Microsoft

20740A

Installation, Storage, and Compute with Windows Server 2016

Companion Content

MICROSOFT LICENSE TERMS
MICROSOFT INSTRUCTOR-LED COURSEWARE

These license terms are an agreement between Microsoft Corporation (or based on where you live, one of its affiliates) and you. Please read them. They apply to your use of the content accompanying this agreement which includes the media on which you received it, if any. These license terms also apply to Trainer Content and any updates and supplements for the Licensed Content unless other terms accompany those items. If so, those terms apply.

BY ACCESSING, DOWNLOADING OR USING THE LICENSED CONTENT, YOU ACCEPT THESE TERMS. IF YOU DO NOT ACCEPT THEM, DO NOT ACCESS, DOWNLOAD OR USE THE LICENSED CONTENT.

If you comply with these license terms, you have the rights below for each license you acquire.

1. **DEFINITIONS.**

    a. "Authorized Learning Center" means a Microsoft IT Academy Program Member, Microsoft Learning Competency Member, or such other entity as Microsoft may designate from time to time.

    b. "Authorized Training Session" means the instructor-led training class using Microsoft Instructor-Led Courseware conducted by a Trainer at or through an Authorized Learning Center.

    c. "Classroom Device" means one (1) dedicated, secure computer that an Authorized Learning Center owns or controls that is located at an Authorized Learning Center's training facilities that meets or exceeds the hardware level specified for the particular Microsoft Instructor-Led Courseware.

    d. "End User" means an individual who is (i) duly enrolled in and attending an Authorized Training Session or Private Training Session, (ii) an employee of a MPN Member, or (iii) a Microsoft full-time employee.

    e. "Licensed Content" means the content accompanying this agreement which may include the Microsoft Instructor-Led Courseware or Trainer Content.

    f. "Microsoft Certified Trainer" or "MCT" means an individual who is (i) engaged to teach a training session to End Users on behalf of an Authorized Learning Center or MPN Member, and (ii) currently certified as a Microsoft Certified Trainer under the Microsoft Certification Program.

    g. "Microsoft Instructor-Led Courseware" means the Microsoft-branded instructor-led training course that educates IT professionals and developers on Microsoft technologies. A Microsoft Instructor-Led Courseware title may be branded as MOC, Microsoft Dynamics or Microsoft Business Group courseware.

    h. "Microsoft IT Academy Program Member" means an active member of the Microsoft IT Academy Program.

    i. "Microsoft Learning Competency Member" means an active member of the Microsoft Partner Network program in good standing that currently holds the Learning Competency status.

    j. "MOC" means the "Official Microsoft Learning Product" instructor-led courseware known as Microsoft Official Course that educates IT professionals and developers on Microsoft technologies.

    k. "MPN Member" means an active Microsoft Partner Network program member in good standing.

l. "Personal Device" means one (1) personal computer, device, workstation or other digital electronic device that you personally own or control that meets or exceeds the hardware level specified for the particular Microsoft Instructor-Led Courseware.

m. "Private Training Session" means the instructor-led training classes provided by MPN Members for corporate customers to teach a predefined learning objective using Microsoft Instructor-Led Courseware. These classes are not advertised or promoted to the general public and class attendance is restricted to individuals employed by or contracted by the corporate customer.

n. "Trainer" means (i) an academically accredited educator engaged by a Microsoft IT Academy Program Member to teach an Authorized Training Session, and/or (ii) a MCT.

o. "Trainer Content" means the trainer version of the Microsoft Instructor-Led Courseware and additional supplemental content designated solely for Trainers' use to teach a training session using the Microsoft Instructor-Led Courseware. Trainer Content may include Microsoft PowerPoint presentations, trainer preparation guide, train the trainer materials, Microsoft One Note packs, classroom setup guide and Pre-release course feedback form. To clarify, Trainer Content does not include any software, virtual hard disks or virtual machines.

2. **USE RIGHTS**. The Licensed Content is licensed not sold. The Licensed Content is licensed on a ***one copy per user basis***, such that you must acquire a license for each individual that accesses or uses the Licensed Content.

2.1 Below are five separate sets of use rights. Only one set of rights apply to you.

a. **If you are a Microsoft IT Academy Program Member:**
   i. Each license acquired on behalf of yourself may only be used to review one (1) copy of the Microsoft Instructor-Led Courseware in the form provided to you. If the Microsoft Instructor-Led Courseware is in digital format, you may install one (1) copy on up to three (3) Personal Devices. You may not install the Microsoft Instructor-Led Courseware on a device you do not own or control.
   ii. For each license you acquire on behalf of an End User or Trainer, you may either:
      1. distribute one (1) hard copy version of the Microsoft Instructor-Led Courseware to one (1) End User who is enrolled in the Authorized Training Session, and only immediately prior to the commencement of the Authorized Training Session that is the subject matter of the Microsoft Instructor-Led Courseware being provided, **or**
      2. provide one (1) End User with the unique redemption code and instructions on how they can access one (1) digital version of the Microsoft Instructor-Led Courseware, **or**
      3. provide one (1) Trainer with the unique redemption code and instructions on how they can access one (1) Trainer Content,
      provided you comply with the following:
   iii. you will only provide access to the Licensed Content to those individuals who have acquired a valid license to the Licensed Content,
   iv. you will ensure each End User attending an Authorized Training Session has their own valid licensed copy of the Microsoft Instructor-Led Courseware that is the subject of the Authorized Training Session,
   v. you will ensure that each End User provided with the hard-copy version of the Microsoft Instructor-Led Courseware will be presented with a copy of this agreement and each End User will agree that their use of the Microsoft Instructor-Led Courseware will be subject to the terms in this agreement prior to providing them with the Microsoft Instructor-Led Courseware. Each individual will be required to denote their acceptance of this agreement in a manner that is enforceable under local law prior to their accessing the Microsoft Instructor-Led Courseware,
   vi. you will ensure that each Trainer teaching an Authorized Training Session has their own valid licensed copy of the Trainer Content that is the subject of the Authorized Training Session,

vii. you will only use qualified Trainers who have in-depth knowledge of and experience with the Microsoft technology that is the subject of the Microsoft Instructor-Led Courseware being taught for all your Authorized Training Sessions,

viii. you will only deliver a maximum of 15 hours of training per week for each Authorized Training Session that uses a MOC title, and

ix. you acknowledge that Trainers that are not MCTs will not have access to all of the trainer resources for the Microsoft Instructor-Led Courseware.

b. **If you are a Microsoft Learning Competency Member**:

i. Each license acquired on behalf of yourself may only be used to review one (1) copy of the Microsoft Instructor-Led Courseware in the form provided to you. If the Microsoft Instructor-Led Courseware is in digital format, you may install one (1) copy on up to three (3) Personal Devices. You may not install the Microsoft Instructor-Led Courseware on a device you do not own or control.

ii. For each license you acquire on behalf of an End User or Trainer, you may either:

1. distribute one (1) hard copy version of the Microsoft Instructor-Led Courseware to one (1) End User attending the Authorized Training Session and only immediately prior to the commencement of the Authorized Training Session that is the subject matter of the Microsoft Instructor-Led Courseware provided, **or**

2. provide one (1) End User attending the Authorized Training Session with the unique redemption code and instructions on how they can access one (1) digital version of the Microsoft Instructor-Led Courseware, **or**

3. you will provide one (1) Trainer with the unique redemption code and instructions on how they can access one (1) Trainer Content,

   provided you comply with the following:

iii. you will only provide access to the Licensed Content to those individuals who have acquired a valid license to the Licensed Content,

iv. you will ensure that each End User attending an Authorized Training Session has their own valid licensed copy of the Microsoft Instructor-Led Courseware that is the subject of the Authorized Training Session,

v. you will ensure that each End User provided with a hard-copy version of the Microsoft Instructor-Led Courseware will be presented with a copy of this agreement and each End User will agree that their use of the Microsoft Instructor-Led Courseware will be subject to the terms in this agreement prior to providing them with the Microsoft Instructor-Led Courseware. Each individual will be required to denote their acceptance of this agreement in a manner that is enforceable under local law prior to their accessing the Microsoft Instructor-Led Courseware,

vi. you will ensure that each Trainer teaching an Authorized Training Session has their own valid licensed copy of the Trainer Content that is the subject of the Authorized Training Session,

vii. you will only use qualified Trainers who hold the applicable Microsoft Certification credential that is the subject of the Microsoft Instructor-Led Courseware being taught for your Authorized Training Sessions,

viii. you will only use qualified MCTs who also hold the applicable Microsoft Certification credential that is the subject of the MOC title being taught for all your Authorized Training Sessions using MOC,

ix. you will only provide access to the Microsoft Instructor-Led Courseware to End Users, and

x. you will only provide access to the Trainer Content to Trainers.

c. **If you are a MPN Member**:
   i. Each license acquired on behalf of yourself may only be used to review one (1) copy of the Microsoft Instructor-Led Courseware in the form provided to you. If the Microsoft Instructor-Led Courseware is in digital format, you may install one (1) copy on up to three (3) Personal Devices. You may not install the Microsoft Instructor-Led Courseware on a device you do not own or control.
   ii. For each license you acquire on behalf of an End User or Trainer, you may either:
      1. distribute one (1) hard copy version of the Microsoft Instructor-Led Courseware to one (1) End User attending the Private Training Session, and only immediately prior to the commencement of the Private Training Session that is the subject matter of the Microsoft Instructor-Led Courseware being provided, **or**
      2. provide one (1) End User who is attending the Private Training Session with the unique redemption code and instructions on how they can access one (1) digital version of the Microsoft Instructor-Led Courseware, **or**
      3. you will provide one (1) Trainer who is teaching the Private Training Session with the unique redemption code and instructions on how they can access one (1) Trainer Content,
      provided you comply with the following:
   iii. you will only provide access to the Licensed Content to those individuals who have acquired a valid license to the Licensed Content,
   iv. you will ensure that each End User attending an Private Training Session has their own valid licensed copy of the Microsoft Instructor-Led Courseware that is the subject of the Private Training Session,
   v. you will ensure that each End User provided with a hard copy version of the Microsoft Instructor-Led Courseware will be presented with a copy of this agreement and each End User will agree that their use of the Microsoft Instructor-Led Courseware will be subject to the terms in this agreement prior to providing them with the Microsoft Instructor-Led Courseware. Each individual will be required to denote their acceptance of this agreement in a manner that is enforceable under local law prior to their accessing the Microsoft Instructor-Led Courseware,
   vi. you will ensure that each Trainer teaching an Private Training Session has their own valid licensed copy of the Trainer Content that is the subject of the Private Training Session,
   vii. you will only use qualified Trainers who hold the applicable Microsoft Certification credential that is the subject of the Microsoft Instructor-Led Courseware being taught for all your Private Training Sessions,
   viii. you will only use qualified MCTs who hold the applicable Microsoft Certification credential that is the subject of the MOC title being taught for all your Private Training Sessions using MOC,
   ix. you will only provide access to the Microsoft Instructor-Led Courseware to End Users, and
   x. you will only provide access to the Trainer Content to Trainers.

d. **If you are an End User:**
   For each license you acquire, you may use the Microsoft Instructor-Led Courseware solely for your personal training use. If the Microsoft Instructor-Led Courseware is in digital format, you may access the Microsoft Instructor-Led Courseware online using the unique redemption code provided to you by the training provider and install and use one (1) copy of the Microsoft Instructor-Led Courseware on up to three (3) Personal Devices. You may also print one (1) copy of the Microsoft Instructor-Led Courseware. You may not install the Microsoft Instructor-Led Courseware on a device you do not own or control.

e. **If you are a Trainer.**
   i. For each license you acquire, you may install and use one (1) copy of the Trainer Content in the form provided to you on one (1) Personal Device solely to prepare and deliver an Authorized Training Session or Private Training Session, and install one (1) additional copy on another Personal Device as a backup copy, which may be used only to reinstall the Trainer Content. You may not install or use a copy of the Trainer Content on a device you do not own or control. You may also print one (1) copy of the Trainer Content solely to prepare for and deliver an Authorized Training Session or Private Training Session.

ii.   You may customize the written portions of the Trainer Content that are logically associated with instruction of a training session in accordance with the most recent version of the MCT agreement. If you elect to exercise the foregoing rights, you agree to comply with the following: (i) customizations may only be used for teaching Authorized Training Sessions and Private Training Sessions, and (ii) all customizations will comply with this agreement. For clarity, any use of "*customize*" refers only to changing the order of slides and content, and/or not using all the slides or content, it does not mean changing or modifying any slide or content.

2.2   **Separation of Components.** The Licensed Content is licensed as a single unit and you may not separate their components and install them on different devices.

2.3   **Redistribution of Licensed Content**. Except as expressly provided in the use rights above, you may not distribute any Licensed Content or any portion thereof (including any permitted modifications) to any third parties without the express written permission of Microsoft.

2.4   **Third Party Notices**. The Licensed Content may include third party code tent that Microsoft, not the third party, licenses to you under this agreement. Notices, if any, for the third party code ntent are included for your information only.

2.5   **Additional Terms**. Some Licensed Content may contain components with additional terms, conditions, and licenses regarding its use. Any non-conflicting terms in those conditions and licenses also apply to your use of that respective component and supplements the terms described in this agreement.

3.   **LICENSED CONTENT BASED ON PRE-RELEASE TECHNOLOGY.** If the Licensed Content's subject matter is based on a pre-release version of Microsoft technology ("**Pre-release**"), then in addition to the other provisions in this agreement, these terms also apply:

a.   **Pre-Release Licensed Content.** This Licensed Content subject matter is on the Pre-release version of the Microsoft technology. The technology may not work the way a final version of the technology will and we may change the technology for the final version. We also may not release a final version. Licensed Content based on the final version of the technology may not contain the same information as the Licensed Content based on the Pre-release version. Microsoft is under no obligation to provide you with any further content, including any Licensed Content based on the final version of the technology.

b.   **Feedback.** If you agree to give feedback about the Licensed Content to Microsoft, either directly or through its third party designee, you give to Microsoft without charge, the right to use, share and commercialize your feedback in any way and for any purpose. You also give to third parties, without charge, any patent rights needed for their products, technologies and services to use or interface with any specific parts of a Microsoft technology, Microsoft product, or service that includes the feedback. You will not give feedback that is subject to a license that requires Microsoft to license its technology, technologies, or products to third parties because we include your feedback in them. These rights survive this agreement.

c.   **Pre-release Term**. If you are an Microsoft IT Academy Program Member, Microsoft Learning Competency Member, MPN Member or Trainer, you will cease using all copies of the Licensed Content on the Pre-release technology upon (i) the date which Microsoft informs you is the end date for using the Licensed Content on the Pre-release technology, or (ii) sixty (60) days after the commercial release of the technology that is the subject of the Licensed Content, whichever is earliest ("**Pre-release term**"). Upon expiration or termination of the Pre-release term, you will irretrievably delete and destroy all copies of the Licensed Content in your possession or under your control.

4. **SCOPE OF LICENSE**. The Licensed Content is licensed, not sold. This agreement only gives you some rights to use the Licensed Content. Microsoft reserves all other rights. Unless applicable law gives you more rights despite this limitation, you may use the Licensed Content only as expressly permitted in this agreement. In doing so, you must comply with any technical limitations in the Licensed Content that only allows you to use it in certain ways. Except as expressly permitted in this agreement, you may not:
   - access or allow any individual to access the Licensed Content if they have not acquired a valid license for the Licensed Content,
   - alter, remove or obscure any copyright or other protective notices (including watermarks), branding or identifications contained in the Licensed Content,
   - modify or create a derivative work of any Licensed Content,
   - publicly display, or make the Licensed Content available for others to access or use,
   - copy, print, install, sell, publish, transmit, lend, adapt, reuse, link to or post, make available or distribute the Licensed Content to any third party,
   - work around any technical limitations in the Licensed Content, or
   - reverse engineer, decompile, remove or otherwise thwart any protections or disassemble the Licensed Content except and only to the extent that applicable law expressly permits, despite this limitation.

5. **RESERVATION OF RIGHTS AND OWNERSHIP**. Microsoft reserves all rights not expressly granted to you in this agreement. The Licensed Content is protected by copyright and other intellectual property laws and treaties. Microsoft or its suppliers own the title, copyright, and other intellectual property rights in the Licensed Content.

6. **EXPORT RESTRICTIONS**. The Licensed Content is subject to United States export laws and regulations. You must comply with all domestic and international export laws and regulations that apply to the Licensed Content. These laws include restrictions on destinations, end users and end use. For additional information, see www.microsoft.com/exporting.

7. **SUPPORT SERVICES**. Because the Licensed Content is "as is", we may not provide support services for it.

8. **TERMINATION.** Without prejudice to any other rights, Microsoft may terminate this agreement if you fail to comply with the terms and conditions of this agreement. Upon termination of this agreement for any reason, you will immediately stop all use of and delete and destroy all copies of the Licensed Content in your possession or under your control.

9. **LINKS TO THIRD PARTY SITES**. You may link to third party sites through the use of the Licensed Content. The third party sites are not under the control of Microsoft, and Microsoft is not responsible for the contents of any third party sites, any links contained in third party sites, or any changes or updates to third party sites. Microsoft is not responsible for webcasting or any other form of transmission received from any third party sites. Microsoft is providing these links to third party sites to you only as a convenience, and the inclusion of any link does not imply an endorsement by Microsoft of the third party site.

10. **ENTIRE AGREEMENT.** This agreement, and any additional terms for the Trainer Content, updates and supplements are the entire agreement for the Licensed Content, updates and supplements.

11. **APPLICABLE LAW.**
    a. United States. If you acquired the Licensed Content in the United States, Washington state law governs the interpretation of this agreement and applies to claims for breach of it, regardless of conflict of laws principles. The laws of the state where you live govern all other claims, including claims under state consumer protection laws, unfair competition laws, and in tort.

b.   Outside the United States. If you acquired the Licensed Content in any other country, the laws of that country apply.

12.   **LEGAL EFFECT**. This agreement describes certain legal rights. You may have other rights under the laws of your country. You may also have rights with respect to the party from whom you acquired the Licensed Content. This agreement does not change your rights under the laws of your country if the laws of your country do not permit it to do so.

13.   **DISCLAIMER OF WARRANTY. THE LICENSED CONTENT IS LICENSED "AS-IS" AND "AS AVAILABLE." YOU BEAR THE RISK OF USING IT. MICROSOFT AND ITS RESPECTIVE AFFILIATES GIVES NO EXPRESS WARRANTIES, GUARANTEES, OR CONDITIONS. YOU MAY HAVE ADDITIONAL CONSUMER RIGHTS UNDER YOUR LOCAL LAWS WHICH THIS AGREEMENT CANNOT CHANGE. TO THE EXTENT PERMITTED UNDER YOUR LOCAL LAWS, MICROSOFT AND ITS RESPECTIVE AFFILIATES EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT.**

14.   **LIMITATION ON AND EXCLUSION OF REMEDIES AND DAMAGES. YOU CAN RECOVER FROM MICROSOFT, ITS RESPECTIVE AFFILIATES AND ITS SUPPLIERS ONLY DIRECT DAMAGES UP TO US$5.00. YOU CANNOT RECOVER ANY OTHER DAMAGES, INCLUDING CONSEQUENTIAL, LOST PROFITS, SPECIAL, INDIRECT OR INCIDENTAL DAMAGES.**

This limitation applies to
o   anything related to the Licensed Content, services, content (including code) on third party Internet sites or third-party programs; and
o   claims for breach of contract, breach of warranty, guarantee or condition, strict liability, negligence, or other tort to the extent permitted by applicable law.

It also applies even if Microsoft knew or should have known about the possibility of the damages. The above limitation or exclusion may not apply to you because your country may not allow the exclusion or limitation of incidental, consequential or other damages.

Please note: As this Licensed Content is distributed in Quebec, Canada, some of the clauses in this agreement are provided below in French.

Remarque : Ce le contenu sous licence étant distribué au Québec, Canada, certaines des clauses dans ce contrat sont fournies ci-dessous en français.

EXONÉRATION DE GARANTIE. Le contenu sous licence visé par une licence est offert « tel quel ». Toute utilisation de ce contenu sous licence est à votre seule risque et péril. Microsoft n'accorde aucune autre garantie expresse. Vous pouvez bénéficier de droits additionnels en vertu du droit local sur la protection dues consommateurs, que ce contrat ne peut modifier. La ou elles sont permises par le droit locale, les garanties implicites de qualité marchande, d'adéquation à un usage particulier et d'absence de contrefaçon sont exclues.

LIMITATION DES DOMMAGES-INTÉRÊTS ET EXCLUSION DE RESPONSABILITÉ POUR LES DOMMAGES. Vous pouvez obtenir de Microsoft et de ses fournisseurs une indemnisation en cas de dommages directs uniquement à hauteur de 5,00 $ US. Vous ne pouvez prétendre à aucune indemnisation pour les autres dommages, y compris les dommages spéciaux, indirects ou accessoires et pertes de bénéfices.
Cette limitation concerne:
•   tout ce qui est relié au le contenu sous licence, aux services ou au contenu (y compris le code) figurant sur des sites Internet tiers ou dans des programmes tiers; et.
•   les réclamations au titre de violation de contrat ou de garantie, ou au titre de responsabilité stricte, de négligence ou d'une autre faute dans la limite autorisée par la loi en vigueur.

Elle s'applique également, même si Microsoft connaissait ou devrait connaître l'éventualité d'un tel dommage. Si votre pays n'autorise pas l'exclusion ou la limitation de responsabilité pour les dommages indirects, accessoires ou de quelque nature que ce soit, il se peut que la limitation ou l'exclusion ci-dessus ne s'appliquera pas à votre égard.

EFFET JURIDIQUE. Le présent contrat décrit certains droits juridiques. Vous pourriez avoir d'autres droits prévus par les lois de votre pays. Le présent contrat ne modifie pas les droits que vous confèrent les lois de votre pays si celles-ci ne le permettent pas.

Revised July 2013

Module 1

Installing, upgrading, and migrating servers and workloads

Contents:

Lesson 1
Introducing Windows Server 2016

Contents:

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.

Question: What new features in Windows Server 2016 do you think will be useful in your organization?

>**Answer:** Answers will vary.

Resources

Managing servers remotely

Additional Reading: For more information about configuring firewall settings to support remote management, refer to the procedure To configure MMC or other tool remote management over DCOM in the topic Configure Remote Management in Server Manager at: http://aka.ms/eyxjjf

Lesson 2
Preparing and installing Nano Server and Server Core

Contents:

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 except for Windows PowerShell. Even with Windows PowerShell the support is only for a limited subset of Windows PowerShell cmdlets. **SConfig.cmd** is deprecated in Windows Server 2016. **Taskmgr.exe** is not available on Nano Server. You can use the Nano Server Recovery Console for the basic configuration of the Windows Firewall rules and network settings.

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.

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 they want you to deploy at their only office. Which Windows Server 2016 installation option would be best?

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

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 Domain Name System (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 Internet Information Services (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 –
packages Microsoft-NanoServer-IIS-Package
```

8. At the **AdministratorPassword** prompt, type **Pa$$w0rd**, 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 **Pa$$w0rd**, 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. On the **Ethernet** adapter, press Enter. In **Network Adapter Settings**, notice that Dynamic Host Configuration Protocol (DHCP) is providing the IP configuration.

15. Press Esc twice.

Lesson 3
Preparing for upgrades and migrations

Contents:

Question and Answers

Question: How does virtualization help in server role consolidation?

> **Answer:** Virtualization allows you to take advantages of separating roles onto different servers. For example, you can more easily troubleshoot issues, you can better manage service uptime, and so on. At the same time, you also gain the advantage of consolidating multiple roles onto fewer computers. You must ensure that there are enough hardware resources on the virtualization hosts 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/p3xxrr

Using solution accelerators

🌐   **Additional Reading:**

- For more information about using MDT as part of a complete deployment solution, refer to Automate and manage Windows operating system deployments at: http://aka.ms/Mi7wfx
- For more information about MDT, including the latest updates, refer to Microsoft Deployment Toolkit at: http://aka.ms/de2ej0

🌐   **Reference Links:** For more information about the Microsoft Assessment and Planning (MAP) Toolkit, refer to: http://aka.ms/u7x2mf

🌐   **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/mr3jqp

Demonstration: Using MAP

Demonstration Steps

Review the MAP options

1. On **LON-CL1**, click **Start**, and then click **Microsoft Assessment and Planning Toolkit**.

2. In the **Microsoft Assessment and Planning Toolkit** console, a dialog box will appear named **Microsoft Assessment and Planning Toolkit**. To close the dialog box, 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 4 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 **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 (AD DS)**, 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 **Pa$$w0rd,** and then click **Next**.

   d. In 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 **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 MAP Toolkit 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, on the left pane expand **C:\Program Files\Microsoft Assessment and Planning Toolkit\Sample**, and then on 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**, on 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 4 for all remaining items in the left pane: **Server**, **Desktop Virtualization**, **Server Virtualization**, **Database**, **Usage Tracking**, and **Environment**.

Lesson 4
Migrating server roles and workloads

Contents:

Question and Answers

Question: What are some reasons 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 could also be necessary as part of a business merger or acquisition.
>
> By performing a cross-forest migration, both the new and old structure will exist at the same time, which will allow you to roll back to the previous structure if there are problems 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/mr3jqp

Lesson 5
Windows Server activation models

Contents:

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 when the computers that are only running Windows Server 2016 and 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/b07bed

Module Review and Takeaways

Review Questions

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

> **Answer:** Use 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.

Tools

These tools were mentioned in this module.

Tool	Used for	Where to find it
RSAT	Used for managing servers remotely from a Windows 10 workstation	Download from the Microsoft download center
DISM.exe	Used for image servicing and management	Start from a command prompt or Windows PowerShell console
Windows Server Migration Tools	Use for assistance in migrating from one version of Windows Server to another version	Download from the Microsoft download center
Volume Activation Management Tool	Use the VAMT to manage Multiple Activation Keys (MAKs)	Download from the Microsoft download center

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Windows PowerShell cmdlets are not available	Make sure that the Windows PowerShell modules (such as Server Manager) are loaded correctly.
You need a non-GUI interface method to shut down or restart a computer that is running Server Core	Use Windows PowerShell or use the **shutdown /r** command from a command prompt.
You are unable to join a computer to the domain	Verify DNS resolution and network connectivity between the host and the domain controller. Verify that the user account has necessary permissions to join the domain.

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 drive, 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 drive 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 appears 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 correctly set 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

Configuring Local Storage

Contents:

Lesson 1
Managing disks in Windows Server

Contents:

Question and Answers

Question: What disk types are you most commonly using in your organization, and do you have a management and provisioning strategy for storage usage in particular scenarios?

       Answer: Answers will vary based on student experiences.

Question: ReFS supports data deduplication in Windows Server 2016.

(   ) True

(   ) False

       Answer:

       (   ) True

       (√) False

Selecting a file system

Question: What file system do you currently use on your file server and will you continue to use it?

       Answer: Answers could vary. A common answer is NTFS, because NTFS should be the basis for any file system used on a Windows Server operating system. If you use FAT32 or Extended FAT (exFAT), you should be able to support your decision, because these file systems do not support security access control lists (ACLs) on files and folders.

       The second part of the question focuses on switching to ReFS when upgrading to Windows Server 2016. You might answer yes because it is more reliable, or you might answer no, because you want to wait until it is used more widely in the market.

Resources

Selecting a partition table format

Additional Reading: For more information, refer to Frequently asked questions about the GUID Partitioning Table disk architecture: http://aka.ms/sha5x0

Selecting a disk type

Additional Reading: For more information, refer to How Basic Disks and Volumes Work: http://aka.ms/afknbd

Selecting a file system

Additional Reading:

- For more information, refer to How FAT Works: http://aka.ms/j4j5nm

- For more information, refer to How NTFS Works: http://aka.ms/H6hp4c

Implementing ReFS

🌐   **Additional Reading:** For more information about ReFS, refer to Building the next generation file system for Windows: ReFS: http://aka.ms/orvy9u

Demonstration: Configuring ReFS

Demonstration Steps

Retrieve information for an NTFS volume

1. On **LON-SVR1** right-click **Start**, and then click **Disk Management**.

2. In the lower half of the display, scroll down and right-click **Disk 2** and then click **Online**.

3. Repeat for Disk 3 and Disk 4.

4. Close and reopen **Disk Management**.

5. In the **Initialize Disk** dialog box, click **OK**.

6. Right-click the Unallocated space on **Disk 2**, and then click **New Simple Volume**.

7. In the New Simple Volume Wizard, click **Next**.

8. On the **Specify Volume Size** page, click **Next**.

9. On the **Assign Drive Letter or Path** page, in the **Assign the following drive letter** list, click **F**, and then click **Next**.

10. On the **Format Partition** page, in the **Volume label** text box, type **New Volume**, and then click **Next**.

11. Click **Finish**.

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

13. At the Windows PowerShell prompt, run the following command to view information about the NTFS volume:

```
fsutil fsinfo volumeinfo f:
```

14. At the Windows PowerShell prompt, run the following command to view the sector information:

```
fsutil fsinfo sectorinfo f:
```

Reformat the volume

1. At the Windows PowerShell prompt, run the following command to reformat the NTFS volume as a ReFS volume:

```
Format-Volume –DriveLetter F –FileSystem ReFS
```

2. If prompted to confirm the format, type **Y**, and then press Enter.

Retrieve Information for an ReFS volume

1. At the Windows PowerShell prompt, run the following command to view information about the ReFS volume:

```
fsutil fsinfo volumeinfo f:
```

2. At the Windows PowerShell prompt, run the following command to view the sector information about the ReFS volume:

```
fsutil fsinfo sectorinfo f:
```

3. Scroll back through the output to view the differences between the file system capabilities.

Lesson 2
Managing volumes in Windows Server

Contents:

Question and Answers

Question: Should you configure all disks with the same amount of fault tolerance?

> **Answer:** No, not all disks need the same tolerance. A common practice is to use RAID 1 for the operating system volume and RAID 5 for the data volumes.

Resources

Extending and shrinking a volume

Additional Reading:

- For more information, refer to Extend a Basic Volume: http://aka.ms/sefpk3

- For more information, refer to Shrink a Basic Volume: http://aka.ms/H7pfnt

Demonstration: Managing volumes

Demonstration Steps

Create a new volume with Diskpart

1. On **LON-SVR1**, in the **Windows PowerShell** window, type **diskpart**, and then press Enter.

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

   ```
   List disk
   ```

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

   ```
   Select disk 3
   ```

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

   ```
   Convert dynamic
   ```

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

   ```
   Create volume simple size=500 disk=3
   ```

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

   ```
   assign letter=G
   ```

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

   ```
   Format
   ```

8. Switch to **Disk Management**.

9. Click **Action**, and then click **Refresh**. Point out that you can see the newly created Drive G formatted for NTFS.

Create a mirrored volume

1. In Disk Management, right-click an area of unallocated space on Disk 3, and then click **New Mirrored Volume**.

2. In the **New Mirrored Volume Wizard**, click **Next**.

3.   On the **Select Disks** page, in the **Available** list, click **Disk 4**, click **Add >**, and then click **Next**.

4.   On the **Assign Drive Letter or Path** page, click **Next**.

5.   On the **Format Volume** page, in the **File system** list, click **ReFS**.

6.   In the **Volume label** text box, type **Mirror**, select the **Perform a quick format** check box, and then click **Next**.

7.   Click **Finish** to create your mirrored volume.

8.   In the **Disk Management** dialog box, click **Yes** to convert the disk to dynamic.

Module Review and Takeaways

Best Practices

The following list is of recommended best practices:

- If you want to shrink a volume, defragment the volume first so you can reclaim more space from the volume.

- Use the GPT partition table format for disks larger than 2 TB.

- For very large volumes, use ReFS.

- Do not use FAT or FAT32 on Windows Server operating system disks.

Review Questions

Question: What are the two disk types in Disk Management?

> **Answer:** The two types of disks are basic and dynamic.

Question: What are the most important implementations of RAID?

> **Answer:** The most important implementations of RAID are:
>
> - RAID 1: Mirrored set without parity or striping.
>
> - RAID 5: Striped set with parity.
>
> - RAID 6: Striped set with dual distributed parity.
>
> - RAID 1+0: Mirrored drives configured as a strip set.

Tools

The following table lists the tools that this module references.

Tool	Use to	Where to find it
Disk Management	- Initialize disks - Create and modify volumes	In Server Manager on the **Tools** menu (part of Computer Management)
Diskpart.exe	- Initialize disks - Create and modify volumes from a command prompt	Command prompt
Mklink.exe	Create a symbolic link to a file or folder	Command prompt
Chkdsk.exe	- Check a disk for an NTFS-formatted volume - Cannot be used for ReFS or virtual disks	Command prompt
Defrag.exe	- Disk defragmentation tool for NTFS-formatted volumes. - Cannot be used for ReFS or virtual disks	Command prompt

Lab Review Questions and Answers

Lab: Configuring local storage

Question and Answers

Question: In the lab, you used the Diskpart.exe command-line tool to create and resize volumes. What alternate Windows PowerShell cmdlets could you have used?

> **Answer:** You could use some of the more common disk management cmdlets:
>
> - **Get-disk**. Lists all available disks installed in the server computer.
>
> - **Clear-disk**. Removes all partitions and volumes from the specified disk.
>
> - **Initialize-disk**. Enables you to initialize a disk in readiness for creation of volumes.
>
> - **Get-volume**. Lists all accessible volumes.
>
> - **Format-volume**. Enables you to format a volume with NTFS.

Question: Your current volume runs out of disk space. You have another disk available in the same server. What actions in the Windows operating system can you perform to help you add disk space?

> **Answer:** Your answers can include converting the disk to a dynamic disk, and extending the volume with the second disk. You also can use the second disk as a mount point to move some large files and reassign their path. You also could use links to move large files to the new volume, and then create a link from their original location.

Module 3

Implementing enterprise storage solutions

Contents:

Lesson 1
Overview of DAS, NAS, and SANs

Contents:

Question and Answers

Question: Which type of storage typically has the lowest implementation costs?

( ) DAS

( ) NAS

( ) SAN

( ) Block-level storage

( ) File-level storage

> **Answer:**
>
> (√) DAS
>
> ( ) NAS
>
> ( ) SAN
>
> ( ) Block-level storage
>
> ( ) File-level storage
>
> **Feedback:**
>
> In most cases, DAS has the lowest implementation costs. However, it has the least flexibility, because the storage is not pooled, and it is difficult to reallocate.

Question: A SAN provides file-level storage.

( ) True

( ) False

> **Answer:**
>
> ( ) True
>
> (√) False
>
> **Feedback:**
>
> A SAN provides block-level storage.

Discussion: Which storage solutions are deployed in your environment?

Question: Which storage solutions does your organization use?

> **Answer:** Answers will vary, but will probably include a mix of direct attached storage (DAS), network-attached storage (NAS), and storage area networks (SANs).

Question: What benefits do those storage solutions offer?

> **Answer:** Each organization will have different ideas as to the benefits offered by their storage solutions. Some benefits might include that:

- DAS is easy to manage.
- A SAN offers many features, including snapshots and replication.

Lesson 2
Comparing Fibre Channel, iSCSI, and Fibre Channel over Ethernet

Contents:

Question and Answers

Question: Can you use your organization's internal TCP/IP network to provide iSCSI?

> **Answer:** Yes, you can. However, as a best practice, you should have a dedicated TCP/IP network for iSCSI, so that other network traffic does not interfere with iSCSI communication, and so iSCSI communication does not interfere with the network traffic.

Question: When would you consider implementing diskless booting from iSCSI targets?

> **Answer:** Answers will vary based on experience, but generally, you might consider this if you want to implement virtualization technologies, such as a Virtual Desktop Infrastructure (VDI), in your organization.

Resources

iSCSI components

Additional Reading: For more information, refer to iSCSI Target Server Scalability Limits: http://aka.ms/dfxgja

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

Demonstration: Configuring an iSCSI target

Demonstration Steps

Add the iSCSI Target Server role service

1. On LON-DC1, in **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 **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, expand **File and Storage Services (2 of 12 installed)**, expand **File and iSCSI Services (1 of 11 installed)**, select the **iSCSI Target Server** check box, and then click **Next**.

6. On the **Select features** page, click **Next**.

7. On the **Confirm installation selections** page, click **Install**.

8. When installation completes, click **Close**.

Create two iSCSI virtual disks and an iSCSI target

1. On LON-DC1, in **Server Manager**, in the navigation pane, click **File and Storage Services**.

2. In the **File and Storage Services** pane, click **iSCSI**.

3. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then, in the **TASKS** list, click **New iSCSI Virtual Disk**.

4. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click volume **C**, and then click **Next**.

5. On the **Specify iSCSI virtual disk name** page, in the **Name** box, type **iSCSIDisk1**, and then click **Next**.

6. On the **Specify iSCSI virtual disk size** page, in the **Size** box, type **5**, ensure that **GB** is selected, and then click **Next**.

7. On the **Assign iSCSI target** page, click **New iSCSI target**, and then click **Next**.

8. On the **Specify target name** page, in the **Name** box, type **LON-DC1**, and then click **Next**.

9. On the **Specify access servers** page, click **Add**.

10. In the **Select a method to identify the initiator** dialog box, click **Enter a value for the selected type**.

11. In the **Type** list, click **IP Address**, in the **Value** field, type **172.16.0.21**, and then click **OK**.

12. On the **Specify access servers** page, click **Next**.

13. On the **Enable Authentication** page, click **Next**.

14. On the **Confirm selections** page, review the parameters, and then click **Create**.

15. On the **View results** page, wait until the virtual disk is created, and then click **Close**.

16. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then, in the **TASKS** list, click **New iSCSI Virtual Disk**.

17. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click volume **C**, and then click **Next**.

18. On the **Specify iSCSI virtual disk name** page, type **iSCSIDisk2**, and then click **Next**.

19. On the **Specify iSCSI virtual disk size** page, in the **Size** box, type **5**, ensure that **GB** is selected, and then click **Next**.

20. On the **Assign iSCSI target** page, click **LON-DC1**, and then click **Next**.

21. On the **Confirm selections** page, review the parameters, and then click **Create**.

22. On the **View results** page, wait until the virtual disk is created, and then click **Close**.

Connect to the iSCSI target

1. On LON-SVR1, if necessary, open **Server Manager**.

2. In **Server Manager**, click the **Tools** menu, and then click **iSCSI Initiator**.

3. In the **Microsoft iSCSI** message box, click **Yes**.

4. In the **iSCSI Initiator Properties** dialog box, on the **Targets** tab, type **LON-DC1**, and then click **Quick Connect**.

5. In the **Quick Connect** dialog box, under **Discovered targets**, click **iqn.1991-05.com.microsoft:lon-dc1-lon-dc1-target,** and then click **Done**.

6. In the **iSCSI Initiator Properties** dialog box, click **OK** to close the dialog box.

Verify the presence of the iSCSI drive

1. On LON-SVR1, in **Server Manager**, in the **Tools** menu, click **Computer Management**.

2. In the **Computer Management** console, under the **Storage** node, click **Disk Management**.

Note: The new disks are added, but they all are currently offline and not formatted. These are listed as Disk 11 and Disk 12.

3. Close the **Computer Management** console.

Lesson 3
Understanding iSNS, DCB, and MPIO

Contents:

Question and Answers

Question: You can use iSNS for both iSCSI and Fibre Channel storage.

(   ) True

(   ) False

> **Answer:**
>
> (√) True
>
> (   ) False
>
> **Feedback:**
>
> You can use iSNS to manage both iSCSI and Fibre Channel storage.

Question: What is the maximum number of paths that Microsoft MPIO can have?

(   ) 4

(   ) 8

(   ) 16

(   ) 32

> **Answer:**
>
> (   ) 4
>
> (   ) 8
>
> (   ) 16
>
> (√) 32
>
> **Feedback:**
>
> Microsoft MPIO is capable of identifying up to 32 paths.

Demonstration: Configuring MPIO

Demonstration Steps

1. On LON-SVR1, in **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 **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, select the **Multipath I/O** check box, and then click **Next**.

7. On the **Confirm installation selections** page, click **Install**.

8. When installation is complete, click **Close**.

9. Restart LON-SVR1 and sign in as **Adatum\Administrator** with the password **Pa$$w0rd**.

10. If necessary, open **Server Manager**.

11. In **Server Manager**, on the menu bar, click **Tools**, and then click **MPIO**.

12. In the **MPIO Properties** dialog box, click the **Discover Multi-Paths** tab.

13. On the **Discover Multi-Paths** tab, select the **Add support for iSCSI devices** check box, and then click **Add**. When you are prompted to reboot the computer, click **Yes**.

14. After the computer restarts, sign in to LON-SVR1 with the user name **Adatum\Administrator** and the password **Pa$$w0rd**.

15. If necessary, open **Server Manager**.

16. In **Server Manager**, on the menu bar, click **Tools**, and then click **MPIO**.

 Note: In the **MPIO Properties** dialog box, on the **MPIO Devices** tab, notice that additional **Device Hardware Id MSFT2005iSCSIBusType_0x9** is added to the list.

17. To close the **MPIO Properties** dialog box, click **OK**.

Lesson 4
Configuring sharing in Windows Server 2016

Contents:

Question and Answers

Question: Which version of SMB do Windows 10 and Windows Server 2016 use?

(   ) SMB 2.1

(   ) SMB 3.0.2

(   ) SMB 3.1.1

(   ) SMB 3.2

> **Answer:**
>
> (   ) SMB 2.1
>
> (   ) SMB 3.0.2
>
> (√) SMB 3.1.1
>
> (   ) SMB 3.2
>
> **Feedback:**
>
> Windows 10 and Windows Server 2016 use SMB 3.1.1 when communicating with other computers that are running Windows 10 and Windows Server 2016.

Question: You cannot use Kerberos authentication with NFS shares because they require AD DS.

(   ) True

(   ) False

> **Answer:**
>
> (   ) True
>
> (√) False
>
> **Feedback:**
>
> You can configure NFS shares to use Kerberos authentication.

Resources

What is SMB?

Additional Reading: For more information, refer to What's New in SMB in Windows Server: http://aka.ms/Uthhq2

Demonstration: Configuring SMB shares by using Server Manager and Windows PowerShell

Demonstration Steps

Create an SMB share by using Server Manager

1. On LON-SVR1, in **Server Manager**, in the navigation pane, click **File and Storage Services** and then click **Shares**.

2. In the **Shares** area, click **TASKS**, and then click **New Share**.

3. In the **New Share Wizard**, on the **Select the profile for this share** page, in the **File share profile** box, click **SMB Share – Quick**, and then click **Next**.

4.   On the **Select the server and path for this share** page, select **LON-SVR1**, click **Select by volume**, click **E:**, and then click **Next**.

5.   On the **Specify share name** page, in the **Share name** box, type **DemoShare**, and then click **Next**.

6.   On the **Configure share settings** page, select the **Enable access-based enumeration** check box, and then click **Next**.

7.   On the **Specify permissions to control access** page, click **Next**.

8.   On the **Confirm selections** page, click **Create**.

9.   When creation of the share is complete, click **Close**.

Create an SMB share by using Windows PowerShell

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

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

```
Mkdir E:\Shares\DemoShare2
```

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

```
New-SmbShare -Name DemoShare2 -Path E:\Shares\DemoShare2 -FolderEnumerationMode
AccessBased
```

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

```
Get-SmbShare
```

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

```
Get-SmbShare DemoShare | FL *
```

View SMB session information

1.   On LON-DC1, on the taskbar, click **File Explorer**.

2.   In **File Explorer**, in the address bar, type **\\LON-SVR1\DemoShare**, and then press Enter.

3.   On LON-SVR1, at the Windows PowerShell prompt, type the following command, and then press Enter:

```
Get-SmbSession
```

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

```
Get-SmbSession -ClientUserName Adatum\Administrator | FL *
```

5.   Close the Windows PowerShell prompt.

6.   On LON-DC1, close **File Explorer**.

Demonstration: Configuring an NFS share by using Server Manager

Demonstration Steps

1. On LON-SVR1, in **Server Manager**, in the navigation pane, click **File and Storage Services**, and then click **Shares**.

2. In the **Shares** area, click **TASKS**, and then click **New Share**.

3. In the **New Share Wizard**, on the **Select the profile for this share** page, in the **File share profile** box, click **NFS Share - Quick**, and then click **Next**.

4. On the **Select the server and path for this share** page, click **LON-SVR1**, click **Select by volume**, click **E:**, and then click **Next**.

5. On the **Specify share name** page, in the **Share name** box, type **DemoNfsShare**, and then click **Next**.

6. On the **Specify authentication methods** page, select **Kerberos v5 authentication(Krb5)**, and then click **Next**.

7. On the **Specify the share permissions** page, click **Add**.

8. In the **Add Permissions** window, click **All Machines.**

9. In the **Share permissions** box, select **Read / Write**, and then click **Add**.

10. On the **Specify the share permissions** page, click **Next**.

11. On the **Specify permissions to control access** page, click **Next**.

12. On the **Confirm selections** page, click **Create**.

13. On the **View results** page, click **Close**.

Module Review and Takeaways

Review Questions

Question: If DAS provides similar performance to SAN, is it suitable to all storage needs?

>**Answer:** Although DAS can provide high performance, managing an expansive DAS environment takes considerably more administrative time than centralized SAN storage.

Question: Which operating systems must you remove from your environment before you can disable SMB1?

>**Answer:** Windows versions that are older than Windows Vista and Windows Server 2008 use SMB1. Therefore, you cannot remove SMB1 from your environment before you remove those operating systems completely from your environment.

Tools

Tool	Use to	Where to find it
Computer Management	• Managing SMB shares • Managing disks • Viewing event logs	In **Server Manager** on the **Tools** menu
Disk Management	• Initializing disks • Creating and modifying volumes	In **Server Manager**, on the **Tools** menu, or within **Computer Management**
fsutil.exe	Managing NTFS volumes; checking disk info, creating files of specific size, much more	Command prompt
File and Storage Services	• Performing basic storage management tasks • Examining storage configuration • Creating volumes	In **Server Manager**, under **File and Storage Services**

Lab Review Questions and Answers

Lab: Planning and configuring storage technologies and components

Question and Answers

Question: Implementing MPIO for iSCSI is not as simple as installing MPIO. In this lab, what other steps did you perform to enable MPIO?

> **Answer:** After you installed MPIO, you had to enable it for iSCSI. Then MPIO did not identify all of the paths automatically. You needed to add the appropriate paths manually from the iSCSI initiator to the iSCSI target.

Question: When you use **Get-SmbOpenFile**, do all open files display?

> **Answer:** No, only recently accessed files display. A few moments after a file is open or a file is saved, the information that **Get-SmbFileOpen** provides does not include a file that is open in an application.

Module 4

Implementing Storage Spaces and Data Deduplication

Contents:

Lesson 1
Implementing Storage Spaces

Contents:

Question and Answers

Enterprise storage needs

Question: Which factors should you consider when planning your enterprise storage strategy?

> **Answer:** Answers will vary, but might include:

- Cost

- Performance

- Simplicity of management

- Ability to scale

- Reliability and recoverability

- Redundancy

Question: What storage technologies does your organization use?

> **Answer:** Answers will vary, but might include:

- DAS

- SANs

- Various redundant array of independent disks (RAID) implementations

- Internet SCSI (iSCSI)

- Cloud-based storage

Discussion: Comparing Storage Spaces to other storage solutions

Question: What are the advantages of using Storage Spaces compared to using SANs or NAS?

> **Answer:** Storage Spaces provides an inexpensive way to manage storage on servers. With Storage Spaces, you do not need to buy specialized storage or network devices. You can attach almost any kind of disk to a server and manage all the disks on your server as a block. You can provide redundancy by configuring mirroring or parity on the disks. Storage Spaces also are easy to expand by adding more disks. By using Storage Spaces tiering, you also can optimize the use of fast and slow disks in your storage space.

Question: What are the disadvantages of using Storage Spaces compared to using SANs or NAS?

> **Answer:** Most SAN and NAS devices provide many of the same features as Storage Spaces. These storage devices also provide redundancy, data tiering, and easy capacity expansion. Additionally, they improve performance by removing all of the storage-related calculations from the server and performing these tasks on dedicated hardware devices. This means that NAS and SAN devices, and SAN devices in particular, are likely to provide better performance than using Storage Spaces.

Question: In what scenarios would you recommend each option?

> **Answer:** Answers will vary, but the discussion might include:

- Storage Spaces provide a potentially inexpensive and full-featured storage solution that traditionally has only been available with more expensive NAS or SAN solutions.

- Storage Spaces are easy to manage and do not require specialized equipment or expertise.

- In larger enterprises that currently are using SANs or NAS, the enhanced performance of using the specialized hardware is likely to be a more important factor than the ease of use and lower cost that Storage Spaces provides.

Resources

What are Storage Spaces?

🌐 **Additional Reading:** For more information about certified hardware, refer to Windows Server Catalog: http://aka.ms/Rdpiy8

Demonstration: Configuring Storage Spaces

Demonstration Steps

Create a storage pool

1. On **LON-SVR1**, click **Start**, and then click **Server Manager**.

2. In **Server Manager**, in the left pane, click **File and Storage Services**, and then, in the **Servers** pane, click **Storage Pools**.

3. In the **STORAGE POOLS** pane, click **TASKS**, and then, in the **TASKS** drop-down list, click **New Storage Pool**.

4. In the **New Storage Pool Wizard**, on the **Before you begin** page, click **Next**.

5. On the **Specify a storage pool name and subsystem** page, in the **Name** text box, type **StoragePool1**, and then click **Next**.

6. On the **Select physical disks for the storage pool** page, in the Physical disks list, select the first five disks listed, and then click **Next**.

7. On the **Confirm selections** page, click **Create**.

8. On the **View results** page, wait until the task completes, and then click **Close**.

Create a virtual disk and a volume

1. Under **STORAGE POOLS**, click **StoragePool1**.

2. In the **VIRTUAL DISKS** pane, click **TASKS**, and then, in the **TASKS** drop-down list, click **New Virtual Disk**.

3. In the **New Virtual Disk Wizard**, on the **Before you begin** page, click **Next**.

4. On the **Select the storage pool** page, click **StoragePool1**, and then click **Next**.

5. On the **Specify the virtual disk name** page, in the **Name** text box, type **Simple vDisk**, and then click **Next**.

6. On the **Specify enclosure resiliency** page, click **Next**.

7. On the **Select the storage layout** page, in the **Layout** list, select **Simple**, and then click **Next**.

8. On the **Specify the provisioning type** page, click **Thin**, and then click **Next**. You should mention that this configures thin provisioning for that volume.

9. On the **Specify the size of the virtual disk** page, in the **Specify size** text box, type **2**, and then click **Next**.

10. On the **Confirm selections** page, click **Create**.

11. On the **View results** page, wait until the task completes. Make sure that the **Create a volume when this wizard closes** check box is selected, and then click **Close**.

12. In the **New Volume Wizard**, on the **Before you begin** page, click **Next**.

13. On the **Select the server and disk** page, under **Disk**, click the **Simple vDisk** virtual disk, and then click **Next**.

14. On the **Specify the size of the volume** page, click **Next** to confirm the default selection.

15. On the **Assign to a drive letter or folder** page, click **Next** to confirm the default selection.

16. On the **Select file system settings** page, in the **File system** drop-down list, select **ReFS**, in the **Volume label** text box, type **Simple Volume**, and then click **Next**.

17. On the **Confirm selections** page, click **Create**.

18. On the **Completion** page, wait until the task completes, and then click **Close.**

Lesson 2
Managing Storage Spaces

Contents:

Resources

Managing Storage Spaces

🌐   **Additional Reading:**
- For more information, refer to Storage Cmdlets in Windows PowerShell:
  http://aka.ms/po9qve
- To use Storage Spaces cmdlets in Windows PowerShell, you must download the StorageSpaces module for use in Windows Server 2016. For more information, refer to Storage Spaces Cmdlets in Windows PowerShell: http://aka.ms/M1fccp

🌐   **Additional Reading:** For more information, refer to Monitoring Storage Tiers Performance: http://aka.ms/Sz4zfi

Demonstration: Managing Storage Spaces by using Windows PowerShell

Demonstration Steps

View the Properties of a Storage Pool

1. Switch to **LON-SVR1**. In **Server Manager**, notice the configuration of StoragePool1 that you created in the preceding demonstration. Draw your students' attention to this. Mention the virtual disk and the physical disks assigned to it.

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

3. In **Windows PowerShell**, type the following command, and then press Enter to return a list of storage pools with their current health and operational status:

```
Get-StoragePool
```

4. In **Windows PowerShell**, type the following command, and then press Enter to return more information about StoragePool1:

```
Get-StoragePool StoragePool1 | fl
```

5. In **Windows PowerShell**, type the following command, and then press Enter to return detailed information about your virtual disks, including provisioning type, parity layout, and health:

```
Get-VirtualDisk | fl
```

6. In **Windows PowerShell**, type the following command, and then press **Enter** to return a list of physical disks that can be pooled:

```
Get-PhysicalDisk | Where {$_.canpool –eq "true"}
```

Add Physical Disks to a Storage Pool

1. In **Windows PowerShell**, type the following command, and then press Enter to create a new virtual disk in StoragePool1:

```
New-VirtualDisk –StoragePoolFriendlyName StoragePool1 -FriendlyName Data –Size 2GB
```

2. Open **Server Manager**, and, in the **Storage Pool** window, click **Refresh** to view the changes. Notice the new virtual disk.

3. In **Windows PowerShell**, type the following command, and then press Enter to add a list of physical disks that can be pooled to the variable:

```
$canpool = Get-PhysicalDisk –CanPool $true
```

4. In **Windows PowerShell**, type the following command, and then press Enter to add the physical disks in the variable to StoragePool1:

```
Add-PhysicalDisk -PhysicalDisks $canpool -StoragePoolFriendlyName StoragePool1
```

5. To view the additional physical disks in Server Manager, open **Server Manager**, and then in the **Storage Pool** window, click **Refresh** to view the changes. Notice that two more physical disks are visible in the pool.

Lesson 3
Implementing Data Deduplication

Contents:

Question and Answers

Question: Can you enable Data Deduplication on a drive with storage tiering enabled?

> **Answer:** Yes.

> **Feedback:** Yes. In fact, this is common in scenarios in which you have a large amount critical data that might not change very frequently. One specific scenario is a large-scale VDI deployment using Hyper-V.

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 Date Deduplication on volumes in which virtual machines are running and apply it to those virtual machines?

> **Answer:** Yes.

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

Resources

Monitoring and maintaining Data Deduplication

Additional Reading: For more information, refer to Troubleshooting Data Deduplication Corruptions: http://aka.ms/Tdz13m

Demonstration: Implementing Data Deduplication

Demonstration Steps

Install the Data Deduplication Role Service

1. On **LON-SVR1**, in **Server Manager**, in the **navigation** pane, click **Dashboard**.

2. 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, expand **File and Storage Services (4 of 12 installed)**.

7. Expand **File and iSCSI Services (3 of 11 installed)**.

8. Select the **Data Deduplication** check box, and then click **Next**.

9. On the **Select features** page, click **Next**.

10. On the **Confirm installation selections** page, click **Install**.

11. When the installation is complete, on the **Installation progress** page, click **Close**.

Enable Data Deduplication

1. On the taskbar, click the **File Explorer** icon.

2. Click **This PC**.

3. In **Server Manager**, in the **navigation** pane, click **File and Storage Services**, and then click **Disks**.

4. In the **Disks** pane, click **1**.

5. Under **VOLUMES**, click **E**.

6. Right-click **E**, and then click **Configure Data Deduplication**.

7. In the **Allfiles (E:\) Deduplication Settings** dialog box, in the **Data deduplication** list, click **General purpose file server**.

8. In the **Deduplicate files older than (in days)** text box, type **1**.

9. Click **Set Deduplication Schedule**.

10. In the **LON-SVR1 Deduplication Schedule** dialog box, select the **Enable throughput optimization** check box, and then click **OK**.

11. In the **Allfiles (E:\) Deduplication Settings** dialog box, click **Add**.

12. In the **Select Folder** dialog box, expand **Allfiles (E:)**, and then click **shares**.

13. Click **Select Folder** and then click **OK**.

Check the Status of Data Deduplication

1. Switch to **Windows PowerShell**.

2. In the **Windows PowerShell command prompt** window, type the following command, and then press Enter:

    ```
    Get-DedupStatus
    ```

3. In the **Windows PowerShell command prompt** window, type the following command, and then press Enter:

    ```
    Get-DedupStatus | fl
    ```

4. In the **Windows PowerShell command prompt window**, type the following command, and then press Enter:

    ```
    Get-DedupVolume
    ```

5. In the **Windows PowerShell command prompt window**, type the following command, and then press Enter:

    ```
    Get-DedupVolume |fl
    ```

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

    ```
    Start-DedupJob E: -Type Optimization –Memory 50
    ```

7. Repeat steps 2 and 4.

    Note: Because most the files on drive E are small, you may not notice a significant amount of saved space.

8. Close all open windows.

Module Review and Takeaways

Review Questions

Question: You attach five 2-TB disks to your Windows Server 2012 computer. You want to simplify the process of managing the disks. In addition, you want to ensure that if one disk fails, the failed disk's data is not lost. What feature can you implement to accomplish these goals?

> **Answer:** You can use the Storage Spaces feature to create a storage pool of all five disks, and then create a virtual disk with parity or mirroring to make it highly available.

Question: Your manager has asked you to consider the use of Data Deduplication within your storage architecture. In what scenarios is the Data Deduplication role service particularly useful?

> **Answer:** You should consider using deduplication for the following areas:

- File shares, including group content publication or sharing, user home folders, and profile redirection for accessing offline files. With the release to manufacturing (RTM) version of Windows Server 2012, you could save approximately 30 to 50 percent of your system's disk space. With the Cluster Shared Volume (CSV) support in Windows Server 2012 R2, the disk savings can increase up to 90 percent in certain scenarios.

- Software deployment shares. This includes software binaries, images, and updates. You might be able to save approximately 70 to 80 percent of your disk space.

- .vhd and .vhdx file libraries. This includes .vhd and .vhdx file storage for provisioning to hypervisors. You might be able to save disk space of approximately 80 to 95 percent.

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Some files cannot be read when the free disk space on a deduplicated volume approaches zero.	To resolve this issue, do one of the following: Run a Garbage Collection task to reclaim disk space. If there is not a recent memory map of the files, copy files elsewhere. If there is a recent memory map of the files, run Robocopy.exe in non-cached Read mode to copy files elsewhere.

Lab Review Questions and Answers

Lab A: Implementing Storage Spaces

Question and Answers

Question: At a minimum, how many disks must you add to a storage pool to create a three-way mirrored virtual disk?

> **Answer:** You require at least five disks. If you do not have five disks available in a disk pool, you can only create a two-way mirrored virtual disk.

Question: You have a USB-attached disk, four SAS disks, and one SATA disk that are attached to a Windows Server 2012 server. You want to provide a single volume to your users that they can use for file storage. What would you use?

> **Answer:** Answers will vary, but the most common answer might be to create a storage pool out of the existing disks, and then create a virtual disk that spans all of the disks and has the largest capacity possible. For reliability reasons, USB disks should not be part of a storage pool. However, you can mix the disk types in a storage pool and create highly available disks using two-way or three-way mirroring or parity for virtual disks.

Lab B: Implementing Data Deduplication

Question and Answers

Question: Your manager is worried about the impact that using data deduplication will have on the write performance of your file servers' volumes. Is this concern valid?

> **Answer:** No. Data deduplication does not have any write performance impact because the data is not deduplicated while the file is being written. However, there is a small performance impact when reading deduplicated files.

Module 5

Installing and configuring Hyper-V and virtual machines

Contents:

Lesson 1
Overview of Hyper-V

Contents:

Question and Answers

Question: Your organization has recently completed a security audit for the data center. One of the concerns raised by the auditors is the level of access that all of the server administrators have for the virtual machines. Which new Hyper-V feature in Windows Server 2016 can address this concern?

( ) Shielded virtual machines

( ) Linux secure boot

( ) Discrete device assignment

( ) Nested virtualization

( ) Host resource protection

> **Answer:**
>
> (√) Shielded virtual machines
>
> ( ) Linux secure boot
>
> ( ) Discrete device assignment
>
> ( ) Nested virtualization
>
> ( ) Host resource protection

Question: A colleague has suggested that you should abandon virtual machines and begin using Windows Server containers instead. Explain why you should consider this carefully instead of implementing immediately.

> **Answer:** Windows Server containers do not offer the same level of isolation that virtual machines do. All of the containers share the same operating system kernel, thus creating the potential for a single problem to affect multiple containers. However, the speed with which containers can be created and started is a potential benefit.

Resources

What is Hyper-V?

Additional Reading: For a current list of supported guest operating systems, refer to Supported Windows guests: http://aka.ms/Geadun

Windows Server Containers and Docker in Hyper-V

Additional Reading: For more information about Windows Server containers, refer to Windows Containers: http://aka.ms/Kt23rj

Lesson 2
Installing Hyper-V

Contents:

Question and Answers

Question: Should nested virtualization be implemented by most organizations?

> **Answer:** No. Nested virtualization should be used only in scenarios in which it is needed, such as a classroom lab where students are learning about Hyper-V. Most data centers do not use nested virtualization.

Question: To install the Hyper-V server role in Windows Server 2016, your server hardware must support SLAT.

( ) True

( ) False

> **Answer:**
>
> (√) True
>
> ( ) False
>
> **Feedback:**
>
> Previous versions of Hyper-V required SLAT only for clients' operating systems, but in Windows Server 2016, SLAT is now a requirement.

Demonstration: Installing the Hyper-V role

Demonstration Steps

1. On **LON-HOST1**, sign in as **Administrator** by using **Pa$$w0rd** as the password.

2. Click **Start** and then click **Server Manager**.

3. In Server Manager, click **Add roles and features**.

4. In the **Add Roles and Features Wizard**, on the **Before you begin** page, click **Next**.

5. On the **Select installation type** page, click **Next**.

6. On the **Select destination server** page, click **Next**.

7. On the **Select server roles** page, select the **Hyper-V** check box, click **Add Features**, and then click **Next**.

8. On the **Select features** page, click **Next**.

9. On the **Hyper-V** page, click **Next**.

10. On the **Create Virtual Switches** page, click **Next**.

11. On the **Virtual Machine Migration** page, click **Next**.

12. On the **Default Stores** page, click **Next**.

13. On the **Confirm installation selections** page, select **Restart the destination server automatically if required**, click **Yes**, and then click **Install**.

   📄 **Note:** Your computer might restart several times following installation of the Hyper-V components.

14. Sign in as **Administrator** with the password **Pa$$w0rd**.

15. Click **Start**, and then click **Server Manager**.

16. Click **Tools**, and then click **Hyper-V Manager**.

17. In **Hyper-V Manager**, click **LON-HOST1**, and then click **Hyper-V Settings**.

18. In the **Hyper-V Settings** for **LON-HOST1** window, click each of the available options in the left pane and read the description.

19. Click **Cancel**.

Lesson 3
Configuring storage on Hyper-V host servers

Contents:

Question and Answers

Question: When you create a virtual hard disk, which 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.

Question: To use a virtual Fibre Channel adapter in a virtual machine, the Hyper-V host must have a physical Fibre Channel adapter.

(   ) True

(   ) False

> **Answer:**
>
> (√) True
>
> (   ) False
>
> **Feedback:**
>
> A physical Fibre Channel adapter in the Hyper-V host is required to access the Fibre Channel SAN. The driver for the physical Fibre Channel adapter must also support virtualizations.

Resources

Storing virtual machines on SMB 3.0 shares

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

Demonstration: Managing storage in Hyper-V

Demonstration Steps

1.   On **LON-HOST1**, on the taskbar, click **File Explorer**.

2.   In **File Explorer**, go to **E:\Program Files\Microsoft Learning\20740\Drives**

> **Note:** The drive letter for this path might vary depending on the configuration of the physical host.

3.   Verify that the **20740A-BASE.vhd** hard disk image file is present.

4. 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. Close **File Explorer**.

6. Click **Start**, and then click the **Windows PowerShell** icon.

7. At the Windows PowerShell prompt, type the following command to link 20740A-BASE.vhd to the correct parent disk and press **Enter**:

    ```
    Set-VHD "E:\Program Files\Microsoft Learning\20740\Drives\20740A-BASE.vhd" -
    ParentPath "E:\Program Files\Microsoft Learning\Base\Base16D-WS16-TP5.vhd"
    ```

8. Switch to **Hyper-V Manager**.

9. In the **Actions** pane, click **New**, and then click **Hard Disk**.

10. On the **Before You Begin** page of the **New Virtual Hard Disk Wizard**, click **Next**.

11. On the **Choose Disk Format** page, select **VHD**, and then click **Next**.

12. On the **Choose Disk Type** page, select **Differencing**, and then click **Next**.

13. 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\20740\Drives\LON-GUEST1**

14. On the **Configure Disk** page, type **E:\Program Files\Microsoft Learning\20740\Drives\20740-BASE.vhd** as the location, and then click **Finish**.

15. At the command prompt in the **Windows PowerShell** command-line interface, type the following command to create a new differencing disk to be used with **LON-GUEST2**, and then press Enter:

    ```
    New-VHD "E:\Program Files\Microsoft Learning\20740\Drives\LON-GUEST2\LON-GUEST2.vhd"
     -ParentPath "E:\Program Files\Microsoft Learning\20740\Drives\20740A-BASE.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\20740\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 **E:\Program Files\Microsoft Learning\20740\Drives\20740A-BASE.vhd** as a parent, and then click **Close**.

Lesson 4
Configuring networking on Hyper-V host servers

Contents:

Question and Answers

Question: You want to configure a network that allows multiple test systems using a private address space to access services on another network. What type of switch should you configure?

( ) Internal

( ) Private

( ) External

( ) NAT

> **Answer:**
>
> ( ) Internal
>
> ( ) Private
>
> ( ) External
>
> (√) NAT
>
> **Feedback:**
>
> A NAT switch is used when you need to allow a private address space to access services on another network.

Question: You are configuring a virtual switch that will be used for virtual machines that are accessed by clients. Which type of switch should you create?

( ) Internal

( ) Private

( ) External

( ) NAT

> **Answer:**
>
> ( ) Internal
>
> ( ) Private
>
> (√) External
>
> ( ) NAT
>
> **Feedback:**
>
> You should create an external switch. An external switch is attached to a physical network card on the Hyper-V host and allows clients on the physical network to communicate with the virtual machines.

Resources

New Hyper-V networking features in Windows Server 2016

Additional Reading: For more information about RDMA and SET, refer to Remote Direct Memory Access (RDMA) and Switch Embedded Teaming (SET): http://aka.ms/dzwmi9

Demonstration: Configuring Hyper-V networks

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**:

    o   Name: **Corporate Network**

    o   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, and then click **Yes**.

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 **Private**, and then click **Create Virtual Switch**.

8. In the **Virtual Switch Properties** section, configure the following settings, and then click **OK**:

    o   Name: **Private Network**

    o   Connection type: **Private network**

Lesson 5
Configuring Hyper-V virtual machines

Contents:

Question and Answers

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.

Question: Which virtual machine characteristics must be present to support hot adding a virtual network adapter? Choose all that apply.

( ) Generation 1 virtual machine

( ) Generation 2 virtual machine

( ) Configuration version 5 (Windows 2012 R2)

( ) Guest Operating System Windows Server 2012 R2

( ) Guest Operating System Windows Server 2016

> **Answer:**
>
> ( ) Generation 1 virtual machine
>
> (√) Generation 2 virtual machine
>
> ( ) Configuration version 5 (Windows 2012 R2)
>
> ( ) Guest Operating System Windows Server 2012 R2
>
> (√) Guest Operating System Windows Server 2016

Resources

Shielded virtual machines

Additional Reading: For more information about shielded virtual machines, refer to Guarded Fabric and Shielded VMs: http://aka.ms/m83kd3

Virtual machine settings

Additional Reading: For detailed information about enabling and configuring discrete device assignment, refer to Discrete Device Assignment - Description and background: http://aka.ms/Elnofg

Additional Reading: For detailed information about supported distributions for Linux and FreeBSD, refer to Supported Linux and FreeBSD virtual machines for Hyper-V on Windows: http://aka.ms/Xa17y0

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\20740\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\20740\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. When you receive 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\20740\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 on LON-HOST1** 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. To close the **Settings for the LON-GUEST2** dialog box, click **OK**.

Lesson 6
Managing virtual machines

Contents:

Question and Answers

Question: When restarting a virtual machine from a production checkpoint, the memory state is saved.

(   ) True

(   ) False

> **Answer:**
>
> (   ) True
>
> (√) False
>
> **Feedback:**
>
> A production checkpoint behaves more like a backup. When you restore a production checkpoint, the virtual machine is in a stopped state.

Question: You can use Windows PowerShell Direct from your workstation to access virtual machines running on a Hyper-V host.

(   ) True

(   ) False

> **Answer:**
>
> (   ) True
>
> (√) False
>
> **Feedback:**
>
> Windows PowerShell Direct can only be used from the Hyper-V host on which the virtual machine is running.

Demonstration: Creating checkpoints

Demonstration Steps

1. In **Hyper-V Manager**, click **LON-GUEST1**.

2. In the **Action**s pane, click **Settings**, and then, under **Management**, click **Checkpoints**.

3. Ensure that checkpoints are enabled and that **Checkpoint Type** is set to **Production Checkpoints**. 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**.

10. In the **Delete Checkpoint Tree** dialog box, click **Delete**.

Demonstration: Using Windows PowerShell Direct

Demonstration Steps

1. In **Hyper-V Manager**, click **LON-GUEST1**.

2. In the **Actions** pane, click **Start**.

3. In the **Actions** pane, click **Connect**.

4. In the **LON-GUEST1 on LON-HOST1 – Virtual Machine Connection** dialog box, on the **Hi there** page, click **Next**.

5. On the **It's time to enter the product key** page, click **Do This Later**.

6. On the **Licenses Terms** page, click **Accept**.

7. On the **Customize settings** page, in the **Password** and **Reenter password** text boxes, type **Pa$$w0rd**, and then click **Finish**.

8. In **Hyper-V Manager**, click **LON-GUEST1**, in the **Actions** pane, click **Settings**, and then click **Network Adapter**.

9. Change the **Virtual switch** drop-down list to **Not Connected**, and then click **OK**.

10. On **LON-HOST1**, open **Windows PowerShell** as **Administrator**.

11. Ping **LON-GUEST1** by typing the following command, and then press Enter:

    ```
    Ping LON-GUEST1
    ```

    This command returns "Ping request could not find host LON-GUEST1". This is expected.

12. Enter the following command, and then press Enter:

    ```
    Enter-PSSession –VMName "LON-GUEST1"
    ```

13. When you receive a prompt for credentials, use **Administrator** as the user name and **Pa$$w0rd** for the password.

14. This will let you enter into a PSSession with **LON-GUEST1**. Type the following command and press Enter, after which **LON-GUEST1** will restart:

    ```
    Restart-Computer
    ```

15. In **Hyper-V Manager**, click **LON-GUEST1**, and then click **Settings**.

16. Click **Network Adapter**.

17. Change the **Virtual switch** to **Private Network**, and then click **OK**.

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: When should you use the .vhdx format instead of .vhd format?

> **Answer:** When you are creating new virtual disks, the default option should be to select .vhdx-formatted disks because of their better performance and better resilience to corruption. A .vhd-formatted disk should be used only when you must check for compatibility with older Hyper-V hosts or when creating a differencing drive for an existing .vhd-based image.

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 on to support this configuration?

> **Answer:** You can only deploy virtual hard disks to file shares that support SMB 3.0. The Windows Server 2012 and newer operating systems support hosting SMB 3.0 file shares.

Real-world Issues and Scenarios

You must ensure that virtual machines are provisioned with adequate memory. Having multiple virtual machines paging a hard disk drive because they are provisioned with inadequate memory decreases performance for all virtual machines on the Hyper-V host.

You should also 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 tools that are related to this module:

Tool	Used for	Where to find it
Sysinternals Disk2vhd	Converts physical hard disks to .vhd format.	**Additional Reading:** For more information, refer to Sysinternals Suite: http://aka.ms/kx5ojf
Microsoft System Center 2012 R2 - Virtual Machine Manager	- Manages virtual machines across multiple Hyper-V servers. - Performs online physical-to-virtual conversions; however, System Center 2012 R2 - Virtual Machine Manager does not support physical-to-virtual conversions.	**Additional Reading:** For more information, refer to Virtual Machine Manager: http://aka.ms/qc0v35

Lab Review Questions and Answers

Lab: Installing and configuring Hyper-V

Question and Answers

Question: Do you need to download the script for enabling nested virtualization separately for each virtual machine?

> **Answer:** No. You can download the script for enabling nested virtualization once and then run it for as many virtual machines as you need. You should check regularly to see if the script has been updated. If the script is updated, you can download a new copy.

Question: Why did adding a private network not create an additional virtual network adapter on LON-HOST1?

> **Answer:** A Hyper-V host cannot communicate on a private network, so a virtual network adapter was not created on LON-HOST1. A virtual network adapter was created for the internal network and the external network because the Hyper-V host can communicate on those types of networks.

Module 6

Deploying and managing Windows and Hyper-V containers

Contents:

Lesson 1
Overview of containers in Windows Server 2016

Contents:

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 2
Deploying Windows Server and Hyper-V containers

Contents:

Demonstration: Installing the Containers Feature and Preparing for Docker

Demonstration Steps

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

2. In the Windows PowerShell Command Prompt window, type the following commands and then press Enter after each command. Explain that these commands are needed to install the **Containers** feature.

    ```
    Install-WindowsFeature Containers
    Restart-Computer –Force
    ```

3. After the host computer LON-HOST1 restarts, sign in as **Adatum\Administrator**, with the password **Pa$$w0rd**.

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

5. In the **Windows PowerShell Command Prompt** window, type the following commands and then press Enter after each command. Explain that these commands are needed to download and install Docker, which will be discussed in the next lesson:

    ```
    Invoke-WebRequest "https://get.docker.com/builds/Windows/x86_64/docker-1.12.0.zip" –
    OutFile "$env:TEMP\docker-1.12.0.zip" -UseBasicParsing
    ```

    ```
    Expand-Archive -Path "$env:TEMP\docker-1.12.0.zip" -DestinationPath $env:ProgramFiles
    ```

    ```
    [Environment]::SetEnvironmentVariable("Path", $env:Path + ";C:\Program
    Files\Docker\", [EnvironmentVariableTarget]::Machine)
    ```

6. Close and then open a **Windows PowerShell (Admin)** command prompt. This will ensure that the new environment variable is active.

7. In the **Windows PowerShell** window, type the following command, and then press Enter to install and register Docker:

    ```
    dockerd.exe --register-service
    ```

8. Type the following command to start the Docker service, and then press Enter:

    ```
    Start-Service docker
    ```

9. Type the following command to download the base image used with Docker:

    ```
    docker pull microsoft/windowsservercore
    ```

📝 **Note:** This will take some time to download the image. Continue teaching the next lesson. You will need to ensure that the image is downloaded before performing the next demonstration.

Lesson 3
Installing, configuring, and managing containers by using Docker

Contents:

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
>
> (√) False
>
> **Feedback:**
>
> You can use Docker from 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 Windows, go to the Dockerfile for Windows Repository, refer to: http://aka.ms/kq8gak

Additional Reading: For more information on the complete list of **Dockerfile** instructions, refer to **Dockerfile** reference: http://aka.ms/wrccuy

Additional Reading: For more information on **docker build**, including a list of all build options, refer to "Docker Build" at Docker.com: http://aka.ms/u29exr

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: http://aka.ms/nrgyui

Additional Reading: For more information about administering containers on Windows Server by using Docker, refer to Windows Containers Quick Start: http://aka.ms/xl3mdn

Additional Reading: For more information on using the **docker run** command to define a container's resources at runtime, refer to the Docker run reference: http://aka.ms/Xjef2h

Overview of Docker Hub

Additional Reading: For more information on registering a Docker ID, refer to Your Docker ID: http://aka.ms/ya2hoo

Additional Reading: For more information on the Docker repositories that the Docker Hub supports and promotes, refer to Official Repositories on Docker Hub: http://aka.ms/f7zl0h

Additional Reading: For more information on pushing a repository to the Docker Hub registry, refer to Build your own images: http://aka.ms/iyggmz

Additional Reading: For more information on creating organizations and teams so that you can delegate access to colleagues for shared image repositories, refer to Organizations and teams: http://aka.ms/wzbstk

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: http://aka.ms/wjudik

📖   **Additional Reading:** For more information, refer to Azure Resource Manager overview: http://aka.ms/p35huz

📖   **Additional Reading:** For more information on using the Azure Container Service to deploy Docker Swarm clusters, refer to Deploy an Azure Container Service cluster: http://aka.ms/F8azgy

Demonstration: Deploying Hyper-V containers by using Docker

Demonstration Steps

Install base OS images

1. On LON-HOST1, if necessary, right-click **Start** and then click **Windows PowerShell (Admin)**.

2. In the **Windows PowerShell** window, type the following to view the downloaded images, and then press Enter:

```
Docker images
```

Download a prebuilt Microsoft and IIS Docker image

1. Type the following command, and then press Enter to view the images available on Docker Hub:

```
Docker search Microsoft
```

2. In the **Windows PowerShell** window, type the following command to download the sample IIS image, and then press Enter:

```
docker pull microsoft/iis
```

3. In the **Windows PowerShell** window, type the following to verify the downloaded image, and then press Enter:

```
docker images
```

Deploy a new container with the prebuilt image

*   In the **Windows PowerShell** window, type the following to deploy the **IIS** container, and then press Enter:

```
docker run –d –p 80:80 microsoft/iis ping –t localhost
```

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

Manage the container

- In the **Windows PowerShell** window, type the following to view the running containers, and then press Enter:

```
docker ps
```

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 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: When configuring Windows Server containers, what Windows PowerShell cmdlet do you use to create a container and what is the equivalent Docker command?

> **Answer:** To create a container, use the **New-Container** Windows PowerShell cmdlet—the equivalent command in Docker is **docker run**.

Module 7

Overview of high availability and disaster recovery

Contents:

Lesson 1
Defining levels of availability

Contents:

Question and Answers

Question: What should high availability provide for applications?

> **Answer:** High availability for applications includes components and technologies that need to be redundant, and enable that application to work in case of failure of any of the computer components. High availability includes scheduled maintenance tasks when an application might not be online.

Question: What should continuous availability provide for applications?

> **Answer:** Continuous availability is a set of technologies and procedures that enable applications to continue working in case of failure or planned downtime.

Lesson 2
Planning high availability and disaster recovery solutions with Hyper-V virtual machines

Contents:

Question and Answers

Question: What are the migration options for virtual machines in Windows Server 2016?

> **Answer:** In Windows Server 2016, you can perform migration of virtual machines by using these methods:

- Virtual Machine and Storage Migration.

- Quick Migration.

- Live Migration.

- Hyper-V Replica.

- Exporting and importing virtual machines.

Question: What is Hyper-V Replica?

> **Answer:** Hyper-V Replica enables virtual machines running at a primary site, or a location or host, to be replicated efficiently to a secondary site (a location or host) across a WAN or a LAN link. Hyper-V Replica enables you to have two instances of a single virtual machine residing on different hosts, one as the primary, or live, copy and the other as a replica, or offline copy. These copies are synchronized on a regular interval, which is configurable in Windows Server 2016. You also can fail over at any time.

High availability considerations with Hyper-V virtual machines

Question: Do you use any high availability solution for virtual machines in your environment?

> **Answer:** Answers might vary. For example, you can use storage replication, which is one alternative for failover clustering.

Planning for Hyper-V Replica

Question: Are there ways that extended replication could benefit your environment?

> **Answer:** Answers will vary.

Demonstration: Configuring live migration (optional)

Demonstration Steps

1. On LON-HOST1, on taskbar, click on **Hyper-V Manager** icon.

2. In Hyper-V Manager, right click **LON-HOST1**, and then click **Hyper-V Settings**.

3. In the Live Migrations pane, check **Enable incoming and outgoing live migrations**.

4. Under Simultaneous live migrations, review the default number of 2.

5. Under **Incoming live migrations**, review network connections settings to accept live migration traffic. Select **Use any available network for live migration**.

6. In **Live Migrations** pane, select **Advanced Features**, and review the Authentication **protocol** options.

7. Under Performance options, review the settings and then click **OK**.

8. Perform steps 1 to 7 on **LON-NVHOST2**.

Demonstration: Configuring storage migration (optional)

Demonstration Steps

1. On LON-HOST1, in Hyper-V Manager, right-click **LON-HOST1**, and then click **Hyper-V Settings**.

2. In Hyper-V Settings window, select **Storage Migrations** and set the simultaneous number of storage migrations to 5.

3. In Hyper-V Manager, in the central pane, click **LON-SVR1-B**.

4. In the Actions pane, click **Start**. Wait until the virtual machine is fully started.

5. Switch back to the Hyper-V Manager console, and in the Actions pane, click **Move**.

6. On the **Before You Begin** page, click **Next**.

7. On the **Choose Move Type** page, click **Move the virtual machine's storage**, and then click **Next**.

8. On the **Choose Options for Moving Storage** page, click **Move all of the virtual machine's data to a single location**, and then click **Next**.

9. On the **Choose a new location for virtual machine** page, click **Browse**.

10. Browse to **C:**, create a new folder named **VM**, click **Select Folder**, and then click **Next**.

11. On the **Summary** page, click **Finish**.

12. Wait for the move process to finish. While the virtual machine is moving, connect to it, and verify that it is fully operational.

Demonstration: Implementing Hyper-V Replica (optional)

Demonstration Steps

1. On LON-NVHOST2, open the **Hyper-V Manager** console.

2. In Hyper-V Manager, right-click **LON-NVHOST2**, and then select **Hyper-V Settings**.

3. In the **Hyper-V Settings** for LON-NVHOST2, click **Replication Configuration**.

4. In the **Replication Configuration** pane, click **Enable this computer as a Replica server**.

5. In the **Authentication and ports** section, select **Use Kerberos (HTTP)**.

6. In the **Authorization and storage** section, click **Allow replication from any authenticated server**, and then click **Browse**.

7. Click **Computer**, double-click **Local Disk (C)**, and then click **New folder**. Type **VMReplica** for folder name, and press Enter. Select the **C:\VMReplica** folder, and then click **Select Folder**.

8. In the **Hyper-V Settings** for LON-NVHOST2, click **OK**.

9. In the **Settings** window, read the notice, and then click **OK**.

10. Click the **Start** screen, and then click the **Control Panel**.

11. In the Control Panel, click **System and Security**, and then click **Windows Firewall**. Click **Advanced settings**, and then click **Inbound Rules**.

12. In the right pane, in the rule list, find and right-click the **Hyper-V Replica HTTP Listener (TCP-In)** rule, and then click **Enable Rule**.

13. Close the **Windows Firewall with Advanced Security** console, and then close **Windows Firewall**.

14. Repeat Steps 1 through 13 on **LON-HOST1**.

15. On LON-HOST1, open **Hyper-V Manager**. Click **LON-HOST1**, and then right-click **20740A-LON-SVR1-B**.

16. Click **Enable Replication.**

17. On the **Before You Begin** page, click **Next**.

18. On the **Specify Replica Server** page, click **Browse**.

19. In the **Select Computer** window, type **LON-NVHOST2**, click **Check Names**, click **OK**, and then click **Next**.

20. On the **Specify Connection Parameters** page, review the settings, and ensure that **Use Kerberos authentication (HTTP)** is selected, and then click **Next**.

21. On the **Choose Replication VHDs** page, ensure that **20740A-LON-SVR1-B.vhd** is selected, and then click **Next**.

22. On the **Configure Replication Frequency** page, from the drop-down list box select **15 minutes**, and then click **Next**.

23. On the **Configure Additional Recovery Points** page, select **Maintain only the latest recovery point**, and then click **Next**.

24. On the **Choose Initial Replication Method** page, click **Send initial copy over the network,** select **Start replication immediately**, and then click **Next**.

25. On the **Completing the Enable Replication Wizard** page, click **Finish**.

26. Wait five to 10 minutes. You can monitor the progress of initial replication in the Status column in the Hyper-V Manager console. When it completes (progress reaches 100 percent), ensure that **20740A-LON-SVR1-B** has appeared on LON-NVHOST2 in **Hyper-V Manager**.

27. On LON-HOST1 in **Hyper-V Manager**, right-click **20740A-LON-SVR1-B**.

28. Select **Replication**, and then click **View Replication Health**.

29. Review the content of the window that appears, ensure that there are no errors, and then click **Close**.

30. On LON-NVHOST2, open **Hyper-V Manager**, and then verify that **20740A-LON-SVR1-B** is turned off.

31. From LON-HOST1, connect to **20740A-LON-SVR1-B** virtual machine.

32. On LON-SVR1-B, click **Start**, click **Power**, click **Shut down**, and then click **OK**.

33. On LON-HOST1, in Hyper-V Manager, right -click **20740A-LON-SVR1-B**, select **Replication**, and then click **Planned Failover**.

34. In the **Failover** window, ensure that the option **Start the Replica virtual machine after failover** is selected, and then click **Fail Over**.

35. On LON-NVHOST2, in **Hyper-V Manager**, ensure that **20740A-LON-SVR1-B** is running.

Lesson 3
Backing up and restoring by using Windows Server Backup

Contents:

Question and Answers

Question: Name several scenarios where you might use Windows Server Backup in your organization.

Answer: You can use Windows Server Backup to:

- Perform a full server backup and bare-metal restore

- Back up and restore system state

- Back up and restore individual files and folders

- Exclude selected files or file types

- Select from more storage locations

- Use Windows Azure Online Backup

Question: Name several scenarios for backup and restore operations.

Answer: Backup and restore operations include:

- Backing up and restoring Hyper-V hosts

- Backing up and restoring VMs

- Backing up and restoring AD DS, file servers, and web servers

- Azure Site Recovery

Lesson 4
High Availability with failover clustering in Windows Server 2016

Contents:

Question and Answers

Question: What are the properties of a failover clustering node?

> **Answer:** In a failover cluster, each node in the cluster has following properties:
>
> - Has full connectivity and communication with the other nodes in the cluster.
>
> - Is aware when another node joins or leaves the cluster.
>
> - Is connected to a network through which client computers can access the cluster.
>
> - Is connected through a shared bus or iSCSI connection to shared storage.
>
> - Is aware of the services or applications that are running locally, and the resources that are running on all other cluster nodes.

Question: What are the failover clustering components of a failover clustering solution?

> **Answer:** A failover clustering solution consists of several components:
>
> - Node - A Windows Server 2016 computer that is part of a failover cluster, and has the failover clustering feature installed.
>
> - Service or application - A service that can be moved between cluster nodes (for example, a clustered file server can run on either node).
>
> - Shared storage - External storage that is accessible to all cluster nodes.
>
> - Quorum - The number of elements that must be online for a cluster to continue to run. The quorum is determined when cluster nodes vote.
>
> - Witness – A server that is participating in cluster voting when number of nodes is even.
>
> - Failover – The process of moving cluster resources from the first node to the second node, as a result of node failure or administrator's action.
>
> - Failback - The process of moving cluster resources back from the second node to the first node, as a result of firs node becoming again online or administrator's action.
>
> - If the service or application fails over from Node1 to Node2, when Node1 is again available, the service or application will fail back to Node1.
>
> - Clients - Computers that connect to the failover cluster, and are not aware which node the service is running on.

What is failover clustering?

Question: Why do I need to implement a cluster if I can Live Migrate virtual machines from any location to another?

> **Answer:** For Live Migration both servers need to be online and actively participating in the Live Migration. Clustering covers the unplanned downtime and outages scenario.

Module Review and Takeaways

Best Practices

- Develop standard configurations before you implement highly available virtual machines. You should configure the host computers as close to identical as possible. To ensure that you have a consistent Hyper-V platform, configure standard network names and use consistent naming standards for CSVs.
- 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 VMM. VMM provides a management layer on top of Hyper-V and Failover Cluster Manager that can block you from making mistakes when you manage highly available virtual machines. For example, you can be blocked from creating virtual machines on storage that is inaccessible from all nodes in the cluster.

Review Question

Question: In Windows Server 2016, must you implement CSV to provide high availability for virtual machines in VMM?

> **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 that access multiple LUNs on shared storage.

Tools

The tools for implementing failover clustering with Hyper-V include:

Tools	Where to Find	Use
Failover Cluster Manager	Administrative Tools	Failover clustering management
Hyper-V Manager	Administrative Tools	Virtual machine management
VMM Console	Start menu	Hyper-V hosts and virtual machine management

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Virtual machine failover fails after you implement CSV and migrate 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.

Common Issue	Troubleshooting Tip
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 failover 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 Performance and Resource Optimization in VMM.

Lab Review Questions and Answers

Lab: Planning and implementing a high availability and disaster recovery solution

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 passive copy and with 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.

Module 8

Implementing failover clustering

Contents:

Lesson 1
Planning a failover cluster

Contents:

Question and Answers

Question: What quorum configuration do you recommend for Windows Server 2016 failover clusters?

Answer: Answers will vary, but should include the dynamic quorum mode and dynamic witness. These provide the highest level of cluster scalability in most standard configurations.

Question: Describe the steps for Cluster Operating System Rolling Upgrade.

Answer: The upgrade steps for each node in the cluster include:

- Pause the cluster node and drain all the virtual machines that run on the node.

- Migrate the virtual machines that run on the node to another node in the cluster.

- Perform a clean installation to replace the cluster node operating system with Windows Server 2016.

- Add back the node that is now running the Windows Server 2016 operating system to the cluster.

- Upgrade all nodes to Windows Server 2016.

- Use the Windows PowerShell cmdlet **Update-ClusterFunctionalLevel** to upgrade the cluster functional level to Windows Server 2016.

Resources

Failover-cluster storage

Reference Links: For more information, refer to Deploy Clustered Storage Spaces: http://aka.ms/b5cjdh

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

Demonstration: Verify a network adapter's RSS and RDMA compatibility on an SMB Server

Demonstration Steps

1. Sign in to **LON-DC1** with username **Administrator** and password **Pa$$w0rd**, and then open Windows PowerShell.

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

```
Get-NetAdapterRSS –Name * | Format-List *
```

3. View the output, and then verify that the **RssOnPortsSupported** value for the network adapter is **True**.

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

```
Get-SMBServerNetworkInterface
```

5. View the output, and then verify that the **RSS Capable** value for the network adapter is **True** and the **RDMA Capable** value for the network adapter is **False**.

Lesson 2
Creating and configuring a new failover cluster

Contents:

Question and Answers

Question: In Failover Cluster Manager what are some of the Windows Server 2016 roles that you can configure?

>   **Answer:** File Services, DHCP, and 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 validate the configuration and to create a cluster with the selected nodes.
	Install the role on all cluster nodes. Use Server Manager to install the server role that you want to use in the cluster.
	Create a clustered application by using the Failover Clustering Management snap-in.
	Configure the application. Configure the options on the application that the cluster uses.
	Test failover. Use the Failover Cluster Management snap-in to test failover by intentionally moving the service from one node to another.

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 validate the configuration and to create a cluster with the selected nodes.
3	Install the role on all cluster nodes. Use Server Manager to install the server role that you want to use in the cluster.
4	Create a clustered application by using the Failover Clustering Management snap-in.
5	Configure the application. Configure the options on the application that the cluster uses.
6	Test failover. Use the Failover Cluster Management snap-in to test failover by intentionally moving the service from one node to another.

Demonstration: Creating a failover cluster

Demonstration Steps

Configure the iSCSI targets

1. On **LON-SVR1**, sign in as **Adatum\Administrator** with the password **Pa$$w0rd**.

2. On the taskbar, click **Start**, and then click **Server Manager**.

3. In Server Manager, in the **navigation** pane, click **File and Storage Services**.

4. In the **File and Storage Services** pane, click **iSCSI**.

5. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then in the **TASKS** drop-down list, select **New iSCSI Virtual Disk**.

6. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click **C:**, and then click **Next**.

7. On the **Specify iSCSI virtual disk name** page, in the **Name** text box, type **iSCSIDisk1**, and then click **Next**.

8. On the **Specify iSCSI virtual disk size** page, in the **Size** text box, type **5**, ensure **GB** is selected in the drop-down list, 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 **lon-svr1**, 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**, and in the **Type** drop-down list, select **IP Address**. In the **Value** text box, type **172.16.0.22**, and then click **OK**.

13. On the **Specify access servers** page, click **Add**.

14. In the **Select a method to identify the initiator** dialog box, click **Enter a value for the selected type**, and in the **Type** drop-down list, select **IP Address**. In the **Value** box, type **172.16.0.23**, and then click **OK**.

15. On the **Specify access servers** page, click **Next**.

16. On the **Enable Authentication** page, click **Next**.

17. On the **Confirm selections page**, click **Create**.

18. On the **View results** page, wait until the creation is complete, and then click **Close**.

19. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then in the **TASKS** drop-down list, select **New iSCSI Virtual Disk**.

20. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click **C:**, and then click **Next**.

21. On the **Specify iSCSI virtual disk name** page, in the **Name** text box, type **iSCSIDisk2**, and then click **Next**.

22. On the **Specify iSCSI virtual disk size** page, in the **Size** text box, type **5**, ensure **GB** is selected in the drop-down list box, and then click **Next**.

23. On the **Assign iSCSI target** page, click **lon-svr1**, and then click **Next**.

24. On the **Confirm selections** page, click **Create**.

25. On the **View results** page, wait until the creation is complete, and then click **Close**.

26. In the **iSCSI VIRTUAL DISKS** pane, click **TASKS**, and then in the **TASKS** drop-down list, select **New iSCSI Virtual Disk**.

27. In the **New iSCSI Virtual Disk Wizard**, on the **Select iSCSI virtual disk location** page, under **Storage location**, click **C:**, and then click **Next**.

28. On the **Specify iSCSI virtual disk name** page, in the **Name** text box, type **iSCSIDisk3**, and then click **Next**.

29. On the **Specify iSCSI virtual disk size** page, in the **Size** text box, type **5**, ensure **GB** is selected in the drop-down list, and then click **Next**.

30. On the **Assign iSCSI target** page, click **lon-svr1**, and then click **Next**.

31. On the **Confirm selections** page, click **Create**.

32. On the **View results** page, wait until the creation is complete, and then click **Close**.

Connect nodes to the iSCSI targets

1. On **LON-SVR2**, open Server Manager, click **Tools**, and then click **iSCSI Initiator**.

2. In the **Microsoft iSCSI** dialog box, click **Yes**.

3. In the **iSCSI Initiator** window, click the **Discovery** tab, and then click **Discover Portal**.

4. In the **IP address or DNS name** text box, type **172.16.0.21**, and then click **OK**.

5. Click the **Targets** tab, and then click **Refresh**.

6. In the **Targets** list, click **iqn.1991-05.com.microsoft:lon-svr1-lon-svr1-target**, and then click **Connect**.

7. Ensure that **Add this connection to the list of Favorite Targets** is selected, and then click **OK** two times.

8. On **LON-SVR3**, open Server Manager, click **Tools**, and then click **iSCSI Initiator**.

9. In the **Microsoft iSCSI** dialog box, click **Yes**.

10. In the **iSCSI Initiator** window, click the **Discovery** tab, and then click **Discover Portal**.

11. In the **IP address or DNS name** text box, type **172.16.0.21**, and then click **OK**.

12. Click the **Targets** tab, and then click **Refresh**.

13. In the **Targets** list, click **iqn.1991-05.com.microsoft:lon-svr1-lon-svr1-target**, and then click **Connect**.

14. Ensure that the **Add this connection to the list of Favorite Targets** check box is selected, and then click **OK** two times.

15. On **LON-SVR2**, in **Server Manager**, click **Tools**, and then click **Computer Management**.

16. Expand **Storage**, and then click **Disk Management**.

17. Right-click **Disk 4**, and then click **Online**.

18. Right-click **Disk 4**, and then click **Initialize Disk**.

19. In the **Initialize Disk** dialog box, click **OK**.

20. Right-click the unallocated space next to **Disk 4**, and then click **New Simple Volume**.

21. On the **Welcome** page, click **Next**.

22. On the **Specify Volume Size** page, click **Next**.

23. On the **Assign Drive Letter or Path** page, click **Next**.

24. On the **Format Partition** page, in the **Volume Label** text box, type **Data**. Select the **Perform a quick format** check box, and then click **Next**.

25. Click **Finish**.

📋 **Note:** If a dialog box appears with a prompt to format the disk, click **Cancel**.

26. Repeat steps 17 through 25 for **Disk 5** and **Disk 6**, using **Data2** and **Data3** respectively for volume labels.

27. Close the **Computer Management** window.

28. On **LON-SVR3**, in Server Manager, click **Tools**, and then click **Computer Management**.

29. Expand **Storage**, and click **Disk Management**.

30. Select and right-click **Disk Management**, and then click **Refresh**.

31. Right-click **Disk 3**, and then click **Online**.

32. Right-click **Disk 4**, and then click **Online**.

33. Right-click **Disk 5**, and then click **Online**.

34. Close the **Computer Management** window.

Install the Failover Clustering feature

1. On **LON-SVR2**, if Server Manager is not open, click the **Server Manager** icon.

2. 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, ensure that **Select a server from the server pool** is selected, and then click **Next**.

6. On the **Select server roles** page, click **Next**.

7. On the **Select features** page, in the **Features** list, select **Failover Clustering**.

8. In the **Add features that are required for Failover Clustering** window, click **Add Features**, and then click **Next**.

9. On the **Confirm installation selections** page, click **Install**.

10. When installation completes and you receive the **Installation succeeded on LON-SVR2.Adatum.com** message, click **Close**.

11. On **LON-SVR3**, repeat steps 1 through 9.

12. When installation completes and you receive the **Installation succeeded on LON-SVR3.Adatum.com** message, click **Close**.

Demonstration: Reviewing the validation wizard

Demonstration Steps

1. On **LON-SVR2**, in Server Manager, click **Tools**, and then click **Failover Cluster Manager**.

2. In **Failover Cluster Manager**, in the **Actions** pane, click **Validate Configuration**.

3. In the **Validate a Configuration Wizard**, click **Next**.

4. In the **Enter Name** text box, type **LON-SVR2**, and then click **Add**.

5. In the **Enter Name** text box, type **LON-SVR3**.

6. Click **Add**, and then click **Next**.

7. Verify that **Run all tests (recommended)** is selected, and then click **Next**.

8. On the **Confirmation** page, click **Next**.

9. Wait for the validation tests to finish (it might take 5 to 7 minutes), and then on the **Summary** page, scroll through the report. Verify that all tests completed without errors. Some warnings are expected.

10. On the **Summary** page, click **Finish**.

Demonstration: Creating a general file-server failover cluster

Demonstration Steps

Create a failover cluster

1. On **LON-SVR2**, in **Failover Cluster Manager**, in the **Actions** pane, click **Create Cluster**.

2. On the **Before you begin** page, click **Next**.

3. On the **Select Servers** page, in the **Enter server name** box, type **lon-svr2**, and then click **Add**.

4. In the **Enter server name** box, type **lon-svr3**, click **Add**, and then click **Next**.

5. On the **Access Point for Administering the Cluster** page, in the **Cluster Name** text box, type **Cluster1**.

6. In the **Address** text box, type **172.16.0.125**, and then click **Next**.

7. On the **Confirmation** page, click **Next**.

8. On the **Summary** page, click **Finish**.

Add a file-server application to the failover cluster

1. On **LON-SVR2**, in the **Failover Cluster Manager** console, expand **Cluster1.Adatum.com**, expand **Storage**, and then click **Disks**.

2. Ensure that three disks named **Cluster Disk 1**, **Cluster Disk 2**, and **Cluster Disk 3** are present and online.

3. Right-click **Roles**, and then click **Configure Role**.

4. On the **Before You Begin** page, click **Next**.

5. On the **Select Role** page, click **File Server**, and then click **Next**.

6. On the **File Server Type** page, click **File Server for general use**, and then click **Next**.

7. On the **Client Access Point** page, in the **Name** text box, type **AdatumFS**, and then in the **Address** text box, type **172.16.0.130**, and then click **Next**.

8. On the **Select Storage** page, select the **Cluster Disk 2** check box, and then click **Next**.

9. On the **Confirmation** page, click **Next**.

10. On the **Summary** page, click **Finish**.

Demonstration: Configuring the quorum

Demonstration Steps

Determine the current quorum model

1. On **LON-SVR2**, open Failover Cluster Manager and Windows PowerShell.

2. In the **Windows PowerShell** console, type the following command, and then press Enter:

```
get-clusterquorum | Get-Member
```

3. Review the command's output to determine the viable options that you can configure.

4. In the **Windows PowerShell** console, type the following command, and then press Enter:

```
Get-ClusterQuorum | Select Cluster, QuorumResource, QuorumType
```

5. Review the command's output.

Create a file share on LON-SVR1

1. On LON-SVR1, on **Taskbar**, click **File Explorer**, right-click the disk **Local Disk (C:)**, click **New**, and then click **Folder**.

2. Type **FSW**, and press Enter.

3. Right-click **FSW**, click **Share with**, and then click **Specific people**.

4. In the **File Sharing** dialog box, type **Everyone**, and then click **Add**.

5. In the **Read** list, click **Read/Write**.

6. Click **Share**, and then click **Done**.

Convert from Disk Witness to File Share Witness

•   On **LON-SVR2**, in the **Windows PowerShell** console, type the following command, and then press Enter:

```
Set-ClusterQuorum -NodeAndFileShareMajority "\\LON-SVR1\fsw"
```

Validate quorum change

1. On **LON-SVR2**, in the **Windows PowerShell** console, type the following command, and then press Enter:

```
Get-ClusterQuorum | Select Cluster, QuorumResource, QuorumType
```

2. Review the command's output.

Lesson 3
Maintaining a failover cluster

Contents:

Question and Answers

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

> **Answer:** 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 storage configuration.

- Checking for group and resource failures.

Question: You have an eight-node cluster that is running Windows Server 2016 Hyper-V. How would you update each node on a schedule without downtime?

> **Answer:** Answers might vary, but might include using CAU or self-updating mode. CAU allows you to schedule a time and have the cluster failover, update, and restart the servers as necessary.

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 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 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, select **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**, and then click **Cancel** to cancel the update process because the virtual machines are not connected to the Internet.

> 📋   **Note:** In a real-world scenario, you should wait until the update preview list generates.

14. In the **Cluster Actions** pane, click **Create or modify Updating Run Profile**.

15. Review and explain the available options. Do not make any changes, and then click **Close**.

16. In the **Cluster Actions** pane, click **Apply updates to this cluster**, click **Next** three times and review the information on each page, and then click **Cancel**.

17. On **Confirm Canelling Wizard** dialog box, click **Yes**.

    📓   **Note:** Emphasize that in real-world scenario one node of the cluster is in a waiting
    state, while the other node is restarting after it updates.

18. On **LON-SVR2**, in the **Server Manager** dashboard, click **Tools**, and then click **Cluster-Aware
    Updating**.

19. In the **Cluster-Aware Updating** window, in the **Connect to a failover cluster** drop-down list, select
    Cluster1, and then click **Connect**.

20. Click **Configure cluster self-updating options**.

21. On the **Getting Started** page, click **Next**.

22. 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**.

23. In the **Specify self-updating schedule** area, click **Weekly**, in the **Time of Day** drop-down list, select
    4:00 AM, and in the **Day of the week** drop-down list, select **Sunday**, and then click **Next**.

24. On the **Advanced Options** page, click **Next**.

25. On the **Additional Update Options** page, click **Next**.

26. On the **Confirmation** page, click **Apply**.

27. After the clustered role is added successfully, click **Close**.

Lesson 4
Troubleshooting a failover cluster

Contents:

Question and Answers

Question: List some of the communication issues that can affect the health of failover clustering.

> **Answer:** Network issues that can threaten failover clustering health include:
>
> - Network latency.
>
> - Network failures.
>
> - Driver issues with network cards.
>
> - Firewall rules.
>
> - Antimalware or intrusion-detection software.

Question: What is the **Cluster.Log** file, where is it located, and how can you can create it?

> **Answer:** The **Cluster.log** file includes details about the cluster objects, such as resources, groups, nodes, networks, network interfaces, and volumes. You can use this file for troubleshooting cluster issues, and you can generate it on servers by using the **Get-ClusterLog** cmdlet in Windows PowerShell. The default location of the **Cluster.log** file is **C:\Windows\Cluster\Reports**.

Demonstration: Reviewing the Cluster.Log file

Demonstration Steps

1. Switch to **LON-SVR3**.

2. In the **Windows PowerShell** console, type the following cmdlet, and then press Enter:

   ```
   Get-ClusterLog
   ```

3. Open File Explorer, go to **C:\Windows\Cluster\Reports**, and then open the **Cluster.log** file.

4. Review the **Cluster.log** file.

5. Search the **Cluster.log** file for the words **heartbeat** and **NETFT** for network-related entries.

6. Search the **Cluster.log** file for the word **ACCEPT** for entries that pertain to accepted inbound connections from remote endpoints.

7. Search the **Cluster.log** file for the word **SV** for entries that pertain to to securing a route between nodes.

Lesson 5
Implementing site high availability with stretch clustering

Contents:

Question and Answers

Question: What features does enabling site-aware clustering in a Windows Server 2016 stretch cluster provide?

> **Answer:** Answers might vary, but might include:

- Failover affinity. A more configurable node affinity for the roles.

- Cross-site heartbeating. Added configuration for thresholds of nodes that are in different sites.

- Preferred site configuration. The feature that controls the split-brain syndrome and role start up 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 best for this scenario?

( ) 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 in this case, and we do not recommend not having a witness.

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

> **Answer:** Yes, this is part of the Cluster Operating System (OS) Rolling Upgrades feature that is new to Windows Server 2016. We recommend that you move towards having the cluster on the same operating system and not run it in mixed mode for an extended period.

Demonstration: Implementing server-to-server storage replica

Demonstration Steps

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, ensure that **Select 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, select **Storage Replica**, click **Add Features**, and then click **Next**.

7. On the **Confirm installation selections** page, click **Install**.

8. When installation is complete, click **Close**, and then restart the virtual machine.

9. Repeat steps from 1 to 8 on **LON-SVR4**.

10. On **LON-SVR1**, in Windows PowerShell, type the following two commands, pressing Enter after each command:

```
MD c:\Temp
Test-SRTopology –SourceComputerName LON-SVR1 –SourceVolumeName M: –
SourceLogVolumeName N: –DestinationComputerName LON-SVR4 –DestinationVolumeName M: –
DestinationLogVolumeName N: –DurationInMinutes 2 –ResultPath c:\temp
```

11. Wait for the test to finish (it might take 5 to 7 minutes).

12. Open the report file located in **C:\Temp** folder. The report file is and HTML file which name starts with **TestSrTopologyReport**, and includes current date. Review the report file data and verify that you meet the Storage Replica requirements.

13. To configure server-to-server replication, at the Windows PowerShell command prompt, type the following command, and then press Enter:

```
New-SRPartnership –SourceComputerName LON-SVR1 –SourceRGName RG01 –SourceVolumeName
M: –SourceLogVolumeName N: –DestinationComputerName LON-SVR4 –DestinationRGName RG02
–DestinationVolumeName M: –DestinationLogVolumeName N:
```

14. To verify the replication source and destination state, at the Windows PowerShell command prompt, type the following the three commands pressing Enter after each command:

```
Get-SRGroup
Get-SRPartnership
(Get-SRGroup).replicas
```

15. To verify the number of the remaining bytes to be replicated on the destination server, at the Windows PowerShell command prompt, type the following command, and then press Enter:

```
(Get-SRGroup).Replicas | Select-Object numofbytesremaining
```

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 cluster configuration.
- Ensure that in case of one node failure, other nodes can manage the load.
- Carefully plan stretch clusters.

Review Questions

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

Answer: New features in Windows Server 2016 include:

- Cluster Operating System (OS) Rolling Upgrades

- Storage Replica

- Cloud witness

- VM resiliency

- Site-aware clusters

- Workgroup and multidomain clusters

Question: Why is it not a good idea, generally, to use a disk-only quorum configuration?

Answer: The failover cluster stops functioning if failure occurs on the LUNs that are used as the quorum disk. Even if all the other resources are available, including the disk for the applications, nodes do not provide service when the quorum disk is not available. It becomes a single point of failure.

Question: What is the purpose of CAU?

Answer: CAU allows administrators to update cluster nodes automatically with little or no availability loss 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 writes successfully on both storage systems. If the data does not write successfully to both storage systems, the application must attempt to write to the disk again. When you use 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 writes successfully 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: Identify an enhanced feature in stretch clusters in Windows Server 2016.

Answer: In Windows Server 2016, you can adjust 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 cannot 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:

Tool	Use for	Location
Failover Cluster Manager console	Managing Failover Cluster	Server Manager
Cluster-Aware Updating console	Managing Failover Cluster updates	Failover Cluster Manager Console
Windows PowerShell	Managing Failover Cluster	Taskbar, Server Manager, or Start Menu
Server Manager	Managing the operating system	Taskbar or Start Menu
iSCSI initiator	Managing iSCSI storage	Server Manager
Disk Management	Managing Disks	Server Manager

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Cluster Validation Wizard reports an error	Review the report that **Cluster Validation Wizard** provides, and determine the problem.
Create Cluster Wizard reports that not all nodes support the desired clustered role	Review installed roles and features on cluster nodes. The clustered 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 A: 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 to know the:
>
> - Number of applications or services that you will deploy on the cluster.
>
> - Performance requirements and characteristics for each application or service.
>
> - Number of servers that must be available to meet the performance requirements.
>
> - Location of the users who use the failover cluster.
>
> - Type of storage that the shared cluster storage will use.

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

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

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

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

Lab B: Managing a failover cluster

Question and Answers

Question: Why would you evict a cluster node from a failover cluster?

> **Answer:** You might evict a node if it is corrupt and needs to be replaced with a new node. You also might do this is your organization changes structure such as number of nodes in the cluster to be reduced from 4 to 3. In that case, you need to evict one of the nodes from the cluster.

Question: Do you perform failure-scenario testing for your high-available applications based on Windows Server failover clustering?

> **Answer:** Answers might vary. Every organization needs to do testing on a regular basis on their high-availability configurations. Testing helps you ensure that high availability with failover clustering has been configured properly and that applications, services, and data will be available in different real–world scenarios.

Module 9

Implementing failover clustering with Windows Server 2016 Hyper-V

Contents:

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

Contents:

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 VM.

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 it has not finished. In addition, you have two VMs called VM1 and VM2. VM1 and VM2 occasionally need to migrate back and forth between Cluster1 and Cluster2. Should you upgrade the configuration version on VM1?

> **Answer:** No, mixed-mode clusters are still technically supported only by the Windows Server 2012 R2 configuration. If you upgrade the configuration version, the VM can no longer run on Cluster2.

Lesson 2
Implementing Hyper-V VMs on failover clusters

Contents:

Question and Answers

Configuring a shared virtual hard disk

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

> **Answer:** If you use a shared hard virtual disk as cluster storage, you do not have to provide Fibre Channel or iSCSI connection to the VMs.

Implementing Scale-Out File Servers for VMs

Question: Have you considered storing VMs 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 VMs on the SMB share.

Maintaining and monitoring VMs in clusters

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

> **Answer:** You can use dedicated monitoring software such as System Center Operations Manager and/or Operations Manager Suite to monitor VMs, 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: http://aka.ms/isec0h

Demonstration: Implementing failover clustering with Hyper-V

Demonstration Steps

Configure failover clustering

1. On **LON-HOST1**, in **Server Manager**, on the **Dashboard**, click **Add roles and features**.

2. 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 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 **Features** list, click **Failover Clustering**. At the **Add features that are required for failover clustering** prompt, click **Add Features**, and then click **Next**.

7. On the **Confirm installation selections** page, click **Install**.

8. When installation is complete, click **Close**.

9. Switch to **LON-NVHOST2**.

10. Repeat steps 1 through 9 on **LON-NVHOST2**.

11. Switch back to **LON-HOST1**.

12. On **LON-HOST1**, in **Server Manager**, click **Tools**, and then click **Failover Cluster Manager**.

13. In **Failover Cluster Manager**, in the center pane, under **Management**, click **Create Cluster**.

14. On the **Before You Begin** page of the **Create Cluster Wizard**, read the information, and then click **Next**.

15. On the **Select Servers** page, in the **Enter server name** text box, type **LON-HOST1**, and then click **Add**. Again in the **Enter server name** text box, type **LON-NVHOST2**, and then click **Add**.

16. Verify the entries, and then click **Next**.

17. On the **Validation Warning** page, click **No. I do not require support from Microsoft for this cluster**, and then click **Next**.

18. On the **Access Point for Administering the Cluster** page, in the **Cluster Name** text box, type **VMCluster**.

19. In the **Address** text box, type **172.16.0.126**, and then click **Next**.

20. In the **Confirmation** dialog box, verify the information, clear the **Add all eligible storage to the cluster** option check box, and then click **Next**.

21. On the **Summary** page, click **Finish**.

Configure disks for failover cluster

1. On **LON-HOST1**, in the **Failover Cluster Manager** console, expand **VMCluster.Adatum.com**, expand **Storage**, right-click **Disks**, and then click **Add Disk**.

2. In the **Add Disks to Cluster** dialog box, verify that all disks are selected, and then click **OK**.

3. Click **Disks**, and then verify that all disks display as available for cluster storage in **Failover Cluster Manager**.

4. Click **Cluster Disk 1**. Right-click that disk, and then click **Add to Cluster Shared Volumes**.

5. Right-click **VMCluster.Adatum.com**, click **More Actions**, click **Configure Cluster Quorum Settings**, and then click **Next**.

6. On the **Select Quorum Configuration Option** page, click **Use default quorum configuration**, and then click **Next**.

7. On the **Confirmation** page, click **Next**.

8. On the **Summary** page, click **Finish**.

Move VM storage to the iSCSI target

1. Ensure that **LON-HOST1** is the owner of the disk that you just assigned to Cluster Shared Volume. You can read owner value in the **Owner node** column. If that is not the case, then move the disk to **LON-HOST1** before proceeding to step two.

   📝 **Note:** To move the disk:
   - Right-click the disk and then click **Move**.
   - Click **Select Node**, click **LON-HOST1**, and then click **OK**.

2. On **LON-HOST1**, on the desktop, on the taskbar, click the **File Explorer** icon.

3. In **File Explorer**, expand drive **E:**, expand **Program Files**, expand **Microsoft Learning**, expand **20740**, expand **Drives**.

   📝 **Note:** The drive letter might be different depending on the physical machine.

4. Copy the **20740A-BASE.vhd** virtual hard disk file to the **C:\ClusterStorage\Volume1** location.

5. **In File Explorer**, expand drive **E:** expand **Program Files**, expand **Microsoft Learning**, expand **Base.**

6. Copy the **Base16D-WS16-TP5**.vhd virtual hard disk file to the **C:\ClusterStorage\Volume1** location.

7. Click **Start,** select **Windows PowerShell**

8. Run the following command.

```
Set-VHD -Path C:\ClusterStorage\Volume1\20740A-BASE.vhd -ParentPath
C:\ClusterStorage\Volume1\Base16D-WS16-TP5.vhd
```

Configure the VM as highly available

1. On **LON-HOST1**, in **Failover Cluster Manager**, click **Roles**, and then in the **Actions** pane, click **Virtual Machines**.

2. Click **New Virtual Machine**.

3. Select **LON-HOST1** as the cluster node, and then click **OK**.

4. In the **New Virtual Machine Wizard**, on the **Before You Begin** page, click **Next**.

5. On the **Specify Name and Location** page, in the **Name** text box, type **TestClusterVM**, click **Store the virtual machine in a different location**, and then click **Browse**.

6. Browse to and select **C:\ClusterStorage\Volume1**, click **Select Folder**, and then click **Next**.

7. On the **Specify Generation** page, click **Generation 1**, and then click **Next**.

8. On the **Assign Memory** page, type **1536**, and then click **Next**.

9. On the **Configure Networking** page, click **Next**.

10. On the **Connect Virtual Hard Disk** page, click **Use an existing virtual hard disk**, and then click **Browse**.

11. Browse to **C:\ClusterStorage\Volume1**, click **20740A-BASE.vhd**, and then click **Open**.

12. Click **Next**, and then click **Finish**. If an error occurs informing you that the Microsoft Management has stopped working, restart this task from step 1.

13. On the **Summary** page of the **High Availability Wizard**, click **Finish**.

14. Right-click the **TestClusterVM**, and then click **Settings**.

15. On **LON-HOST1**, in the **Settings for TestClusterVM**, in the left navigation pane, expand **Processor**, and then click **Compatibility**.

16. In the right pane, select the **Migrate to a physical computer with a different processor version** check box, and then click **OK**.

17. Right-click **TestClusterVM**, and then click **Start**.

18. Ensure that the VM starts successfully.

Lesson 3
Key features for VMs in a clustered environment

Contents:

Question and Answers

Question: When is a good time to remove the Network Health Protections settings?

> **Answer:** Answers might vary but most should include examples of when the network is not important to production functions. For instance, if you have a backup network or test network that can allow for more troubleshooting before attempting to move the VM.

Question: What options do you need to enable VMMS to easily shutdown a guest operating system during a host initiated shut down?

( ) Integrated Services, Operating system shutdown

( ) Automatic Stop Action, Save the virtual machine state

( ) Automatic Stop Action, Turn off virtual machine

( ) Automatic Stop Action, Shut down the guest operating system

( ) Integrated Services, Backup (volume checkpoint)

> **Answer:**
>
> (√) Integrated Services, Operating system shutdown
>
> ( ) Automatic Stop Action, Save the virtual machine state
>
> ( ) Automatic Stop Action, Turn off virtual machine
>
> (√) Automatic Stop Action, Shut down the guest operating system
>
> ( ) Integrated Services, Backup (volume checkpoint)
>
> **Feedback:**
>
> Integrated Services needs to have the Operating system shutdown option installed. This allows the VMMS process to initiate a guest operating system shutdown, which will easily shutdown the guest operating system instead of placing it in a saved state or abruptly turning off the guest operating system.

Demonstration: Configure drain on shutdown

Demonstration Steps

Live migrate a VM

1. On **LON-NVHOST2**, open **Failover Cluster Manager**.

2. Expand **VMCluster.Adatum.com**, and then click **Roles**.

3. Right-click **TestClusterVM**, click **Move**, click **Live Migration**, and then click **Select Node**.

4. Click **LON-NVHOST2**, and then click **OK**. Wait until the VM is migrated. You will see that the **Owner Node** column will change the value when migration completes.

5. Right-click **TestClusterVM**, and then click **Connect**.

6. Ensure that you can access and operate the VM when it is migrated to another host.

Configure drain on shutdown

1. On **LON-HOST1,** select **Windows Start**, and then launch **Windows PowerShell**.

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

```
(Get-Cluster).DrainOnShutdown
```

📋   **Note:** Should return a value of **"1".**

3. On **LON-HOST1** launch Server Manager.

4. Select **Tools**, and then **Failover Cluster Manager**.

5. Select **Roles** in **Failover Cluster Manager**.

6. On **LON-NVHOST2** click on **Windows Start**, select **Power,** and then select **Shut down.**

7. On the popup dialog select **Continue.**

8. On **LON-HOST1** observe **TestClusterVM** live migrate to **LON-HOST1** from **LON-NVHOST2** before shutting down.

Module Review and Takeaways

Best Practices

- Develop standard configurations before you implement highly available VMs. 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 Servers clusters as storage for highly available VMs.
- Implement VM Manager. VM 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 VMs. For example, it stops you from creating VMs on storage that is inaccessible from all nodes in the cluster.

Review Question

Question: Do you have to implement CSV in order to provide high availability for VMs 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
VM 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 VM 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 VMs 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 VMs running on the host.	By default, VMs do not fail back to a host computer after they have migrated to another host. You can enable failback on the VM properties in Failover Cluster Manager.

Lab Review Questions and Answers

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

Question and Answers

Question: What is an example of when you might not want Protected Network selected for a Virtual Network Adapter?

> **Answer:** When the network might not be important enough to disrupt the production process and therefore, would not warrant a move. For example, backup networks could go offline for a node and you might not want all VMs to attempt a move for that one network that goes offline.

Question: What is the difference between live migration and storage migration?

> **Answer:** In live migration, you move the VM from one host to another; in storage migration, you move VM storage, and optionally, configuration files to another location on the same server.

Module 10

Implementing Network Load Balancing

Contents:

Lesson 1
Overview of NLB

Contents:

Question and Answers

Question: What is the difference between server failure and application failure, and how does that difference affect your high availability solution?

> **Answer:** A *server failure* is the failure of the actual hardware or software (operating system) of a server. An *application failure* is a failure of software running on the server environment. NLB can only detect server failure; it cannot detect application failure. This means that if a web application fails but the server remains operational, the NLB cluster will continue to forward traffic to the cluster node that hosts the failed application. To create a truly high-availability application, you will need to address both server and application failure. NLB addresses server failure. One way to manage application failure is to implement a monitoring solution such as System Center Operations Manager (Operations Manager). With Operations Manager, you can monitor the functionality of applications. You also can configure Operations Manager to generate an alert or even take action to fix a problem, in the event that an application on a cluster node fails.

Question: How many nodes does NLB support in Windows Server 2016?

( ) 2

( ) 8

( ) 16

( ) 32

( ) 64

> **Answer:**
>
> (√) 2
>
> (√) 8
>
> (√) 16
>
> (√) 32
>
> ( ) 64
>
> **Feedback:**
>
> NLB supports any number of nodes between 2 to 32.

Lesson 2
Configuring an NLB cluster

Contents:

Question and Answers

Question: Describe a situation where the single affinity setting would be appropriate.

> **Answer:** Single affinity would be appropriate in an e-commerce web application where it is necessary to ensure that a disconnected client reconnects to the same session.

Question: When would you want to use port rules other than the default port rule?

> **Answer:** You can use port rules to load balance different applications by using the same set of hosts. For example, you might want to load balance all incoming requests on port 80 across all the nodes in the cluster, and direct all incoming requests on port 5678 to a single host.

Demonstration: Deploying NLB

Demonstration Steps

Create an NLB cluster in Windows Server 2016

1. On **LON-SVR1**, click **Start**, and then click **Server Manager**.

2. In the **Server Manager** console, click **Tools**, and then click **Windows PowerShell ISE**.

3. In the **Windows PowerShell ISE** window, type the following command, and then press Enter:

```
Invoke-Command -Computername LON-SVR1,LON-SVR2 -command {Install-WindowsFeature
NLB,RSAT-NLB}
```

> 📋 **Note:** If you receive warnings about the network connection to each server, ignore these.

4. In the **Windows PowerShell ISE** window, type the following command, and then press Enter:

```
New-NlbCluster -InterfaceName "Ethernet" -OperationMode Multicast -ClusterPrimaryIP
172.16.0.42 -ClusterName LON-NLB
```

5. In the **Windows PowerShell ISE** window, type the following command, and then press Enter:

```
Add-NlbClusterNode -InterfaceName "Ethernet" -NewNodeName "LON-SVR2" -
NewNodeInterface "Ethernet"
```

6. In the **Server Manager** console, click **Tools**, and then click **Network Load Balancing Manager**.

7. Click **OK** to dismiss the **Warning** message box.

8. Click **LON-NLB (172.16.0.42)**.

9. Verify that nodes **LON-SVR1** and **LON-SVR2** display with the status of **Converged** for the LON-NLB cluster.

10. Right-click the **LON-NLB** cluster, and then click **Cluster Properties**.

11. In the **LON-NLB(172.16.0.42) Properties** dialog box, on the **Cluster Parameters** tab, verify that the cluster is set to use the Multicast operations mode.

12. On the **Port Rules** tab, verify that there is a single port rule with the following values:

    o   Cluster IP address: **All**

    o   Start: **0**

    o   End: **65535**

     o   Protocols: **Both** Transmission Control Protocol (TCP) and User Datagram Protocol (UDP)

     o   Affinity: **Single**

13. Click **OK** to close the dialog box.

Leave the virtual machine running

- When you finish the demonstration, leave the virtual machines running for the next demonstration.

Demonstration: Configuring NLB affinity and port rules

Demonstration Steps

Configure affinity for NLB cluster nodes

1. On **LON-SVR2**, click **Start**, and then click **Windows PowerShell**.

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

```
Mkdir c:\porttest
```

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

```
Xcopy /s c:\inetpub\wwwroot c:\porttest
```

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

```
New-Website -Name PortTest -PhysicalPath "C:\porttest" -Port 5678
```

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

```
New-NetFirewallRule -DisplayName PortTest -Protocol TCP -LocalPort 5678
```

Configure NLB port rules

1. On **LON-SVR1**, in the **Network Load Balancing Manager** console, right-click **LON-NLB (172.16.0.42)**, and then click **Cluster Properties**.

2. In the **LON-NLB(172.16.0.42) Properties** dialog box, on the **Port Rules** tab, select the **All** port rule. Click **Remove**, and then click **OK** to close the **LON-NLB (172.16.0.42)**. **Properties** dialog box.

3. In the **Network Load Balancing Manager** console, right-click **LON-NLB (172.16.0.42)**, and then click **Cluster Properties**.

4. In the **LON-NLB(172.16.0.42) Properties** dialog box, on the **Port Rules** tab, click **Add**.

5. In the **Add/Edit Port Rule** dialog box, type the following information, and then click **OK**:

     o   Port range: **80** to **80**

     o   Protocols: **Both**

     o   Filtering mode: **Multiple host**

     o   Affinity: **None**

6. Click **OK** to close the **LON-NLB(172.16.0.42) Properties** dialog box.

7. In the **Network Load Balancing Manager** console, right-click **LON-NLB (172.16.0.42)**, and then click **Cluster Properties**.

8. On the **Port Rules** tab, click **Add**.

9. In the **Add/Edit Port Rule** dialog box, type the following information, and then click **OK**:

- o   Port range: **5678** to **5678**

- o   Protocols: **Both**

- o   Filtering mode: **Single host**

10. Click **OK** to close the **LON-NLB(172.16.0.42) Properties** dialog box.

11. In the **Network Load Balancing Manager** console, right-click **LON-SVR1 (Ethernet)**, and then click **Host Properties**.

12. On the **Port Rules** tab, click the port rule that has **5678** as the **Start** and **End** value, and then click **Edit**.

13. In the **Handling priority** list, click **10**.

14. Click **OK** twice to close both the **Add/Edit Port Rule** dialog box and the **LON-SVR1(Ethernet) Properties** dialog box.

Revert the virtual machines

When you finish the demonstration, revert the virtual machine to its initial state. To do this, complete the following steps:

1. On the host computer, open **Hyper-V Manager**.

2. In Microsoft Hyper-V Manager, in the **Virtual Machines** list, right-click **20740A-LON-DC1**, and then click **Revert**.

3. In the **Revert Virtual Machine** dialog box, click **Revert**.

4. Repeat steps 2 and 3 for **20740A-LON-SVR1** and **20740A-LON-SVR2**.

Lesson 3
Planning an NLB Implementation

Contents:

Question and Answers

Question: Why do you use both port rules and firewall rules when securing NLB?

> **Answer:** Cluster nodes can be addressed both indirectly through the NLB cluster, and directly by hosts. For example, a web application that uses the www.adatum.com address (an address used by the cluster), will also accept traffic on port 80 directed at each individual cluster node. By configuring Internet Information Services (IIS), you can ensure that the node will respond only to the traffic that is directed at the cluster address rather than at the node address.

Question: Why should you use the principle of least privilege when assigning permission to NLB servers?

> **Answer:** Application administrators rarely need local Administrator privilege on host servers. You should ensure that application administrators have only the minimum permissions necessary to carry out application administration tasks. In most scenarios, application administrators do not need to perform NLB cluster management tasks.

Resources

Considerations for upgrading NLB clusters

Additional Reading: For more information, refer to Upgrading an Existing Network Load Balancing Cluster: http://aka.ms/U4sqyq

Module Review and Takeaways

Review Questions

Question: You have created a four-node Windows Server 2016 NLB cluster. The cluster hosts a website that is hosted on IIS. What happens to the cluster if you shut down the World Wide Web publishing service on one of the nodes?

> **Answer:** Nothing will happen, because NLB only detects server failure and not the failure of a particular application. In addition, approximately every fourth request to the application from clients will not be served.

Question: You want to host the www.contoso.com, www.adatum.com, and www.fabrikam.com websites on a four-node NLB cluster. The cluster IP address will be a public IP address, and each fully qualified domain name (FQDN) is mapped in DNS to the cluster's public IP address. What steps should you take on each node to ensure that traffic is directed to the appropriate site?

> **Answer:** You must configure host headers for each site on each node. In addition, you must ensure that host header configuration is identical.

Question: You have an eight-node Windows NLB cluster that hosts a web application. You want to ensure that traffic from a client that uses the cluster remains with the same node throughout their session, but that traffic from separate clients distributes equitably across all nodes. Which option do you configure to accomplish this goal?

> **Answer:** You must configure affinity settings to accomplish this.

Real-world Issues and Scenarios

To create a true high-availability solution, use a monitoring solution with NLB that will detect application failure. This is because NLB clusters will continue to direct traffic to nodes with failed applications providing NLB, which is independent of the application, continues to send heartbeat traffic.

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
You receive a message about conflicting IP addresses when restarting an NLB host.	Along with verifying that the IP address does not already exist on the network, verify that all hosts are using the same operation mode, either unicast or multicast.
NLB Manager is having trouble connecting to a host.	NLB Manager pings the host to verify that it is reachable. This might be blocked by the router or firewall settings. Either enable Internet control message protocol (ICMP) in the firewall or use NLB Manager's **/noping** option when starting nlbmgr.exe from the command line.
Hosts start converging, but do not complete the process.	If port rules were configured on different hosts, and they are incompatible or conflict in some way, this can prevent convergence. You will need to look at each cluster host and verify that they have identical port rules.
	In addition, network problems such as hardware issues or IP address conflicts also can cause problems with convergence. Use the **ping**

Common Issue	Troubleshooting Tip
	command to test connectivity or view the Windows event log to check for errors.
A default host is handling all the workload instead of it being balanced across nodes in the cluster.	The most likely issue is a missing port rule. All traffic not covered by port rules goes to the default host. You should also verify that all nodes in the cluster are converging successfully.

Lab Review Questions and Answers

Lab: Implementing NLB

Question and Answers

Question: How many additional nodes can you add to the LON-NLB cluster?

> **Answer:** The LON-NLB cluster can scale up to 32 nodes.

Question: What steps would you take to ensure that LON-SVR1 always manages requests for web traffic on port 5678, given the port rules that were established by the end of this set of exercises?

> **Answer:** You will configure the host priority. You also will set the rule to use the single-host filtering mode.

Question: What is the difference between a Stop and a Drainstop command?

> **Answer:** Stop terminates all active connections immediately. Drainstop blocks new connections, but allows existing connections to complete normally.

Module 11

Creating and managing deployment images

Contents:

Lesson 1
Introduction to deployment images

Contents:

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	Contains Windows SIM, which can be used to make answer files.
2	Is a Windows Server 2016 server role.
3	Creates the Deployment Share.
4	Allows you to create provisioning packages to customize images without having to re-image them.
5	Start computers from the network using PXE.
6	Uses task sequences to capture and deploy images.
7	Use the makeWinPEMedia /ufd command to create the bootable USB device.
8	Has both a deployment and transport server role service.
9	Needs Windows ADK as a prerequisite before using.

Category 1		Category 2		Category 3
Windows ADK for Windows 10		Windows DS		MDT 2013 Update 2

Answer:

Category 1		Category 2		Category 3
Windows ADK for Windows 10		Windows DS		MDT 2013 Update 2
Contains Windows SIM, which can be used to make answer files. Allows you to create provisioning packages to customize images without having to re-image them. Use the makeWinPEMedia /ufd command to create the bootable USB device.		Is a Windows Server 2016 server role. Start computers from the network using PXE. Has both a deployment and transport server role service.		Creates the Deployment Share. Uses task sequences to capture and deploy images. Needs Windows ADK as a prerequisite before using.

Resources

Overview of image-based installation tools

Additional Reading: For more information on Windows PowerShell DISM cmdlets, refer to DISM Cmdlets: http://aka.ms/dtayll

Demonstration: Preparing a Windows Server 2016 Image in MDT

Demonstration Steps

Create an MDT deployment share

1. On LON-SVR1, in the localhost **Virtual Machine Connection** window, click **Media**, point to **DVD Drive**, and then click **Insert Disk**.

2. In the **Open** dialog box, browse to **D:\Program files\Microsoft Learning\20740\Drives**.

3. Click the **WinServer2016_TP5.ISO** file, and then click **Open**.

4. On LON-SVR1, click the **Start** button, click **All Apps**, scroll down the list of apps, expand **Microsoft Deployment Toolkit**, and then click the **Deployment Workbench** item.

5. In the **Deployment Workbench** console, click the **Deployment Shares** node.

6. Right-click the **Deployment Shares** node, and then click **New Deployment Share**.

7. In the **New Deployment Share Wizard**, on the **Path** page, in the **Deployment share path** field, ensure that **C:\DeploymentShare** is listed in the **Deployment share path** text box. If it is not, enter it into the text box, and then click **Next**.

8. On the **Share** page, notice the name of the deployment share (it is a hidden share), and then click **Next**.

9. On the **Descriptive Name** page, note that this name, and not the path, will appear in the Deployment Workbench, and then click **Next**.

10. Review the **Options** page, explaining what each option does.

11. Ensure that the **Ask for a product key** and **Ask to set the local Administrator password** check boxes are cleared, and then click **Next**.

12. On the **Summary** page, click **Next**.

13. On the **Confirmation** page, click **View Script**. Explain that Notepad opens with the Windows PowerShell cmdlets, to perform the action in a script named **NewDP.ps1**.

14. Explain that because the **MDT 2013 Update 2** console uses a provider written in Windows PowerShell, the corresponding script for each completed action is generally available. You can save these scripts for documentation purposes, or to repeat similar actions on other systems, by changing real value names.

15. Close Notepad without saving the script, and then click **Finish**.

Examine the deployment share properties

1. In the Deployment Workbench, expand the **Deployment Share** node, and then expand **MDT Deployment Share (C:\DeploymentShare)**.

2. Briefly discuss each item shown.

3. Right-click **MDT Deployment Share (C:\DeploymentShare)**, and then click **Properties**.

4. In the **MDT Deployment Share (C:\DeploymentShare) Properties** dialog box, review the **General** tab, discuss the settings that you configured by using the wizard. Point out that the **Platforms Supported** settings are selected by default.

5. Click the **Rules** tab, and then explain that the rules are stored in the **CustomSettings.ini** file in the Control folder, which is based directly on the options that you choose during the share creation.

6. Click **Edit Bootstrap.ini**. Explain that this file also is in the Control folder.

7. Close **Notepad**.

8. Click the **Windows PE** tab. Explain that these settings control the boot media's creation. Review the **Features** tab and the **Drivers and Patches** tab. Explain that you need to configure the settings separately for both platform types.

9. Close the **MDT Deployment Share (C:\DeploymentShare) Properties** dialog box by clicking **Cancel**.

Import operating system files into the deployment share

1. Right-click the **Operating Systems** folder, and then click **Import Operating System**.

2. In the **Import Operating System Wizard**, on the **OS Type** page, select the **Full set of source files** option, and then click **Next**.

3. On the **Source** page, in the **Source directory** text box, type **D:**, and then click **Next**.

4. On the **Destination** page, in the **Destination directory name** text box, type **WindowsServer2016x64**, and then click **Next**.

5. On the **Summary** page, click **Next**.

6. On the **Confirmation** page, once again note the **View Script** button, but do not click it.

7. Click **Finish**.

8. In the **Deployment Workbench** console, ensure the **Operating Systems** folder is selected. Observe the list of operating systems in the details pane. Go over the list with the class. You should have four separate entries one each for the Standard and Datacenter versions, in both Core and GUI. Note that the list will depend on the different versions found in the **Install.wim** file.

Lesson 2
Creating and managing deployment images by using MDT

Contents:

Question and Answers

Question: Which one of the following operating systems can MDT 2013 Update 2 deploy? Choose all that apply.

( ) Windows 7

( ) Windows Server Vista

( ) Windows 10

( ) Windows 2008

( ) Windows Server 2012 R2

> **Answer:**
>
> (√) Windows 7
>
> ( ) Windows Server Vista
>
> (√) Windows 10
>
> ( ) Windows 2008
>
> (√) Windows Server 2012 R2

Lesson 3
Virtual machine environments for different workloads

Contents:

Question and Answers

Question: You are the IT manager for the Adatum company. Your organization server infrastructure consists of multiple datacenters connected to each other through a Multiprotocol Label Switching (MPLS) network. Over the previous decade, the company has made several different server purchases, and recently added Hyper-V servers with virtual servers running various server roles. The CIO has decided that it is time for a datacenter hardware update. You have been asked to develop a cost-effective plan to upgrade or replace all the older systems to Hyper-V capable servers. As part of the planning phase, you have been gathering comments from the various datacenter administrators about the environment. You are seeing frequent complaints about performance. How could you use the MAP toolkit to assist with the migration planning, and to explore and assess the complaints, and address performance issues, as necessary?

> **Answer:** Answers will vary. However, they should include a discussion of the Server Virtualization assessment and the collection of performance metrics.

Demonstration: Assessing the computing environment by using the MAP toolkit

Demonstration Steps

Use MAP to collect inventory data

1. On LON-CL1, click **Start**, click **All apps**, click **Microsoft Assessment and Planning and Toolkit**, and then click **Microsoft Assessment and Planning and Toolkit**.

2. On the **Data source** page, in the **Create or select a database** section, in the **Name** text box, type **Demo**, and then click **OK**.

3. In MAP, on the **Overview** page, on the left side, click **Server Virtualization**, and under the **Steps to complete** section, click **Collect inventory data**.

4. In the **Inventory and Assessment Wizard**, on the **Inventory Scenarios** page, select the **Windows computers** check box, and then click **Next**.

5. On the **Discovery Methods** page, ensure that **Use Active Directory Domain Services (AD DS)** is selected, and then click **Next**.

6. On the **Active Directory Credentials** page, in the **Domain** text box, type **Adatum**, in the **Domain account** text box, type **administrator**, in the **Password** text box, type **Pa$$w0rd**, and then click **Next**.

7. On the **Active Directory Options** page, ensure that **Find all computers in all domains, containers, and organizational units** is selected, and then click **Next**.

8. On the **All Computer Credentials** page, click **Create**.

9. In the **Account Entry** dialog box, in the **Account name** text box, type **adatum\administrator**, in the **Password** text box, type **Pa$$w0rd**, in the **Confirm password** text box, type **Pa$$w0rd**, click **Save**, and then click **Next**.

10. On the **Credentials Order** page, click **Next**.

11. On the **Summary** page, review the summary, and then click **Finish**.

12. In the **Inventory and Assessment** page, review the results of the data collection, wait for the assessment to show as **Completed**, and then click **Close**.

Use MAP to collect performance data

1. Under the **Steps to complete** page, click **Collect performance data**.

2. In the **Performance Metrics Wizard**, on the **Collection Configuration** page, ensure that the **Windows-based machines** check box is selected, leave the default time, and then click **Next**.

3. On the **Choose Computers** page, ensure that **Choose the computers from a list on the next step of the wizard** is selected, and then click **Next**.

4. On the **Computer List** page, select the check box next to **Computer Name**, which selects all the computers, and then click **Next**.

5. On the **All Computers Credential** page, ensure that the **adatum\administrator** account is selected, and then click **Next**.

6. On the **Credentials Order** page, click **Next**.

7. On the **Summary** page, click **Finish**.

8. Review the details on the metrics page, and then click **Close**.

Create a hardware configuration

Before you can work with MAP features, you must first cancel the running process that you initiated in a previous step.

1. At the bottom-left of the MAP console screen, in the running task drop-down list box, click **Cancel processing**, and then, in the pop-up window, click **Yes**.

2. In the **Steps to complete** section, click **Create hardware configuration**.

3. On the **Choose Scenario** page, click **General Server Consolidation/Desktop Virtualization**, and then click **Next**.

4. On the **Hardware Configuration** page, click **Create new**.

5. In the **Create new** text box, type **Server-Type1**, and then click **Next**.

6. On the **Infrastructure** page, click **Next**.

7. On the **CPU** page, click each of the following attributes drop-down list boxes, and then assign the following values:

    o   Manufacturer: **Intel**

    o   Model: **Xeon X7560**

    o   Number of physical processors: **2**

    o   Processor speed (GHz): **2.262** (default value)

    o   Cores per processor **8** (default value)

8. Leave the L2, L3, Cache size, and Bus Speed (MHz) as default values, and then click **Next**.

9. On the **Storage** page, click **Define IOPS and total available storage**. In the **Maximum disk I/O per second (IOPS)** text box, type **20000**, in the **Total available storage and (GB)** text box, type **1800**, and then click **Next**.

10. On the **Network and Memory** page, in the **Total Network throughput (Mbps)** text box, type **4000**, in the **Amount of memory (GB)** text box, type **128**, and then click **Next**.

11. On the **Summary** page, review the settings, and then click **Finish**.

Review the collected data

1. On the **MAP console**, in the console tree, select **Server Virtualization**.

2. In the details pane, scroll down to the **Hardware Library** section, and then select **Hardware Library**.

3. A table will appear showing the **Configurations** collected. Scroll through them and explain the data collected. In the upper-left of the **MAP console**, click the back arrow.

4. Note that you could also run the **Server Consolidation** and **Private Cloud Fast Track** wizards, which, due to time constraints, will not be done.

Module Review and Takeaways

Best Practices

- Build your reference system by using a virtual machine. This will avoid having an image with any hardware-specific configurations embedded.
- Create folders in the **Out-of-Box-Drivers** node to organize all your vendor or model-specific drivers.
- Use **Profile Selections** to deploy only the required drivers to a given hardware configuration
- Build thin images and apply applications on demand through the applications node. This will allow you to keep the application current as updates and patches are released, without having to rebuild the image.

Review Question

Question: What could you do to bypass having to enter credentials to connect to the deployment share?

> **Answer:** You could edit the **Bootstrap.ini** file to specify the path to the deployment share, and to provide the proper credentials.

Real-world Issues and Scenarios

When working with the MAP toolkit, consider backing up your database regularly. If you are running assessments over a long period, the data could become critical to the timeframe of your project.

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Mismatch between versions of MDT and Windows AIK or Windows ADK.	Ensure that when you install MDT 2013 Update 2 that you also install the version of Windows ADK for Windows 10. You do not have to uninstall the earlier version. Running the ADK setup will update the existing components of the ADK installation.
Cannot find lite-touch boot media in the Boot folder of the Deployment Share.	You first must run the **Update Deployment Share Wizard**. It will create all the items in the various Deployment Share folders.
In MAP, when you click on most operations, you receive a warning that states, "The task processor is currently busy. You cannot perform this operation while the task processor is running. Please wait for the task processor to complete or cancel the task process before retrying this operation."	At the lower-left of the MAP console, next to the database name, the name of a task that is running is displayed. Next to the task name, click the drop-down list box, and then either view the status of the running task, or cancel it.

Lab Review Questions and Answers

Lab: Using MDT to deploy Windows Server 2016

Question and Answers

Question: In the lab, you used the **Monitoring** node to observe the deployment task sequence status. What should you do if there no values in the **Monitoring** node's detail pane?

Answer: Right-click the node and select **Refresh**.

Question: When you added the Install.win source files, four separate wim files appeared. Why?

Answer: A .wim file can contain multiple images. In the case of Windows Server 2016, you will have a Standard and Datacenter version, with each version having a full GUI and a Core image.

Module 12

Managing, monitoring, and maintaining virtual machine installations

Contents:

Lesson 1
WSUS overview and deployment options

Contents:

Question and Answers

Question: What are some benefits of using WSUS to manage Windows updates?

Answer: Answers will vary depending on the students' experiences. Some benefits are:

- Ability to deploy updates to non-production environments for testing.

- Ability to deploy updates on a staggered schedule.

- Better control of the Internet bandwidth while downloading updates.

Resources

WSUS server deployment options

Additional Reading: For more information about capacity requirements for WSUS servers, refer to Determine Capacity Requirements: http://aka.ms/qbj2o8

Additional Reading: For more information on determining capacity for WSUS servers, refer to Determine Capacity Requirements: http://aka.ms/Shljv4

Lesson 2
Update management process with WSUS

Contents:

Question and Answers

Question: Why would you use Group Policy to configure Windows systems to use WSUS?

> **Answer:** Answers will vary depending on the students' experience. Answers could include that using Group Policy to configure Windows Updates helps to prevent configuration errors.

Resources

WSUS troubleshooting

Additional Reading: For more information on the downloadable tools and utilities for WSUS and its components, refer to Windows Server Update Services Tools and Utilities: http://aka.ms/vz5zxz

Demonstration: Deploying updates by using WSUS

Demonstration Steps

1. On LON-SVR2, click **Start**, click **Windows Administrative Tools**, and then double-click **Windows Server Update Services**.

2. In Windows Server Update Services, expand **Updates**, and then click **All Updates**.

3. Right-click **Update for Windows 10 Version 1511 for x64-based Systems (KB3140741)**, and then click **Approve**.

4. In the **Approve Updates** window, in the **All Computers** drop-down list, select **Approved for Install**.

5. In the **Approve Updates** window, in the **All Computers** drop-down list, select **Apply to Children**.

6. Click **OK**, and then click **Close**.

7. Verify that the **Approval** column shows **Install**.

8. Close the **Update Services** console.

Lesson 3
Overview of Windows PowerShell DSC

Contents:

Question and Answers

Question: How can PowerShell DSC help you manage your environment?

Answer: Answers will vary based on the students' experiences. Answers could include:

- By ensuring that computers with similar roles, such as file servers, have a common configuration.

- By ensuring that undesired changes to a system are automatically returned to a desired state.

Lesson 4
Overview of Windows Server 2016 monitoring tools

Contents:

Question and Answers

Question: Which of the tools discussed in this lesson would you use if you want to check which resources an application is using?

>   **Answer:** Answers will vary based on the students' experience, but could include:
>
>   - Task Manager, because it helps to provide an overview of the resources that an application is using.
>
>   - Performance Monitor, because it helps to provide a view of the historical information.
>
>   - Resource Monitor, because it helps to provide a more detailed view of resource usage.

Lesson 5
Using Performance Monitor

Contents:

Question and Answers

Question: Why is it important to determine the baseline performance of a server?

> **Answer:** If you do not establish the baseline performance, you will not be able to accurately measure the change in performance when software or resources are added.

Demonstration: Capturing counter data with a data collector set

Demonstration Steps

Create a data collector set

1. Switch to the LON-SVR1 computer.

2. Click the **Search** button, and then type **Perfmon** in the **Search the web and Windows** box.

3. In the **Best match** list, click **Perfmon**.

4. In Performance Monitor, in the navigation pane, expand **Data Collector Sets**, and then click **User Defined**.

5. Right-click **User Defined**, point to **New**, and then click **Data Collector Set**.

6. In the **Create new Data Collector Set** wizard, in the **Name** text box, type **LON-SVR1 Performance**.

7. Click **Create manually (Advanced)**, and then click **Next**.

8. On the **What type of data do you want to include?** page, select the **Performance counter** check box, and then click **Next**.

9. On the **Which performance counters would you like to log?** page, click **Add**.

10. In the **Available counters** list, expand **Processor**, click **% Processor Time**, and then click **Add >>.**

11. In the **Available counters** list, expand **Memory**, click **Pages/sec**, and then click **Add >>.**

12. In the **Available counters** list, expand **PhysicalDisk**, click **% Disk Time**, and then click **Add >>**.

13. Click **Avg. Disk Queue Length**, and then click **Add >>**.

14. In the **Available counters** list, expand **System**, click **Processor Queue Length**, and then click **Add >>**.

15. In the **Available counters** list, expand **Network Interface**, click **Bytes Total/sec**, click **Add >>**, and then click **OK**.

16. On the **Which performance counters would you like to log?** page, in the **Sample interval** text box, type **1**, and then click **Next**.

17. On the **Where would you like the data to be saved?** page, click **Next**.

18. On the **Create the data collector set?** page, click **Save and close**, and then click **Finish**.

19. In Performance Monitor, in the results pane, right-click **LON-SVR1 Performance**, and then click **Start**.

Create a disk load on the server

1. Click **Start**, and then click **Windows PowerShell**.

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

```
Fsutil file createnew bigfile 104857600
```

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

```
Copy bigfile \\LON-dc1\c$
```

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

```
Copy \\LON-dc1\c$\bigfile bigfile2
```

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

```
Del bigfile*.*
```

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

```
Del \\LON-dc1\c$\bigfile*.*
```

7. Close the Windows PowerShell window.

Analyze the resulting data in a report

1. Switch to Performance Monitor.

2. In the navigation pane, right-click **LON-SVR1 Performance**, and then click **Stop**.

3. In Performance Monitor, in the navigation pane, click **Performance Monitor**.

4. On the toolbar, click **View log data** icon.

5. In the **Performance Monitor Properties** dialog box, on the **Source** tab, click **Log files**, and then click **Add**.

6. In the **Select Log File** dialog box, double-click **Admin**.

7. Double-click **LON-SVR1 Performance**, double-click the **LON-SVR1_date-000001** folder, and then double-click **DataCollector01.blg**.

8. Click the **Data** tab, and then click **Add**.

9. In the **Add Counters** dialog box, in the **Available counters** list, expand **Memory**, click **Pages/sec**, and then click **Add >>**.

10. Expand **Network Interface**, click **Bytes Total/sec**, and then click **Add >>**.

11. Expand **PhysicalDisk**, click **%Disk Time**, and then click **Add >>**.

12. Click **Avg. Disk Queue Length**, and then click **Add >>**.

13. Expand **Processor**, click **%Processor Time**, and then click **Add >>**.

14. Expand **System**, click **Processor Queue Length**, click **Add >>**, and then click **OK**.

15. In the **Performance Monitor Properties** dialog box, click **OK**.

16. On the toolbar, on the **Change graph type** icon, click the down arrow, and then click **Report**.

Demonstration: Configuring an alert

Demonstration Steps

Create a data collector set with an alert counter

1. On LON-SVR1 computer, in Performance Monitor, in the navigation pane, expand **Data Collector Sets**, and then click **User Defined**.

2. Right-click **User Defined**, point to **New**, and then click **Data Collector Set**.

3. In the **Create new Data Collector Set** wizard, in the **Name** box, type **LON-SVR1 Alert**.

4. Click **Create manually (Advanced)**, and then click **Next**.

5. On the **What type of data do you want to include?** page, click **Performance Counter Alert**, and then click **Next**.

6. On the **Which performance counters would you like to monitor?** page, click **Add**.

7. In the **Available counters** list, expand **Processor**, click **%Processor Time**, click **Add >>**, and then click **OK**.

8. On the **Which performance counters would you like to monitor?** page, in the **Alert when** list, click **Above**.

9. In the **Limit** text box, type **10**, and then click **Next**.

10. On the **Create the data collector set?** page, click **Finish**.

11. In the navigation pane, expand the **User Defined** node, and then click **LON-SVR1 Alert**.

12. In the results pane, right-click **DataCollector01**, and then click **Properties**.

13. In the **DataCollector01 Properties** dialog box, in the **Sample interval** box, type **1**, and then click the **Alert Action** tab.

14. Select the **Log an entry in the application event log** check box, and then click **OK**.

15. In the navigation pane, right-click **LON-SVR1 Alert**, and then click **Start**.

Generate a server load that exceeds the configured threshold

1. Click the **Start** button, and then click **Windows PowerShell ISE**.

2. In the Windows PowerShell ISE, open and run the following script:

    ```
    E:\Labfiles\Mod12\StressTest.ps1
    ```

3. Allow the script to finish running.

4. Close Windows PowerShell ISE.

Examine the event log for the resulting event

1. Click the **Search** button, and then type **Eventvwr**, and then in the **Best match** list, click **Eventvwr**.

2. In Event Viewer, in the navigation pane, expand **Applications and Services Logs**, expand **Microsoft**, expand **Windows**, expand **Diagnosis-PLA**, and then click **Operational**.

3. Examine the log for performance-related messages. These have an Event ID of 2031. Leave Event Viewer running.

Demonstration: Viewing reports in Performance Monitor

Demonstration Steps

View a performance report

1. On LON-SVR1, in **Performance Monitor**, in the navigation pane, expand **Reports**, expand **User Defined**, and then expand **LON-SVR1 Performance**.

2. Click the folder beneath **LON-SVR1 Performance**. The data collector set's previous collection process generated this report. You can change from the chart view to any other supported view.

3. If the report is not displayed, click the **Refresh** button on the toolbar, and then repeat **Step 2**.

4. Close all open windows.

Lesson 6
Monitoring event logs

Contents:

Question and Answers

Question: In your environment, how often do you check the event logs on your servers?

> **Answer:** Answers will vary based on the students' experiences. You can use this time to discuss the importance of regular monitoring to ensure a healthy environment.

Demonstration: Creating a custom view

Demonstration Steps

View Server Roles custom views

1. On LON-SVR1, open **Event Viewer**.

2. In the **navigation** pane, expand **Custom Views**, expand **Server Roles**, and then click **Web Server (IIS)**. This is the Web Server role-specific custom view.

Create a custom view

1. In the navigation pane, right-click **Custom Views**, and then click **Create Custom View**.

2. In the **Create Custom View** dialog box, select the **Critical**, **Warning**, and **Error** check boxes.

3. In the **Create Custom View** dialog box, in the **Event logs** drop-down list, expand **Windows Logs**, and then select the **System** and **Application** check boxes. Click the mouse pointer back into the **Create Custom View** dialog box, and then click **OK**.

4. In the **Save Filter to Custom View** dialog box, in the **Name** box, type **Adatum Custom View**, and then click **OK**.

5. In Event Viewer, in the right-side pane, view the events that are visible within your custom view.

Demonstration: Configuring an event subscription

Demonstration Steps

Configure the source computer

1. Switch to LON-DC1.

2. If required, sign in as **Adatum\Administrator** with the password **Pa$$w0rd**.

3. Click the **Search** button, and then type **Cmd** in the search box.

4. In the **Best match** list, click **Cmd**.

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

```
winrm quickconfig
```

    Note that the service is already running.

6. From the **Server Manager**, click **Tools**, and then click **Active Directory Users and Computers**.

7. In **Active Directory Users and Computers** console, in the navigation pane, expand **Adatum.com**, and then click **Builtin**.

8. In the results pane, double-click **Administrators**.

9. In the **Administrators Properties** dialog box, click the **Members** tab.

10. Click **Add**, and in the **Select Users**, **Contacts**, **Computers**, **Service Accounts**, **or Groups** dialog box, click **Object Types**.

11. In the **Object Types** dialog box, select the **Computers** check box, and then click **OK**.

12. In the **Select Users, Contacts, Computers, Service Accounts, or Groups** dialog box, in the **Enter the object names to select** box, type **LON-SVR1**, and then click **OK**.

13. In the **Administrator Properties** dialog box, click **OK**.

Configure the collector computer

1. Switch to LON-SVR1.

2. Click the **Search** button, and then type **Cmd** in the Search box.

3. In the **Best match** list, click **Command Prompt**.

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

   ```
   Wecutil qc
   ```

5. When prompted, type **Y**, and then press Enter.

Create and view the subscribed log

1. In Event Viewer, in the navigation pane, click **Subscriptions**.

2. Right-click **Subscriptions**, and then click **Create Subscription**.

3. In the **Subscription Properties** dialog box, in the **Subscription name** text box, type **LON-DC1 Events**.

4. Click **Collector Initiated**, and then click **Select Computers**.

5. In the **Computers** dialog box, click **Add Domain Computers**.

6. In the **Select Computer** dialog box, in the **Enter the object name to select** text box, type **LON-DC1**, and then click **OK**.

7. In the **Computers** dialog box, click **OK**.

8. In the **Subscription Properties – LON-DC1 Events** dialog box, click **Select Events**.

9. In the **Query Filter** dialog box, in the **Logged** drop-down list, click **Last 30** days.

10. Select the **Critical, Warning, Information, Verbose**, and **Error** check boxes.

11. In the **Event logs** drop-down list, select **Windows Logs**. Switch to the **Query Filter** dialog box, and then click **OK**.

12. In the **Subscription Properties – LON-DC1 Events** dialog box, click **OK**.

13. In Event Viewer, in the **navigation** pane, expand **Windows Logs**.

14. Click **Forwarded Events**.

15. Examine any listed events.

Module Review and Takeaways

Best Practices

- Create an end-to-end monitoring strategy for your IT infrastructure. Monitoring should focus on proactively detecting potential failures or performance issues.
- When monitoring, estimate the baseline system utilizations for each server. This will help you determine whether the system is performing well or is overused.

Review Questions

Question: Your manager has asked if all updates to the Windows operating system should be applied automatically when they are released. Do you recommend an alternative process?

> **Answer:** All updates should be tested before they are applied in a production environment. That is, you should first deploy updates to a set of test computers by using WSUS.

Question: Your organization implements several applications that are not Microsoft applications. A colleague has proposed using WSUS to deploy application and operating system updates. Are there any potential issues with using WSUS?

> **Answer:** Yes. WSUS is an excellent tool for deploying updates for Microsoft applications such as the Microsoft Office system and Windows operating system updates. However, WSUS does not deploy updates for all Microsoft applications, and it does not deploy updates for non-Microsoft applications. Microsoft System Center 2012 Configuration Manager is a better choice when you need to deploy updates for non-Microsoft applications.

Question: Why is WSUS easier to manage in an Active Directory Domain Services (AD DS) domain?

> **Answer:** WSUS takes advantage of the AD DS organizational unit (OU) structure for deploying client settings through Group Policy. You can also use Group Policy settings to configure client-side targeting to determine the WSUS group membership of a client computer.

Question: What significant counters should you monitor in Performance Monitor?

> **Answer:** You should monitor the following:
>
> - **Processor > % Processor Time**
>
> - **System > Processor Queue Length**
>
> - **Memory > Pages/sec**
>
> - **Physical Disk > % Disk Time**
>
> - **Physical Disk > Avg. Disk Queue Length**

Question: Why is it important to monitor server performance periodically?

> **Answer:** By monitoring server performance, you can perform capacity planning, identify and remove performance bottlenecks, and assist with server troubleshooting.

Question: Why should you use performance alerts?

> **Answer:** By using alerts, you can react more quickly to any emerging performance-related problems, perhaps before these potential problems start to affect users' productivity.

Tools

The following table lists the tools that this module references.

Tool	Use	Where to find it
WSUS Administration console	Administer WSUS	Server Manager - Tools
Windows PowerShell WSUS cmdlets	Administer WSUS from the command-line interface	Windows PowerShell
Server Manager Dashboard	Monitoring multiple servers	Server Manager
Performance Monitor	Monitoring and analyzing real-time and logged performance data	Server Manager/Tools
Reliability Monitor	Monitoring hardware and software issues	Control Panel
Resource Monitor	Monitoring the use and performance of CPUs, disks, networks, and memory in real time	Server Manager/Tools
Event Viewer	Viewing and managing event logs	Server Manager/Tools
Task Manager	Identifying and resolving performance-related problems	Server Manager/Tools

Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
During monitoring, multiple sources are concurrently reporting different problems.	Collect as much information as possible about each of the reported problems. Although there might be multiple issues, it is likely that you will find a connection between these issues or problems.

Lab Review Questions and Answers

Lab B: Monitoring and troubleshooting Windows Server 2016

Question and Answers

Question: During the lab, you collected data in a data collector set. What is the advantage of collecting data this way?

> **Answer:** By collecting data in data collector sets, you can analyze and compare the data against historical data, and then derive conclusions regarding server capacity.