

OFFICIAL MICROSOFT LEARNING PRODUCT

# 10992B

**Integrating On-Premises Core Infrastructure  
with Microsoft Azure**

*Companion Content*

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Product Number: 10992B

Released: 02/2018

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Revised July 2013

# Module 1

## Introduction to Microsoft Azure

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## Lesson 1

# Overview of cloud computing and Azure

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## Question and Answers

**Question:** Which of the following are limitations of the Azure classic portal?

- It does not support customization.
- You must be an Account Administrator to access it.
- You must be either the Service Administrator or a Co-administrator to access it.
- You cannot modify subscription-level settings.
- It does not support recently introduced features.

**Answer:**

- It does not support customization.
- You must be an Account Administrator to access it.
- You must be either the Service Administrator or a Co-administrator to access it.
- You cannot modify subscription-level settings.
- It does not support recently introduced features.

**Feedback:** Unlike the Azure portal, the Azure classic portal does not support customization of its graphical interface. It also does not support any new features, which are being implemented directly in the Azure portal. Furthermore, you must either be the Service Administrator or a Co-administrator to access the Azure classic portal.

You also can modify subscription-level settings by using the **settings** page.

## Resources

### Overview of Azure services

 **Additional Reading:** For more information on newly announced Azure geographies and regions, including planned regional datacenter deployments, refer to “Azure regions” at <http://aka.ms/Tzcz4g>.

 **Additional Reading:** Microsoft is improving and enhancing Azure continuously, and adds new services regularly. For a full list of services that are currently available in Azure, refer to the “Popular products” section on the “Your vision. Your cloud” page at <http://aka.ms/Qe9skc>.

### The Azure service model

 **Additional Reading:** For more information about the Pay-As-You-Go plan, including usage quotas, refer to “Pay-As-You-Go” at <http://aka.ms/Gote79>.

 **Additional Reading:** For more information, refer to “Get Started with Azure in Open Licensing” at <http://aka.ms/Kem08f>.

 **Additional Reading:** For more information, refer to “Licensing Azure for the Enterprise” at <http://aka.ms/Voag7x>.

 **Additional Reading:** For more information, refer to “Azure Hybrid Benefit” at <https://aka.ms/wb8zc9>.

 **Additional Reading:** For more information, refer to “Azure Reserved VM Instances (RIs)” at <https://aka.ms/C1tgud>.

-  **Additional Reading:** For more information about members' benefits, refer to "Member Offers" at <http://aka.ms/Nse6tf>.
-  **Additional Reading:** For more information, refer to "Azure pricing" at: <http://aka.ms/Svvpfj>.
-  **Additional Reading:** For more information, refer to "Azure migration center" at <http://azuremigrationcenter.com/>.
-  **Additional Reading:** For more information, refer to "Azure Cost Management Documentation" at <https://docs.microsoft.com/en-us/azure/cost-management/>.
-  **Additional Reading:** For more information about support plans, refer to "Azure support plans" at <http://aka.ms/cqf65f>.
-  **Additional Reading:** For more information about Azure SLAs, refer to "Service Level Agreements" at <http://aka.ms/Q8rdkh>.
-  **Additional Reading:** For more information about Azure accounts and subscriptions, refer to "Azure subscription and service limits, quotas, and constraints" at <https://docs.microsoft.com/en-us/azure/azure-subscription-service-limits>.
-  **Additional Reading:** The Azure Account Center is available at <https://account.windowsazure.com/Subscriptions>.
-  **Additional Reading:** You can configure a Microsoft account with multi-factor authentication by using the Microsoft Authenticator app. For details, refer to "Get started with the Microsoft Authenticator app" at <https://docs.microsoft.com/en-us/azure/multi-factor-authentication/end-user/microsoft-authenticator-app-how-to>.

## Azure management and development interfaces and tools

-  **Additional Reading:** For the list of services that still require the use of the Azure classic portal, refer to "Azure portal availability chart" at <https://aka.ms/ianie6>.
-  **Additional Reading:** At the time of authoring this course, Azure PowerShell modules on non-Windows platforms required installation of PowerShell 6 (beta). The installation files are available from GitHub at <https://aka.ms/Efcja0> and <https://aka.ms/wuzyh8> for Linux and macOS, respectively.
-  **Additional Reading:** For more information, refer to "Windows Management Framework 5.1" at <https://aka.ms/Wt4bd5>.
-  **Additional Reading:** For more information, refer to "PackageManagement PowerShell Modules Preview" at <http://aka.ms/Onym5y>.
-  **Additional Reading:** The Web Platform Installer-based installation of Azure PowerShell is available from the "Downloads" page at <http://aka.ms/Nc0773>.
-  **Additional Reading:** The Azure PowerShell GitHub-based repository is accessible at <https://aka.ms/X91ifv>.
-  **Additional Reading:** For more information, refer to "Microsoft Azure Active Directory PowerShell Module Version Release History" at <http://aka.ms/Cqfzpq>.
-  **Additional Reading:** For more information about Windows Subsystem for Linux, refer to "Windows Subsystem for Linux Documentation" at <https://aka.ms/Xohxa9>.
-  **Additional Reading:** For more information about Cloud Shell, refer to "Overview of Azure Cloud Shell" at <https://docs.microsoft.com/en-us/azure/cloud-shell/overview>.
-  **Additional Reading:** For more information about installing Azure CLI 2.0, refer to "Install Azure CLI 2.0" at <https://aka.ms/R19qhb>.

 **Additional Reading:** You can install Visual Studio on Windows and macOS operating systems. For .NET Azure development on Linux, you have the option of installing Visual Studio Code, which requires the installation of .NET Core SDK. For more information, refer to “Tools for .NET Azure developers” at <https://aka.ms/C2qv4e>.

 **Additional Reading:** To download the Azure SDK for Visual Studio on Windows, refer to “Downloads” at <http://aka.ms/Nc0773>.

## Lesson 2

# Overview of the Azure deployment models

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## Question and Answers

**Question:** Which of the following features did Azure Resource Manager introduce?

- Tags
- Template-based deployment
- RBAC
- Azure web portal
- Windows PowerShell-based management of Azure services

**Answer:**

- Tags
- Template-based deployment
- RBAC
- Azure web portal
- Windows PowerShell-based management of Azure services

**Feedback:** Azure Resource Manager introduced the concept of resource groups, and made it possible to tag these groups' resources and delegate administrative access via Role-Based Access Control (RBAC).

The web portal and Windows PowerShell-based management were available in the Service Management (classic) model, and they are also available in the Azure Resource Manager deployment model. However, the portal interface has changed considerably.

## Resources

### Azure Resource Manager vs. Azure classic deployment model

 **Additional Reading:** To find out more about Azure VM scale sets, refer to "What are virtual machine scale sets in Azure?" at <https://docs.microsoft.com/en-us/azure/virtual-machine-scale-sets/virtual-machine-scale-sets-overview>.

 **Additional Reading:** Azure Load Balancer Standard is in preview at the time of authoring this content. To find out more about Azure Load Balancer Standard, refer to "Azure Load Balancer Standard overview (preview)" at <https://docs.microsoft.com/en-us/azure/load-balancer/load-balancer-standard-overview>.

### Considerations for environments using both deployment models

 **Additional Reading:** To find out more about Azure Virtual network peering, refer to "Virtual network peering" at <https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-peering-overview>.

 **Additional Reading:** You also have the option of migrating classic resources to an Azure Resource Manager environment. To find out more about this procedure, refer to "Migrate IaaS resources from classic to Azure Resource Manager by using Azure PowerShell" at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/migration-classic-resource-manager-ps>.

# Module Review and Takeaways

## Review Question

**Question:** How will cloud computing benefit your organization?

**Answer:** Use this discussion topic to ensure that the students understand how cloud computing might benefit their organizations. Ask the students whether their organizations have implemented cloud computing.

Answers will vary, but might include:

- Reduce operations costs.
- Reduce capital expenses.
- Consolidate servers.
- Improve the resiliency and agility of IT systems.

## Tools

The following table lists the tools that this module references:

Tool	Use to	Where to find it
Azure portal	Manage Azure resources	 <b>Additional Reading:</b> For more information, refer to the Azure portal at <a href="http://aka.ms/Jf3q96">http://aka.ms/Jf3q96</a> .
Azure classic portal	Manage Azure resources	 <b>Additional Reading:</b> For more information, refer to Microsoft Azure at <a href="http://aka.ms/Hiet61">http://aka.ms/Hiet61</a> .
Azure Enterprise portal	Manage multiple Azure subscriptions under an Enterprise Agreement	 <b>Additional Reading:</b> For more information, refer to <a href="http://ea.microsoftazure.com">ea.microsoftazure.com</a> at <a href="http://aka.ms/V91c9h">http://aka.ms/V91c9h</a> .
Azure Account Center	Manage multiple Azure subscriptions that are not part of an Enterprise Agreement	 <b>Additional Reading:</b> For more information, refer to Account Center at <a href="http://aka.ms/Cbnltm">http://aka.ms/Cbnltm</a> .
Azure modules for Windows PowerShell	Manage Azure by using Windows PowerShell	Install from PowerShell Gallery or by using the Web Platform Installer.
Azure CLI	Manage Azure by using Azure CLI 2.0	Install Azure CLI 2.0 from <a href="https://aka.ms/Cq47vj">https://aka.ms/Cq47vj</a> .

# Lab Review Questions and Answers

## Lab: Using the Azure portal, Azure PowerShell, Azure CLI, and Visual Studio to deploy and manage Azure resources

### Question and Answers

**Question:** Which deployment methodology would you use to provision a multi-tier solution in Azure?

**Answer:** Microsoft recommends using Azure Resource Manager templates to deploy multi-tier solutions into Azure.

While the traditional deployment methods that rely on GUI interfaces or scripting methods are still available, Azure Resource Manager templates offer additional benefits. Similar to scripts, they facilitate deploying multi-tier solutions in an automated manner. However, unlike scripts, Azure Resource Manager templates do not explicitly specify individual steps required to provision these solutions. Instead, they simply define their intended end state.

Azure Resource Manager templates rely on the intelligence built into the Azure platform to deploy all necessary resources in the most optimal way, which results in minimized deployment time and considerably reduces the potential for errors. The Azure platform analyzes dependencies between resources included in the template to help ensure that they are created in the correct order.

**Question:** What method would you use to create a Resource Manager template?

**Answer:** Answers may vary, but most likely they will include Visual Studio. As the steps provided in the lab illustrate, Visual Studio greatly simplifies creating and editing of Azure Resource Manager deployment templates. You can rely on the GUI to add additional resources into a template, without having to modify directly the corresponding JSON content. In addition, you can easily review the JSON elements by relying on the JSON Outline window.

# Module 2

## Integrating with Azure Compute Services

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## Lesson 1

# Overview of Azure virtual machines and Azure cloud services

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## Question and Answers

**Question:** Which of the following Windows Server roles can you install on an Azure virtual machine?

- Windows Deployment Services
- Dynamic Host Configuration Protocol Server
- Domain Name System Server
- Rights Management Services
- Active Directory Certificate Services

**Answer:**

- Windows Deployment Services
- Dynamic Host Configuration Protocol Server
- Domain Name System Server
- Rights Management Services
- Active Directory Certificate Services

**Feedback:** You can install the DNS Server role and Active Directory Certificate Services on an Azure virtual machine. Azure virtual machines do not support Windows DS, DHCP Server, or RMS.

## Resources

### Hyper-V virtual machines vs. Azure IaaS virtual machines

 **Additional Reading:** For an up-to-date listing of all standard Azure virtual machine sizes, refer to “Sizes for virtual machines in Azure” at <https://docs.microsoft.com/en-in/azure/virtual-machines/windows/sizes?toc=%2Fazure%2Fvirtual-machines%2Fwindows%2Ftoc.json> (for Windows) and at <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/sizes?toc=%2Fazure%2Fvirtual-machines%2Flinux%2Ftoc.json> (for Linux).

 **Additional Reading:** For more information regarding S2D in Azure, refer to “Storage Spaces Direct in Azure” at <https://aka.ms/Mtl5tv>.

 **Additional Reading:** For more information regarding SIOS DataKeeper, refer to “SIOS DataKeeper” at <https://aka.ms/llrwn0>.

 **Additional Reading:** For more information regarding Cloud Witness, refer to “Deploy a Cloud Witness for a Failover Cluster” at <https://aka.ms/Fiollk>.

### Azure virtual machines vs. Azure Cloud Services

 **Additional Reading:** For more information regarding high availability and disaster recovery strategy for Azure virtual machines, refer to “Azure Resiliency” at <https://aka.ms/Dakrdm>.

 **Additional Reading:** For more information regarding disaster recovery strategy for Azure Cloud Services, refer to “What to do in the event of an Azure service disruption that impacts Azure Cloud Services” at <https://docs.microsoft.com/en-us/azure/cloud-services/cloud-services-disaster-recovery-guidance>.

 **Additional Reading:** The virtual machine sizes that you can use when deploying Azure Cloud Services instances constitute a subset of the sizes available when deploying Azure virtual

machines. For an up-to-date listing of all virtual machine sizes for Azure Cloud Services, refer to “Sizes for Cloud Services” at <https://docs.microsoft.com/en-us/azure/cloud-services/cloud-services-sizes-specs>.

## Identifying workloads for Azure virtual machines and Azure Cloud Services



**Additional Reading:** For up-to-date information regarding the Azure Cloud Services lifecycle support policy, refer to “Lifecycle support policy FAQ - Microsoft Azure” at <http://aka.ms/Dk2dqg>.



**Additional Reading:** For up-to-date information about Microsoft server software support for Azure virtual machines, refer to “Microsoft server software support for Microsoft Azure virtual machines” at <http://aka.ms/H0kr23>.

## Lesson 2

# Migrating workloads to Azure virtual machines by using virtual machine images and disks

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## Question and Answers

**Question:** Which of the following virtual disks can you upload to Azure by using the **Add-AzureRmVhd** cmdlet and then attach to an Azure virtual machine?

- ( ) A .vhd file of 8,192 GB in size containing a fixed virtual disk
- ( ) A .vhd file of 2,0487 GB in size containing a fixed virtual disk
- ( ) A .vhdx file of 1,023 GB in size containing a fixed virtual disk
- ( ) A .vhdx file of 2,047 GB in size containing a fixed virtual disk
- ( ) A .vhd file of 2,047 GB in size containing a dynamically expanding virtual disk

**Answer:**

- ( ) A .vhd file of 8,192 GB in size containing a fixed virtual disk
- (v) A .vhd file of 2,0487 GB in size containing a fixed virtual disk
- ( ) A .vhdx file of 1,023 GB in size containing a fixed virtual disk
- ( ) A .vhdx file of 2,047 GB in size containing a fixed virtual disk
- (v) A .vhd file of 2,047 GB in size containing a dynamically expanding virtual disk

**Feedback:** You can upload and attach to an Azure virtual machine a 2,047-GB .vhd file that contains a fixed virtual disk and a 2,047-GB .vhd file that contains a dynamically expanding virtual disk. The **Add-AzureRmVhd** cmdlet automatically converts the dynamically expanding virtual disk to fixed.

The first option is incorrect because the maximum size of a .vhd file that you can attach to an Azure virtual machine is 2 TB. Azure does not support .vhdx virtual disk files, which eliminates options 3 and 4.

## Resources

### Planning for moving virtual machine workloads between an on-premises Hyper-V environment and Azure

 **Additional Reading:** For more information about virtual machine sizes, including any changes after this course was published, refer to "Sizes for virtual machines in Azure" at <https://docs.microsoft.com/en-in/azure/virtual-machines/windows/sizes?toc=%2Fazure%2Fvirtual-machines%2Fwindows%2Ftoc.json>.

### Implementing Azure virtual machines by using custom on-premises images

 **Additional Reading:** For details regarding preparing computers running different Linux distributions for upload to Azure, refer to the "Prepare the VM" section of "Create a Linux VM from custom disk with the Azure CLI 2.0" at <https://docs.microsoft.com/en-us/azure/virtual-machines/virtual-machines-linux-upload-vhd?toc=%2Fazure%2Fvirtual-machines%2Flinux%2Ftoc.json>.

 **Additional Reading:** To download the Disk2vhd utility, refer to "Disk2vhd v2.01" at <http://aka.ms/j41qji>.

 **Additional Reading:** For instructions on how to create a managed image of a generalized Azure VM, refer to <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/capture-image-resource>.

For instructions on how to create an unmanaged image of a generalized Azure VM, refer to <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/sa-copy-generalized>.

 **Additional Reading:** For more information about uploading a Windows virtual machine image to Azure for Resource Manager deployments, refer to “Upload a Windows VHD from an on-premises VM to Azure” at <https://docs.microsoft.com/en-in/azure/virtual-machines/windows/upload-generalized-managed?toc=%2Fazure%2Fvirtual-machines%2Fwindows%2Ftoc.json> and to “Create a Linux VM from custom disk with the Azure CLI 2.0” at <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/upload-vhd>.

 **Additional Reading:** For more information regarding deploying Azure VMs by using custom unmanaged images, refer to “Upload a generalized VHD to Azure to create a new VM” at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/sa-upload-generalized>.

 **Additional Reading:** For more information regarding creating Azure VMs by using specialized disks hosting your on-premises, Windows-based workloads, refer to “Create a Windows VM from a specialized disk” at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/create-vm-specialized>. For equivalent information regarding Linux-based workloads, refer to “Create a Linux VM from custom disk with the Azure CLI 2.0” at <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/upload-vhd>.

 **Additional Reading:** You can use the same approach to migrate virtual machines from non-Microsoft cloud providers. For an example of such a procedure, with steps for migrating an EC2 instance from Amazon Web Services, refer to “Move a Windows VM from Amazon Web Services (AWS) to Azure using PowerShell” at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/aws-to-azure>.

## Moving virtual disk files between an on-premises Hyper-V environment and Azure

 **Additional Reading:** For details regarding SAS, refer to “Using Shared Access Signatures (SAS)” at <https://docs.microsoft.com/en-in/azure/storage/common/storage-dotnet-shared-access-signature-part-1> and “Shared Access Signatures, Part 2: Create and use a SAS with Blob storage” at <https://docs.microsoft.com/en-in/azure/storage/blobs/storage-dotnet-shared-access-signature-part-2>.

 **Additional Reading:** For details regarding both Azure PowerShell cmdlets, refer to the “VM VHDs” section of “AzureRM.Compute” at <https://aka.ms/Pfsz5y>.

 **Additional Reading:** To find more information regarding AzCopy and to download its latest version, refer to “Transfer data with the AzCopy Command-Line Utility” at <https://docs.microsoft.com/en-in/azure/storage/common/storage-use-azcopy>.

## Lesson 3

# Extending HPC workloads to Azure

### Contents:

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## Resources

### Introduction to Microsoft HPC technologies

-  **Additional Reading:** To download the latest version of the HPC Pack (HPC Pack 2016 at the time of this writing), refer to HPC Pack 2016 at <https://aka.ms/Faahsn>.
-  **Additional Reading:** Starting with HPC Pack 2016, you can use Azure Active Directory (Azure AD) for cluster authentication. This option is primarily intended for HPC Pack 2016 cluster deployments in Azure. For more information regarding this topic, refer to “Manage an HPC Pack cluster in Azure using Azure Active Directory” at <https://docs.microsoft.com/azure/virtual-machines/virtual-machines-windows-hpcpack-cluster-active-directory>.
-  **Additional Reading:** You can considerably simplify HPC 2016 deployments to Azure by using Azure Resource Manager deployment templates, which are available on GitHub at <https://aka.ms/L4o8nj>.
-  **Additional Reading:** For details regarding deploying an on-premises HPC cluster by using HPC Pack 2016, refer to “Getting Started Guide for Microsoft HPC Pack 2016” at <https://aka.ms/Dfdx69>. For details regarding deploying an HPC cluster in Azure, refer to “Deploy an HPC Pack 2016 cluster in Azure” at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/hpcpack-2016-cluster>.
-  **Additional Reading:** For more information regarding the deployment of HPC clusters on Azure VMs and VM scale sets, refer to “Options with HPC Pack to create and manage a Windows HPC cluster in Azure” at <https://docs.microsoft.com/en-in/azure/virtual-machines/windows/hpcpack-cluster-options?toc=%2Fazure%2Fvirtual-machines%2Fwindows%2Ftoc.json>.

### Bursting HPC workloads to Azure Cloud Services by using the HPC Pack

-  **Additional Reading:** For more information about setting up a hybrid HPC cluster by using the HPC Pack, refer to “Burst to Azure Worker Instances with Microsoft HPC Pack” at <https://aka.ms/Cgfzep>.
-  **Additional Reading:** For more information about automatically growing and shrinking the HPC Pack cluster resources in Azure according to the cluster workload, refer to “Automatically grow and shrink the HPC Pack cluster resources in Azure according to the cluster workload” at <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/classic/hpcpack-cluster-node-autogrowshrink>.

### Bursting HPC workloads to Azure Batch by using the HPC Pack

-  **Additional Reading:** For more information about bursting to Azure Batch by using the HPC Pack, refer to “Burst to Azure Batch with Microsoft HPC Pack 2016 Update 1” at <https://aka.ms/Xj99sn>.

## Lesson 4

# **Integrating compute workloads by using containers, container orchestration, and Azure Service Fabric**

### **Contents:**

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## Resources

### Introduction to containers

 **Additional Reading:** For more information about containers, refer to “Service Fabric and containers” at <https://docs.microsoft.com/en-us/azure/service-fabric/service-fabric-containers-overview>.

### Implementing Docker hosts in Azure

 **Additional Reading:** For more information about the Windows PowerShell module for Docker, refer to “Microsoft/Docker-PowerShell” at <https://aka.ms/hrk0t9>.

 **Additional Reading:** For details about installing the Docker VM extension, refer to “Create a Docker environment in Azure using the Docker VM extension” at <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/dockerextension>.

 **Additional Reading:** You can modify the default settings described above by including additional command-line parameters and assigning custom values to them. For example, to deploy a different image, use the `--azure-image` parameter. For the full syntax of the **docker-machine create -d azure** command, refer to “Microsoft Azure” at <https://aka.ms/mrs5mc>.

 **Additional Reading:** Docker Machine is available on Windows, Linux, and Mac OS X operating systems. For installation instructions and links to download locations, refer to “Install Docker Machine” at <https://aka.ms/rwfvoc>.

 **Additional Reading:** At the time of authoring this content, Azure Container Instances is in preview. For more information about its functionality, refer to “Azure Container Instances Documentation” at <https://docs.microsoft.com/en-us/azure/container-instances/>.

### Running containers on Azure virtual machines

 **Additional Reading:** For the full syntax of the **docker run** command, refer to “docker run” at <https://aka.ms/rnaxx2>.

 **Additional Reading:** For more details regarding running containers on Azure VMs by using Docker Machine, refer to “How to use Docker Machine to create hosts in Azure” at <https://docs.microsoft.com/en-in/azure/virtual-machines/linux/docker-machine?toc=%2Fazure%2Fvirtual-machines%2Flinux%2Ftoc.json>.

 **Additional Reading:** For information about the **Dockerfile** syntax, refer to “Dockerfile reference” at <http://aka.ms/wrccuy>.

 **Additional Reading:** For more information on **docker build**, including a list of all the build options, refer to “docker build” at <http://aka.ms/u29exr>.

### Overview of Azure Service Fabric

 **Additional Reading:** For more information about Azure Service Fabric, refer to “Overview of Service Fabric” at <https://docs.microsoft.com/en-us/azure/service-fabric/service-fabric-overview>.

## Extending Azure Service Fabric to on-premises environments



**Additional Reading:** For more information about creating and managing a Service Fabric cluster and for the link to download the Windows Server package, refer to “Create and manage a cluster running on Windows Server” at <https://docs.microsoft.com/en-us/azure/service-fabric/service-fabric-cluster-creation-for-windows-server>.

# Module Review and Takeaways

## Best Practice

When uploading images of on-premises virtual machines to Azure, ensure that the paging file is configured to reside on drive **D**. This way, you can use the temporary disk that the Azure platform automatically provides for Azure virtual machines. The Azure virtual machine's temporary disk maps to local storage on the Hyper-V hosts rather than to Azure storage. By using the local Hyper-V storage, you typically improve paging performance. In addition, you avoid transactional charges for Azure storage usage whenever the operating system running in the Azure virtual machine accesses the paging file.

When planning for moving virtual machine workloads to Azure, consider using Azure Site Recovery. For more information on this subject, refer to Module 5, "Designing and implementing Azure Site Recovery solutions."

## Review Question

**Question:** What approach would you use when migrating a Generation 2 Hyper-V virtual machine to Azure?

**Answer:** The answers might vary, but they should include using Azure Site Recovery. Azure Site Recovery automatically converts Hyper-V virtual machines from Generation 2 to Generation 1 when uploading them to Azure Storage. This allows you to perform migration without having to re-create a Generation 1 virtual machine on premises.

## Lab Review Questions and Answers

### Lab A: Uploading an on-premises virtual disk file to Azure

#### Question and Answers

**Question:** What type of conversion is necessary prior to uploading virtual disk files to an Azure storage account?

**Answer:** You should convert virtual disk files in the VHDX format to the VHD format before you upload them to Azure, as long as you intend to attach them to Azure virtual machines. This is necessary because, at the time of this writing, Azure does not support .vhdx files for Azure virtual machines. Although Azure does not support dynamically expanding virtual disks, converting such disks to the fixed format prior to an upload is not required if you use the **Add-AzureRmVhd** PowerShell cmdlet. This cmdlet automatically performs the conversion as part of the upload.

**Question:** What would be your primary considerations when downloading virtual disk files from Azure to your on-premises computers?

**Answer:** Answers might vary, but they will likely include:

- Bandwidth. You must consider the amount of data stored on the virtual disk that you download. However, note that the Windows PowerShell cmdlet that you use to download virtual disk files downloads only the portion of the disk that is in use.
- Disk space. You should remember that virtual disks of Azure virtual machines are of the fixed type. This means that a disk of 1 terabyte (TB) in size, when downloaded to your on-premises computer, will occupy 1 TB of disk space.

### Lab B: Moving containers between on-premises Hyper-V virtual machines and Azure virtual machines

#### Question and Answers

**Question:** Which tools would you use to manage hybrid deployments of Docker containers?

**Answer:** The answers might vary but will likely include the Docker Toolbox. This is an installer available for Windows and Mac OS X that installs the Docker client and Docker Machine Azure driver. Docker Machine is a command-line utility that allows you to perform several Docker-related administrative tasks, including provisioning new Docker hosts. The utility includes support for deploying Docker hosts on-premises and on Azure virtual machines.

**Question:** How can you use Azure when configuring a private Docker Registry?

**Answer:** You can configure an Azure storage account to host a private Docker Registry. This allows you to use the practically unlimited storage and resiliency built into the Azure platform.

# Module 3

## Integrating with Azure virtual networks

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## Lesson 1

# Overview of Azure Virtual Network Service

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## Question and Answers

**Question:** Which of the following options are differences between on-premises networks and Azure virtual networks?

- Azure virtual networks must use the public IP address space.
- Azure virtual machines must be restarted for the virtual network DNS configuration change to take effect.
- Azure virtual networks do not support custom routing.
- Azure virtual networks require custom DNS configuration to provide resolution of Internet names.
- You can use all IP addresses within each subnet of a virtual network.

**Answer:**

- Azure virtual networks must use the public IP address space.
- Azure virtual machines must be restarted for the virtual network DNS configuration change to take effect.
- Azure virtual networks do not support custom routing.
- Azure virtual networks require custom DNS configuration to provide resolution of Internet names.
- You can use all IP addresses within each subnet of a virtual network.

**Feedback:** Only the second option is correct. You have to restart Azure virtual machines if you want the Domain Name System (DNS) configuration changes that you apply to the virtual network where these virtual machines reside to take effect. Azure virtual networks can utilize both public and private IP address space, although most commonly their IP address assignment follows RFC 1918. They also support user-defined routes and offer built-in DNS name resolution for Internet based names. The Azure platform reserves five IP addresses on each subnet for its own use.

## Resources

### Azure Resource Manager networking components

 **Additional Reading:** At the time of authoring this content, Standard Load Balancer is in preview. For more information about its capabilities, refer to "Azure Load Balancer Standard overview (preview)" at <https://docs.microsoft.com/en-us/azure/load-balancer/load-balancer-standard-overview>.

 **Additional Reading:** For more information about this scenario, refer to "High availability ports overview" at <https://docs.microsoft.com/en-us/azure/load-balancer/load-balancer-ha-ports-overview>.

Note that this scenario requires Azure Standard Load Balancer, which at the time of authoring this content, is in preview.

 **Additional Reading:** For an overview of the architecture of this scenario, refer to "DMZ between Azure and the Internet" at <https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/dmz/secure-vnet-dmz>.

Details of implementing high availability are NVA-specific. For an example of a configuration that illustrates this approach when using Barracuda Next Generation (NG) Firewall virtual appliances, refer to <https://aka.ms/fcwkmku>.



**Additional Reading:** For more information about both scenarios, refer to "Network DMZ" at <https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/dmz/>.

## Lesson 2

# Extending on-premises networks to Azure

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## Question and Answers

**Question:** Which of the following options are the advantages of route-based Azure VPN gateways over policy-based Azure VPN gateways? (Choose all that apply.)

- Support for point-to-site VPNs.
- Support for site-to-site VPNs.
- Support for transitivity.
- Support for static routing.
- Support for IKEv2.

**Answer:**

- Support for point-to-site VPNs.
- Support for site-to-site VPNs.
- Support for transitivity.
- Support for static routing.
- Support for IKEv2.

**Feedback:** Unlike policy-based Azure VPN gateways, route-based Azure VPN gateways offer support for point-to-site VPNs, up to 30 IP security (IPsec) tunnels, connection transitivity, and Internet Key Exchange version 2 (IKEv2). Both types of gateways offer support for site-to-site VPN and static routing.

## Resources

### Overview of cross-premises connectivity options to Azure virtual networks

 **Additional Reading:** For more information, refer to “About VPN devices and IPsec/IKE parameters for Site-to-Site VPN Gateway connections” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-vpn-devices>.

### Overview of a site-to-site VPN

 **Additional Reading:** Using BGP in a site-to-site VPN allows you to implement a number of previously unsupported scenarios. These scenarios include:

- Transitive routing between your on-premises locations and multiple Azure virtual networks
- Multiple tunnels between a virtual network and an on-premises location in active-passive or active-active configuration, with automatic failover between them

For more information, refer to “Overview of BGP with Azure VPN Gateways” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-bgp-overview> and “Highly Available Cross-Premises and VNet-to-VNet Connectivity” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-highlyavailable>.

 **Additional Reading:** For a list of VPN devices that Microsoft has validated in partnership with their vendors, in addition to their configuration instructions, refer to “About VPN devices for

Site-to-Site VPN Gateway connections” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-vpn-devices>.

 **Additional Reading:** The SKUs listed above are available when you use the Azure Resource Manager deployment model. For information regarding SKUs that are available for the classic deployment model, refer to “Working with virtual network gateway SKUs (legacy SKUs)” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-skus-legacy>.

 **Additional Reading:** It is possible to connect multiple on-premises policy-based VPN devices that support IKEv2 to a single route-based Azure VPN gateway. This configuration leverages custom IPsec/IKE policies with a prefix-based traffic selector available with the route-based Azure VPN gateway. Note, however, that this configuration does not support connection transitivity. For more information, refer to “Connect multiple policy-based VPN devices” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-connect-multiple-policybased-rm-ps>.

 **Additional Reading:** For up-to-date site-to-site VPN pricing information, refer to “VPN Gateway pricing” at <http://aka.ms/Y57p7y>.

## Overview of a point-to-site VPN

 **Additional Reading:** Alternatively, you can use RADIUS authentication for point-to-site connections. At the time of authoring this content, this functionality is in preview. For more information, refer to “Configure a Point-to-Site connection to a VNet using RADIUS authentication: PowerShell (Preview)” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/point-to-site-how-to-radius-ps>.

 **Additional Reading:** For up-to-date point-to-site VPN pricing information, refer to “VPN Gateway pricing” at: <http://aka.ms/Y57p7y>.

## Overview of ExpressRoute

 **Additional Reading:** You can use Microsoft peering to provide public peering functionality by implementing route filters for Azure platform as a service (PaaS) services. This offers several benefits, such as minimizing the size of routing tables by using community tags to target specific PaaS services in designated Azure regions. It also enables Azure PaaS or software as a service (SaaS) services to initiate connections to on-premises networks. For more information about transitioning from public peering to Microsoft peering, refer to “Move a public peering to Microsoft peering” at <https://docs.microsoft.com/en-us/azure/expressroute/how-to-move-peering>.

 **Additional Reading:** Because ExpressRoute depends on having access to provider services, its availability depends on the customer location. For up-to-date information, refer to “ExpressRoute partners and peering locations” at <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-locations>.

 **Additional Reading:** For more details, refer to ExpressRoute routing requirements: <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-routing>.

## Implementing a site-to-site VPN by using the Azure Resource Management deployment model

 **Additional Reading:** To find a description of the equivalent procedure by using the Azure portal, refer to “Create a Site-to-Site connection in the Azure portal” at

<https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-howto-site-to-site-resource-manager-portal>.

To find a description of the equivalent procedure by using Azure CLI, refer to “Create a virtual network with a Site-to-Site VPN connection using CLI” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-howto-site-to-site-resource-manager-cli>.

 **Additional Reading:** For more details regarding this process, refer to “Create a VNet with a Site-to-Site VPN connection using PowerShell” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-create-site-to-site-rm-powershell>.

## Implementing a point-to-site VPN with certificate-based authentication by using Azure PowerShell

 **Additional Reading:** In earlier versions of Windows, you can use the makecert tool available as part of the Windows 10 Software Development Kit (SDK). Follow the directions available in “Generate and export certificates for point-to-site connections using MakeCert” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-certificates-point-to-site-makecert>.

 **Additional Reading:** For information about setting up point-to-site VPN via the Azure portal, refer to “Configure a Point-to-Site connection to a VNet using native Azure certificate authentication: Azure portal” at <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-howto-point-to-site-resource-manager-portal>.

## Implementing ExpressRoute by using Azure Resource Manager

 **Additional Reading:** For details regarding creating an ExpressRoute circuit by using the Azure portal, refer to “Create and modify an ExpressRoute circuit” at <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-howto-circuit-portal-resource-manager>.

For details regarding creating an ExpressRoute circuit by using Azure PowerShell, refer to “Create and modify an ExpressRoute circuit using PowerShell” at <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-howto-circuit-arm>.

For details regarding creating an ExpressRoute circuit by using Azure CLI, refer to “Create and modify an ExpressRoute circuit using CLI” at <https://docs.microsoft.com/en-us/azure/expressroute/howto-circuit-cli>.

## Configuring networking for hybrid solutions

 **Additional Reading:** For details regarding configuring internal Load Balancer Standard with High Availability Ports in combination with NVAs, refer to “Understanding High Availability Ports at: <https://docs.microsoft.com/en-us/azure/load-balancer/load-balancer-ha-ports-overview>

 **Additional Reading:** For details regarding configuring forced tunneling by using Azure PowerShell, refer to: <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-forced-tunneling-rm>.

 **Additional Reading:** For more information regarding configuring the custom route to KMS, refer to Configure forced tunneling using the Azure Resource Manager deployment model: <http://aka.ms/mx9zgg>

 **Additional Reading:** To learn about Microsoft best practices for design and implementation of hybrid connectivity and secure Azure virtual networks, refer to “Azure

Reference Architectures” at <https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/>.

# Module Review and Takeaways

## Best Practices

1. Review the Azure Reference Architectures documentation available at <https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/> when designing hybrid connectivity infrastructure.
2. Leverage VNet peering capabilities in hybrid connectivity scenarios that involve multiple Azure virtual networks. Besides pricing and performance benefits, VNet peering offers additional advantages by allowing routing of traffic via virtual appliances and VPN gateways between the peered virtual networks. In particular, this involves the following capabilities:
  - o Service chaining facilitates routing from one of two virtual networks via a virtual appliance located on the other virtual network
  - o Gateway transit facilitates routing from one Azure virtual network to your on-premises location via another Azure virtual network configured with a site-to-site VPN or ExpressRoute.

## Review Question

**Question:** If you decide to implement some of your services on the Azure platform, do you need to create Azure virtual networks?

**Answer:** The answers might vary, but in general:

- You must create virtual networks when deploying Azure virtual machines.
- Azure cloud services support virtual networks, but can operate without them.
- The Web Apps feature of Azure App Service supports integration with Azure virtual networks to facilitate direct connectivity to Azure virtual machines. However, you do not provision web apps directly into a virtual network.
- Services such as Microsoft Azure SQL Database or Azure Storage do not depend on virtual networks. However, you can implement connectivity between these services and virtual networks by using service endpoints.



**Additional Reading:** At the time of authoring this course, service endpoints are in preview. For more information, refer to “Virtual Network Service Endpoints (Preview)” at <https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-service-endpoints-overview>.

## Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
<p>Common hybrid connectivity issues include:</p> <ul style="list-style-type: none"><li>• Incorrect virtual network configuration</li><li>• Availability and performance issues of a cross-premises connection</li></ul>	<ul style="list-style-type: none"><li>• Use the <b>Test-NetConnection</b> command to verify connectivity across the VPN tunnel.</li><li>• Use the Azure VPN Gateway diagnostics described in "Step-by-Step: Capturing Azure Resource Manager (ARM) VNET Gateway Diagnostic Logs" at <a href="https://aka.ms/khh018">https://aka.ms/khh018</a>.</li><li>• Use Azure Connectivity Toolkit, available from <a href="http://aka.ms/Ckfnrk">http://aka.ms/Ckfnrk</a>. This is a collection of PowerShell scripts and server-side webpages that analyze cross-premises connectivity to an Azure virtual network.</li><li>• Configure Network Performance Monitor for ExpressRoute by following the instructions at <a href="https://docs.microsoft.com/en-us/azure/expressroute/how-to-npm">https://docs.microsoft.com/en-us/azure/expressroute/how-to-npm</a>. Network Performance Monitor is part of Microsoft Operations Management Suite. Note that, at the time of authoring this content, this functionality is in preview.</li></ul>

## Lab Review Questions and Answers

### Lab: Implementing a point-to-site VPN by using Azure Resource Manager

#### Question and Answers

**Question:** What are the key steps for implementing a point-to-site VPN?

**Answer:** When you are implementing a point-to-site VPN, you need to perform the following high-level steps:

1. Defining an IP address range for VPN clients.
2. Requesting a public IP address for the VPN gateway.
3. Creating a VPN gateway subnet in the target Azure virtual network.
4. Creating a root certificate and client certificates.
5. Provisioning a VPN gateway.
6. Installing client certificates on users' computers.
7. Downloading and installing the VPN configuration package.
8. Initiating VPN connections from users' computers.

**Question:** If you have on-premises Linux virtual machines, can you initiate a point-to-site VPN connection?

**Answer:** No, you need to run a 32-bit or 64-bit client or server Windows operating system. On-premises Linux systems would, however, be able to connect to an Azure virtual network when using a site-to-site VPN or Microsoft Azure ExpressRoute.

# Module 4

## Integrating with Azure Storage and data services

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## Lesson 1

# Overview of Azure Storage and data services

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## Question and Answers

**Question:** You need to provide an on-premises customer time-limited access to the content of a blob container in an Azure Storage account. You must ensure that the access can be revoked without affecting other customers who access the same storage account. What should you do?

- Give the customer the primary access key.
- Give the customer the secondary access key.
- Configure the container as public.
- Give the customer a SAS.
- Configure a stored access policy. Give the customer a SAS-based on the stored access policy.

**Answer:**

- Give the customer the primary access key.
- Give the customer the secondary access key.
- Configure the container as public.
- Give the customer a SAS.
- Configure a stored access policy. Give the customer a SAS-based on the stored access policy.

**Feedback:** Only by giving the customer a SAS based on a stored access policy can you provide time-limited access to a blob container and easily revoke it if needed without affecting others who access the same container. Revoking an ad-hoc SAS requires regenerating the account access keys. Having a primary or a secondary key grants full, unlimited access to the corresponding storage account. Configuring a container as public provides unauthenticated access to its content.

## Resources

### Overview of Azure Storage

 **Additional Reading:** For more information, refer to Azure Storage Pricing: <http://aka.ms/Mzo4x7>

 **Additional Reading:** For a detailed description of AzCopy.exe, including its command-line switches and example commands, refer to “Transfer data with the AzCopy Command-Line Utility” at <http://aka.ms/dc878m>.

 **Additional Reading:** To download Storage Explorer, refer to “Azure Storage Explorer” at <https://azure.microsoft.com/en-us/features/storage-explorer>.

 **Additional Reading:** For more information, refer to “Manage the resources associated with your Azure accounts in Visual Studio Cloud Explorer” at <https://docs.microsoft.com/en-us/azure/vs-azure-tools-resources-managing-with-cloud-explorer>.

 **Additional Reading:** For more information on the list of storage tools, refer to “Azure Storage Client Tools” at <https://docs.microsoft.com/en-us/azure/storage/common/storage-explorers>.

 **Additional Reading:** For more information about using SASs and stored access policies, refer to “Using Shared Access Signatures (SAS)” at <https://docs.microsoft.com/en-us/azure/storage/common/storage-dotnet-shared-access-signature-part-1>.

## Overview of Azure Backup

 **Additional Reading:** For more information, refer to “Azure Backup Pricing” at <http://aka.ms/Yam0ns>.

## SQL Server Stretch Database

 **Additional Reading:** You can download Microsoft Data Migration Assistant at <https://aka.ms/Qhaw5n>.

 **Additional Reading:** For more information about blocking issues that affect the ability to implement Stretch Database as well as its limitations, refer to “Limitations for Stretch Database” at <http://aka.ms/V6m1ii>.

 **Additional Reading:** For more information, refer to “SQL Server Stretch Database Pricing” at <http://aka.ms/Ttofhp>.

## ADF with Data Management Gateway

 **Additional Reading:** At the time of authoring of this content, the new version of ADF (version 2) is in preview. The new version introduces many new features, including control flow activities, trigger-based scheduling of pipelines, pipeline parameters, and support for direct migration of SSIS workloads. There are also some changes in terminology. For example, the new name of Data Management Gateway is Self-hosted Integration Runtime, even though its functionality and implementation remain the same. For a comprehensive listing of new and enhanced features in ADF v2, refer to “Compare ADF versions 1 and 2” at <https://docs.microsoft.com/en-us/azure/data-factory/compare-versions>.

 **Additional Reading:** For a detailed walkthrough of the process described above, refer to “Move data between on-premises sources and the cloud with Data Management Gateway” at <https://docs.microsoft.com/en-us/azure/data-factory/v1/data-factory-move-data-between-onprem-and-cloud>.

 **Additional Reading:** For more information, refer to “ADF Pricing” at <http://aka.ms/Wrg2x8>.

## Azure CDN

 **Additional Reading:** For the latest POP list, refer to “Azure CDN POP Locations” at <https://docs.microsoft.com/en-us/azure/cdn/cdn-pop-locations>.

 **Additional Reading:** For more information, refer to “Getting started with Azure CDN” at <https://docs.microsoft.com/en-us/azure/cdn/cdn-create-new-endpoint>.

 **Additional Reading:** For more information regarding features available with each CDN product, refer to “Overview of the Azure Content Delivery Network (CDN)” at <https://docs.microsoft.com/en-us/azure/cdn/cdn-overview>.

 **Additional Reading:** For details regarding using the **asverify** subdomain, refer to “How to map Custom Domain to Content Delivery Network (CDN) endpoint” at <https://docs.microsoft.com/en-us/azure/cdn/cdn-map-content-to-custom-domain>.

 **Additional Reading:** For more information, refer to “Pricing - Content Deliver Network (CDN)” at <http://aka.ms/uj1nw9>.

## Lesson 2

# Implementing Azure Backup for on-premises workloads

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## Question and Answers

**Question:** You need to minimize the time it will take to perform an initial backup of your on-premises Windows Server to Azure Recovery Services vault. What Azure service should you use?

- ADF
- Azure Import/Export
- StorSimple
- Azure File storage
- CDN

**Answer:**

- ADF
- Azure Import/Export
- StorSimple
- Azure File storage
- CDN

**Feedback:** By using Azure Import/Export service, you can copy the entire on-premises data set to physical disks, encrypt them and ship them to the Azure datacenter where the Azure Recovery Services vault is located. The content gets restored directly to the vault. Effectively, the initial backup consists only of incremental changes between the current, locally hosted data and the data set you copied to Azure via the Import/Export service.

ADF does not support transferring on-premises data directly to the Azure Recovery Services vault. Similarly, there is no such option available when using StorSimple or Azure File storage. The purpose of CDN is to cache static web content at globally distributed caching servers, which is not relevant in this context.

## Resources

### Implementing Azure Recovery Services agent-based backups

 **Additional Reading:** You will complete these configuration tasks in the lab. For more information, refer to “Back up a Windows Server or client to Azure with Azure Backup using the Resource Manager deployment model” at <https://docs.microsoft.com/en-us/azure/backup/backup-configure-vault>.

### Integrating System Center DPM with Azure Backup and implementing Azure Backup Server

 **Additional Reading:** For details regarding integrating Azure Backup with System Center DPM, refer to “Preparing to back up workloads to Azure with DPM” at <https://docs.microsoft.com/en-us/azure/backup/backup-azure-dpm-introduction>

 **Additional Reading:** The information presented in this topic refers to “Azure Backup Server version 2”, available for download from <https://aka.ms/Omt06x>. Note that to install Azure Backup Server v2, the computer should be a member of an Active Directory Domain Services domain. For more information regarding its capabilities, refer to <https://aka.ms/Mb2qiz>



**Additional Reading:** For details regarding configuration of Azure Backup Server, refer to Preparing to back up workloads using Azure Backup Server at <https://docs.microsoft.com/en-us/azure/backup/backup-azure-microsoft-azure-backup>.

# Module Review and Takeaways

## Best Practices

When using Azure Storage, consider the following best practices:

- Choose the most appropriate storage type based on your application requirements and the format of the data to store.
- Take advantage of the hot and cool access tiers offered by blob storage accounts.
- Identify storage account replication options most suitable for your disaster recovery and resiliency needs.

## Review Question

**Question:** What are the benefits of using Azure Backup Server when compared with installing Azure Recovery Services agent directly on your on-premises servers?

**Answer:** Installing Azure Recovery Services agent offers a straightforward solution to protecting files and folders and System State on individual Windows computers. This approach might be suitable in smaller, on-premises environments. However, in larger environments, Azure Backup Server offers a single point of administration, minimizing management overhead. In addition, Azure Backup Server supports application-consistent backup for most popular Windows Server workloads, including SQL Server, SharePoint Server, and Exchange Server. Finally, with Azure Backup Server, you can back up Linux computers.

## Lab Review Questions and Answers

### Lab: Implementing the Azure Recovery Services agent-based backups

#### Question and Answers

**Question:** After you install the Azure Recovery Services agent on the lab virtual machine, what additional step did you have to perform to perform an on-demand backup?

**Answer:** To perform an on-demand backup, you must first create a scheduled backup. The on-demand backup uses the same data set that scheduled backup.

# Module 5

## Designing and implementing Azure Site Recovery solutions

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## Lesson 1

# Overview of Site Recovery

### Contents:

Question and Answers

3

## Question and Answers

**Question:** Which of the following scenarios does Site Recovery support? (Select all that apply.)

- Failover and failback between on-premises physical computers running Windows Server and Azure virtual machines
- Failover and failback between on-premises physical Linux computers and Azure virtual machines
- Failover and failback between Hyper-V virtual machines across two on-premises sites without using VMM
- Failover and failback between on-premises Hyper-V virtual machines and Azure virtual machines without using VMM
- Migration of virtual machines running Windows Server from Amazon Web Services to Azure

**Answer:**

- Failover and failback between on-premises physical computers running Windows Server and Azure virtual machines
- Failover and failback between on-premises physical Linux computers and Azure virtual machines
- Failover and failback between Hyper-V virtual machines across two on-premises sites without using VMM
- Failover and failback between on-premises Hyper-V virtual machines and Azure virtual machines without using VMM
- Migration of virtual machines running Windows Server from Amazon Web Services to Azure

**Feedback:** Site Recovery supports the following scenarios:

- Disaster recovery of Hyper-V virtual machines that are not managed by VMM from an on-premises location to Azure with Site Recovery-based replication.
- Migration of virtual machines from a third-party cloud hosting provider to Azure with Site Recovery-based replication.

Site Recovery supports the protection of physical computers with failover to Azure virtual machines. However, at the time of authoring this content, there is no support for failback to physical computers. Instead, you must fail back to VMware virtual machines.

There is also no support for failover and failback between Hyper-V virtual machines across two on-premises sites, without using VMM.

## Lesson 2

# Planning for Site Recovery

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## Question and Answers

**Question:** Which of the following on-premises virtual machines can you protect by using Site Recovery?

- A Generation 2 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 1 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 4 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system iSCSI disk that is 512 GB in size
- A VMware Linux virtual machine with an operating system virtual disk that is 2 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 2 TB in size

**Answer:**

- A Generation 2 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 1 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 4 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system iSCSI disk that is 512 GB in size
- A VMware Linux virtual machine with an operating system virtual disk that is 2 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 2 TB in size

**Feedback:** You can protect the following virtual machines by using Site Recovery:

- A VMware Linux virtual machine with an operating system virtual disk that is 2 TB in size
- A Generation 1 Hyper-V virtual machine running Windows Server 2016 with an operating system .vhd virtual disk that is 2 TB in size

On-premises virtual machines must comply with most of the requirements that Azure virtual machines must meet, including:

- The virtual machine operating system disk sizes cannot exceed 2 TB when replicating Generation 1 Hyper-V VMs, VMware VMs, or physical servers to Azure and 300 GB when replicating Generation 2 Hyper-V VMs to Azure.
- The virtual machine data disk sizes cannot exceed 4 TB.
- The virtual machine data disk count cannot exceed 16 when replicating Hyper-V VMs to Azure and 64 when replicating VMware VMs to Azure.
- The virtual machine disks cannot be iSCSI, Fibre Channel, or shared virtual hard disks.

At the time of authoring this content, Azure does not support the .vhdx disk type or the Generation 2 Hyper-V virtual machine type. Instead, Azure virtual machines must use the .vhd disk type and the Generation 1 Hyper-V virtual machine type. Fortunately, these limitations are not relevant when it comes to virtual machine protection. Site Recovery is capable of automatically converting the virtual disk type and the generation of Windows virtual machines when replicating virtual machine disks to Azure Storage.

## Resources

### Primary considerations in planning for cross-premises Azure Site Recovery implementations

-  **Additional Reading:** You can download Azure Site Recovery Capacity Planner from <http://aka.ms/V33646>.
-  **Additional Reading:** For more information, refer to "Microsoft Assessment and Planning (MAP) Toolkit for Hyper-V" at <http://aka.ms/le3khf>.
-  **Additional Reading:** For more information, refer to "Plan capacity for protecting Hyper-V VMs with Site Recovery" at <http://aka.ms/N7fbp8>.
-  **Additional Reading:** For the sizing recommendations of the configuration server, refer to <https://docs.microsoft.com/en-in/azure/site-recovery/site-recovery-plan-capacity-vmware#size-recommendations-for-the-configuration-server>.
-  **Additional Reading:** At the time of authoring this content, the Deployment Planner tool for VMware replication to Azure is in preview. For more information, refer to "Azure Site Recovery Deployment Planner for VMware to Azure" at: <https://docs.microsoft.com/en-us/azure/site-recovery/site-recovery-deployment-planner>.
-  **Additional Reading:** For more information, refer to "Protect Active Directory and DNS with Azure Site Recovery" at <https://docs.microsoft.com/en-us/azure/site-recovery/site-recovery-active-directory>.
-  **Additional Reading:** For more information, refer to "Set up IP addressing to connect after failover to Azure" at <http://aka.ms/Kp8i0b>.

## Lesson 3

# Implementing Site Recovery with Azure as the disaster recovery site

### Contents:

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## Question and Answers

**Question:** What components can you include in a recovery plan for a failover to Azure?

- Groups containing protected virtual machines
- Manual actions
- Azure Automation runbooks
- Web jobs
- VMM library scripts

**Answer:**

- Groups containing protected virtual machines
- Manual actions
- Azure Automation runbooks
- Web jobs
- VMM library scripts

**Feedback:** A recovery plan consists of one or more recovery groups, which serve as logical containers of protected virtual machines. You arrange groups in a sequence that dictates the order in which Site Recovery failover and failback bring the protected virtual machines online. Within this sequence, you can add **pre** and **post actions**. Each action can represent a manual recovery step or an Azure Automation runbook. By using Azure Automation, you have the option to fully automate your disaster recovery. You can also use it to provision and configure additional Azure components, such as load balancers.

There is no direct support for specifying Web jobs in the recovery plans. There is no support for VMM library scripts when failing over to Azure.

## Resources

### Implementing Azure-based protection of Hyper-V virtual machines without VMM

 **Additional Reading:** For more information, refer to "Set up disaster recovery of on-premises Hyper-V VMs to Azure" at <http://aka.ms/Hv9v2k>.

### Implementing Azure-based protection of Hyper-V virtual machines located in VMM clouds

 **Additional Reading:** For more information, refer to "Set up disaster recovery of on-premises Hyper-V VMs to Azure" at <http://aka.ms/Hv9v2k>.

 **Additional Reading:** For more information, refer to "Set up disaster recovery of on-premises Hyper-V VMs to Azure" at <http://aka.ms/Pq02tj>.

## Implementing Azure-based protection of VMware virtual machines and physical servers

 **Additional Reading:** For more information, refer to “Set up disaster recovery to Azure for on-premises VMware VMs” at VMs <http://aka.ms/Npb5bk>.

 **Additional Reading:** For more information, refer to “Set up disaster recovery to Azure for on-premises VMware VMs” at <http://aka.ms/Npb5bk>.

# Module Review and Takeaways

## Review Question

**Question:** What would you consider to be the biggest benefits of Site Recovery?

**Answer:** The answers might vary, but they could include:

- Disaster recovery of physical servers running the Windows and Linux operating systems from on-premises locations to Azure.
- Disaster recovery of Hyper-V and vSphere virtual machines from on-premises locations to Azure.
- Disaster recovery of physical servers running the Windows and Linux operating systems from the primary on-premises site to vSphere virtual machines in another on-premises site.
- Disaster recovery of Hyper-V and vSphere virtual machines from one on-premises location to another.
- Migration of physical computers and virtual machines to Azure.
- Migration of virtual machines from one Azure region to another.
- Migration of virtual machines from a third-party cloud hosting provider to Azure.
- Automation and orchestration of the disaster recovery process.

## Common Issues and Troubleshooting Tips

Common Issue	Troubleshooting Tip
Enabling protection of a virtual machine fails or takes an extended period of time.	Enabling protection of a virtual machine in the Site Recovery vault triggers an <b>Enable Protection</b> job. You can monitor its progress in the Azure portal. The job will initiate replication of the virtual machine disks to the Azure storage account. The time to complete this initial replication depends on a number of factors, such as the disk space usage and bandwidth of the network connection to Azure. After the initial replication completes, subsequent replication events include only incremental updates, containing changes to disks of the protected virtual machine.

## Lab Review Questions and Answers

### Lab: Implementing protection of on-premises Hyper-V virtual machines in Azure by using Site Recovery

#### Question and Answers

**Question:** Why did the lab not include failover and failback?

**Answer:** Initial replication of protected computers takes some time, which makes such a task unrealistic to implement in a classroom environment. After the initial replication completes, subsequent changes to virtual machine disks are replicated incrementally. You should consider an estimated volume of initial and delta replications when you are evaluating whether to rely on Internet connectivity or whether to implement ExpressRoute as part of your Site Recovery solution.

**Question:** If you wanted to protect multiple Hyper-V virtual machines that reside behind an on-premises load balancer, how would you configure your Site Recovery solution?

**Answer:** To protect multiple Hyper-V virtual machines and place them automatically behind an Azure load balancer, you would create a recovery plan containing a recovery group and an Azure Automation runbook. The recovery group would allow you to fail over both virtual machines at the same time. With the Azure Automation runbook, you would be able to automatically provision the load balancer.

# Module 6

## Designing and implementing cross-premises applications

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## Lesson 1

# Overview of cross-premises application capabilities and their design considerations

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## Question and Answers

**Question:** How does Traffic Manager differ from Azure Load Balancer?

**Answer:** Azure Load Balancer supports the distribution of traffic across endpoints located within the same virtual network. In addition, Azure Load Balancer operates on the transport layer. Azure Traffic Manager functions by customizing the DNS name resolution process, which allows it to distribute traffic globally, regardless of the location of endpoints.

## Resources

### Azure Service Bus–based cross-premises relay functionality

 **Additional Reading:** To download the Group Policy administrative templates for managing HCM, refer to “Microsoft Azure Hybrid Connection Manager Administrative Templates” at the Microsoft Download Center at <http://aka.ms/Ta77xp>.

 **Additional Reading:** For specifics regarding Service Bus Relay pricing, refer to “Service Bus Pricing” at <http://aka.ms/mct6u1>.

### Azure Traffic Manager

 **Additional Reading:** For information about incorporating Traffic Manager into Microsoft Azure Site Recovery–based solutions, refer to “Reduce RTO by using Azure Traffic Manager with Azure Site Recovery” at <http://aka.ms/Y2qtkg>.

 **Additional Reading:** For specifics regarding Traffic Manager pricing, refer to “Traffic Manager Pricing” at <http://aka.ms/u3lsy1>.

## Lesson 2

# Implementing cross-premises solutions for desktop, web, and mobile apps

### Contents:

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## Question and Answers

**Question:** You have an on-premises website and an Azure web app configured as endpoints of the same Traffic Manager profile. You need to ensure that if your on-premises website fails, your customers can connect to the Azure web app as soon as possible. What should you do? (Choose one answer.)

- ( ) Modify the Traffic Manager profile DNS TTL.
- ( ) Set the Traffic Manager profile routing method to priority.
- ( ) Set the Traffic Manager profile routing method to weighted.
- ( ) Set the Traffic Manager profile routing method to performance.
- ( ) Replace the external endpoint with an Azure endpoint.

**Answer:**

- (✓) Modify the Traffic Manager profile DNS TTL.
- ( ) Set the Traffic Manager profile routing method to priority.
- ( ) Set the Traffic Manager profile routing method to weighted.
- ( ) Set the Traffic Manager profile routing method to performance.
- ( ) Replace the external endpoint with an Azure endpoint.

**Feedback:** To ensure the faster failover, you need to minimize the impact of DNS caching. To accomplish this, you need to lower the value of the DNS TTL of the DNS record that represents the Traffic Manager profile.

The routing method in this case has no relevance, because the failover takes place regardless of its value. Replacing the external endpoint is not valid in this context. The existing endpoint must be configured as external, because it represents an on-premises website.

## Resources

### Implementing App Service Hybrid Connections with Web apps

 **Additional Reading:** For details regarding implementing Azure App Service Hybrid Connections, refer to "Azure App Service Hybrid Connections" at <https://aka.ms/Wigikd>.

 **Additional Reading:** For details regarding creating a hybrid connection by modifying Azure App Service web apps and mobile apps in the Azure portal, refer to "Azure App Service Hybrid Connections" at <http://aka.ms/Mhna1u>.

# Module Review and Takeaways

## Best Practices

Follow these rules and best practices to ensure the most optimal operations of Traffic Manager:

- Remember the implications of changing the DNS TTL value. This value determines how long DNS servers and DNS clients can cache the name returned by Traffic Manager. In case of a failover, clients might not be able to benefit from the Traffic Manager automatic redirection for the duration of the TTL.
- Endpoints within a Traffic Manager profile can represent Azure services in different subscriptions and websites external to Azure. However, if you are using endpoints that do not belong to the same Azure subscription, Traffic Manager will not remove them automatically from the profile if they are de-provisioned. You must delete them manually.
- Make sure that endpoints are provisioned in a consistent manner. If the content and processing power of endpoints differ, then the customer browsing experience will be unpredictable.
- Disable individual endpoints during their maintenance windows. By disabling an endpoint, you can perform maintenance operations on it without causing any service interruptions. Traffic Manager automatically redirects all incoming traffic to other endpoints.

## Review Question

**Question:** Which Traffic Manager benefits would you consider to be most relevant to your organization?

**Answer:** Answers will vary but will likely include the following responses:

- Improving end user browsing experience
- Increasing scalability of web apps
- Enhancing availability of web apps
- Upgrading web apps in a nondisruptive manner
- Performing seamless cross-premises migrations.

# Lab Review Questions and Answers

## Lab: Implementing Traffic Manager

### Question and Answers

**Question:** In the last exercise of this lab, you used the DNS name within the trafficmanager.net namespace to access your web app. Can you use your own registered domain name in combination with Traffic Manager?

**Answer:** Yes, this is possible. You can create a CNAME DNS record within your own domain that references the DNS name within the trafficmanager.net namespace. The CNAME record would resolve to the host DNS record associated with the Traffic Manager profile. Traffic Manager, in turn, would return the DNS name representing one of its endpoints according to the routing method that you configured. Finally, this name would get resolved to the corresponding IP address of the endpoint.

**Question:** What value would you consider using for the Traffic Manager profile DNS TTL?

**Answer:** Answers will vary depending on students' priorities.

DNS TTL determines the amount of time that the DNS name associated with the Traffic Manager profile remains in the DNS cache on client computers and servers participating in the name resolution process. With larger TTL values, if an endpoint becomes unavailable, then clients might not benefit from the Traffic Manager endpoint monitoring and automatic redirection until the TTL expires. However, smaller TTL values increase the volume of DNS queries. By default, this value equals 5 minutes, but you can reduce it to 30 seconds.

# Module 7

## Integrating operations and application monitoring and management

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## Lesson 1

# Overview of the cross-premises monitoring and management capabilities of Microsoft Azure

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## Question and Answers

**Question:** Identify systems and services that you can configure as sources connected to Microsoft Operations Management Suite.

- An Azure virtual machine running Linux
- An Azure logic app
- An Azure web app
- A Windows Server 2016 virtual machine hosted in Amazon Web Services cloud
- An on-premises 32-bit Windows 10 Enterprise computer

**Answer:**

- An Azure virtual machine running Linux
- An Azure logic app
- An Azure web app
- A Windows Server 2016 virtual machine hosted in Amazon Web Services cloud
- An on-premises 32-bit Windows 10 Enterprise computer

**Feedback:** By using OMS, you can designate a number of connected sources, including physical computers and virtual machines running Windows and Linux operating systems hosted in Azure, at on-premises datacenters, or by third-party hosting providers. But you cannot specify Azure web apps or logic apps as connected sources. On the other hand, to monitor such systems, you can configure data collection of these apps' diagnostics logs that are stored in an Azure storage account, and set up this storage account as a connected data source.

## Resources

### Microsoft Operations Management Suite

 **Additional Reading:** For an up-to-date list of Linux distributions and their respective versions supported by OMS, refer to "Collect data from Linux computers hosted in your environment" at <https://docs.microsoft.com/en-in/azure/log-analytics/log-analytics-quick-collect-linux-computer>.

### Azure Automation

 **Additional Reading:** For an up-to-date list of supported Linux distributions and their respective versions, refer to "Collect data from Linux computers hosted in your environment" at <https://docs.microsoft.com/en-in/azure/log-analytics/log-analytics-quick-collect-linux-computer>.

## Application Insights



**Additional Reading:** You can use the HockeyApp to monitor Microsoft Store and Mobile apps. For more information, refer to “Transitioning Mobile Apps from Application Insights to HockeyApp” at <http://aka.ms/Mljwgd>.



**Additional Reading:** Status Monitor installer is available at <https://aka.ms/Lujz5i>.

## Lesson 2

# Implementing cross-premises Azure monitoring and management solutions

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## Question and Answers

**Question:** You plan to execute Azure Automation runbooks on your on-premises computers. What additional Azure service do you configure?

- ExpressRoute
- OMS
- Service Bus
- PaaS Cloud Service
- App Service

**Answer:**

- ExpressRoute
- OMS
- Service Bus
- PaaS Cloud Service
- App Service

**Feedback:** The only service that is necessary for running Automation runbooks on-premises is OMS. ExpressRoute might improve the performance of Automation activities, but it is not required. In general, Automation does not have a dependency on the PaaS services listed above.

## Resources

### How to implement Operations Management Suite

 **Additional Reading:** You can start your “Operations Management Suite trial” at <http://aka.ms/Nq2f3q>.

### Implementing Azure Automation for on-premises workloads

 **Additional Reading:** For more information, refer to “PowerShell Workflows: The Basics” at <http://aka.ms/Sq39iv>.

 **Additional Reading:** For more information, refer to “DSC Configurations” at <http://aka.ms/Rzp23g>.

 **Additional Reading:** You can download “Windows Management Framework 5.1” at <http://aka.ms/Ds8s47>.

 **Additional Reading:** For more information on the DSC configuration script and Azure PowerShell script that generate DSC metaconfigurations, refer to the “Generating DSC metaconfigurations” section of the article “Onboarding machines for management by Azure Automation DSC” at <https://docs.microsoft.com/en-us/azure/automation/automation-dsc-onboarding#generating-dsc-metaconfigurations>.

 **Additional Reading:** You can download “PowerShell Desired State Configuration for Linux” from <http://aka.ms/hobnmp>.

 **Additional Reading:** For more information, refer to “Onboarding machines for management by Azure Automation DSC” at <https://docs.microsoft.com/en-us/azure/automation/automation-dsc-onboarding>.

## Implementing Application Insights



**Additional Reading:** For more information about implementing and configuring Application Insights, refer to “What is Application Insights?” at <https://docs.microsoft.com/en-us/azure/application-insights/app-insights-overview>.



**Additional Reading:** You can download the Status Monitor installer from <http://aka.ms/y30y4o>.



**Additional Reading:** For more information, refer to “Application Insights for Azure Cloud Services” at <https://docs.microsoft.com/en-us/azure/application-insights/app-insights-cloudservices>.

## Module Review and Takeaways

### Review Question

**Question:** What are the potential benefits and challenges of running Azure Automation jobs in hybrid scenarios?

**Answer:** A big advantage of Azure Automation jobs is that they can execute in an unattended manner. They also allow you to maintain your hybrid environment in a consistent manner, minimizing the management overhead. On the other hand, you should keep in mind that jobs running in Azure for more than three hours are subject to Fair Share. In such cases, you should implement checkpoints so that when the job resumes it will not start from the beginning but from the most recently completed checkpoint. Note that Fair Share does not apply to jobs running on Hybrid Runbook Workers.

# Lab Review Questions and Answers

## Lab: Implementing Azure Automation

### Question and Answers

**Question:** What is the reason that you did not use the Run As Azure Automation account in the lab?

**Answer:** By default, jobs executing Azure Automation runbooks on Hybrid Runbook Worker groups operate in the security context of the local System account. This was sufficient to complete the sample lab runbook. However, you have two options that allow you to specify custom credentials if, for example, jobs must authenticate to access on-premises network resources:

- Credential and Certificate Automation assets. This is defined within the Automation account.
- RunAs account. This is defined as part of Hybrid Worker group settings.

**Question:** How can you determine the outcome of Azure Automation jobs running on Hybrid Runbook workers?

**Answer:** Output and messages generated by Azure Automation jobs running on Hybrid Runbook workers are forwarded from the on-premises computers to the Azure Automation account. This means that you can view them the same way you would be able to view the outcome of Automation jobs running in Azure.

For more in-depth troubleshooting, you can examine logs stored on hybrid workers in subfolders of the **C:\ProgramData\Microsoft\System Center\Orchestrator\7.2\SMA\Sandboxes** folder or events in the Microsoft SMA Operational event log.