Question:** What are some of the troubleshooting techniques for failover clusters?

**Answer:** The answers might vary but might include:

- Reviewing events in logs (cluster, hardware, storage)
- Using the **Validate a Configuration Wizard**
- Defining a process for troubleshooting failover clusters
- Reviewing the storage configuration
- Checking for group and resource failures

**Question:** You have an eight-node cluster running Hyper-V in Windows Server 2016. How would you run Windows updates on each node on a schedule without downtime?

**Answer:** The answers might vary but might include CAU or self-updating mode. This would provide the ability to schedule a time and have the cluster fail over, update, and restart the servers as needed.

## Demonstration: Configuring CAU

### Demonstration Steps

1. On **LON-DC1**, in Server Manager, click **Add roles and features**.
2. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.
3. On the **Select installation type** page, click **Next**.
4. On the **Select destination server** page, ensure that **Select a server from the server pool** is selected, and then click **Next**.
5. On the **Select server roles** page, click **Next**.
6. On the **Select features** page, in the list of features, expand **Remote Server Administration Tools**, and then expand **Feature Administration Tools**.
7. Select **Failover Clustering Tools**, and then click **Next**.
8. On the **Confirm installation selections** page, click **Install**.
9. When the installation is complete, click **Close**.
10. On **LON-DC1**, on the **Server Manager Dashboard**, click **Tools**, and then click **Cluster-Aware Updating**.
11. In the **Cluster-Aware Updating** window, in the **Connect to a failover cluster** drop-down list box, click **CLUSTER1**, and then click **Connect**.
12. In the **Cluster Actions** pane, click **Preview updates for this cluster**.
13. In the **Cluster1-Preview Updates** window, click **Generate Update Preview List**.
14. After a few minutes, updates will appear in the list. Review the updates, and then click **Close**. (Note that there might be no updates available. However, you should still be able to perform the rest of the demonstration steps.)
15. In the **Cluster Actions** pane, click **Create or modify Updating Run Profile**.
16. Review and explain the available options. Do not make any changes. When you are finished, click **Close**.
17. Click **Apply updates to this cluster**.

18. On the **Getting Started** page, click **Next**.
19. On the **Advanced options** page, review the options for updating, and then click **Next**.
20. On the **Additional Update Options** page, click **Next**.
21. On the **Confirmation** page, click **Update**, and then click **Close**.
22. In the **Cluster nodes** pane, review the updating progress window.



**Note:** Emphasize that one node of the cluster is in a **Waiting** state, whereas the other node is restarting after it updates.

23. Wait until the updating process finishes.



**Note:** This might require restarting both nodes, and it can take up to 30 minutes to complete. To avoid waiting you can proceed with the rest of the steps in this lab.

24. On **LON-SVR2**, on the **Server Manager Dashboard**, click **Tools**, and then click **Cluster-Aware Updating**.
25. In the **Cluster-Aware Updating** window, in the **Connect to a failover cluster** drop-down list box, select **Cluster1**, and then click **Connect**.
26. Click **Configure cluster self-updating options**.
27. On the **Getting Started** page, click **Next**.
28. On the **Add CAU Clustered Role with Self-Updating Enabled** page, click **Add the CAU clustered role, with self-updating mode enabled, to this cluster**, and then click **Next**.
29. In the **Specify self-updating schedule** area, click **Weekly**, in the **Time of Day** drop-down list box, click **4:00 AM**, in the **Day of the week** drop-down list box, click **Sunday**, and then click **Next**.
30. On the **Advanced Options** page, click **Next**.
31. On the **Additional Update Options** page, click **Next**.
32. On the **Confirmation** page, click **Apply**.
33. After the clustered role is successfully added, click **Close**.

## Lesson 5

# Implementing a stretch cluster

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## Question and Answers

**Question:** What added features does enabling site-aware clustering in a stretch cluster provide?

**Answer:** The answers might vary but might include:

- Failover affinity. A more-configurable node affinity for the roles.
- Cross-site heartbeating. An added configuration for the thresholds of nodes that reside in different sites.
- Preferred site configuration. A feature that controls split-brain syndrome and role startup preferences.

**Question:** You have only two datacenter locations with a Windows Server 2016 stretch cluster built across both sites. What type of dynamic witness is the best to create?

- File share witness
- Azure Cloud Witness
- Disk witness
- No witness

**Answer:**

- File share witness
- Azure Cloud Witness
- Disk witness
- No witness

**Feedback:**

A file share witness would require a third datacenter location. A disk witness would require shared local storage that is not available, and no witness is not a recommended configuration with dynamic witness now an option.

# Module Review and Takeaways

## Best Practices

- Try to avoid using a quorum model that depends only on the disk for Hyper-V high availability or Scale-Out File Server.
- Perform regular backups of the cluster configuration.
- Ensure that in the case of one node failure, other nodes can manage the load.
- Carefully plan stretch clusters.

## Review Questions

**Question:** Why is using a disk-only quorum configuration generally not a good idea?

**Answer:** The failover cluster stops functioning if the logical unit numbers (LUNs) that are used as the disk for the quorum fails. Even if all the other resources are available (including the disk for the applications), the nodes do not provide service when the quorum disk is not available, and it becomes a single point of failure.

**Question:** What is the purpose of CAU?

**Answer:** CAU allows administrators to automatically update cluster nodes with little or no loss in availability during the update process.

**Question:** What is the main difference between synchronous and asynchronous replication in a stretch cluster scenario?

**Answer:** When you use synchronous replication, the host receives a write complete response from the primary storage after the data successfully writes to both storage systems. If the data does not successfully write to both storage systems, the application must attempt to write to the disk again. With synchronous replication, both storage systems are identical.

When you use asynchronous replication, the node receives a write complete response from the storage after the data successfully writes on the primary storage. The data writes to the secondary storage on a different schedule, depending on the hardware or software vendor's implementation.

**Question:** What is an enhanced feature in stretch clusters in Windows Server 2016?

**Answer:** In Windows Server 2016, you can adjust the cluster quorum settings so that nodes do or do not have a vote when the cluster determines whether it has quorum.

## Real-world Issues and Scenarios

Your organization is considering the use of a geographically dispersed cluster that includes an alternate datacenter. Your organization has only a single physical location together with an alternate datacenter. Can you provide an automatic failover in this configuration?

Answer: Yes, you can provide an automatic failover in this configuration. To provide an automatic failover, you must configure an Azure Cloud Witness.

## Tools

The following is a list of the tools that this module references:

- Failover Cluster Manager console
- Cluster-Aware Updating console
- Windows PowerShell

- Server Manager
- Internet Small Computer System Interface (iSCSI) initiator
- Disk Management

## Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
The <b>Cluster Validation Wizard</b> reports an error.	Review the report that the <b>Cluster Validation Wizard</b> provides, and determine the problem.
The <b>Create Cluster Wizard</b> reports that not all nodes support the wanted clustered role.	Review the installed roles and features on the cluster nodes. The wanted role must be installed on each cluster node.
You cannot create a print server cluster.	This is not supported in Windows Server 2012. You should use other technologies to provide a highly available print server.

## Lab Review Questions and Answers

### Lab: Implementing failover clustering

#### Question and Answers

**Question:** What information do you need for planning a failover cluster implementation?

**Answer:** To plan a failover cluster, you need:

- The number of applications or services that you will deploy on the cluster.
- The performance requirements and characteristics for each application or service.
- The number of servers that must be available to meet the performance requirements.
- The location of the users who will use the failover cluster.
- The type of storage that the shared cluster storage will use.

**Question:** After running the **Validate a Configuration Wizard**, how can you resolve the network communication single point of failure?

**Answer:** You can resolve the network communication single point of failure by adding network adapters on a separate network. This provides communication redundancy among cluster nodes.

**Question:** In which situations might it be important to enable failback for a clustered application during a specific time?

**Answer:** Setting the failback to a preferred node at a specific time is important when you have to help ensure that the failback will not interfere with client connections, backup windows, or other maintenance that a failback would interrupt.

# Module 12

## Implementing failover clustering with Windows Server 2016 Hyper-V

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## Lesson 1

# Overview of the integration of Hyper-V Server 2016 with failover clustering

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## Question and Answers

**Question:** Why is using shared storage a best practice in Windows Server Hyper-V failover clustering?

**Answer:** All nodes in the cluster must be able to read and write to the same virtual hard disk when hosting the virtual machine.

**Question:** You have two clusters. One is a Windows Server 2016 cluster (Cluster1), and the other is a mixed mode cluster of Windows Server 2012 R2 and Windows Server 2016 (Cluster2) that is in the process of upgrading, but the upgrade is not completed. You also have two virtual machines named **VM1** and **VM2**. **VM1** and **VM2** need to migrate back and forth between Cluster1 and Cluster2 occasionally. Should you upgrade the configuration version on **VM1**?

**Answer:** No.

**Feedback:** Technically, only the Windows Server 2012 R2 configuration still supports mixed mode clusters. If the configuration version is upgraded, the virtual machine can no longer run on Cluster2.

## Lesson 2

# Implementing Hyper-V virtual machines on failover clusters

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## Question and Answers

### Configuring a shared virtual hard disk

**Question:** What is the primary benefit of using shared virtual hard disks?

**Answer:** If you use a shared virtual hard disk as cluster storage, you do not have to provide Fibre Channel or Internet small computer system interface (iSCSI) connection to the virtual machines.

### Implementing Scale-Out File Server for virtual machines

**Question:** Have you considered storing virtual machines on the SMB share? Why or why not?

**Answer:** Answers might vary. Students will most likely emphasize performance issues as a reason for not deploying virtual machines on the SMB share.

### Maintaining and monitoring virtual machines in clusters

**Question:** What are some alternative Microsoft technologies that you can use for virtual machine monitoring and network monitoring?

**Answer:** You can use dedicated monitoring software such as System Center Operations Manager and Operations Manager Suite to monitor virtual machines and to monitor your network.

## Resources

### Configuring a shared virtual hard disk

 **Additional Reading:** For more information, refer to “Deploy a Guest Cluster Using a Shared Virtual Hard Disk” at: <http://aka.ms/ise0h>

## Lesson 3

# Implementing Windows Server 2016 Hyper-V virtual machine migration

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## Question and Answers

### Virtual machine migration options

**Question:** When will you export and import a virtual machine instead of migrating it?

**Answer:** If you want to move a virtual machine to the host that does not support a shared-nothing migration, or if you do not have a cluster, or if there are network considerations between the locations. You must export and import the virtual machine. For example, moving a virtual machine in an isolated network from one Hyper-V host to another.

## Lesson 4

# Implementing Hyper-V Replica

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## Question and Answers

### Hyper-V Replica in Windows Server 2016

**Question:** Do you see extended replication as a benefit for your environment?

**Answer:** Answers will vary. A good example would be a scenario where you need to have a replica of a virtual machine that is easily accessible in your primary datacenter; however, you also would like a replica for disaster recovery in a separate geographic location.

## Module Review and Takeaways

### Best Practices

- Develop standard configurations before you implement highly available virtual machines. You should configure the host computers to be as close to identical as possible. To ensure that you have a consistent Hyper-V platform, you should configure standard network names, and use consistent naming standards for CSV volumes.
- Use new features in Hyper-V Replica to extend your replication to more than one server.
- Consider using Scale-Out File Server clusters as storage for highly available virtual machines.
- Implement Virtual Machine Manager. Virtual Machine Manager provides a management layer on top of Hyper-V and Failover Cluster Manager that can stop you from making mistakes when you manage highly available virtual machines. For example, it stops you from creating virtual machines on storage that is inaccessible from all nodes in the cluster.

### Review Question

**Question:** Do you have to implement CSV to provide high availability for virtual machines in VMM in Windows Server 2016?

**Answer:** No. You do not have to implement CSV to provide high availability. However, CSV makes it much easier to implement and manage an environment where you have multiple Hyper-V hosts accessing multiple LUNs on shared storage.

### Tools

Tools for implementing failover clustering with Hyper-V include:

- Failover Cluster Manager
- Hyper-V Manager
- VMM console

### Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Virtual machine failover fails after implementing CSV and migrating the shared storage to CSV.	The CSV home folder is located on the host-server system drive. You cannot move it. If the host computers use different system drives, the failovers will fail because the hosts cannot access the same storage location. All failover cluster nodes should use the same hard-drive configuration.
A virtual machine fails over to another node in the host cluster, but loses all network connectivity.	All the nodes in a host cluster must have the same networks configured. If they do not, then the virtual machines cannot connect to a network when they fail over to another node.
Four hours after restarting a Hyper-V host that is a member of a host cluster, there are still no virtual machines running on the host.	By default, virtual machines do not fail back to a host computer after they have migrated to another host. You can enable failback on the virtual machine properties in Failover Cluster Manager, or you can implement the Performance and Resource Optimization feature in Virtual Machine Manager.

## Lab Review Questions and Answers

### Lab: Implementing failover clustering with Windows Server 2016 Hyper-V

#### Question and Answers

**Question:** How can you extend Hyper-V Replica in Windows Server 2016?

**Answer:** You can use the extended replication feature to add a third host machine that can replicate with a passive copy and with a configurable replication timeout.

**Question:** What is the difference between Live Migration and Storage Migration?

**Answer:** In Live Migration, you move the machine from one host to another. In Storage Migration, you move virtual machine storage and, optionally, configuration files to another location on the same server.