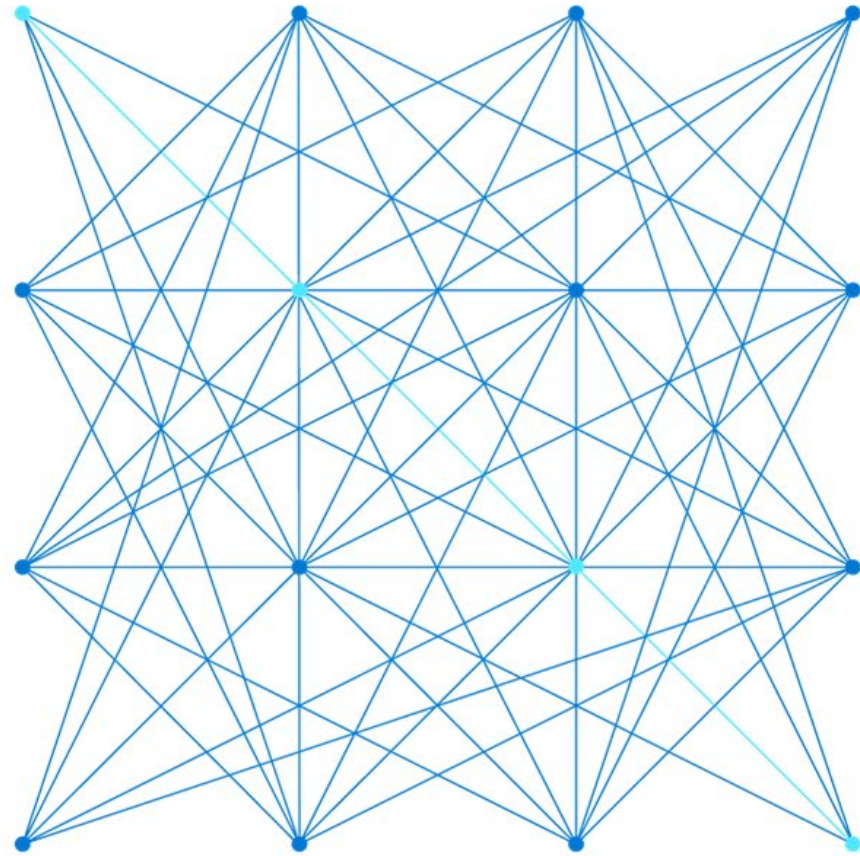


# Microsoft Azure Administrator

## 2 Days Webinar



## Hello! Instructor Introduction

**Instructor: Göran Eibel**

Solution Architect

University Lecturer

Trainer

Author

[goeran.eibel@gecon.at](mailto:goeran.eibel@gecon.at)



HELLO

## About this course: Prerequisites

Successful Azure Administrators start this role with experience on operating systems, virtualization, cloud infrastructure, storage structures, and networking



Understanding of on-premises virtualization technologies, including: VMs, virtual networking, and virtual hard disks

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Understanding of network configuration, including TCP/IP, Domain Name System (DNS), virtual private networks (VPNs), firewalls, and encryption technologies

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Understanding of Active Directory concepts, such as users, groups, and role-based access control

---



Understanding of resilience and disaster recovery, including backup and restore operations

## About this course: Course Outline



Module 01: Identity

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Module 02: Governance and Compliance

---



Module 03: Azure Administration

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Module 04: Virtual Networking

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Module 05: Intersite Connectivity

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Module 06: Network Traffic Management



Module 07: Azure Storage

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Module 08: Azure Virtual Machines

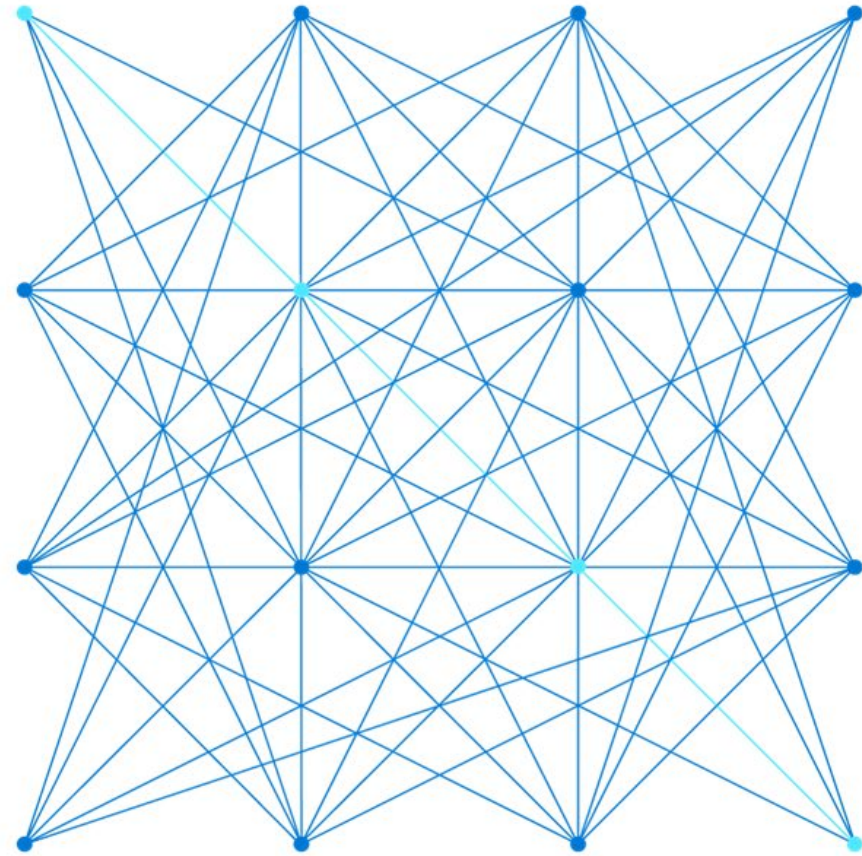
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Module 09: Monitoring

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# Module 01: Identity



## Module Overview



Lesson 01: Azure Active Directory

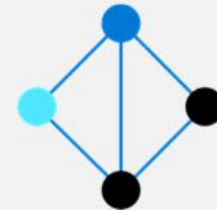
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Lesson 02: Users and Groups

---

# Lesson 01: Azure Active Directory



# Azure Active Directory Overview



Azure Active Directory



Azure AD Concepts



AD DS vs. Azure Active Directory



Azure Active Directory Editions



Azure AD Join

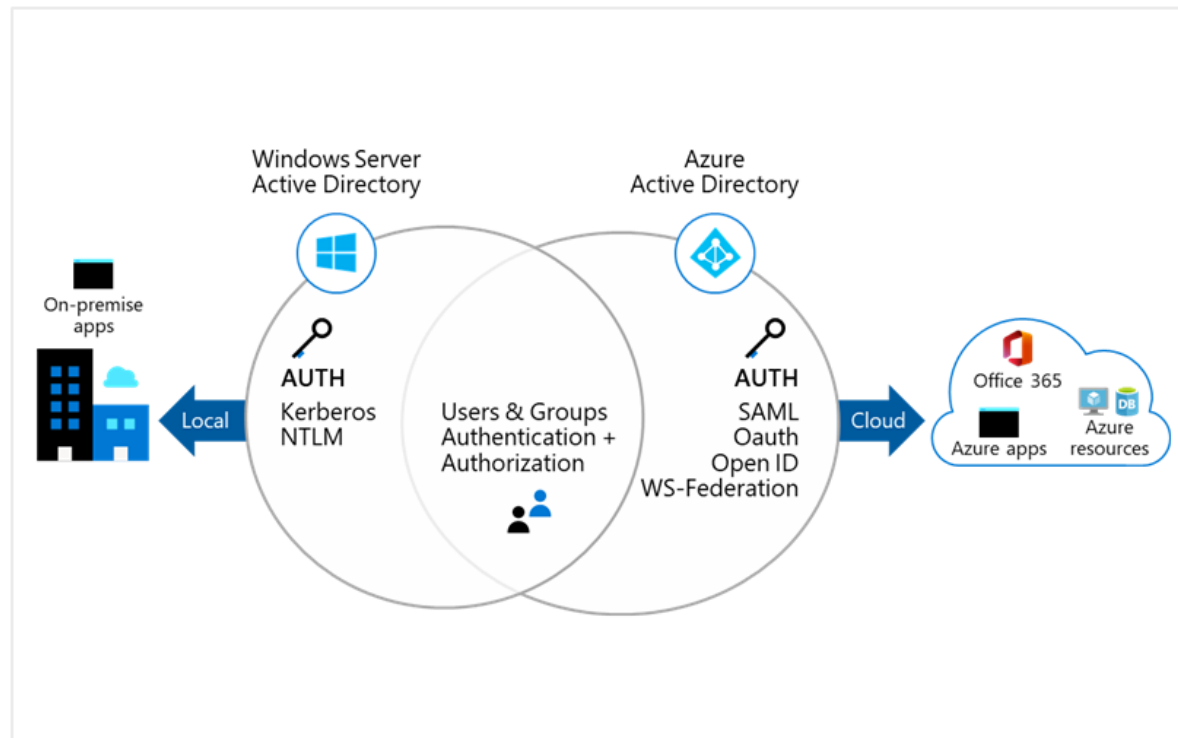


Self-Service Password Reset

# Azure Active Directory

A cloud-based suite of identity management capabilities that enables you to securely manage access to Azure services and resources for your users

Provides application management, authentication, device management, and hybrid identity



## Azure AD Concepts

Concept	Description
Identity	An object that can be authenticated
Account	An identity that has data associated with it
Azure AD account	An identity created through Azure AD or another Microsoft cloud service
Azure AD tenant	A dedicated and trusted instance of Azure AD that's automatically created when your organization signs up for a Microsoft cloud service subscription
Azure AD directory	Each Azure tenant has a dedicated and trusted Azure AD directory
Azure subscription	Used to pay for Azure cloud services

## AD DS vs Azure Active Directory



Azure AD is primarily an identity solution, and designed for HTTP and HTTPS communications

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Queried using the REST API over HTTP and HTTPS. Instead of LDAP

---



Uses HTTP and HTTPS protocols such as SAML, WS-Federation, and OpenID Connect for authentication (and OAuth for authorization). Instead of Kerberos

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Includes federation services, and many third-party services (such as Facebook)

---

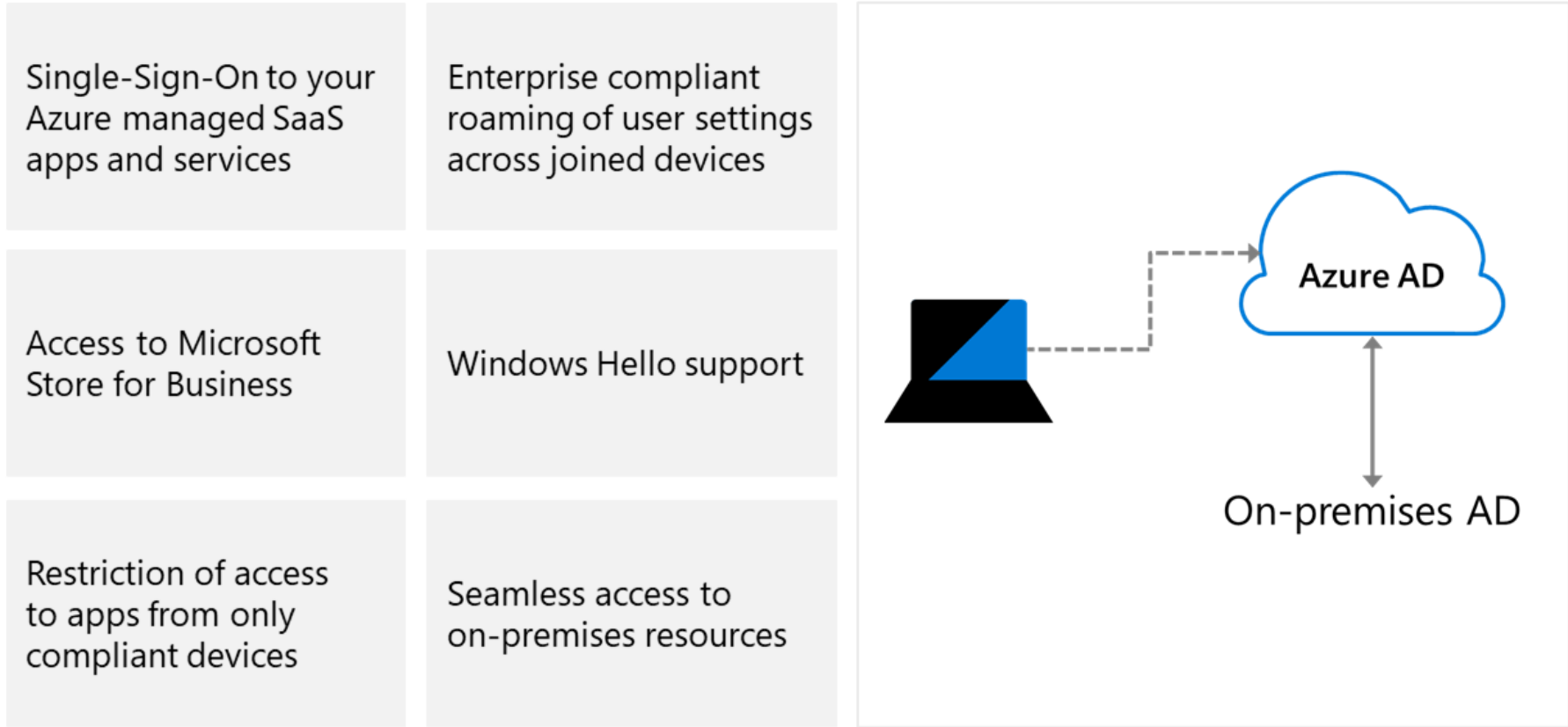


Azure AD users and groups are created in a flat structure, and there are no Organizational Units (OUs) or Group Policy Objects (GPOs)

## Azure Active Directory Editions

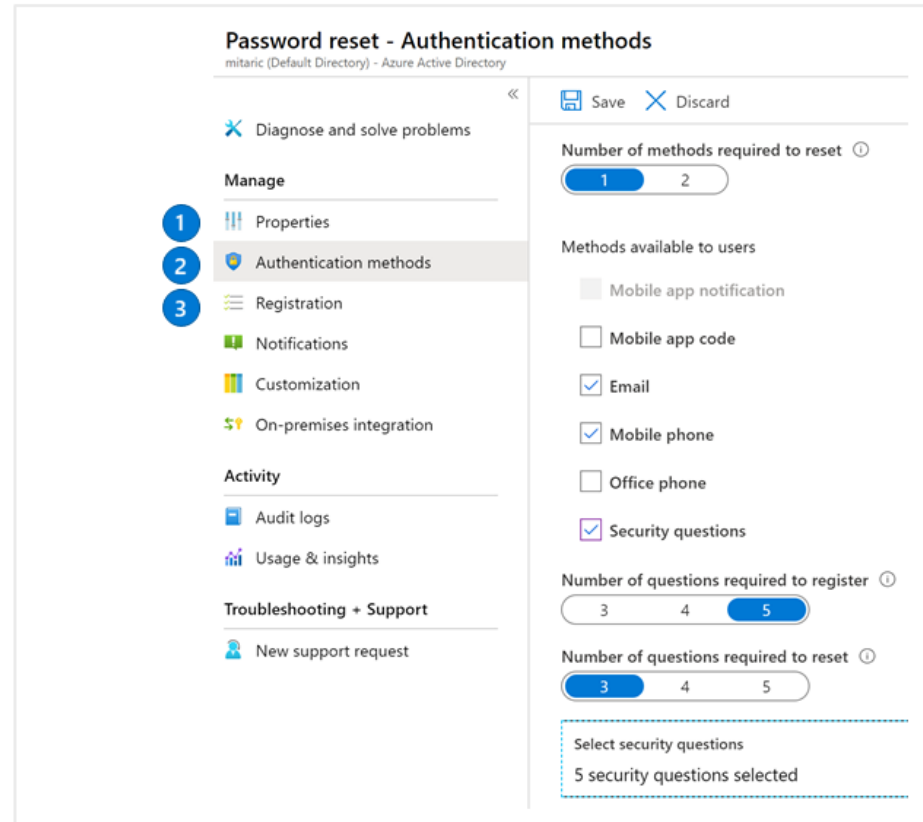
Feature	Free	Office 365 Apps	Premium P1	Premium P2
Directory Objects	500,000 objects	No object limit	No object limit	No object limit
Single Sign-On	Up to 10 apps	Up to 10 apps	Unlimited	Unlimited
Core Identity and Access	X	X	X	X
B2B Collaboration	X	X	X	X
Identity & Access for O365		X	X	X
Premium Features			X	X
Hybrid Identities			X	X
Advanced Group Access			X	X
Conditional Access			X	X
Identity Protection				X
Identity Governance				X

## Azure AD Join



# Self-Service Password Reset

1. Determine who can use self-service password reset
2. Choose the number of authentication methods required and the methods available (email, phone, questions)
3. You can require users to register for SSPR (same process as MFA)



## Lesson 02: Users and groups



## Users and Groups Overview



User Accounts



Managing User Accounts



Bulk User Accounts




Group Accounts








Managing Multiple Directories

# User Accounts

 **Users | All users**  
Microsoft - Azure Active Directory

- All users
- Deleted users
- Password reset
- User settings
- Diagnose and solve problems

Name	User name	User type	Source
<input type="checkbox"/>  □Ziaulla	ziaulla@mac...	Guest	<a href="#">External Azure Active Directory</a>
<input type="checkbox"/>  □Retail Crisis Notificati	rscrisis@mic...	Member	<a href="#">Windows Server AD</a>
<input type="checkbox"/>  "Planning & Launch Se	plsoem@mi...		<a href="#">Windows Server AD</a>
<input type="checkbox"/>  'amckenziecec	'amckenziec...	Guest	<a href="#">Invited user</a>
<input type="checkbox"/>  'Evento FY20 Colombia	kickcolo@mi...	Member	<a href="#">Windows Server AD</a>

All users must have an account

The account is used for authentication and authorization

Identity Sources: Cloud, Directory-synchronized, and Guest

# Managing User Accounts

+ New user + New guest user ↑ Bulk create ↑ Bulk invite ↑ Bulk delete ↓ Download users ↻ Refresh 🔑 Reset password 🔗 Multi-Factor Authentication ...

---

## New user

Microsoft

**Create user**  
Create a new user in your organization. This user will have a user name like `alice@Microsoft.onmicrosoft.com`.  
[I want to create users in bulk](#)

**Invite user**  
Invite a new guest user to collaborate with your organization. The user will be emailed an invitation they can accept in order to begin collaborating.  
[I want to invite guest users in bulk](#)

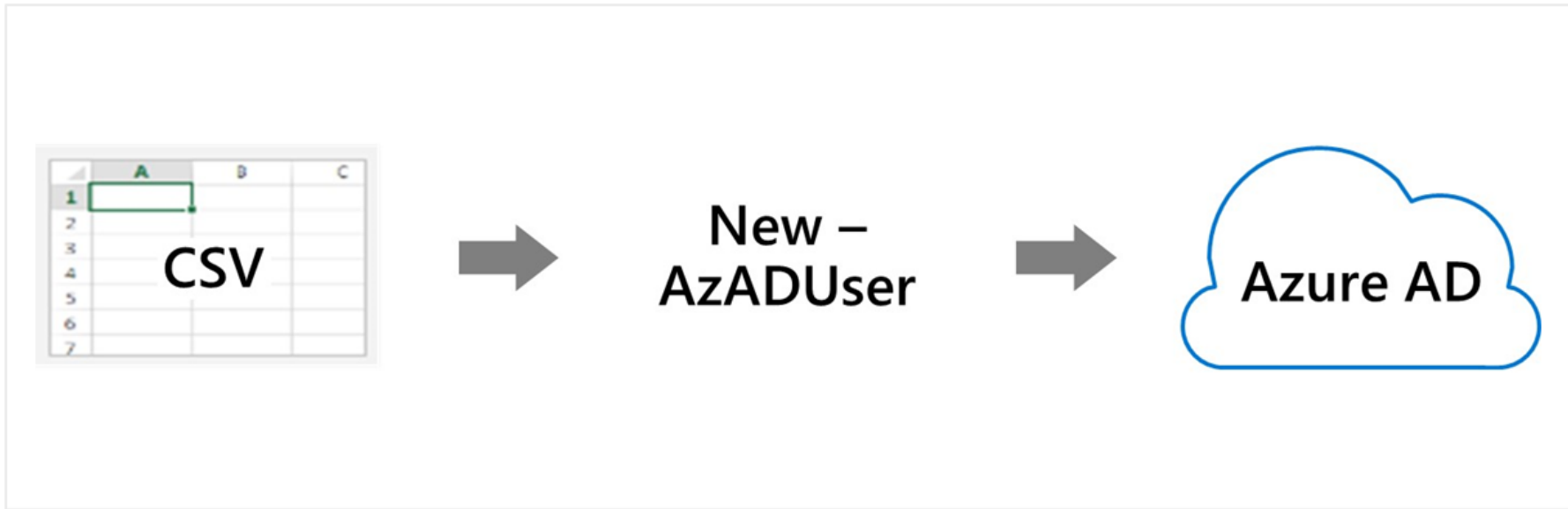
Must be Global Administrator or User Administrator to manage users

User profile (picture, job, contact info) is optional

Deleted users can be restored for 30 days

Sign in and audit log information is available

## Bulk User Accounts






Create the comma-separated values (CSV) file with the list of all the users and their properties

Loop through the file processing each user

Consider error handling, duplicate users, initial password settings, empty properties, and when the account is enabled

## Group Accounts

<input type="text" value="Search groups"/>		<input type="button" value="Add filters"/>		
<input type="checkbox"/>	Name	↑↓	Group Type	Membership Type
<input type="checkbox"/>	 Managers		Security	Assigned
<input type="checkbox"/>	 Virtual Machine Administrators		Security	Assigned
<input type="checkbox"/>	 Virtual Network Administrators		Security	Assigned

### Group Types

- Security groups
- Office 365 groups

### Assignment Types

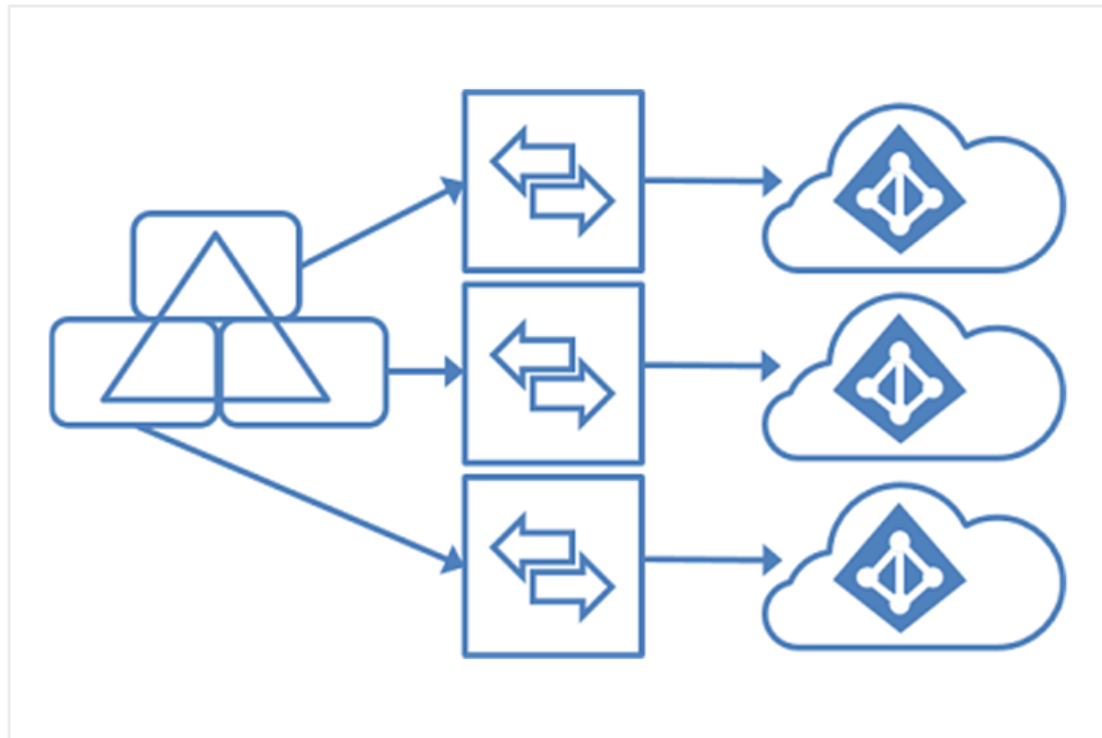
- Assigned
- Dynamic User
- Dynamic Device (Security groups only)

## Managing Multiple Directories

In Azure Active Directory (Azure AD), each tenant is a fully independent resource

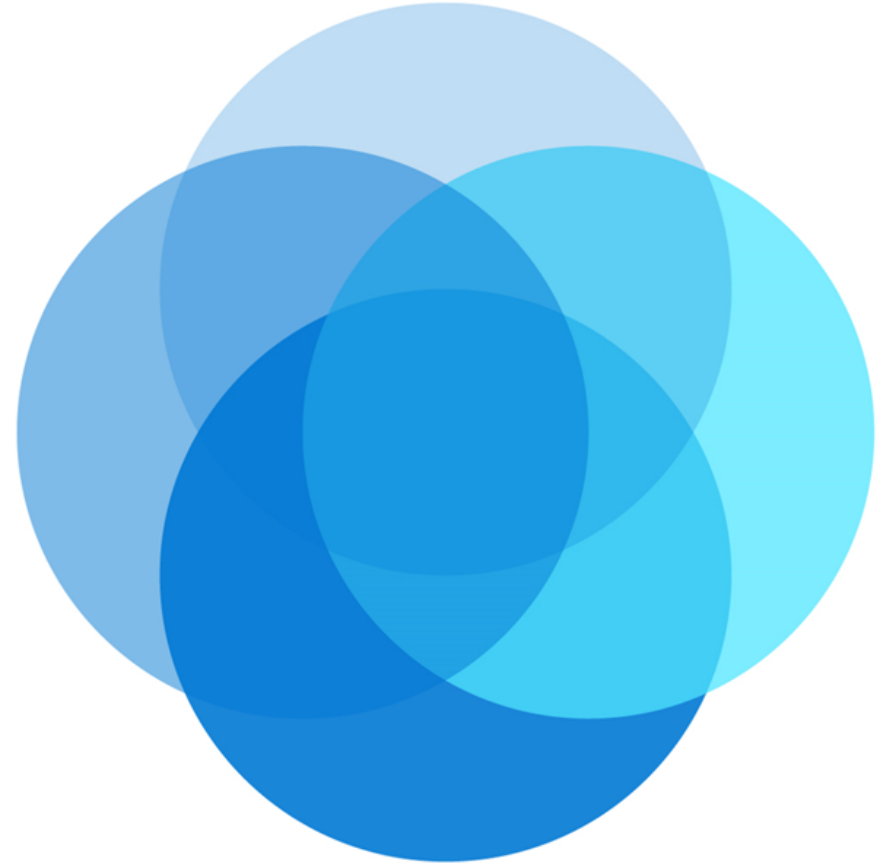
There is no parent-child relationship between tenants

This independence between tenants includes resource, administrative, and synchronization



It is recommended to use a supported synchronization configuration

# Module 02: Governance and Compliance



## Module Overview



Lesson 01: Subscriptions and Accounts

---



Lesson 02: Azure Policy

---



Lesson 03: Role-Based Access Control

---

# Lesson 01: Subscriptions and Accounts



# Subscriptions and Accounts Overview



Regions



Azure Subscriptions



Getting a Subscription



Subscription Usage



Cost Management



Resource Tags



Cost Savings

# Regions

A region represents a collection of datacenters

Provides flexibility and scale

Preserves data residency

Select regions close to your users

Be aware of region deployment availability

There are global services that are region independent

Regions are paired for high availability



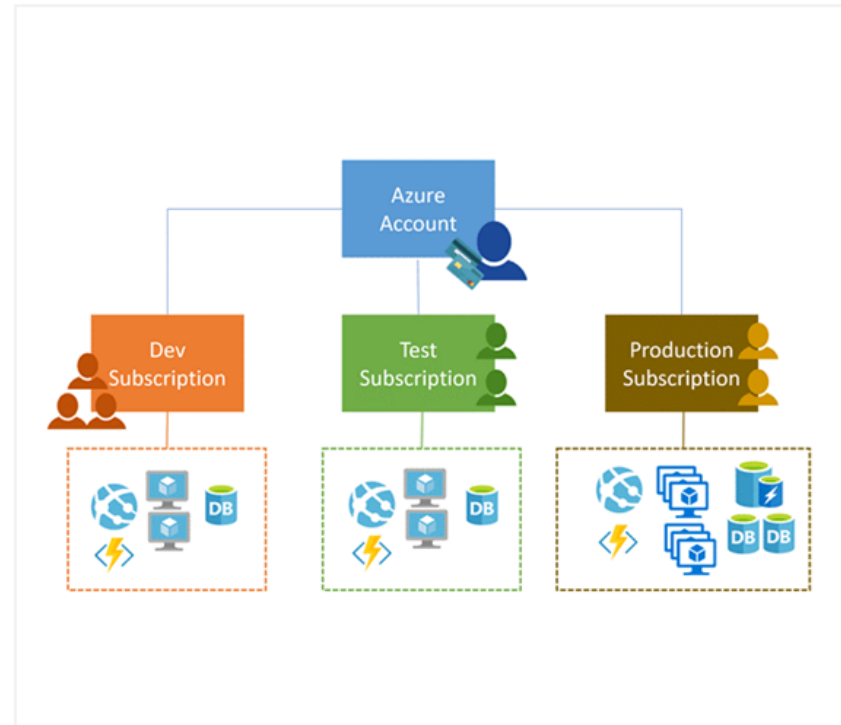
**Worldwide there are 60+ regions representing 140 countries**

# Azure Subscriptions

Logical unit of Azure services that is linked to an Azure account

Security and billing boundary

Includes accounts – Identities in Azure Active Directory (Azure AD) or in a directory that is trusted by Azure AD, such as a work or school organization



## Getting a Subscription

**Enterprise Agreement** customers make an upfront monetary commitment and consume services throughout the year

**Resellers** provide a simple, flexible way to purchase cloud services

**Partners** can design and implement your Azure cloud solution

**Personal free account** – Start right away



## Subscription Usage

Subscription	Usage
Free	Includes a \$200 credit for the first 30 days, free limited access for 12 months
Pay-As-You-Go	Charges you monthly
Enterprise	One agreement, with discounts for new licenses and Software Assurance – targeted at enterprise-scale organizations
Student	Includes \$100 for 12 months – must verify student access

# Cost Management

Conduct cost analysis

Create a budget

Review recommendations

Export the data



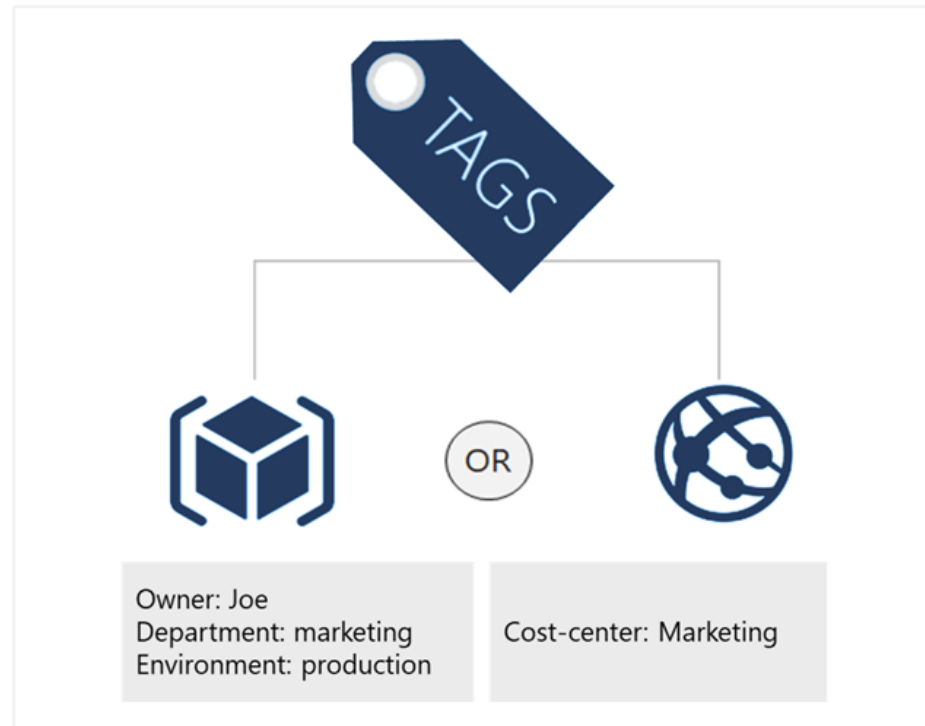
## Resource Tags

Provides metadata for your Azure resources

Logically organizes resources into a taxonomy

Consists of a name-value pair

Very useful for rolling up billing information



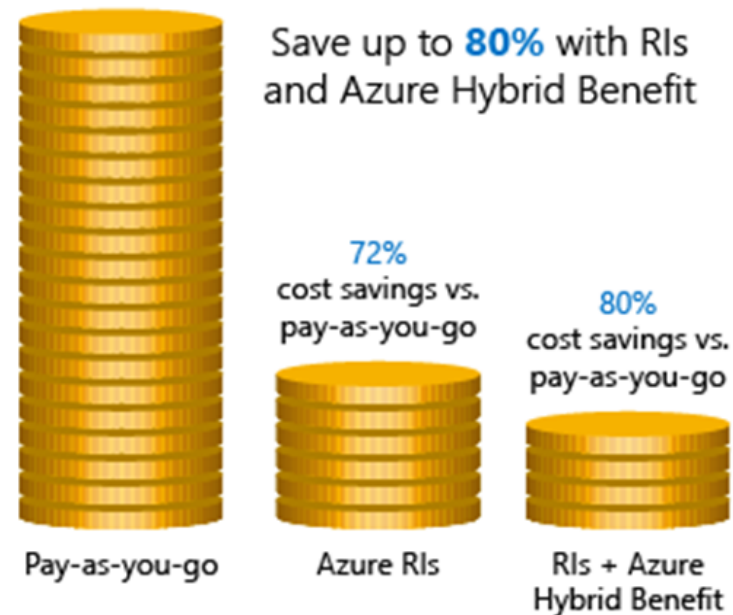
## Cost Savings

**Azure Reservations** – Helps you save money by pre-paying for services

**Azure Hybrid Benefits** – Use Windows Server and SQL Server on-premises licenses with Software Assurance

**Azure Credits** – Monthly credit benefit that allows you to experiment with, develop, and test new solutions on Azure

**Regions** – Choose low-cost locations and regions



## Lesson 02: Azure Policy



# Azure Policy Overview



Management Groups



Azure Policy



Implementing Azure Policy



Policy Definitions



Create Initiative Definitions



Scope the Initiative Definition



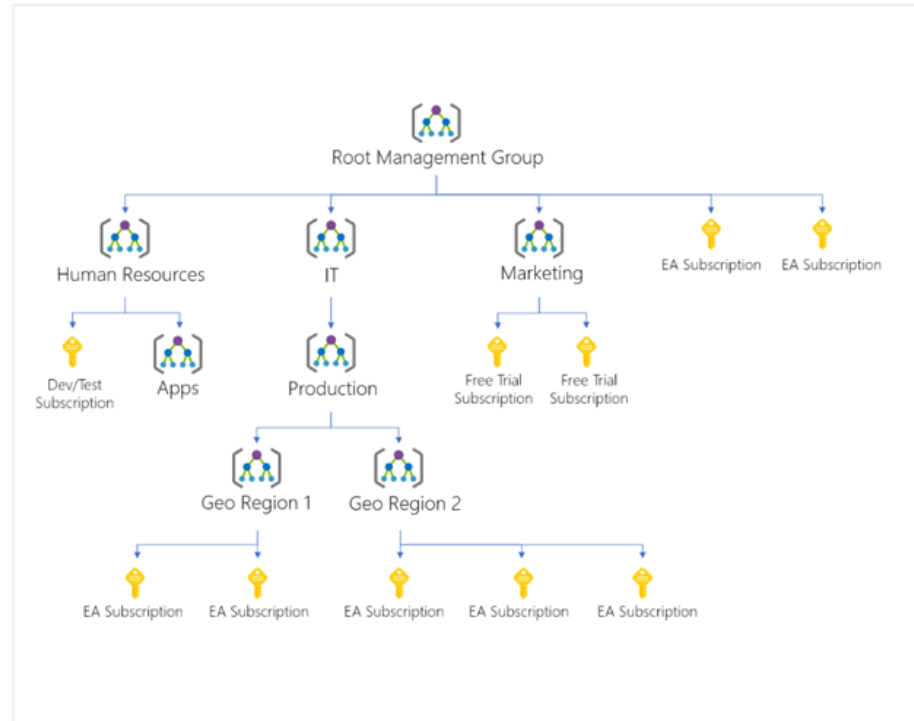
Determine Compliance

# Management Groups

Provides a level of scope above subscriptions

Targeting of policies and spend budgets across subscriptions and inheritance down the hierarchies

Compliance and cost reporting by organization (business/teams)



# Azure Policy

Azure Policy is a service in Azure that you use to create, assign and, manage policies

Azure Policy runs evaluations and scans for non-compliant resources

## Advantages:

Enforcement and compliance  
Apply policies at scale  
Remediation

## Usage Cases

**Allowed resource types** – Specify the resource types that your organization can deploy

**Allowed virtual machine SKUs** – Specify a set of virtual machine SKUs that your organization can deploy

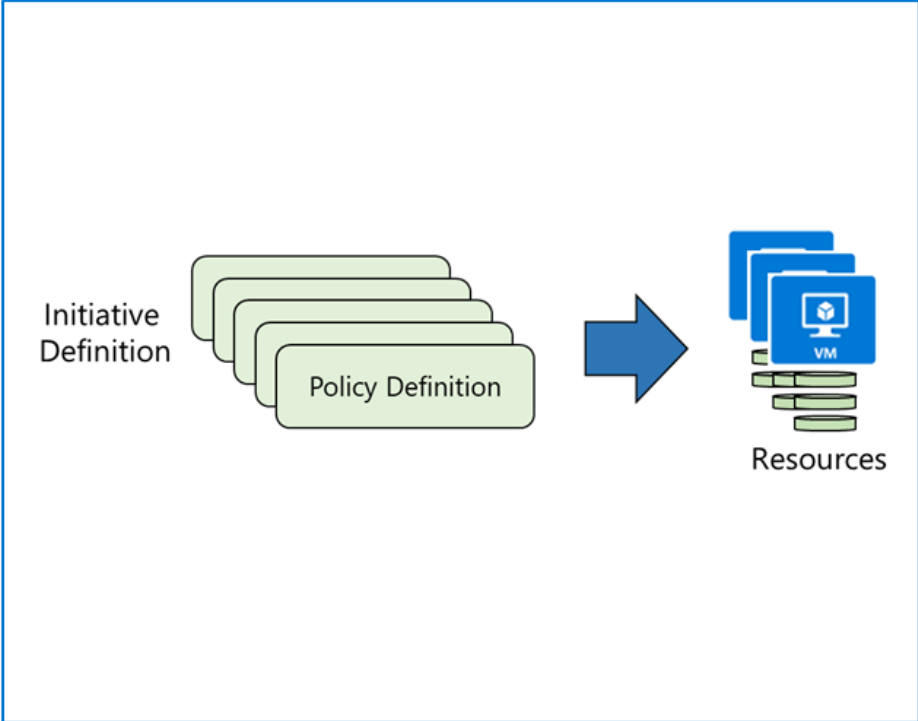
**Allowed locations** – Restrict the locations your organization can specify when deploying resources

**Require tag and its value** – Enforces a required tag and its value

**Azure Backup should be enabled for Virtual Machines** – Audit if Azure Backup service is enabled for all Virtual machines

# Implementing Azure Policy

- 1. Browse Policy Definitions
- 2. Create Initiative Definitions
- 3. Scope the Initiative Definition
- 4. View Policy evaluation results



# Policy Definitions

Many policy definitions are available

You can import policies from GitHub

Policy Definitions have a specific JSON format

You can create custom policy definitions

**Policy definition**  
New Policy definition

---

**BASICS**

---

**Definition location \***  
Visual Studio Enterprise

**Name \* ⓘ**  
Github Sample Policy

**Description**  
A sample policy from Github.

**Category ⓘ**  
 Create new  Use existing  
Category

**POLICY RULE**  
↓ Import sample policy definition from GitHub

# Create Initiative Definitions

Group policy definitions

Include one or more policies

Requires planning

### Initiative definition

New Initiative definition

---

**BASICS**

Definition location \*  
Visual Studio Enterprise ...

Name \* ⓘ  
East Region ✓

Description ⓘ  
East Region Initiative Definition

Category ⓘ  
 Create new  Use existing  
General ▼

<b>namingPolicyDefinition</b>	Policy to specify allowed naming convention	Custom	<a href="#">Delete</a>
<b>regionPolicyDefinition</b>	Policy to allow resource creation only in certain regions	Custom	<a href="#">Delete</a>

# Scope the Initiative Definition

Policy - Assignments

Search (Ctrl+/) << Assign initiative Assign policy Refresh

Scope: Visual Studio Enterprise Definition type: All definition types Search: Filter by name or id... Category: All categories

Total Assignments: 2 Initiative Assignments: 2 Policy Assignments: 0

name	Scope	Type	Policies	Category
East Region	Visual Studio Enterprise	Initiative	2	General
ASC Default (subscription:)	Visual Studio Enterprise	Initiative	96	Security Center

Assign the definition to a scope

The scope enforces the policy

Select the subscription, and optionally the resource group

# Determine Compliance

**Policy - Compliance**

Search (Ctrl+/) << Assign policy Assign initiative Refresh

Scope: Visual Studio Enterprise Type: All definition types Compliance state: All compliance states Search: Filter by name or id...

Overall resource compliance **98%** (159 out of 162)  
Non-compliant initiatives **1** (out of 2)  
Non-compliant policies **12** (out of 98)  
Non-compliant resources **3** (out of 162)

Name	Scope	Compliance state	Resource compli...	Non-Compliant Resources	Non-compliant policies
ASC Default (subscription: 957...	Visual Studio Enterprise	Non-compliant	98% (159 out of 162)	3	12
East Region	Visual Studio Enterprise	Not started	100% (0 out of 0)	0	0

Non-compliant initiatives

Non-compliant policies

Non-compliant resources

## Lesson 03: Role-Based Access Control



# Role-Based Access Control Overview



Role-Based Access Control



Role Definition



Role Assignment



Azure RBAC Roles vs Azure AD Administrator Roles



RBAC Authentication



Azure RBAC Roles

# Role-Based Access Control

Provides fine-grained access management of resources in Azure

Built on Azure Resource Manager  
Segregate duties within your team  
Grant only the amount of access to users that they need to perform their jobs

## Concepts

**Security principal.** Object that represents something that is requesting access to resources

**Role definition.** Collection of permissions that lists the operations that can be performed

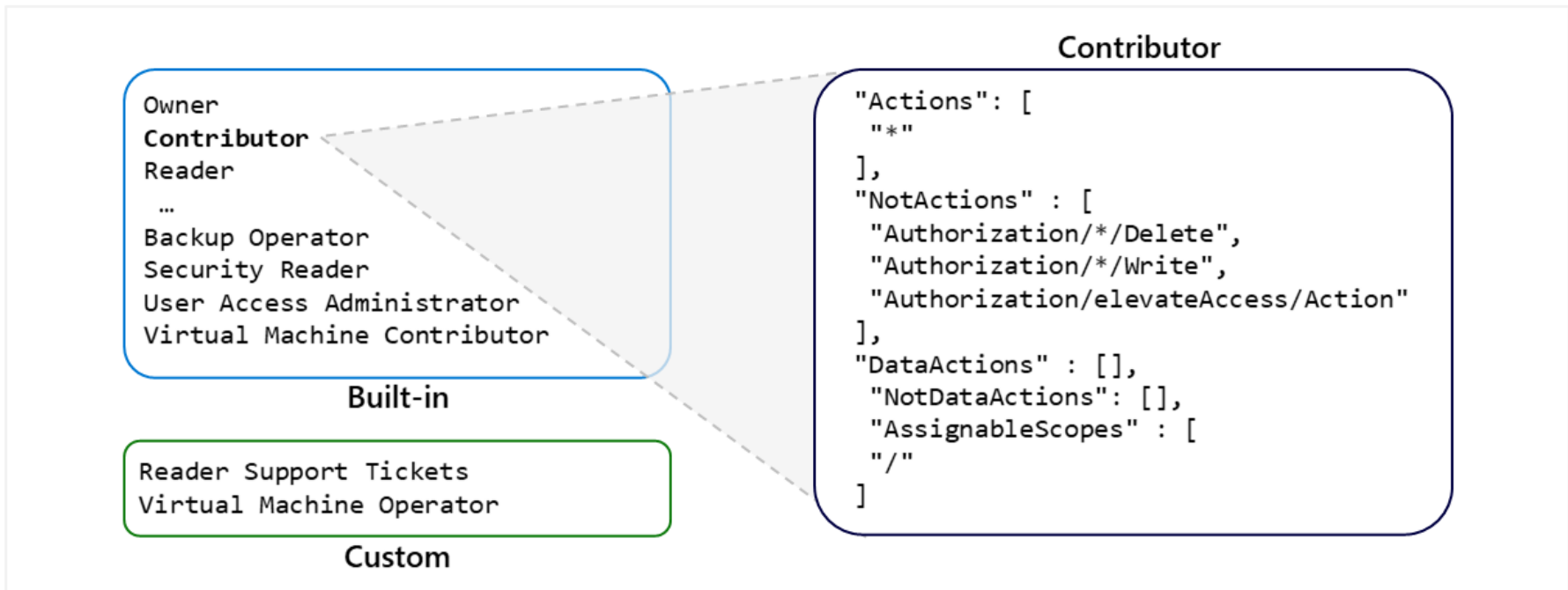
**Scope.** Boundary for the level of access that is requested

**Assignment.** Attaching a role definition to a security principal at a particular scope:

- Users can grant access described in a role definition by creating an assignment
- Deny assignments are currently read-only and are set by Azure Blueprints and Azure Managed Apps

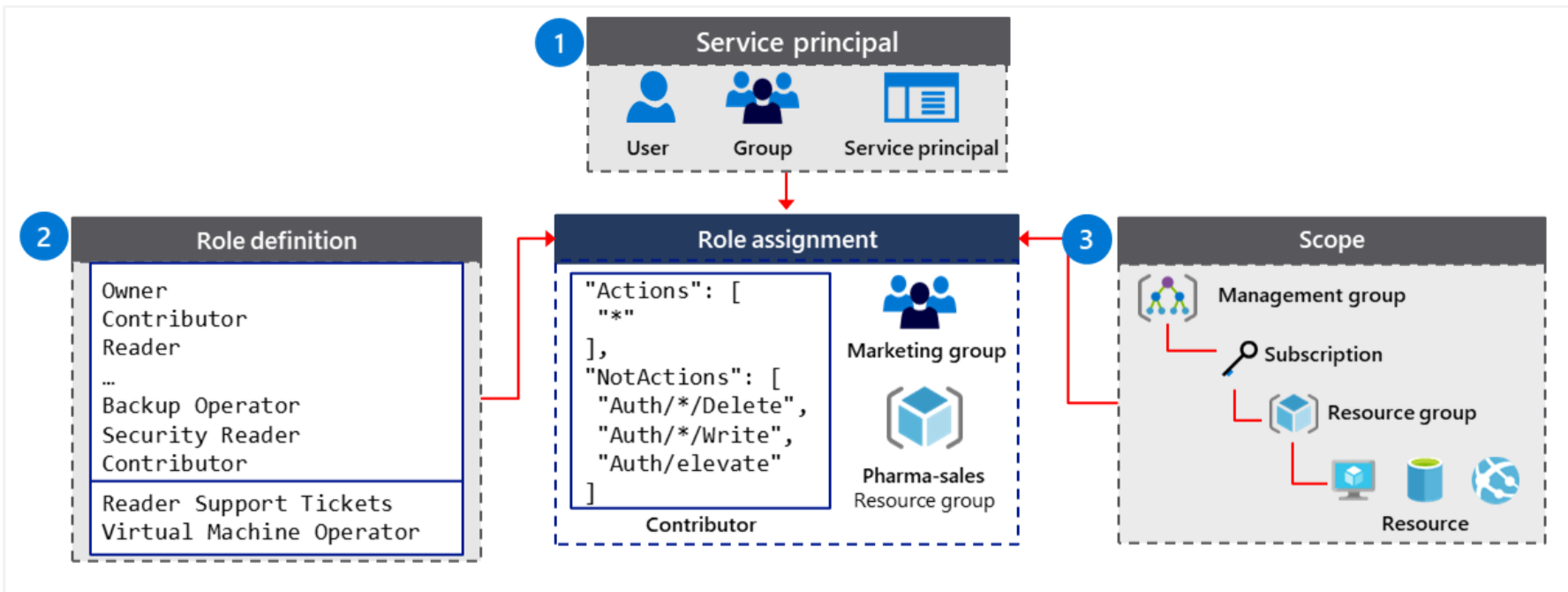
# Role Definition

Collection of permissions that lists the operations that can be performed



# Role Assignment

Process of binding a role definition to a user, group, or service principal at a scope for the purpose of granting access



## Azure RBAC Roles vs. Azure AD Roles

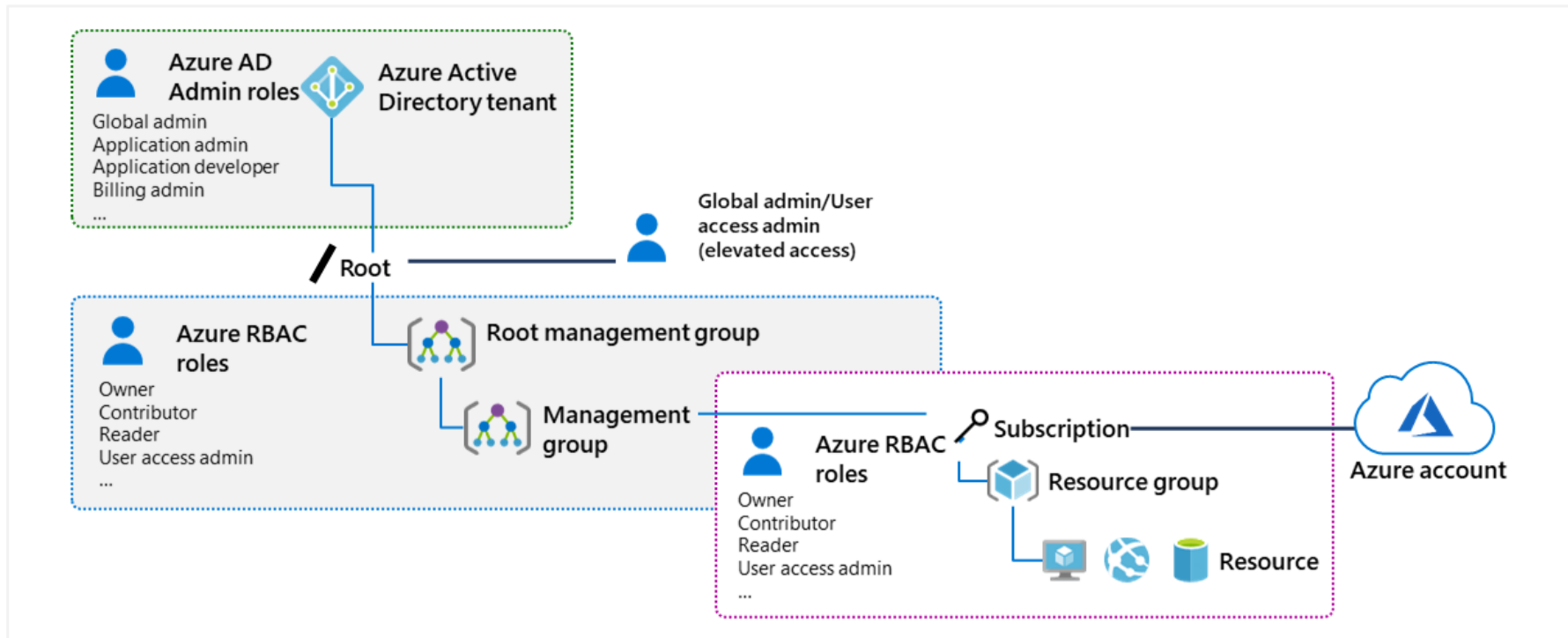
Azure and Azure AD offer two types of roles

Azure RBAC roles	Azure AD roles
Manage access to Azure resources	Manage access to Azure AD objects
Scope can be specified at multiple levels	Scope is at the tenant level
Role information can be accessed in the Azure portal, Azure CLI, Azure PowerShell, Azure Resource Manager templates, REST API	Role information can be accessed in Azure portal, Office 365 admin portal, Microsoft Graph, Azure Active Directory PowerShell for Graph



Classic administrator roles should be avoided if using Azure Resource Manager

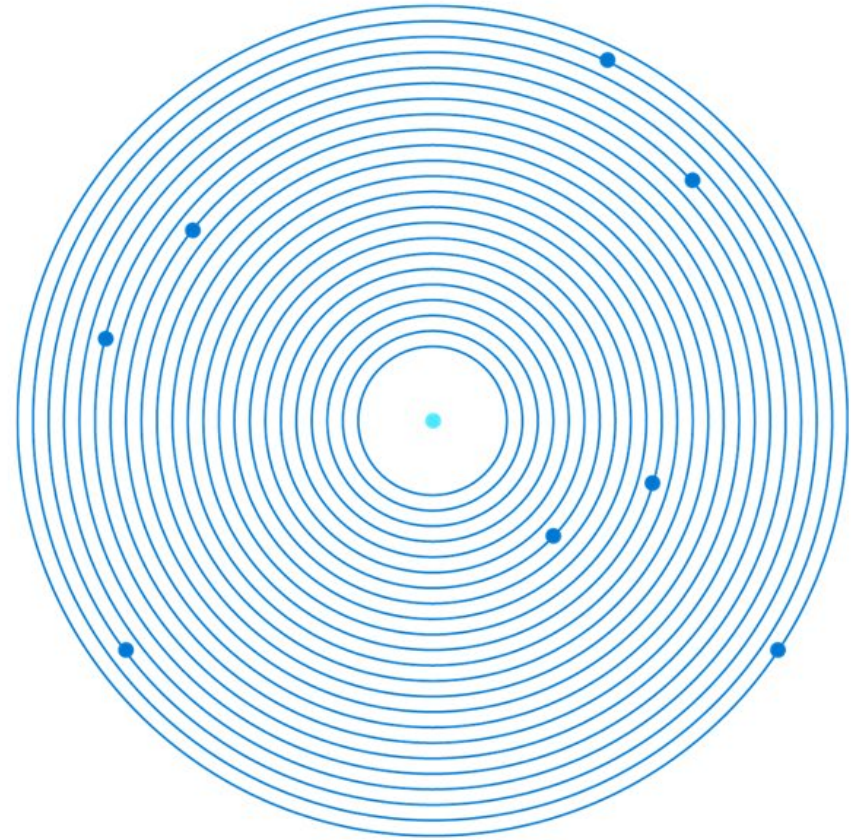
# RBAC Authentication



## Azure RBAC Roles

RBAC role in Azure	Permissions	Notes
Owner	Has full access to all resources and can delegate access to others	The Service Administrator and Co-Administrators are assigned the Owner role at the subscription scope. This applies to all resource types
Contributor	Creates and manages all types of Azure resources but cannot grant access to others	This applies to all resource types
Reader	Views Azure resources	This applies to all resource types
User Access Administrator	Manages user access to Azure resources	This applies to managing access, rather than to managing resources

# Module 03: Azure Administration



## Module Overview



Lesson 01: Resource Manager

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Lesson 02: Azure Portal and Cloud Shell

---



Lesson 03: Azure PowerShell and CLI

---



Lesson 04: ARM Templates

---

# Lesson 01: Resource Manager



# Resource Manager Overview



Resource Manager



Terminology



Resource Group Deployments



Resource Manager Locks



Moving Resources



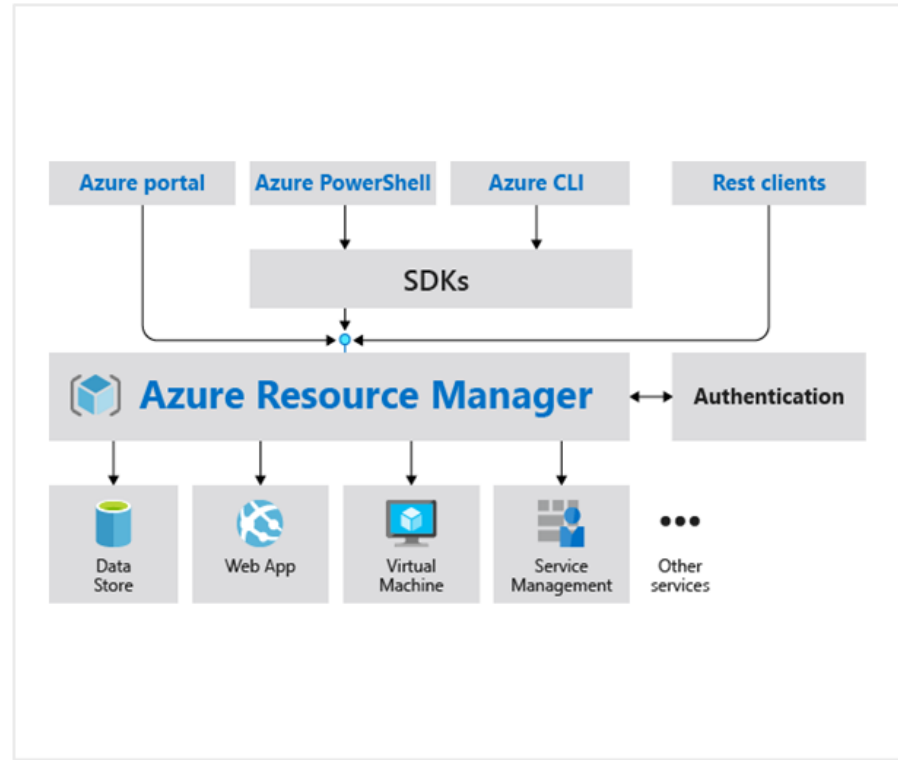
Removing Resources and Resource Groups



Resource Limits

# Resource Manager

- Provides a consistent management layer
- Enables you to work with the resources in your solution as a group
- Deploy, update, or delete in a single, coordinated operation
- Provides security, auditing, and tagging features
- Choose the tools and APIs that work best for you



## Terminology



A **resource** is simply a single service instance in Azure

---



A **resource group** is a logical grouping of resources

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An **Azure Resource Manager template** is a JSON file that allows you to declaratively describe a set of resources

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A **declarative syntax** is what a template uses to state what you intend to create

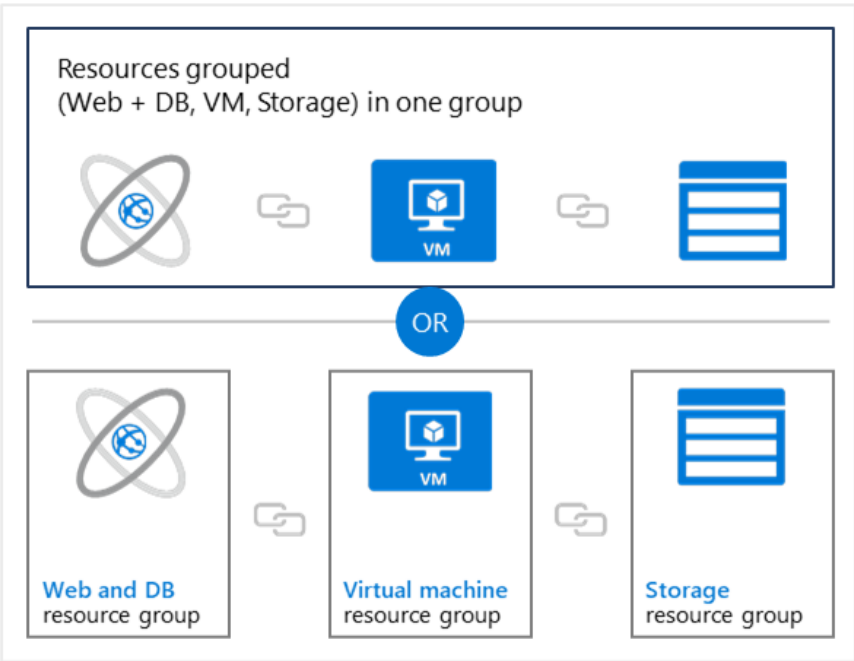
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A **resource provider** is service that supplies the resources you can deploy and manage through Resource Manager

# Resource Group Deployments

- Resources can only exist in one resource group
- Groups cannot be renamed
- Groups can have resources of many different types (services)
- Groups can have resources from many different regions
- Deployments are incremental



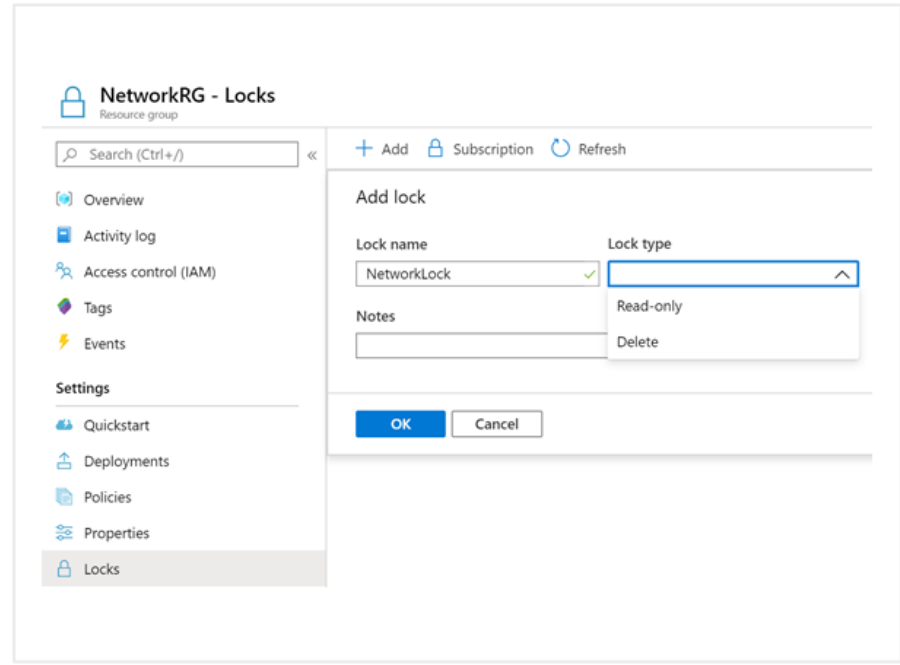
# Resource Manager Locks

Associate the lock with a subscription, resource group, or resource

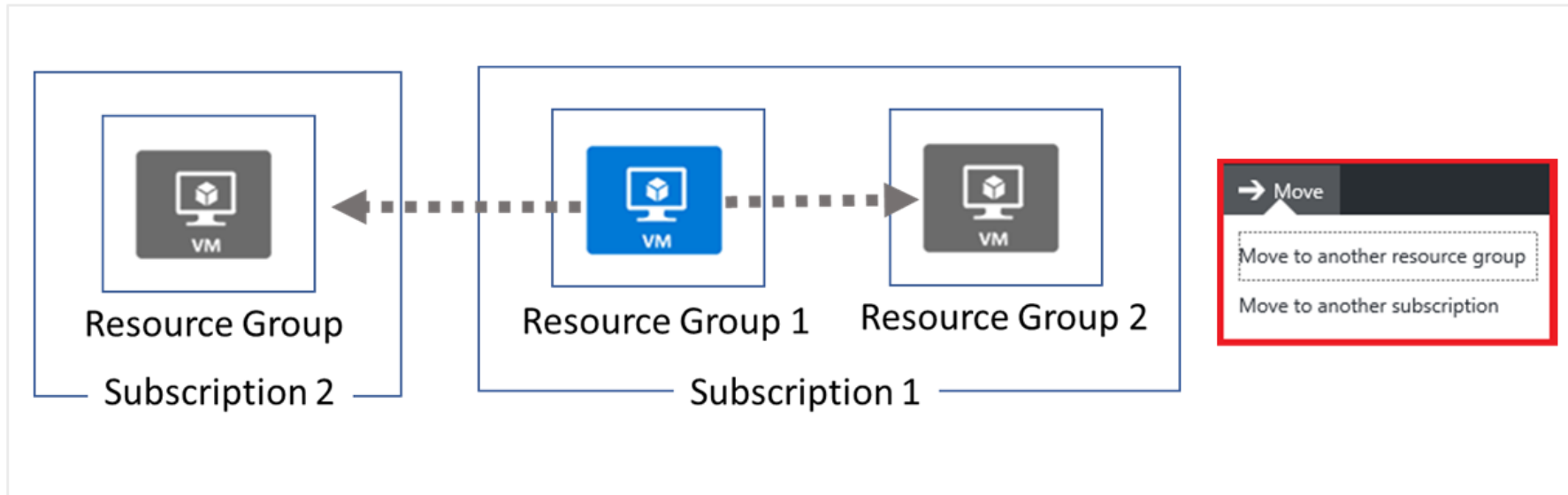
Locks are inherited by child resources

Read-Only locks prevent any changes to the resource

Delete locks prevent deletion



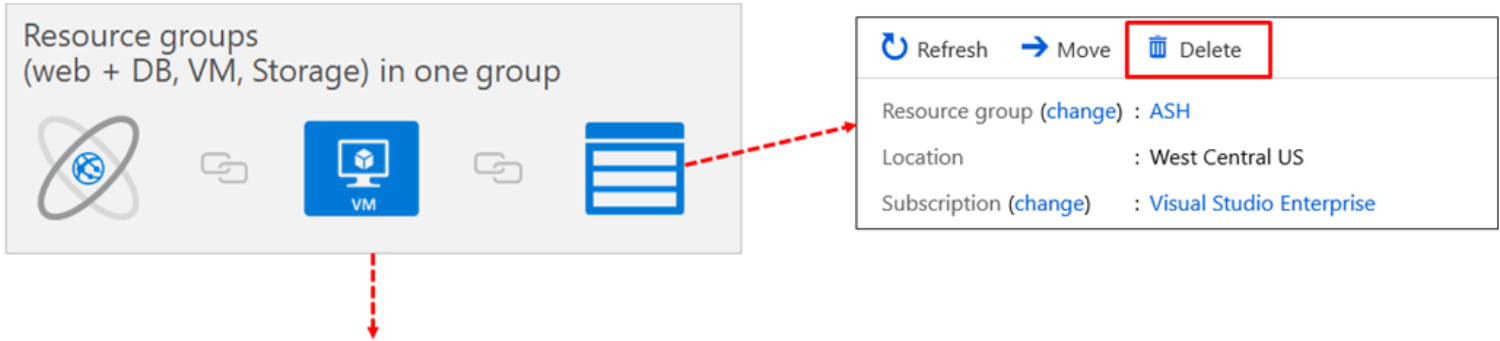
## Moving Resources



When moving resources, both the source group and the target group are locked during the operation

Services that cannot be moved: Azure AD Domain Services, ExpressRoute, and Site Recovery. Other restrictions apply

## Removing Resources and Resource Groups



The screenshot shows the Azure portal interface. On the left, a box titled "Resource groups (web + DB, VM, Storage) in one group" contains icons for a database, a VM, and a storage account. A red dashed arrow points from the VM icon to a context menu on the right. The context menu has three options: "Refresh", "Move", and "Delete". The "Delete" option is highlighted with a red border. Below the context menu, the details for the selected resource group are shown: "Resource group (change) : ASH", "Location : West Central US", and "Subscription (change) : Visual Studio Enterprise". Below the screenshot, a PowerShell command is displayed: `Get-AzResourceGroup -Name 'az104-03*' | Remove-AzResourceGroup -Force -AsJob`. The `-AsJob` parameter is highlighted in yellow.

```
Get-AzResourceGroup -Name 'az104-03*' | Remove-AzResourceGroup -Force -AsJob
```

Remove Azure resources that you no longer use

Ensures you will not see unexpected charges

Remove individual resources or remove the resource group

# Resource Limits

**ASC DEMO | Usage + quotas**  
Subscription

**Settings**

- Programmatic deployment
- Resource groups
- Resources
- Usage + quotas**
- Policies
- Security
- Events

You can use each Microsoft Azure resource up to its quota. Each subscription has separate quotas and usage is tracked per subscription. If you reach a quota cap, you can request an increase via Help + Support. [Learn more](#) [Request Increase](#)

Quota	Provider	Location	Usage		
Total Regional vCPUs	Microsoft.Compute	East US	<div style="width: 25%;"><div style="background-color: #0070C0;"></div></div> 25 %	25	of 100
Total Regional vCPUs	Microsoft.Compute	West Europe	<div style="width: 21%;"><div style="background-color: #0070C0;"></div></div> 21 %	21	of 100
Total Regional vCPUs	Microsoft.Compute	Central US	<div style="width: 17%;"><div style="background-color: #0070C0;"></div></div> 17 %	17	of 100
Standard Dv2 Family vCPUs	Microsoft.Compute	West Europe	<div style="width: 16%;"><div style="background-color: #0070C0;"></div></div> 16 %	16	of 100
Standard DSv2 Family vCPUs	Microsoft.Compute	Central US	<div style="width: 14%;"><div style="background-color: #0070C0;"></div></div> 14 %	14	of 100

Resources have a default limit also known as quota

Helpful to track current usage, and plan for future use

You can open a free support case to increase limits to published maximums

## Lesson 02: Azure Portal and Cloud Shell



# Azure Portal and Cloud Shell overview



Azure Portal



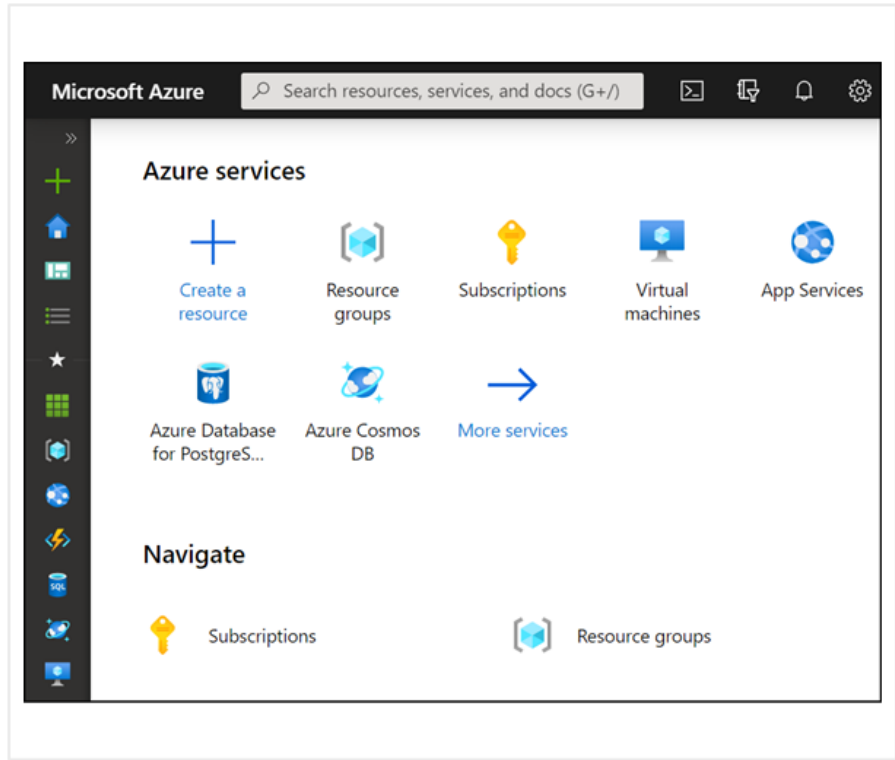
Demonstration – Azure Portal



Azure Cloud Shell

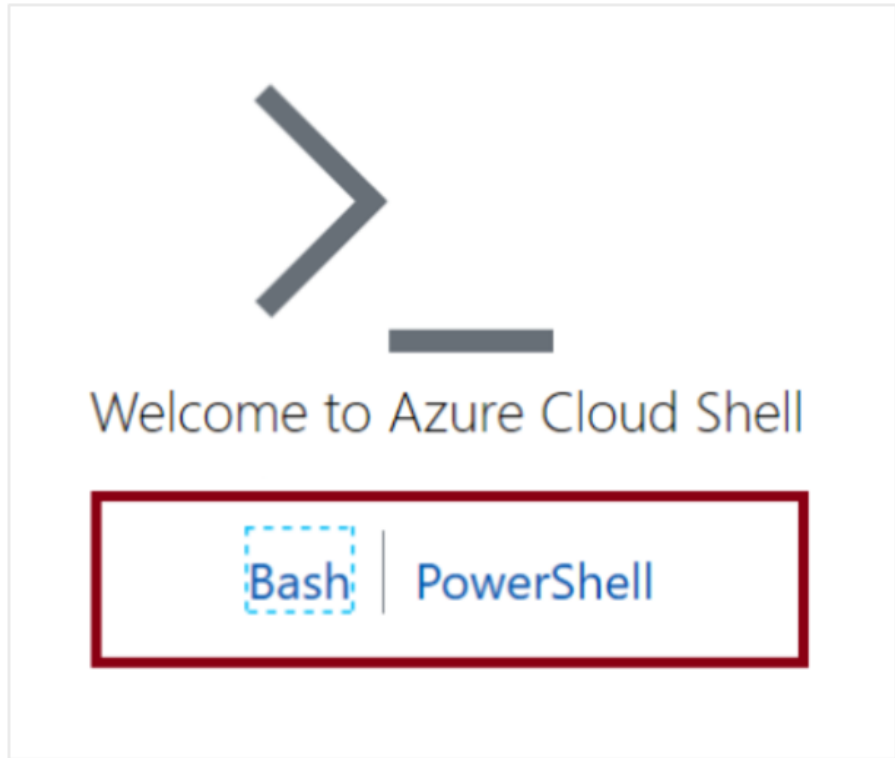
# Azure Portal

- Search resources, services, and docs
- Manage resources
- Create customized dashboards and favorites
- Access the Cloud Shell
- Receive notifications



# Azure Cloud Shell

- Interactive, browser-accessible shell
- Offers either Bash or PowerShell
- Is temporary and provided on a per-session, per-user basis
- Requires a resource group, storage account, and Azure File share
- Authenticates automatically
- Integrated graphical text editor
- Is assigned one machine per user account
- Times out after 20 minutes



## Lesson 03: Azure PowerShell and CLI



# Azure PowerShell and CLI Overview



Azure PowerShell



PowerShell Cmdlets and Modules



Demonstration – Working with PowerShell locally



Azure CLI

## Azure PowerShell

```
New-AzVm `
  -ResourceGroupName "CrmTestingResourceGroup" `
  -Name "CrmUnitTests" `
  -Image "UbuntuLTS" `
  ...
```

Connect to your Azure subscription and manage resources

Adds the Azure-specific commands

Available inside a browser via the Azure Cloud Shell

Available as a local installation on Linux, macOS, or Windows

Has an interactive and a scripting mode

## PowerShell Cmdlets and Modules

### Get-Module

# Output

ModuleType	Version	Name
-----	-----	----
Manifest	3.1.0.0	Microsoft.PowerShell.Management
Manifest	3.1.0.0	Microsoft.PowerShell.Utility
Binary	1.0.0.1	PackageManagement
Script	1.0.0.1	PowerShellGet
Script	2.0.0	PSReadline

Cmdlets follow a verb-noun naming convention; shipped in modules

Modules are a DLL file with the code to process each cmdlet

Load cmdlets by loading the module containing them

Use **Get-Module** to see a list of loaded modules

## Azure CLI

```
az vm restart -g MyResourceGroup -n MyVm
```

Cross-platform command-line program

Runs on Linux, macOS, and Windows

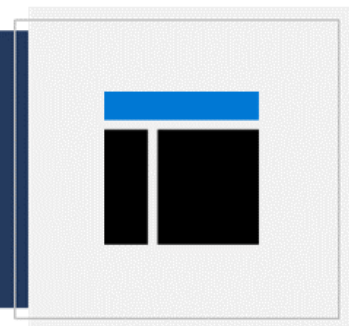
Can be used interactively or through scripts

Commands are structured in *\_groups\_* and *\_subgroups\_*

Use *find* to locate commands

Use *--help* for more detailed information

# Lesson 04: ARM templates



# ARM Templates Overview



Template Advantages



Template Schema



Template Parameters



QuickStart Templates

## Template Advantages

Improves consistency

Express complex deployments

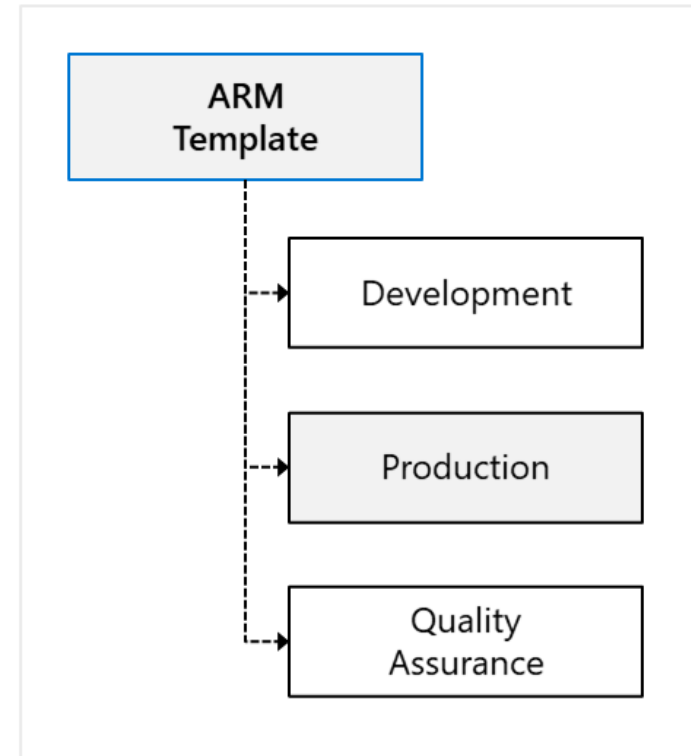
Reduce manual, error prone tasks

Express requirements through code

Promotes reuse

Modular and can be linked

Simplifies orchestration



## Template Schema

Defines all the Resource manager resources in a deployment

Written in JSON

A collection of key-value pairs

Each key is a string

Each values can be a string, number, Boolean expression, list of values, object

```
{
  "$schema":
    "http://schema.management.
    azure.com/schemas/2019-04-
    01/deploymentTemplate.json#",
  "contentVersion": "",
  "parameters": {},
  "variables": {},
  "functions": [],
  "resources": [],
  "outputs": {}
}
```

## Template Parameters

Specify which values are configurable when the template runs

This example has two parameters: one for a VM's username (adminUsername), and one for its password (adminPassword)

```
"parameters": {
  "adminUsername": {
    "type": "string",
    "metadata": {
      "description": "Username for the VM."
    }
  },
  "adminPassword": {
    "type": "securestring",
    "metadata": {
      "description": "Password for the VM."
    }
  }
}
```





# QuickStart Templates

Resource Manager templates provided by the Azure community

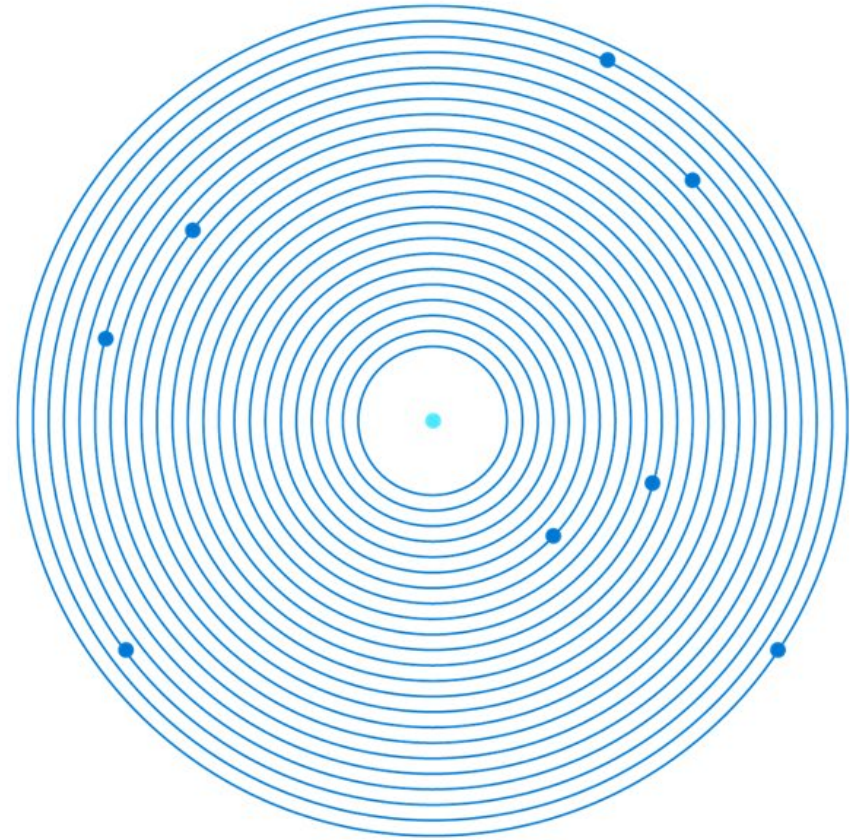
Provides everything you need to deploy your solution or serves as a starting point for your template

<https://azure.microsoft.com/en-us/resources/templates/>

757 Quickstart templates are currently in the gallery.

<p><b>Create Configuration Manager Tech Preview Lab in Azure</b></p> <p>This template creates a new System Center Configuration Manager Technical Preview Lab environment. It creates 4 new Azure VMs, configuring a new AD Domain Contr...</p> <p> by Yizhong Wu, Last updated: 12/10/2018</p>	<p><b>Create a Standard Storage Account</b></p> <p>This template creates a Standard Storage Account</p> <p> by Brian Moore, Last updated: 12/4/2018</p>
<p><b>Deploy a Django app</b></p> <p>This template uses the Azure Linux CustomScript extension to deploy an application. This example creates an Ubuntu VM, does a silent install of Python, Django...</p> <p> by Madhan Arumugam Ramakrishnan, Last updated: 7/19/2018</p>	<p><b>Create an new AD Domain with 2 Domain Controllers</b></p> <p>This template creates 2 new VMs to be AD DCs (primary and backup) for a new Forest and Domain</p> <p> by Simon Davies, Last updated: 7/5/2018</p>

# Module 04: Virtual Networking



## Module Overview



Lesson 01: Virtual Networks

---



Lesson 02: IP Addressing

---



Lesson 03: Network Security Groups

---



Lesson 04: Azure Firewall

---



Lesson 05: Azure DNS

---

# Lesson 01: Virtual Networks



# Virtual Networks Overview



Azure Networking Components



Virtual Networks



Subnets















Implementing Virtual Networks

# Azure Networking Components

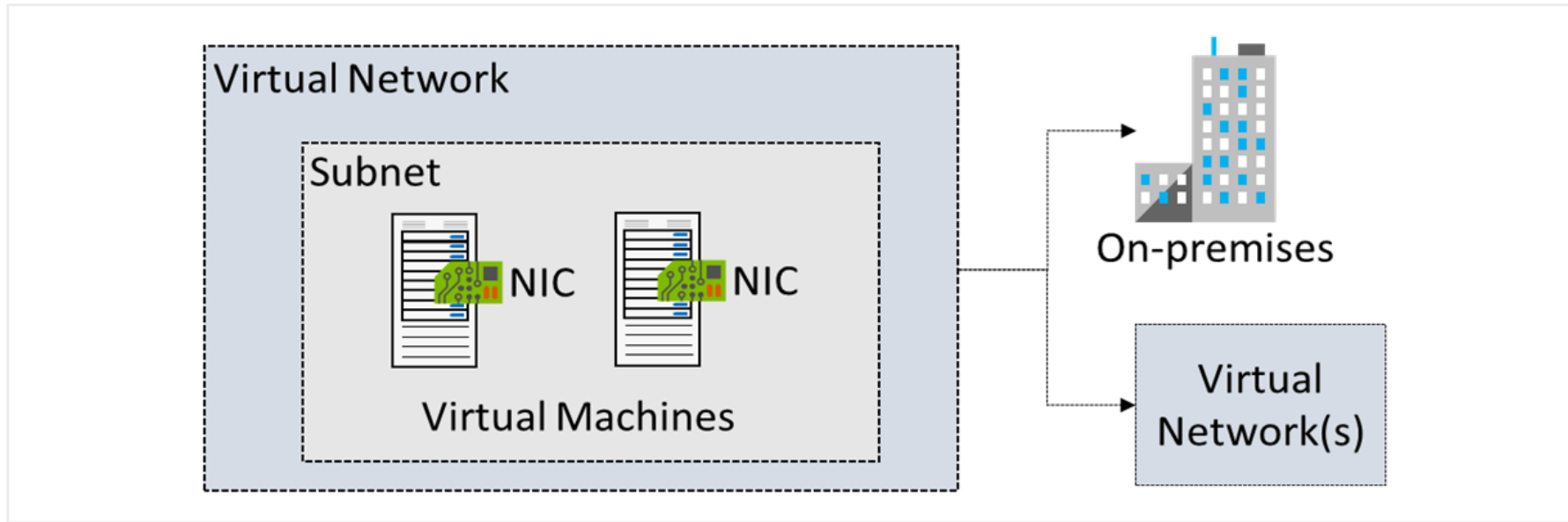
Adopting cloud solutions can save time and simplify operations

Azure requires the same types of networking functionality as on-premises infrastructure

Azure networking offers a wide range of services and products

 <p><b>Virtual Network</b> Microsoft Create a logically isolated section in Microsoft Azure and securely connect it outward.</p> 	 <p><b>Load Balancer</b> Microsoft A load balancer that distributes incoming traffic among backend virtual machine instances.</p> 	 <p><b>Application Gateway</b> Microsoft Scalable layer-7 load balancer offering various traffic routing rules and SSL termination for backend</p> 
 <p><b>Traffic Manager profile</b> Microsoft Create a Microsoft Azure Traffic Manager Profile that allows you to control the distribution of user</p> 	 <p><b>Virtual network gateway</b> Microsoft The VPN device in your Azure virtual network and used with site-to-site and VNet-to-VNet VPN</p> 	 <p><b>Virtual WAN</b> Microsoft Azure Virtual WAN is a networking service that provides optimized and automated branch-to-branch</p> 

# Virtual Networks



Logical representation  
of your own network

Create a dedicated  
private cloud-only  
virtual network

Securely extend  
your datacenter with  
virtual networks

Enable hybrid  
cloud scenarios

# Subnets

+ Subnet + Gateway subnet Refresh

Search subnets

Name	↑↓	Address range	↑↓	IPv4 available addresses	↑↓	Delegated to	↑↓	Security group
subnet0		10.1.0.0/24		251		-		nsg0
subnet1		10.1.1.0/24		251		-		-
subnet2		10.1.2.0/24		251		-		nsg2
GatewaySubnet		10.1.255.0/24		251		-		-

A virtual network can be segmented into one or more subnets

Subnets provide logical divisions within your network

Subnets can help improve security, increase performance, and make it easier to manage the network

Each subnet must have a unique address range – cannot overlap with other subnets in the virtual network in the subscription

# Implementing Virtual Networks

Create new virtual networks at any time

Add virtual networks when you create a virtual machine

Need to define the address space, and at least one subnet

Be careful with overlapping address spaces

## Create virtual network

[Basics](#) [IP Addresses](#) [Security](#) [Tags](#) [Review + create](#)

### Project details

Subscription \* ⓘ

Resource group \* ⓘ  [Create new](#)

### Instance details

Name \*  ✓

Region \*

# Lesson 02: IP Addressing



# IP Addressing Overview



IP Addressing



Creating IP Addresses

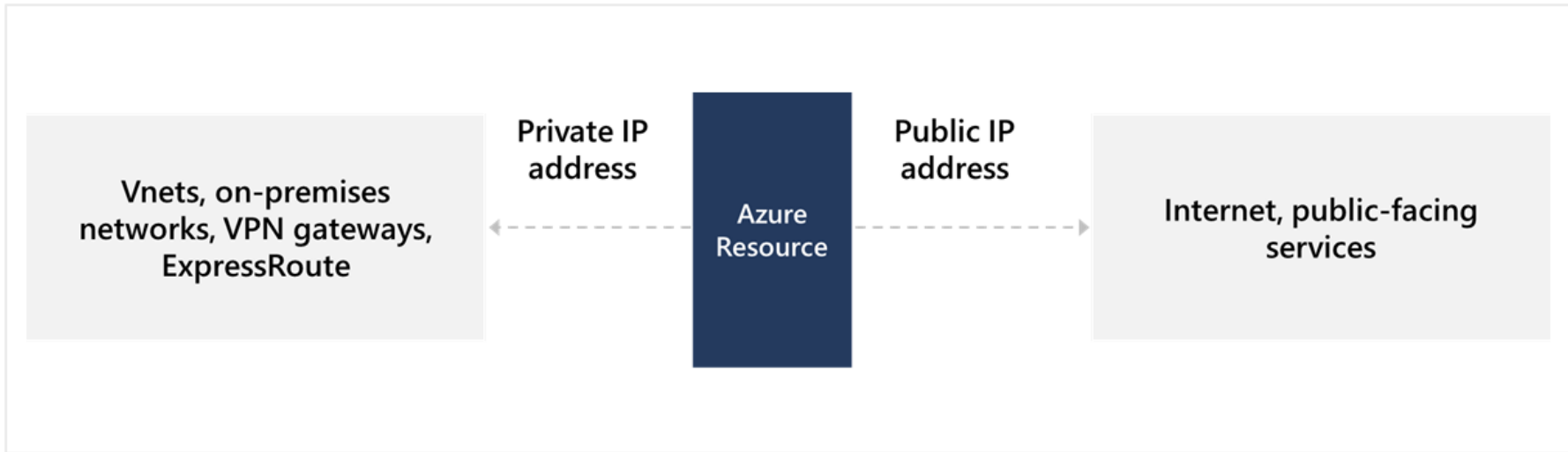


Public IP Addresses



Private IP Addresses

## IP Addressing



**Private IP addresses** - used within an Azure virtual network (VNet), and your on-premises network, when you use a VPN gateway or ExpressRoute circuit to extend your network to Azure

**Public IP addresses** - used for communication with the Internet, including Azure public-facing services

## Creating Public IP Addresses

Available in IPv4 or IPv6 or both

Basic vs Standard SKU

Available in Dynamic, Static or both  
(depending on SKU):

Zone redundant

Not mixable or immutable

Range of contiguous addresses available as a prefix

### Create public IP address

IP Version \* ⓘ

IPv4  IPv6  Both

SKU \* ⓘ

Basic  Standard

IPv4 IP Address Configuration

Name \*

IP address assignment \*

Dynamic  Static

## Public IP Addresses

Public IP addresses	IP address association	Dynamic	Static
Virtual Machine	NIC	Yes	Yes
Load Balancer	Front-end configuration	Yes	Yes
VPN Gateway	Gateway IP configuration	Yes	No
Application Gateway	Front-end configuration	Yes	Yes*

A public IP address resource can be associated with virtual machine network interfaces, internet-facing load balancers, VPN gateways, and application gateways

\*Static IP addresses only available on certain SKUs.

## Private IP Addresses

Private IP Addresses	IP address association	Dynamic	Static
Virtual Machine	NIC	Yes	Yes
Internal Load Balancer	Front-end configuration	Yes	Yes
Application Gateway	Front-end configuration	Yes	Yes

**Dynamic (default).** Azure assigns the next available unassigned or unreserved IP address in the subnet's address range

**Static.** You select and assign any unassigned or unreserved IP address in the subnet's address range

## Lesson 03: Network Security Groups



# Network Security Groups Overview



Network Security Groups (NSG)



NSG Rules



NSG Effective Rules



Creating NSG Rules

# Network Security Groups

The screenshot displays the Azure portal interface for a Network Security Group (NSG) named 'nsg0'. The breadcrumb path is 'Network security group' > 'Directory: Microsoft'. The left-hand navigation pane includes 'Overview' (selected), 'Activity log', 'Access control (IAM)', 'Tags', and 'Diagnose and solve problems'. The main content area shows the NSG's properties: Resource group (change) : rg01, Location : East US, Subscription (change) : [blank], Subscription ID : [blank], and Tags (change) : [Click here to add tags](#). On the right side, it indicates 'Custom security rules : 1 inbound, 0 outbound' and 'Associated with : 1 subnets, 0 network interfaces'. Action buttons for 'Move', 'Delete', and 'Refresh' are visible at the top of the main content area.

Limit network traffic to resources in a virtual network

Contains a list of security rules that allow or deny inbound or outbound network traffic

Can be associated to a subnet or a network interface

# NSG Rules

Inbound security rules						
Priority	Name	Port	Protocol	Source	Destination	Action
100	⚠ RDP_Inbound	3389	Any	Any	Any	✔ Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	✔ Allow
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	✔ Allow
65500	DenyAllInBound	Any	Any	Any	Any	✘ Deny

Outbound security rules						
Priority	Name	Port	Protocol	Source	Destination	Action
65000	AllowVnetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	✔ Allow
65001	AllowInternetOutBound	Any	Any	Any	Internet	✔ Allow
65500	DenyAllOutBound	Any	Any	Any	Any	✘ Deny

Security rules in NSGs enable you to filter network traffic that can flow in and out of virtual network subnets and network interfaces

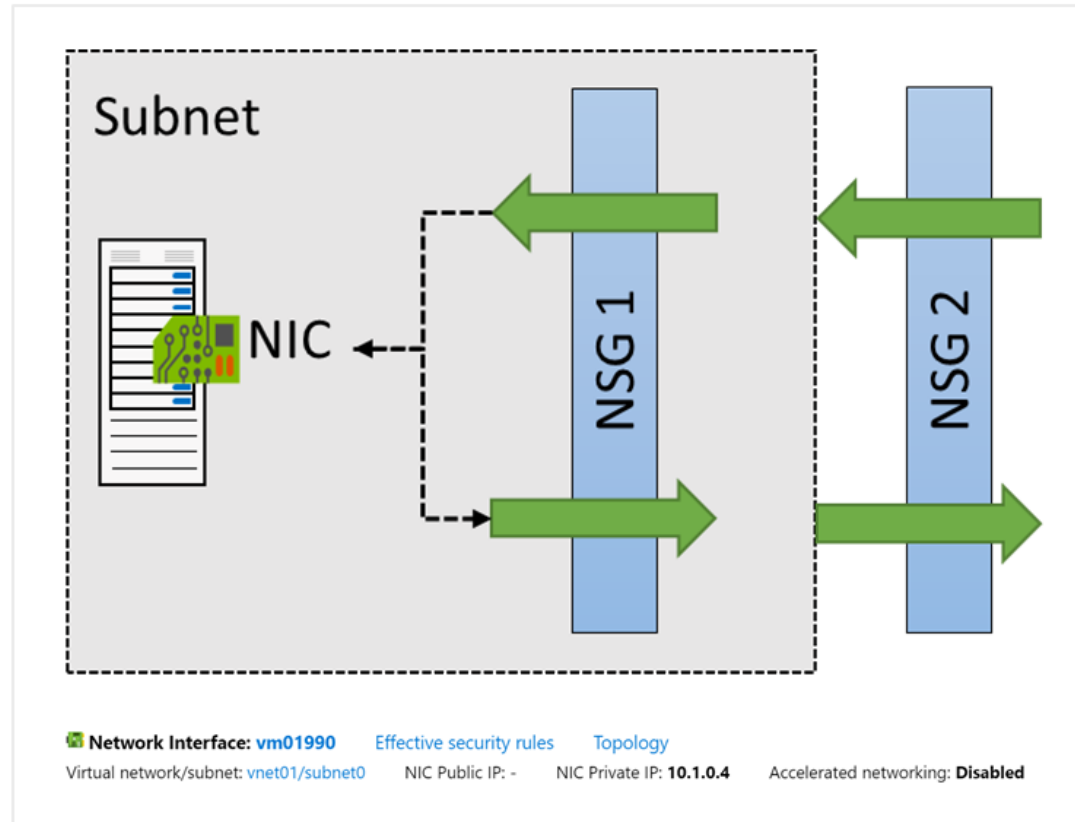
There are default security rules. You cannot delete the default rules, but you can add other rules with a higher priority

## NSG Effective Rules

NSGs are evaluated independently for the subnet and NIC

An "allow" rule must exist at both levels for traffic to be admitted

Use the Effective Rules link if you are not sure which security rules are being applied



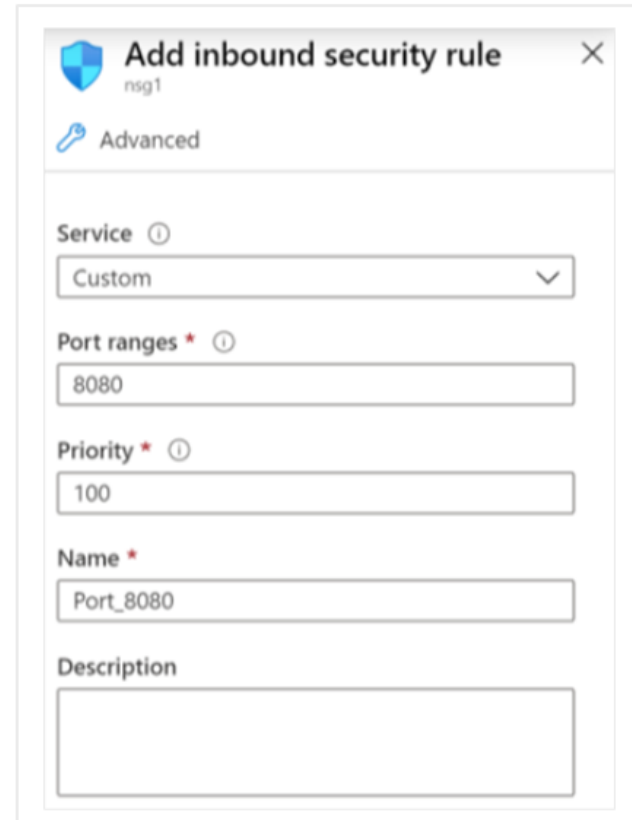
## Creating NSG rules

Select from a large variety of services

**Service** – The destination protocol and port range for this rule

**Port ranges** – Single port or multiple ports

**Priority** – The lower the number, the higher the priority



The screenshot shows a dialog box titled "Add inbound security rule" for a network security group named "nsg1". The dialog is set to "Advanced" mode. The configuration fields are as follows:

- Service**: A dropdown menu set to "Custom".
- Port ranges**: A text input field containing "8080".
- Priority**: A text input field containing "100".
- Name**: A text input field containing "Port\_8080".
- Description**: An empty text input field.

## Lesson 04: Azure Firewall



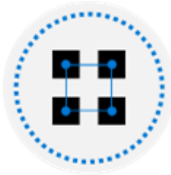
# Azure Firewall Overview



Azure Firewall



Implementing Firewalls



Firewall Rules

# Azure Firewall

Stateful firewall as a service

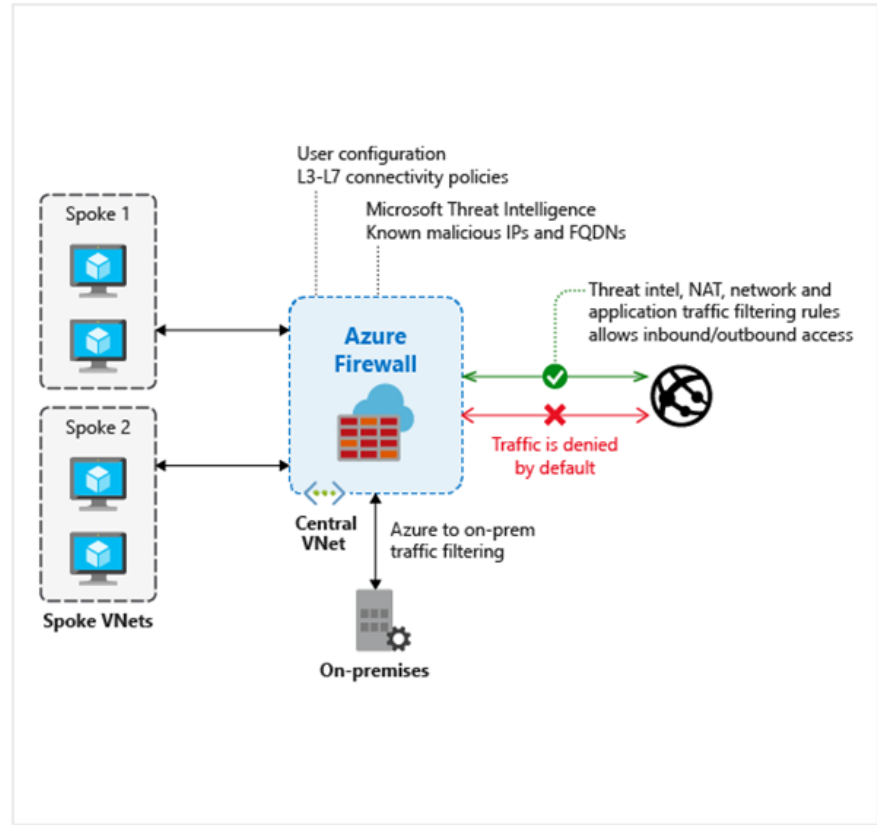
Built-in high availability with unrestricted cloud scalability

Create, enforce, and log application and network connectivity policies

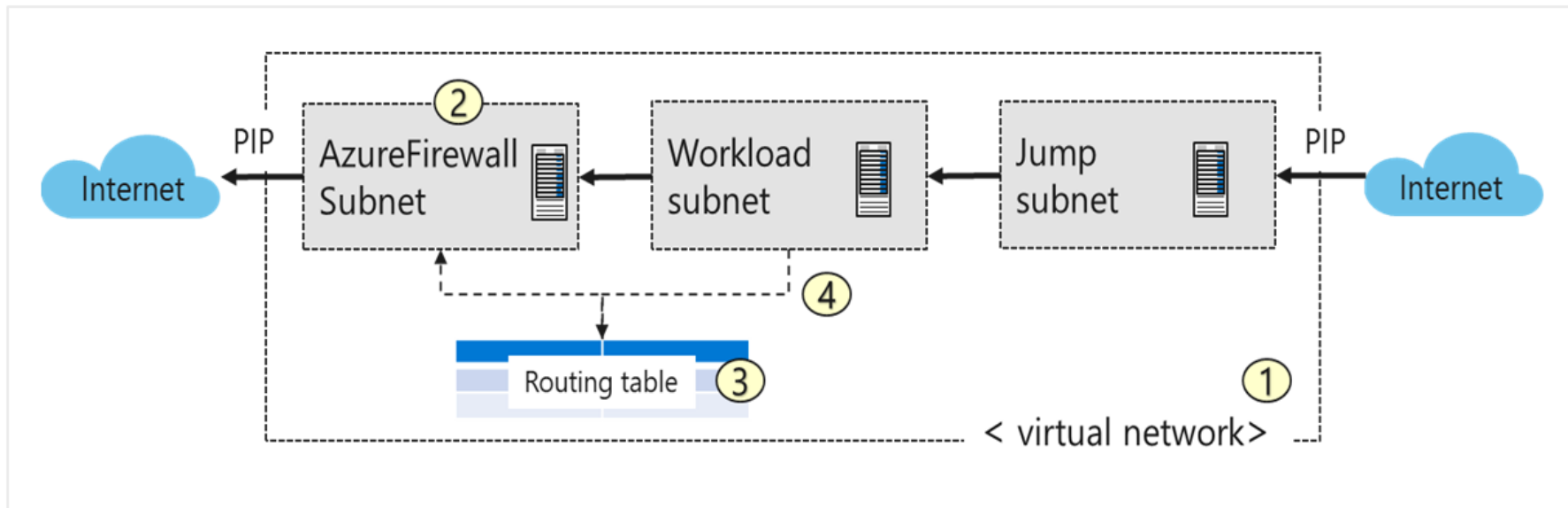
Threat intelligence-based filtering

Fully integrated with Azure Monitor for logging and analytics

Support for hybrid connectivity through deployment behind VPN and ExpressRoute Gateways



## Implementing Firewalls



1. Create the network infrastructure

2. Deploy the firewall

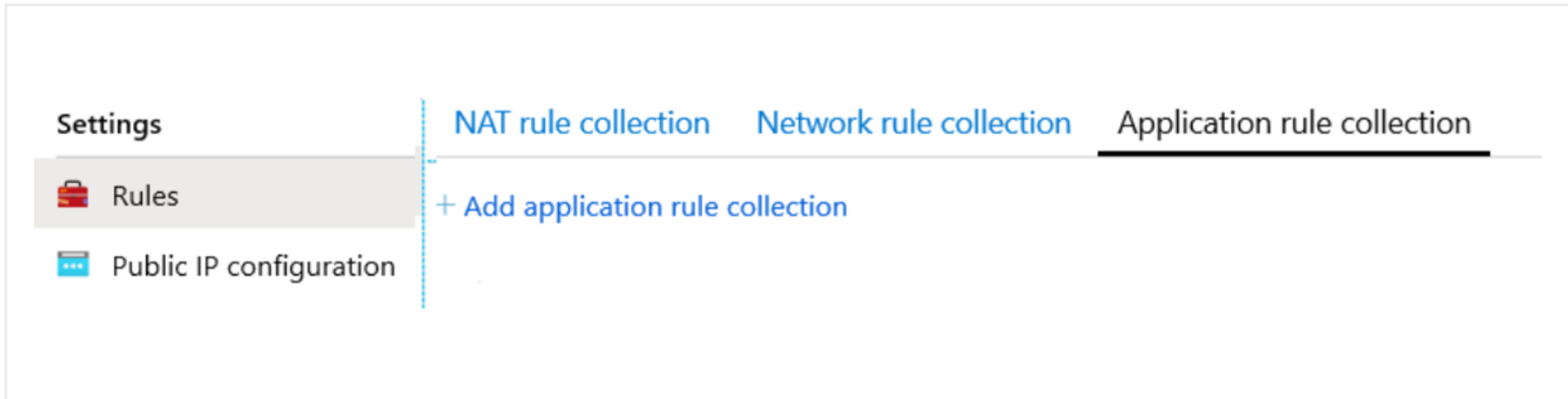
3. Create a default route

4. Configure rules



In production deployments, a Hub and Spoke model is recommended.

# Firewall Rules

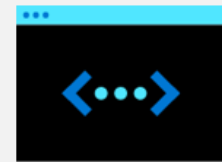


**NAT rules.** Configure DNAT rules to allow incoming connections

**Network rules.** Configure rules that contain source addresses, protocols, destination ports, and destination addresses

**Application rules.** Configure fully qualified domain names (FQDNs) that can be accessed from a subnet

# Lesson 05: Azure DNS



# Azure DNS Overview



Domains and Custom Domains



Verifying Custom Domain Names



Azure DNS Zones



DNS Delegation



DNS Record Sets



DNS for Private Domains



Private Zones Scenarios

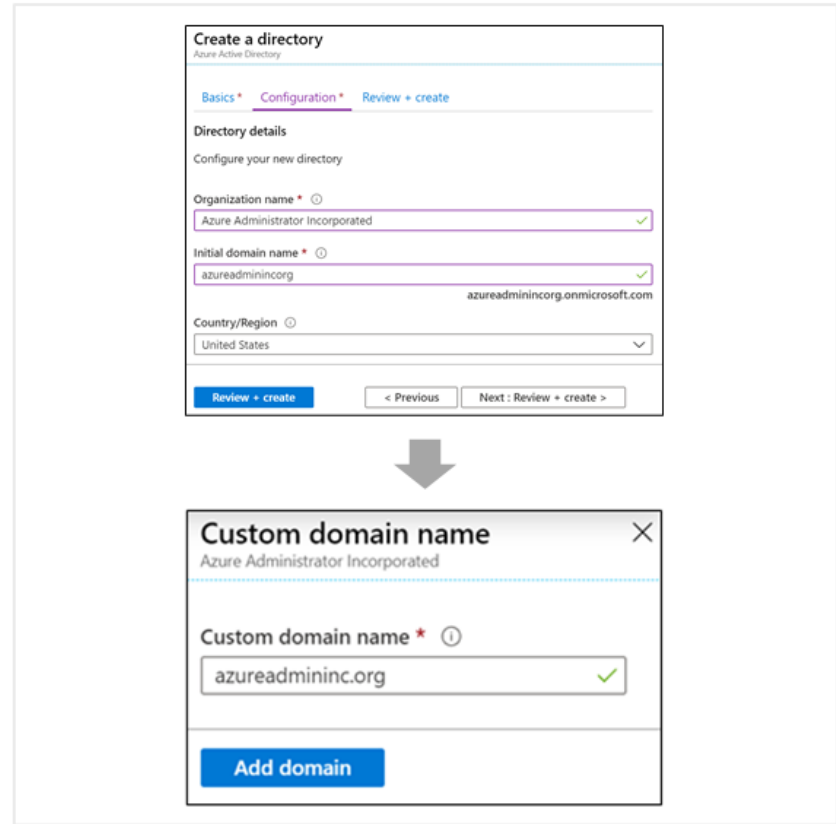
## Domains and Custom Domains

When you create an Azure subscription an Azure AD domain is created for you

The domain has initial domain name in the form *domainname.onmicrosoft.com*

You can customize/change the name

After the custom name is added it must be verified (next topic)



## Verify the Custom Domain Name

Verification demonstrates ownership of the domain name

Add a DNS record (MX or TXT) that is provided by Azure into your company's DNS zone


Azure will query the DNS domain for the presence of the record

This could take several minutes or several hours

azureadmininc.org

Custom domain name


 Delete |  Got feedback?

 To use azureadmininc.org with your Azure AD, create a new TXT record with your domain name registrar using the info below.


Record type

TXT  MX


Alias or host name

@ 

Destination or points to address

MS=ms79094380 

TTL

3600 

[Share these settings via email](#)

Verification will not succeed until you have configured your domain with your registrar as described above.

# Azure DNS Zones

A DNS zone hosts the DNS records for a domain

The name of the zone must be unique within the resource group

Where multiple zones share the same name, each instance is assigned different name server addresses

Root/Parent domain is registered at the registrar and pointed to Azure NS

### Create DNS zone ✕

---

[Basics](#) [Tags](#) [Review + create](#)

A DNS zone is used to host the DNS records for a particular domain. For example, the domain 'contoso.com' may contain a number of DNS records such as 'mail.contoso.com' (for a mail server) and 'www.contoso.com' (for a web site). Azure DNS allows you to host your DNS zone and manage your DNS records, and provides name servers that will respond to DNS queries from end users with the DNS records that you create. [Learn more.](#)

**Project details**

Subscription \*

Resource group \*  [Create new](#)

**Instance details**

Name \*

Resource group location ⓘ

---

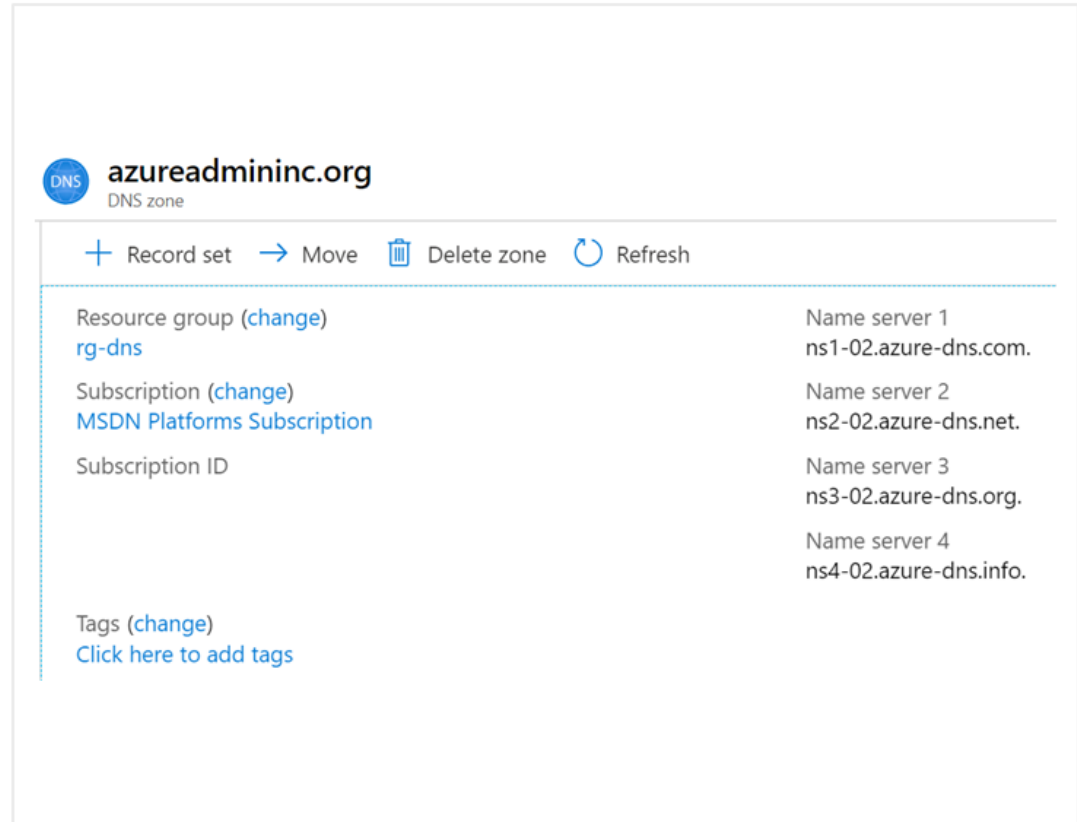
[Review + create](#) [Previous](#) [Next : Tags >](#) [Download a template for automation](#)

## DNS Delegation

When delegating a domain to Azure DNS, you must use the name server names provided by Azure DNS – use all four

Once the DNS zone is created, update the parent registrar

For child zones, register the NS records in the parent domain



The screenshot displays the Azure portal interface for a DNS zone named 'azureadmininc.org'. At the top, there is a header with the DNS icon, the domain name, and the text 'DNS zone'. Below the header is a toolbar with four actions: '+ Record set', '→ Move', '🗑️ Delete zone', and '🔄 Refresh'. The main content area is divided into two columns. The left column lists metadata: 'Resource group (change) rg-dns', 'Subscription (change) MSDN Platforms Subscription', 'Subscription ID', and 'Tags (change) Click here to add tags'. The right column lists the four name servers: 'Name server 1 ns1-02.azure-dns.com.', 'Name server 2 ns2-02.azure-dns.net.', 'Name server 3 ns3-02.azure-dns.org.', and 'Name server 4 ns4-02.azure-dns.info.'

## DNS Record Sets

A record set is a collection of records in a zone that have the same name and are the same type

You can add up to 20 records to any record set

A record set cannot contain two identical records

Changing the drop-down Type, changes the information required

### Add record set ✕

azureadmininc.org

---

Name  
helloworld ✓  
.azureadmininc.org

Type  
A ▾

Alias record set ⓘ  
 Yes  No

TTL \*  TTL unit  ▾

IP address  
 ...

## DNS for Private Domains

Use your own custom domain names

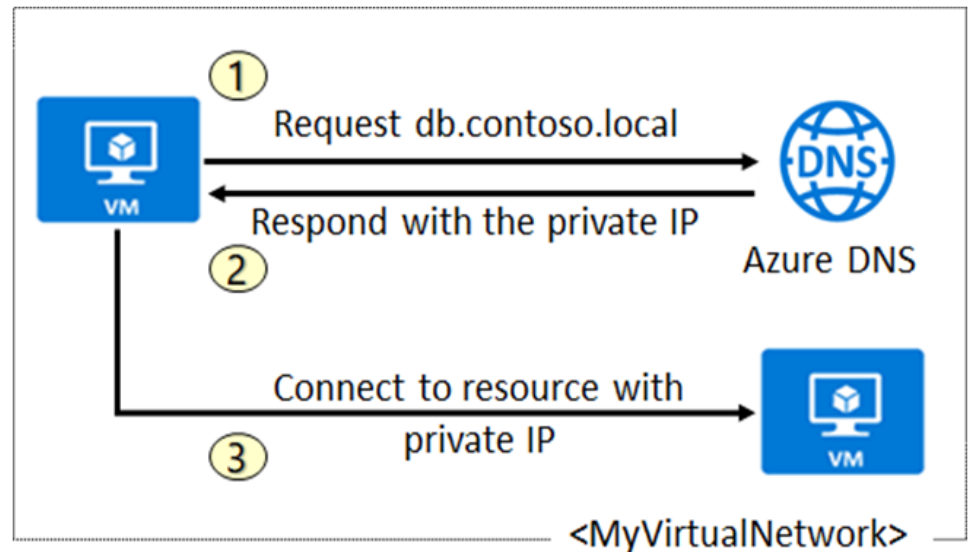
Provides name resolution for VMs within a VNet and between VNets

Automatic hostname record management

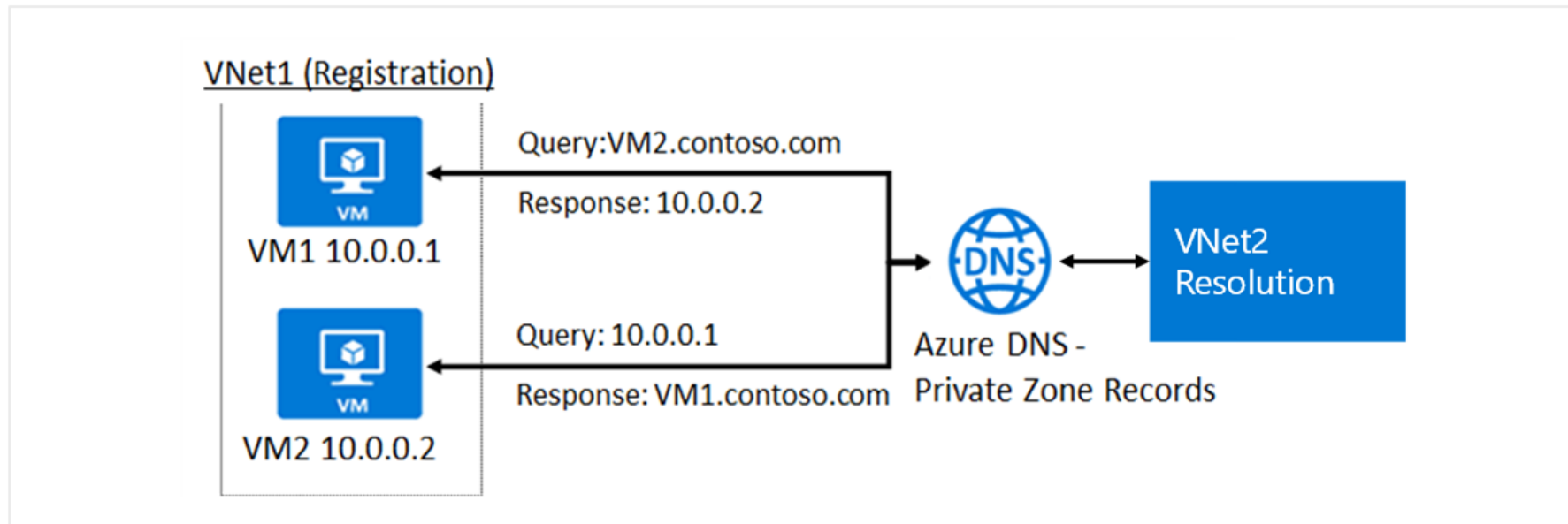
Removes the need for custom DNS solutions

Use all common DNS records types

Available in all Azure regions



## Private Zone Scenarios



DNS resolution in VNet1 is private and not accessible from the Internet

DNS queries across the virtual networks are resolved

Reverse DNS queries are scoped to the same virtual network

# Module 05: Intersite Connectivity



## Module Overview



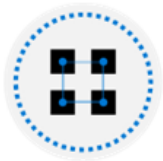
Lesson 01: VNet Peering

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Lesson 02: VPN Gateway Connections

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Lesson 03: ExpressRoute and Virtual WAN

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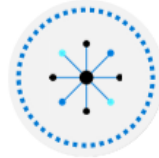
# Lesson 01: VNet Peering



## VNet Peering Overview



VNet Peering



Gateway Transit and Connectivity



Configure VNet Peering



Service Chaining

# VNet Peering

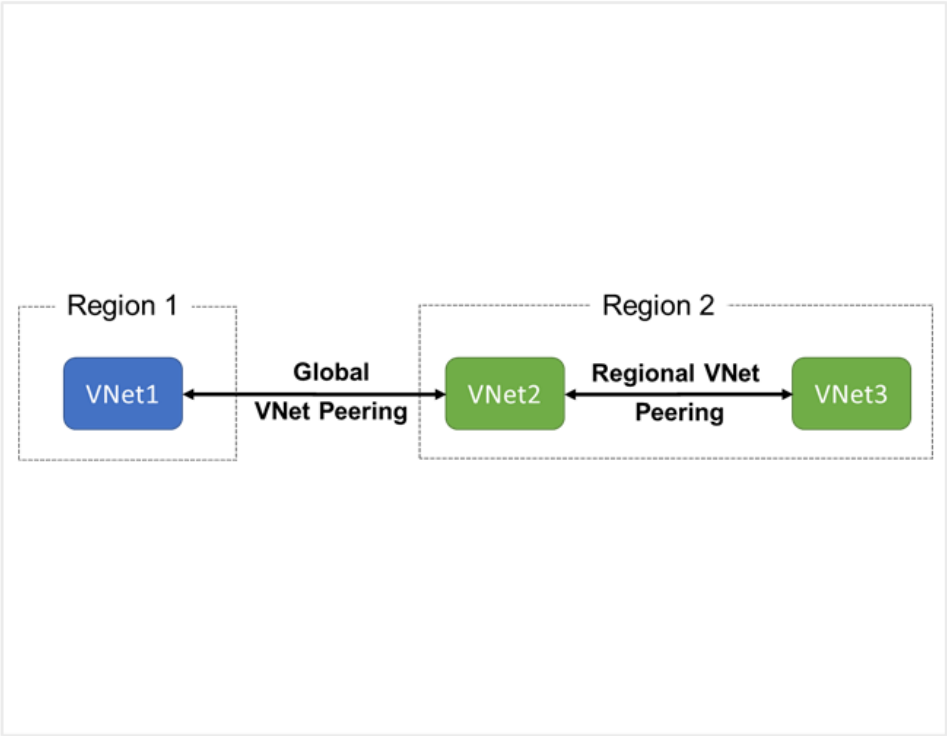
VNet peering connects two Azure virtual networks

Two types of peering: Regional and Global

Peered networks use the Azure backbone for privacy and isolation

You can peer across subscriptions

Easy to setup, seamless data transfer, and great performance

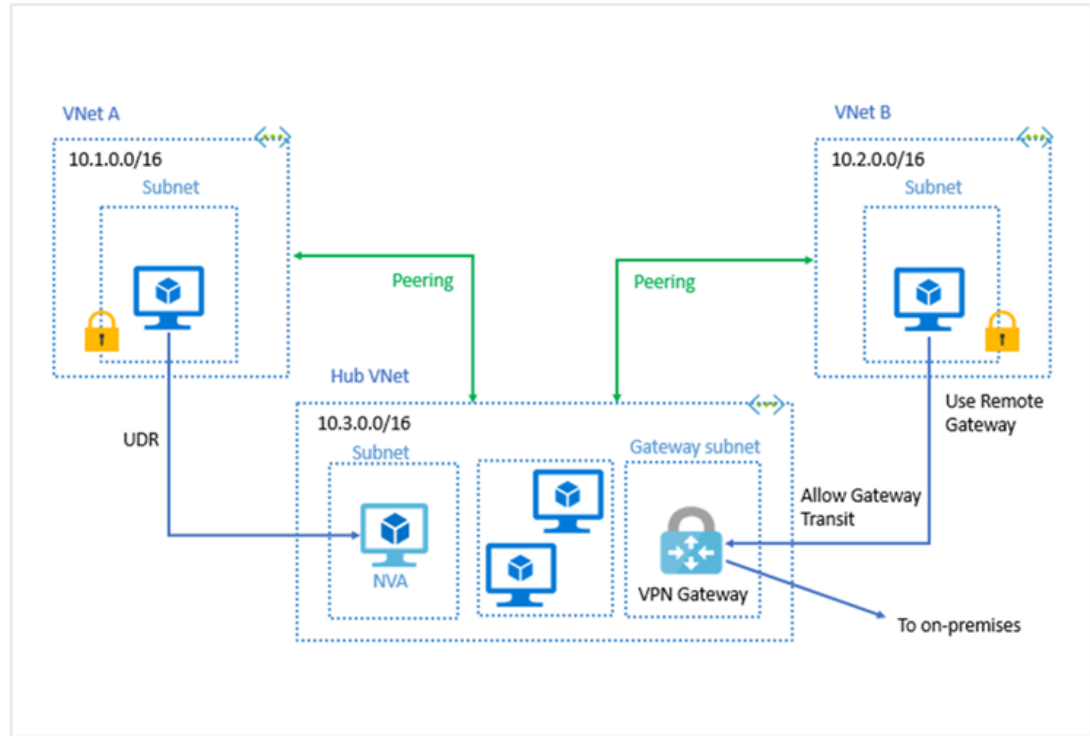


# Gateway Transit and Connectivity

Gateway transit allows peered virtual networks to share the gateway and get access to resources

No VPN gateway is required in the peered virtual network

Default VNet peering provides full connectivity



✓ IP address spaces of connected networks can't overlap

## Configure VNet Peering

**Allow forwarded traffic** – From within the peer virtual network into your virtual network

**Allow gateway transit** – Allows the peer virtual network to use your virtual network gateway

**Use remote gateways** – Allows the virtual network to use another virtual network's gateway

Configuration

Configure virtual network access settings

Allow virtual network access from vnet1 to vnet2 ⓘ

Disabled  Enabled

Configure forwarded traffic settings

Allow forwarded traffic from vnet2 to vnet1 ⓘ

Disabled  Enabled

Configure gateway transit settings

Allow gateway transit ⓘ

Configure Remote Gateways settings

Use remote gateways ⓘ



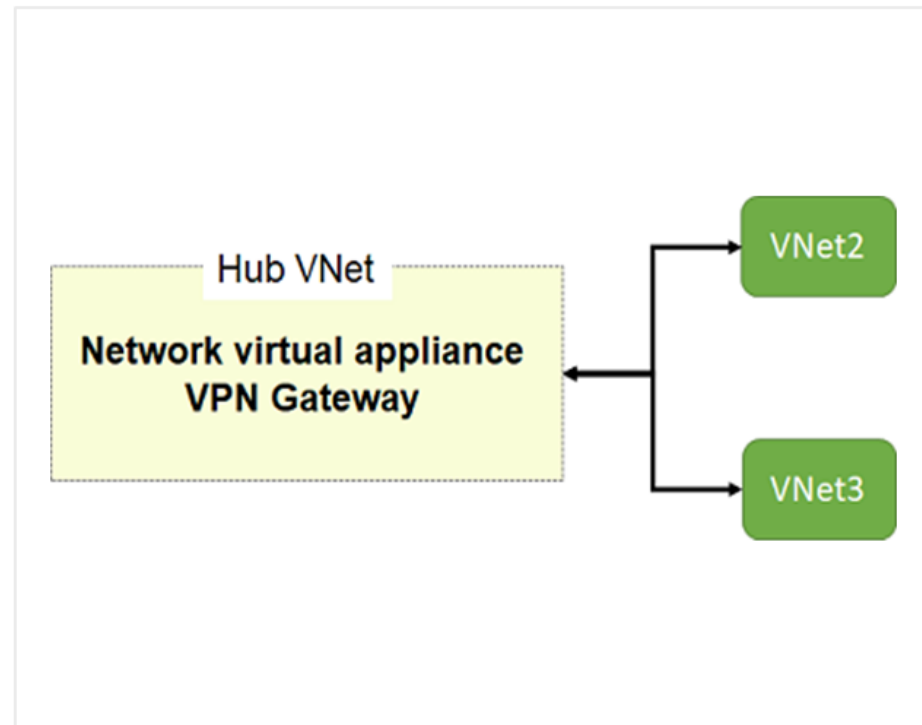
If you select 'Allow gateway transit' on one virtual network; then you should select 'Use remote gateways' on the other virtual network

## Service Chaining

Leverage user-defined routes and service chaining to implement custom routing

Implement a VNet hub with a network virtual appliance or a VPN gateway

Service chaining enables you to direct traffic from one virtual network to a virtual appliance, or virtual network gateway, in a peered virtual network, through user-defined routes



## Lesson 02: VPN Gateway Connections



# VPN Gateway Connections Overview



VPN Gateways



Implement Site-to-Site  
VPN Connections



Create the Gateway Subnet



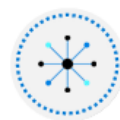
VPN Gateway Configuration



VPN Gateway Types



VPN Gateway SKU and Generation



Create the Local Network Gateway



Configure the On-premises  
VPN Device

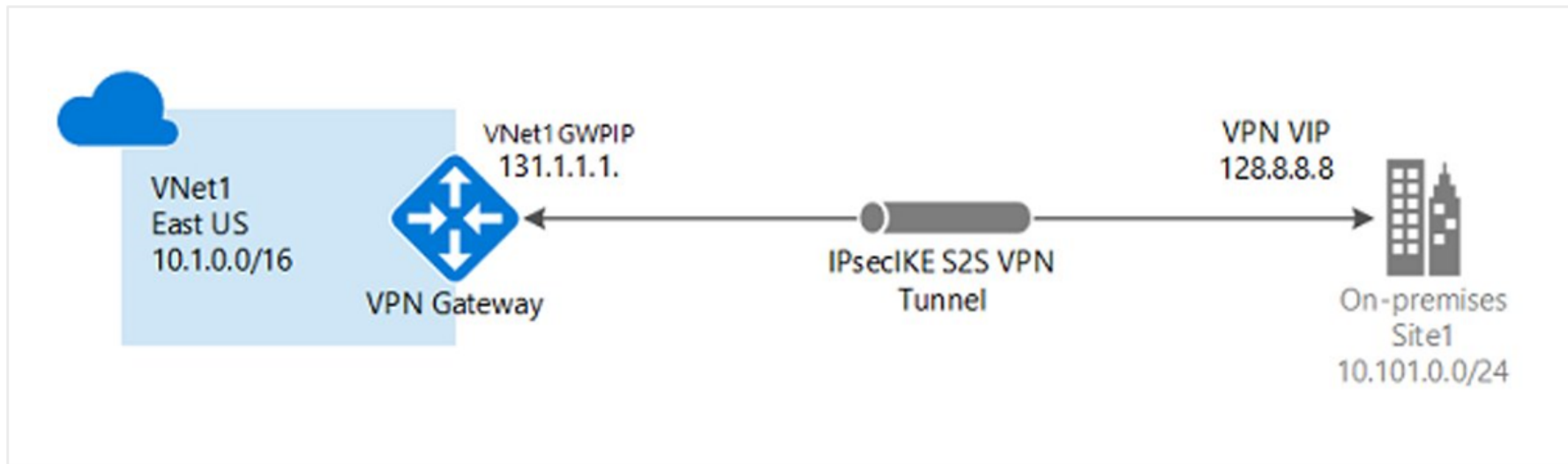


Create the VPN Connection



High Availability Scenarios

## VPN Gateways

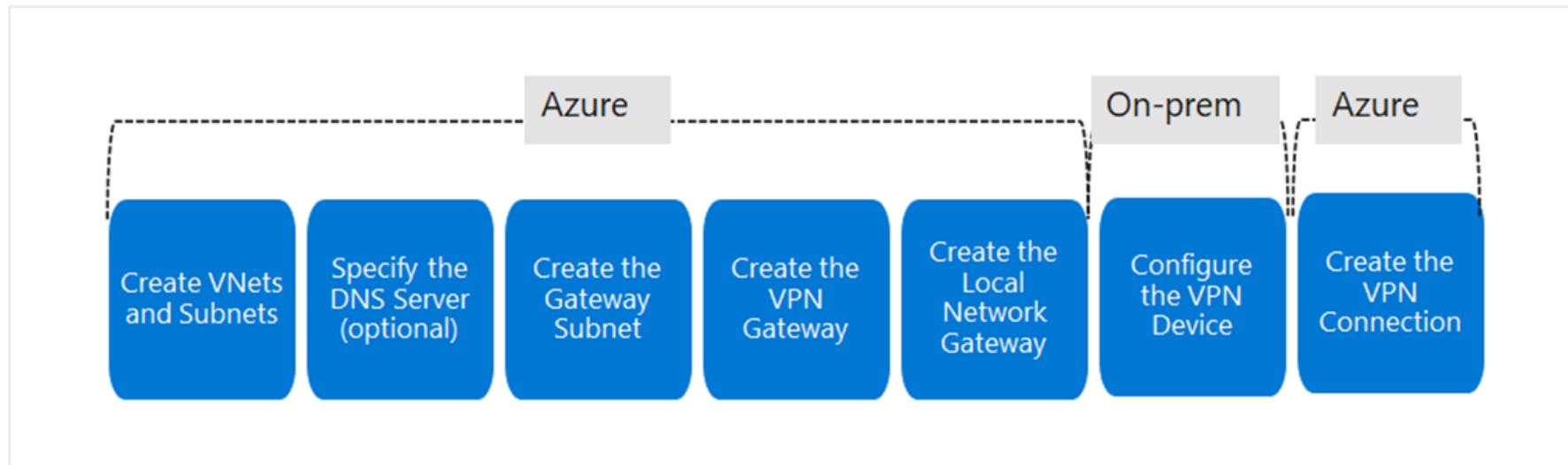


**Site-to-site connections** connect on-premises datacenters to Azure virtual networks

**Network-to-network connections** connect Azure virtual networks (custom)

**Point-to-site (User VPN) connections** connect individual devices to Azure virtual networks

## Implement Site-to-Site VPN Connections



Take time to carefully plan your network configuration

The on-premises part is necessary only if you are configuring Site-to-Site

Always verify and test your connections

## Create the Gateway Subnet

The gateway subnet contains the IP addresses; if possible, use a CIDR block of /28 or /27

When you create your gateway subnet, gateway VMs are deployed to the gateway subnet and configured with the required VPN gateway settings

Never deploy other resources (for example, additional VMs) to the gateway subnet

Avoid associating a NSG with the gateway subnet

The screenshot shows the Azure portal interface for configuring a subnet. At the top, the breadcrumb navigation is 'vnet01 - Subnets' with 'Virtual network' below it. A search bar contains 'Search (Ctrl+/)'. To the right are buttons for '+ Subnet', '+ Gateway subnet' (highlighted with a red box), and 'Refresh'. Below this is a modal dialog titled 'Add subnet' for 'vnet01'. The dialog fields are: Name: 'GatewaySubnet'; Address range (CIDR block): '10.1.255.0/27' (with a green checkmark and a note '10.1.255.0 - 10.1.255.31 (27 + 5 Azure reserved addresses)'); NAT gateway: 'None'; Add IPv6 address space: unchecked; Network security group: 'None'; Route table: 'None'; Service endpoints: '0 selected'; Delegate subnet to a service: 'None'.

# VPN Gateway Configuration

Most VPN types are Route-based

Your choice of gateway SKU affects the number of connections you can have and the aggregate throughput benchmark

Associate a virtual network that includes the gateway subnet

The gateway needs a public IP address

**Create virtual network gateway**

**Instance details**

Name \*

Region \*

Gateway type \* ⓘ  VPN  ExpressRoute

VPN type \* ⓘ  Route-based  Policy-based

SKU \* ⓘ

Generation ⓘ

**VIRTUAL NETWORK**

Virtual network \* ⓘ

ⓘ Only virtual networks in the currently selected subscription and region are listed.

Enable active-active mode \* ⓘ  Enabled  Disabled

Configure BGP ASN \* ⓘ  Enabled  Disabled

 It can take up to 45 minutes to provision the VPN gateway

## VPN Gateway Types

**Route-based VPNs** use routes in the IP forwarding or routing table to direct packets:

Supports for IKEv2

Can use dynamic routing protocols

**Policy-based VPNs** encrypt and direct packets through IPsec tunnels based on the IPsec policies:

Support for IKEv1 only

Legacy on-premises VPN devices

### Create virtual network gateway

VPN type ⓘ



Route-based



Policy-based

Most VPN gateway configurations require a Route-based VPN

# Gateway SKU and Generation

## Sampling of available SKUs

SKU \* ⓘ

Generation ⓘ

Gen	SKU	S2S/VNet-to-VNet Tunnels	P2S IKEv2 Connections	Throughput Benchmark
1	VpnGw1/Az	Max. 30	Max. 250	650 Mbps
1	VpnGw2/Az	Max. 30	Max. 500	1.0 Gbps
2	VpnGw2/Az	Max. 30	Max. 500	1.25 Gbps
1	VpnGw3/Az	Max. 30	Max. 1000	1.25 Gbps
2	VpnGw3/Az	Max. 30	Max. 1000	2.5 Gbps
2	VpnGw4/Az	Max. 30	Max. 5000	5.0 Gbps

The Gateway SKU affects the connections and the throughput

Resizing is allowed within the generation

The Basic SKU (not shown) is legacy and should not be used

## Create the Local Network Gateway

Defines the on-premises network configuration

Give the site a name by which Azure can refer to it

The local gateway needs a public IP address

Specify the IP address prefixes that will be routed through the gateway to the VPN device

### Create local network gateway

Name \*

VNet1LocalNet ✓

IP address \* ⓘ

33.2.1.5 ✓

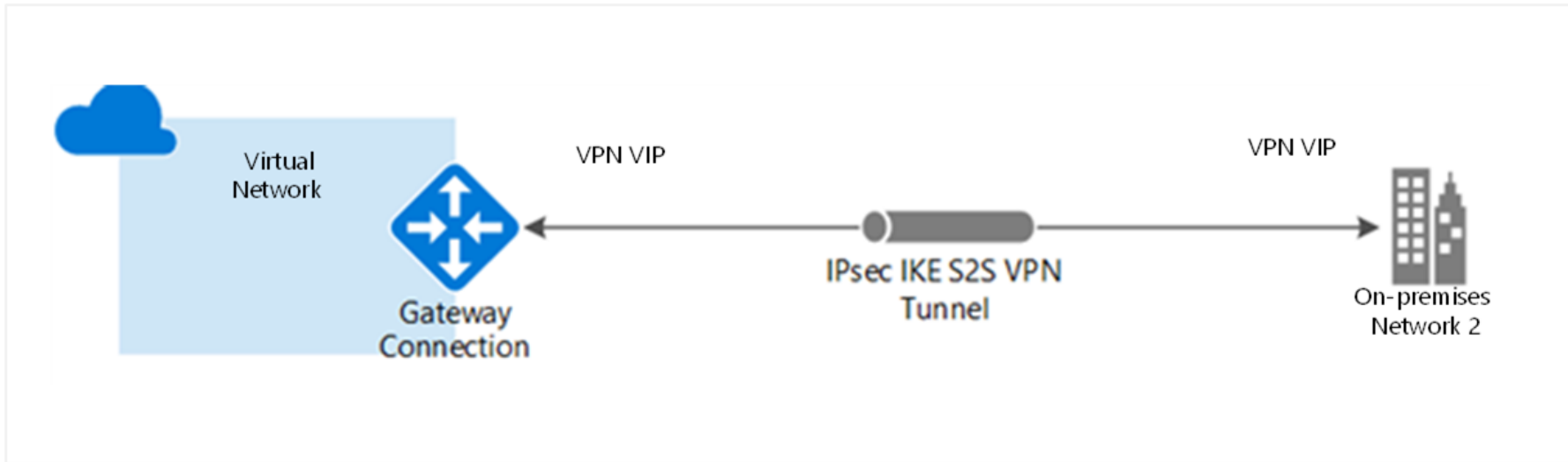
Address space ⓘ

192.168.3.0/24 ...

Add additional address range ...

Configure BGP settings

## Configure the On-premises VPN Device



Consult the list of supported VPN devices (Cisco, Juniper, Ubiquiti, Barracuda Networks)

A VPN device configuration script may be available

Remember the shared key for the Azure connection (next step)

Specify the public IP address (previous step)

## Create the VPN Connection

Once your VPN gateway is created and the on-premises device is configured, create a connection object

Configure a name for the connection and specify the type as Site-to-site (IPsec)

Select the VPN gateway and the Local Network Gateway

Enter the Shared key for the connection

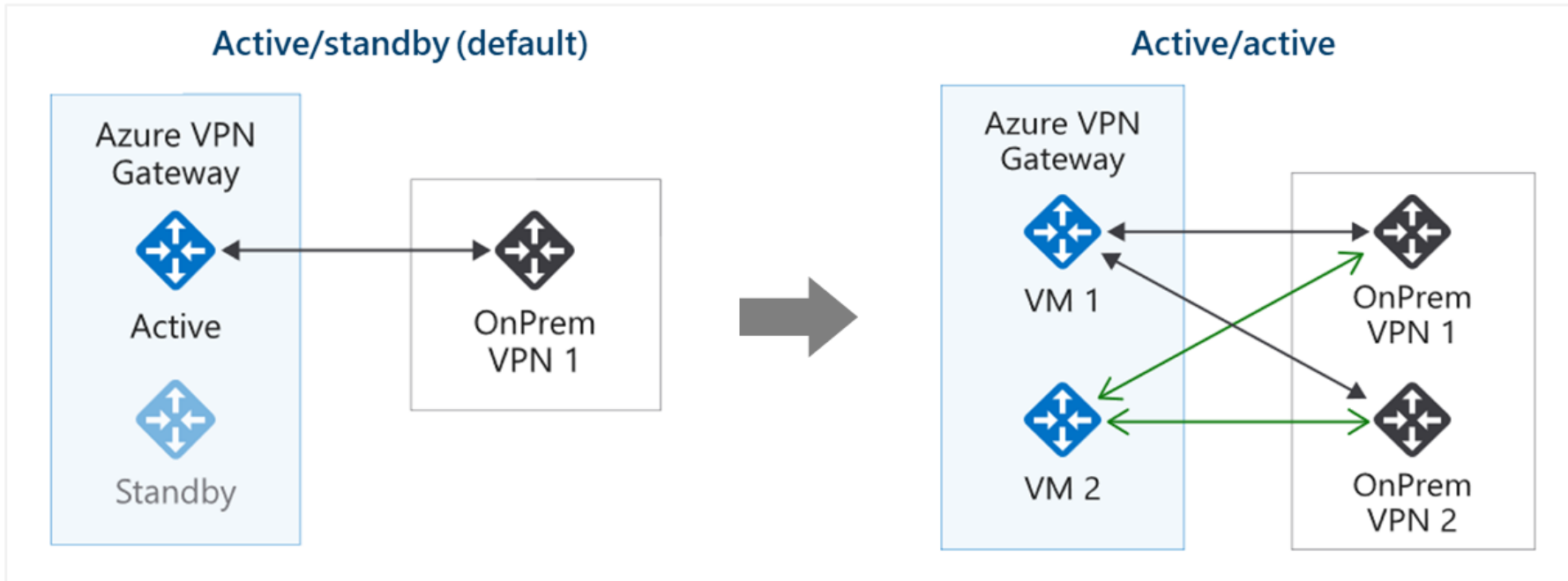
The screenshot shows the 'Add connection' dialog box in the Azure portal. The dialog is titled 'Add connection' and has a close button (X) in the top right corner. It is divided into two panes. The left pane contains the following fields:

- Name \***: A text input field containing 'Azure-to-OnPrem' with a green checkmark on the right.
- Connection type ⓘ**: A dropdown menu with 'Site-to-site (IPsec)' selected.
- \*Virtual network gateway ⓘ**: A field containing 'vng01' with a lock icon on the right.
- \*Local network gateway ⓘ**: A field containing 'Azure-to-OnPrem' with a right-pointing arrow on the right.
- Shared key (PSK) \* ⓘ**: A text input field containing 'abc123' with a green checkmark on the right.

The right pane is titled 'Choose local network gat...' and has a close button (X) in the top right corner. It contains a list of local network gateways:

- A '+ Create new' button.
- A selected item: 'Azure-to-OnPrem NetworkRG' with a green plus icon to its left.

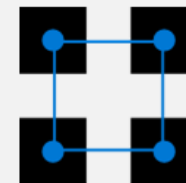
# High Availability Scenarios



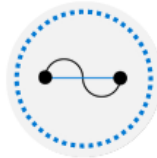
VPN gateways are deployed as two instances

Enable **active/active mode** for higher availability

## Lesson 03: ExpressRoute and Virtual WAN



# ExpressRoute and Virtual WAN Overview



ExpressRoute



ExpressRoute Capabilities



Coexisting Site-to-Site and ExpressRoute

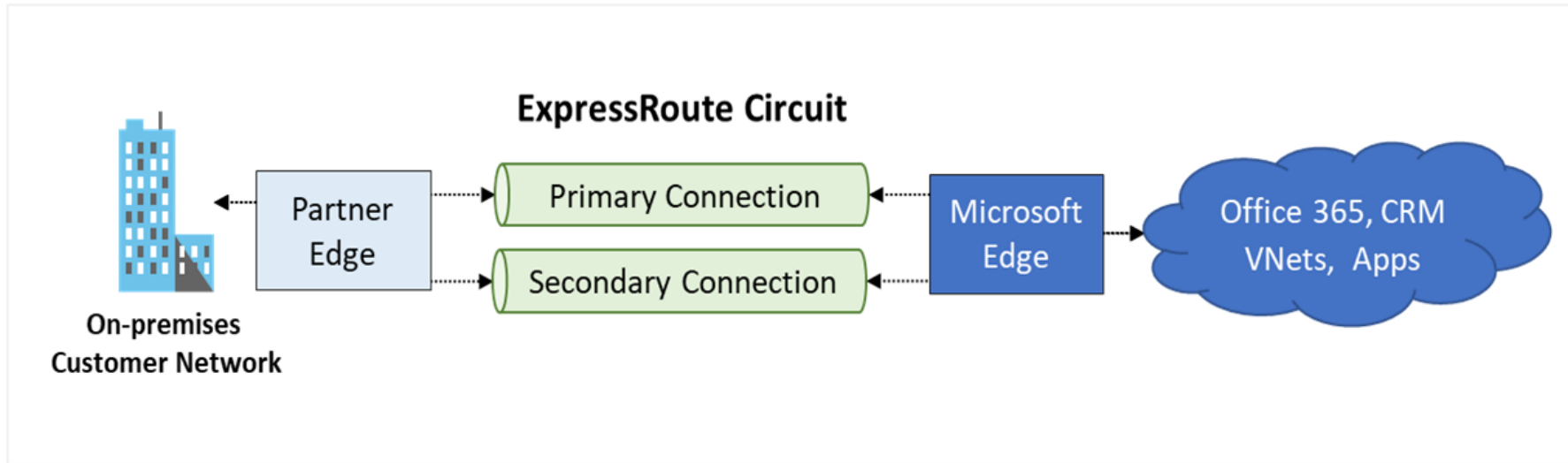


Intersite Connection Comparisons



Virtual WANs

# ExpressRoute



Private connections between your on-premises network and Microsoft datacenters

Connections do not go over the public Internet – Partner network

Secure, reliable, low latency, high speed connections

# ExpressRoute Capabilities

Layer 3 connectivity with redundancy

Connectivity to all regions within a geography

Global connectivity with ExpressRoute premium add-on

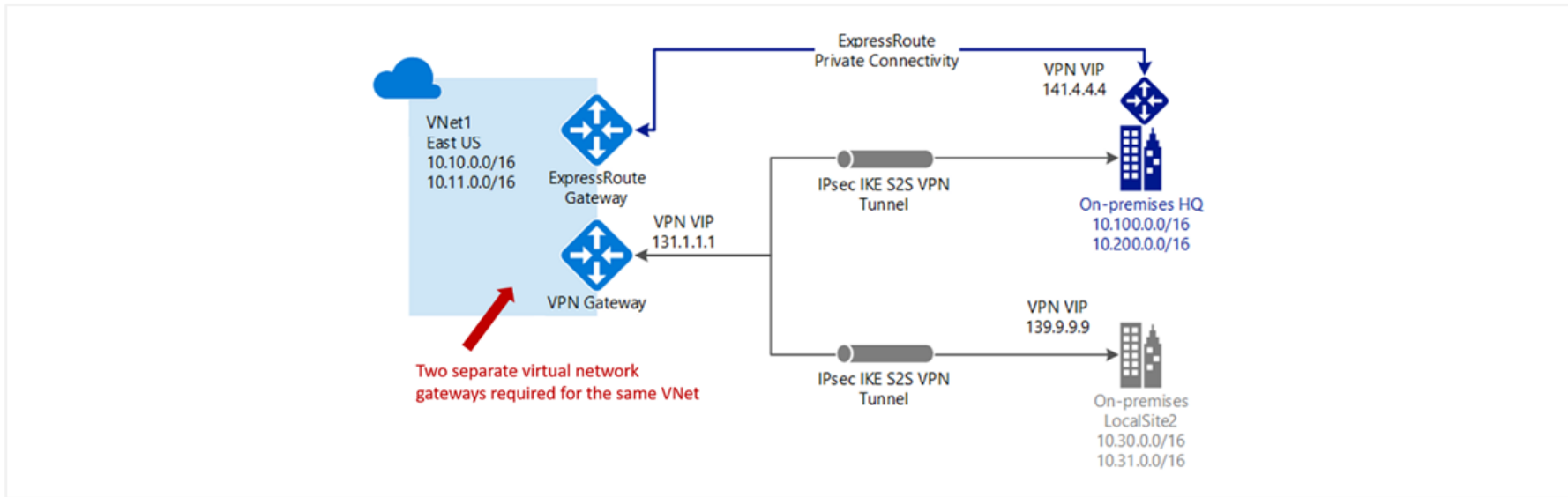
Across on-premises connectivity with ExpressRoute Global Reach

Bandwidth options – 50 Mbps to 100 Gbps

Billing models – Unlimited, metered, premium



# Coexisting Site-to-Site and ExpressRoute



Use S2S VPN as a secure failover path for ExpressRoute

Use S2S VPNs to connect to sites that are not connected with ExpressRoute

Notice two VNet gateways for the same virtual network

## Intersite Connections Comparison

Connection	Azure services supported	Bandwidth	Protocols	Typical use case
Virtual network, point-to-site	Azure IaaS services, Azure Virtual Machines	Based on the gateway SKU	Active/passive	Dev, test, and lab environments for cloud services and virtual machines
Virtual network, site-to-site	Azure IaaS services, Azure Virtual Machines	Typically <1 Gbps aggregate	Active/passive Active/active	Dev, test, and lab environments. Small-scale production workloads and virtual machines
ExpressRoute	Azure IaaS and PaaS services, Microsoft Office 365 services	50 Mbps up to 100 Gbps	Active/active	Enterprise-class and mission-critical workloads. Big data solutions

# Virtual WANs

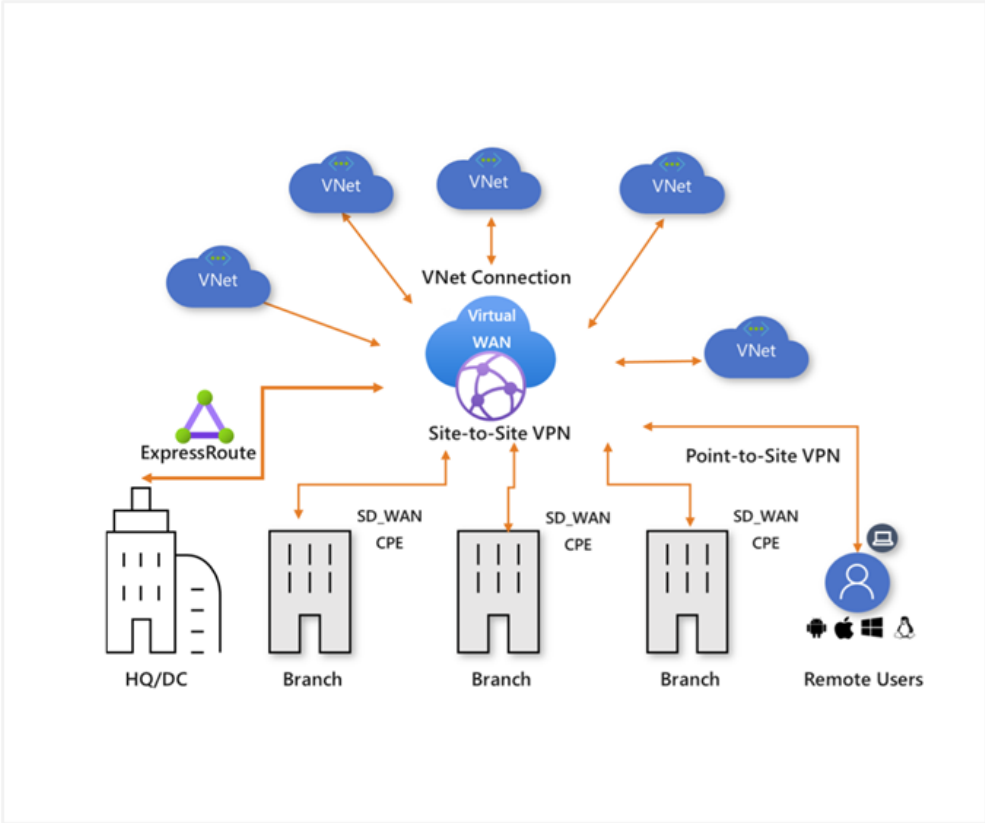
Brings together S2S, P2S, and ExpressRoute

Integrated connectivity using a hub-and-spoke connectivity model

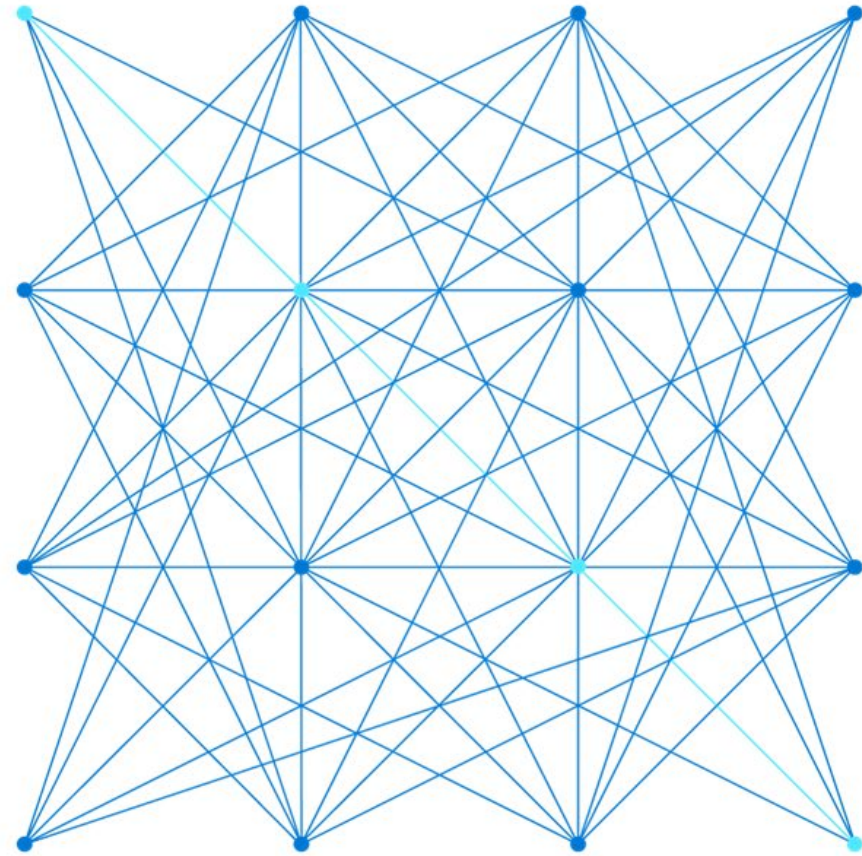
Connect virtual networks and workloads to the Azure hub automatically

Visualize the end-to-end flow within Azure

Two types: Basic and Standard



# Module 06: Network Traffic Management



## Module Overview



Lesson 01: Network Routing and Endpoints

---



Lesson 02: Azure Load Balancer

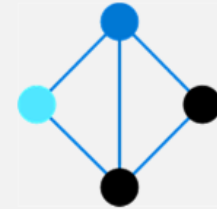
---



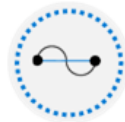
Lesson 03: Application Gateway

---

# Lesson 01: Network Routing and Endpoints



# Network Routing and Endpoints Overview



System Routes



User Defined Routes



Routing Example



Create a Routing Table



Create a Custom Route



Associate the Route Table



Demonstration –  
Custom Routing tables



Service Endpoints



Service Endpoint Services

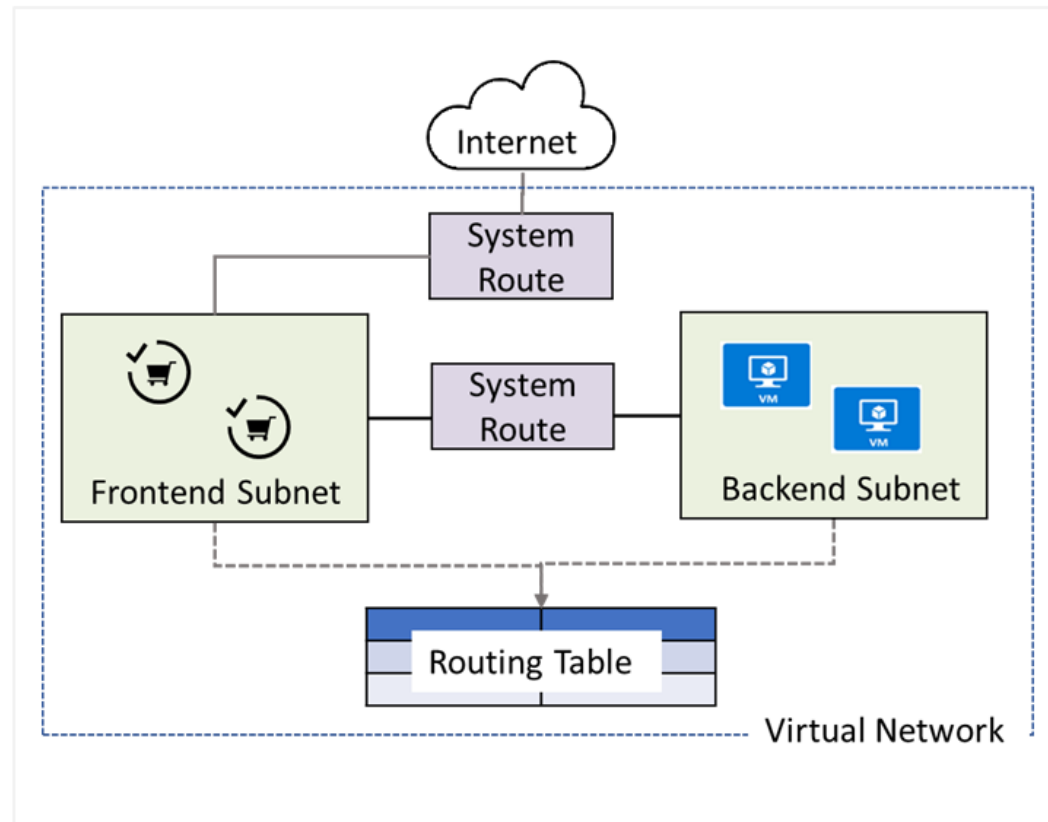


Private Link

## System Routes

System routes direct network traffic between virtual machines, on-premises networks, and the Internet:

- Traffic between VMs in the same subnet
- Between VMs in different subnets in the same virtual network
- Data flow from VMs to the Internet
- Communication between VMs using a VNet-to-VNet VPN
- Site-to-Site and ExpressRoute communication through the VPN gateway

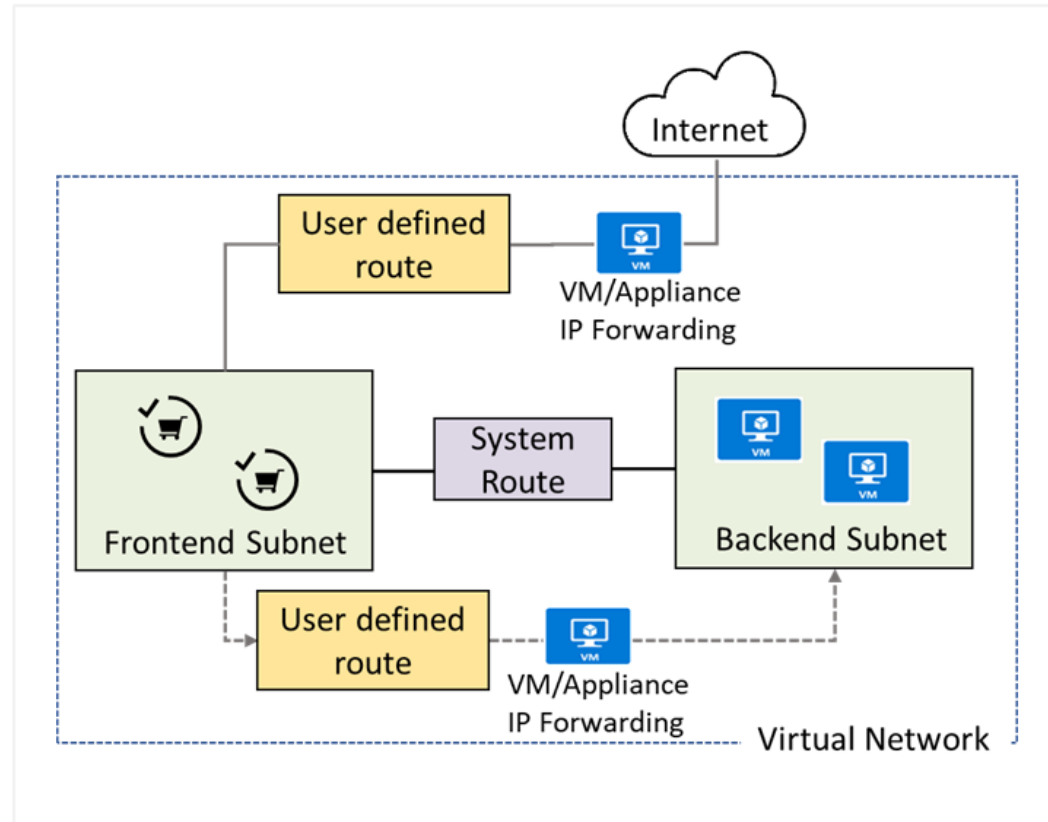


## User Defined Routes

A route table contains a set of rules, called routes, that specifies how packets should be routed in a virtual network

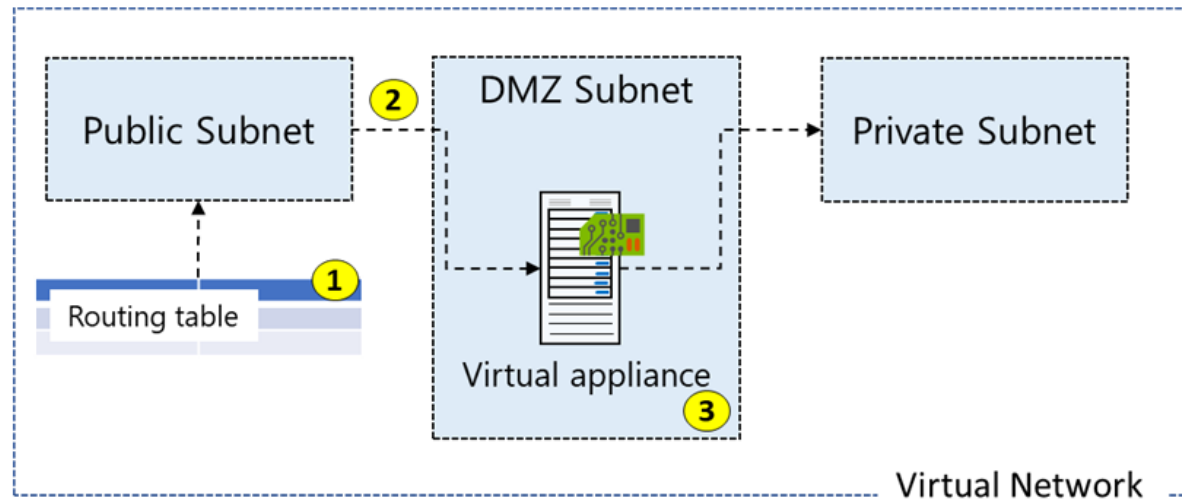
User-defined routes are custom routes that control network traffic by defining routes that specify the next hop of the traffic flow

The next hop can be a virtual network gateway, virtual network, internet, or virtual appliance



## Routing Example

All traffic coming into the public subnet and headed for the private subnet must go through the virtual network appliance



1. Create a routing table

2. Add a custom route that requires all private subnet traffic be directed to a network appliance

3. Associate the new route to the public subnet

## Create a Routing Table

A standard routing protocol is used to exchange routing and reachability information between two or more networks

Routes are automatically added to the route table of all subnets with virtual network gateway route propagation enabled

In most situations you will want to enable route propagation

### Create route table □ ×

You can add routes to this table after it's created.

---

\* Name  
 ✓

\* Subscription  
 ▼

\* Resource group  
 ▼  
[Create new](#)

\* Location  
 ▼

Virtual network gateway route propagation  
 Disabled  Enabled

---

[Automation options](#)

## Create a Custom Route

When you create a route there are several Next hop types

In this example, any private subnet IP addresses will be sent to the virtual appliance

Other choices are Virtual network gateway, Virtual network, Internet, and None

### Add route

myRouteTablePublic

Route name \*

Address prefix \* ⓘ

Next hop type ⓘ

- Virtual network gateway
- Virtual network gateway
- Virtual network
- Internet
- Virtual appliance**
- None

## Associate the Route Table

Each subnet can have zero or one route table associated to it

In our example, the Public subnet will be associated with the routing table

**Add subnet** ✕  
VNet1

**Name \***  
Public ✓

**Address range (CIDR block) \* ⓘ**  
10.0.1.0/24 ✓  
10.0.1.0 - 10.0.1.255 (251 + 5 Azure reserved addresses)

**NAT gateway ⓘ**  
None ▾

Add IPv6 address space

**Network security group**  
None ▾

**Route table**  
myRouteTablePublic ▾

# Service Endpoints

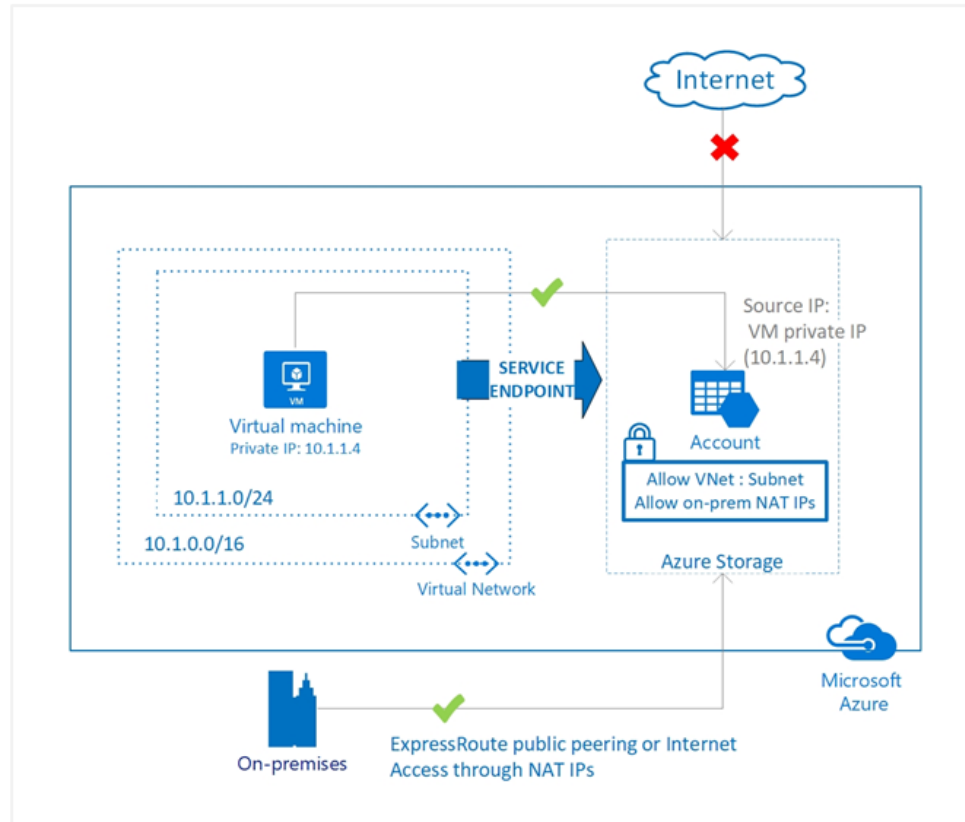
Endpoints limit network access to specific subnets and IP addresses

Improved security for your Azure service resources

Optimal routing for Azure service traffic from your virtual network

Endpoints use the Microsoft Azure backbone network

Simple to set up with less management overhead



# Service Endpoint Services

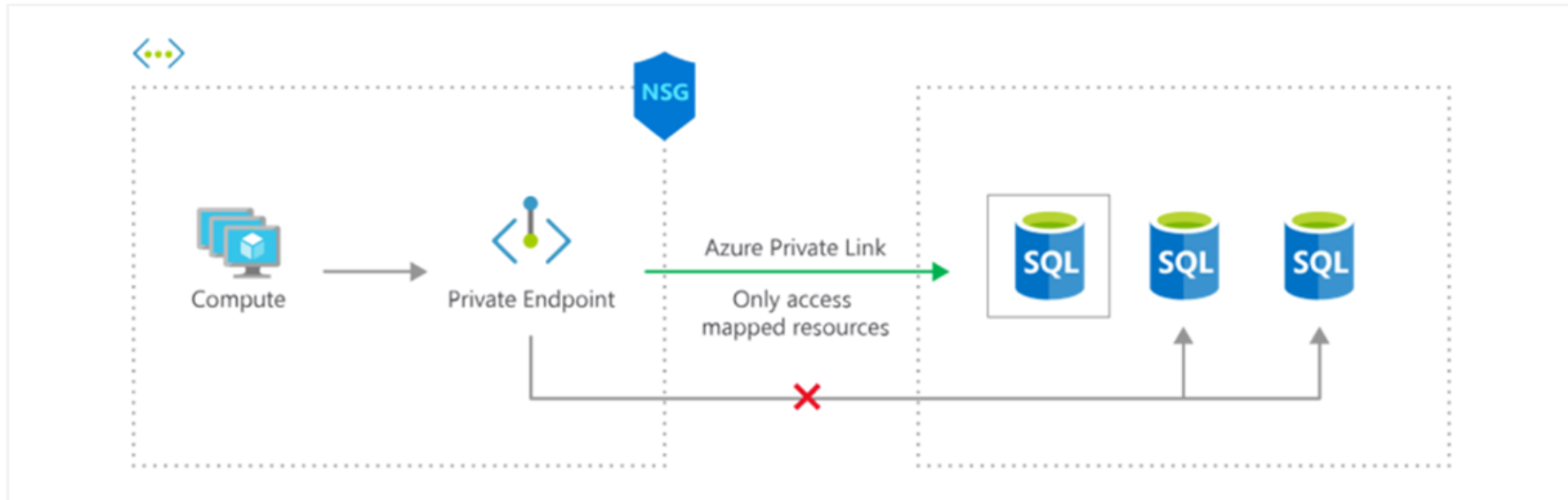
There are many types of service endpoints

The screenshot shows a dialog box titled "Add service endpoints" with a close button (X) in the top right corner. Below the title is a section labeled "Service \*". It contains a search input field with the text "Filter services" and a list of service names. The list includes: Microsoft.Storage, Microsoft.AzureActiveDirectory, Microsoft.AzureCosmosDB, Microsoft.CognitiveServices, Microsoft.ContainerRegistry, Microsoft.EventHub, Microsoft.KeyVault, Microsoft.ServiceBus, Microsoft.Sql, Microsoft.Storage (highlighted), and Microsoft.Web. At the bottom of the dialog is a blue "Add" button.



Adding service endpoints can take up to 15 minutes to complete

# Private Link



Private connectivity to services on Azure. Traffic remains on the Microsoft network, with no public internet access

Integration with on-premises and peered networks

In the event of a security incident within your network, only the mapped resource would be accessible

## Lesson 02: Azure Load Balancer



# Azure Load Balancer Overview



Azure Load Balancer



Backend Pools



Public Load Balancer



Load Balancer Rules



Internal Load Balancer



Session Persistence

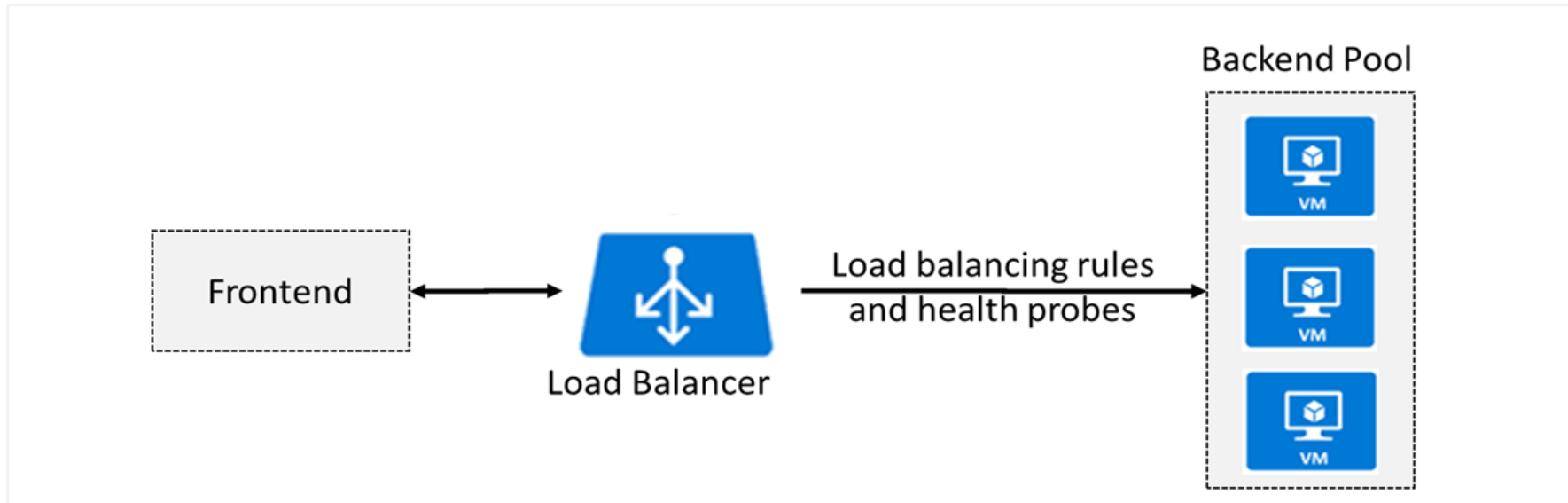


Load Balancer SKUs



Health Probes

# Azure Load Balancer

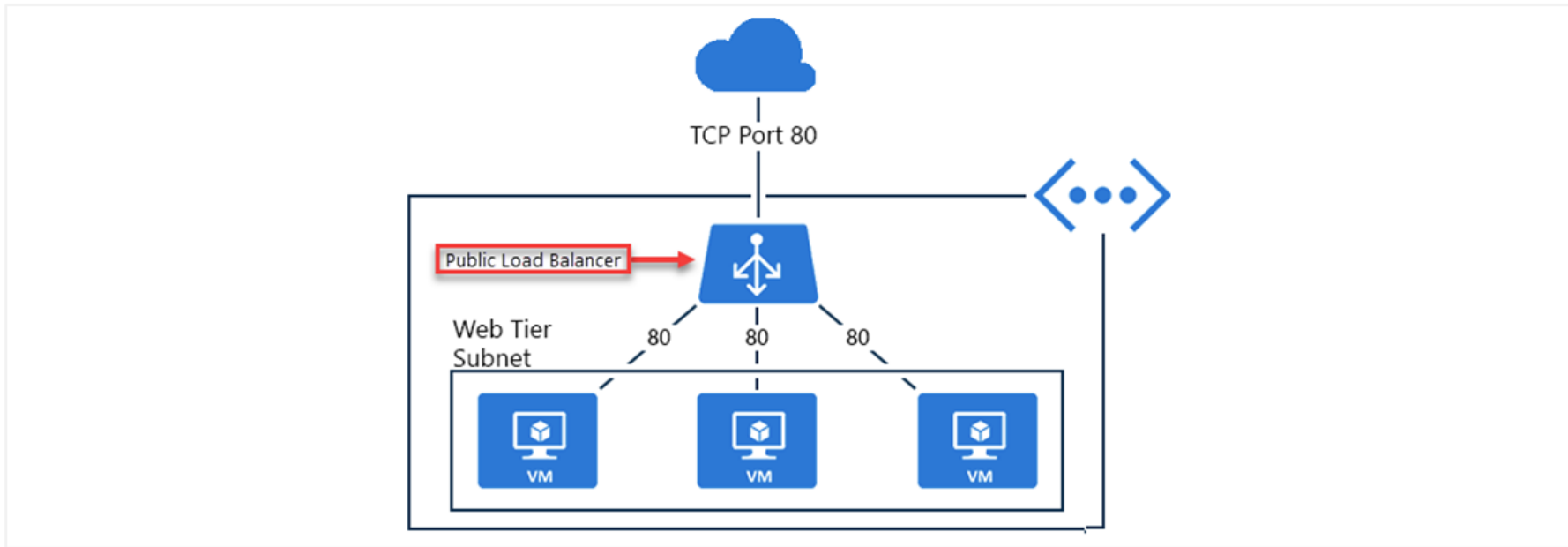


Distributes inbound traffic to backend resources using load-balancing rules and health probes

Can be used for both inbound/outbound scenarios

Two types: Public and Internal

# Public Load Balancer



Maps public IP addresses and port number of incoming traffic to the VM's private IP address and port number, and vice versa

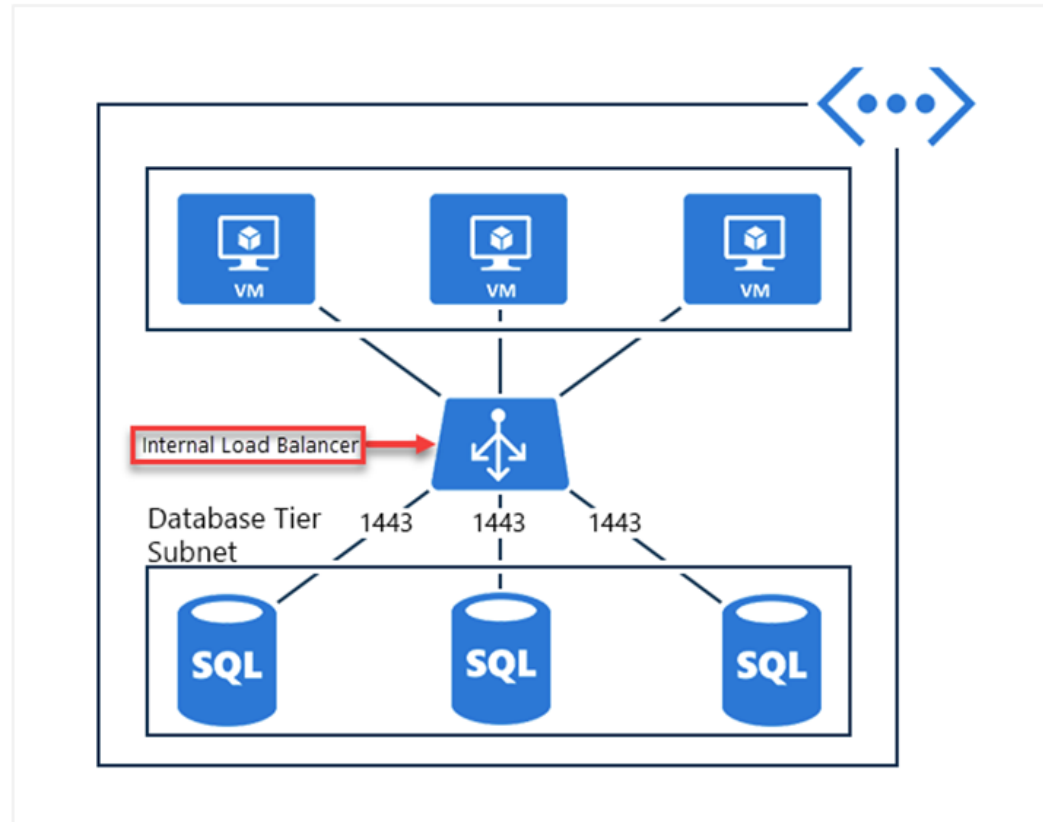
Apply load balancing rules to distribute traffic across VMs or services

## Internal Load Balancer

Directs traffic only to resources inside a virtual network or that use a VPN to access Azure infrastructure

Frontend IP addresses and virtual networks are never directly exposed to an internet endpoint

Enables load balancing within a virtual network, for cross-premises virtual networks, for multi-tier applications, and for line-of-business applications



## Load Balancer SKUs

Load balancer supports both Basic and Standard (newer) SKUs

SKUs are not mutable

Only Standard Load Balancer rules can span two virtual networks

No charge for the Basic Load Balancer SKU

### Instance details

Name \*

lb01 ✓

Region \*

(US) East US ↓

Type \* ⓘ

Internal  Public

SKU \* ⓘ

Basic  Standard

### Configure virtual network.

Virtual network \* ⓘ

vnet01 ↓

Subnet \*

subnet01 (10.1.0.0/24) ↓

[Manage subnet configuration](#)

IP address assignment \*

Static  Dynamic

## Backend Pools

SETTINGS

Backend pools

\* Name  
cesbackendpool

Associated to ⓘ

Unassociated ^

Unassociated

Availability set

Single virtual machine

Virtual machine scale set

SKU	Backend pool endpoints
Basic SKU	VMs in a single availability set or VM scale set
Standard SKU	Any VM in a single virtual network, including a blend of VMs, availability sets, and VM scale sets

To distribute traffic, a back-end address pool contains the IP addresses of the virtual NICs that are connected to the load balancer

## Load Balancer Rules

Maps a frontend IP and port combination to a set of backend IP addresses and port combination

Rules can be used in combination with NAT rules

A NAT rule is explicitly attached to a VM (or network interface) to complete the path to the target

**Add load balancing rule** ✕

lb01

Name \*  
lbr01 ✓

IP Version \*  
 IPv4  IPv6

Frontend IP address \* ⓘ  
10.1.0.4 (LoadBalancerFrontEnd) ▾

Protocol  
 TCP  UDP

Port \*  
80

Backend port \* ⓘ  
80

Backend pool ⓘ  
bep01 ▾

Health probe ⓘ  
hp01 (HTTP:80) ▾

Session persistence ⓘ  
None ▾

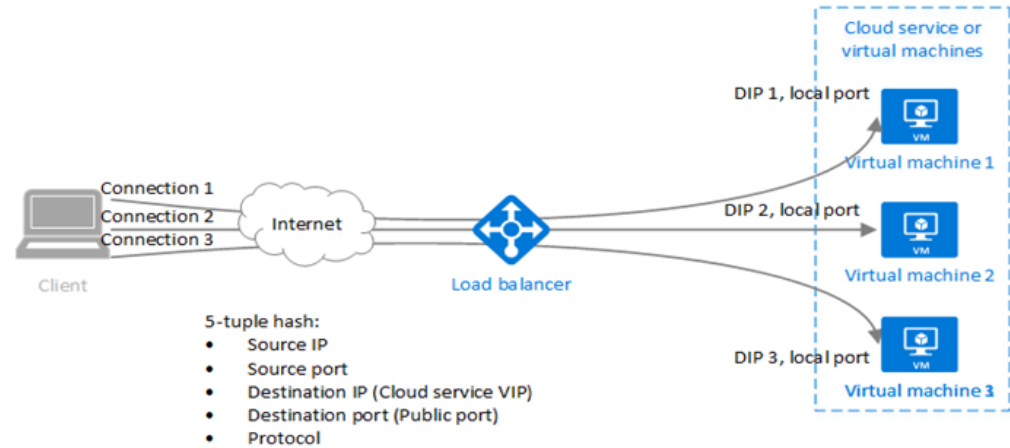
Idle timeout (minutes) ⓘ  
0 ————— 4

Floating IP (direct server return) ⓘ  
 Disabled  Enabled

# Session Persistence

Session persistence ⓘ

- None
- None
- Client IP
- Client IP and protocol



Session persistence specifies how client traffic is handled

**None** (default) requests can be handled by any virtual machine

**Client IP** requests will be handled by the same virtual machine

**Client IP and protocol** specifies that successive requests from the same address and protocol will be handled by the same virtual machine

# Health Probes

Allows the load balancer to monitor the status of an app

Dynamically adds or removes VMs from the load balancer rotation based on their response to health checks

HTTP custom probe (preferred) pings every 15 seconds

TCP custom probe tries to establish a successful TCP session

### Add health probe ✕

lb01

---

Name \*  ✓

Protocol ⓘ  ▾

Port \* ⓘ

Path \* ⓘ

Interval \* ⓘ  seconds

Unhealthy threshold \* ⓘ  consecutive failures

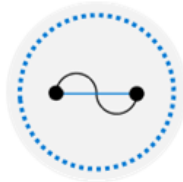
# Lesson 03: Azure Application Gateway



# Application Gateway Overview



Application Gateway

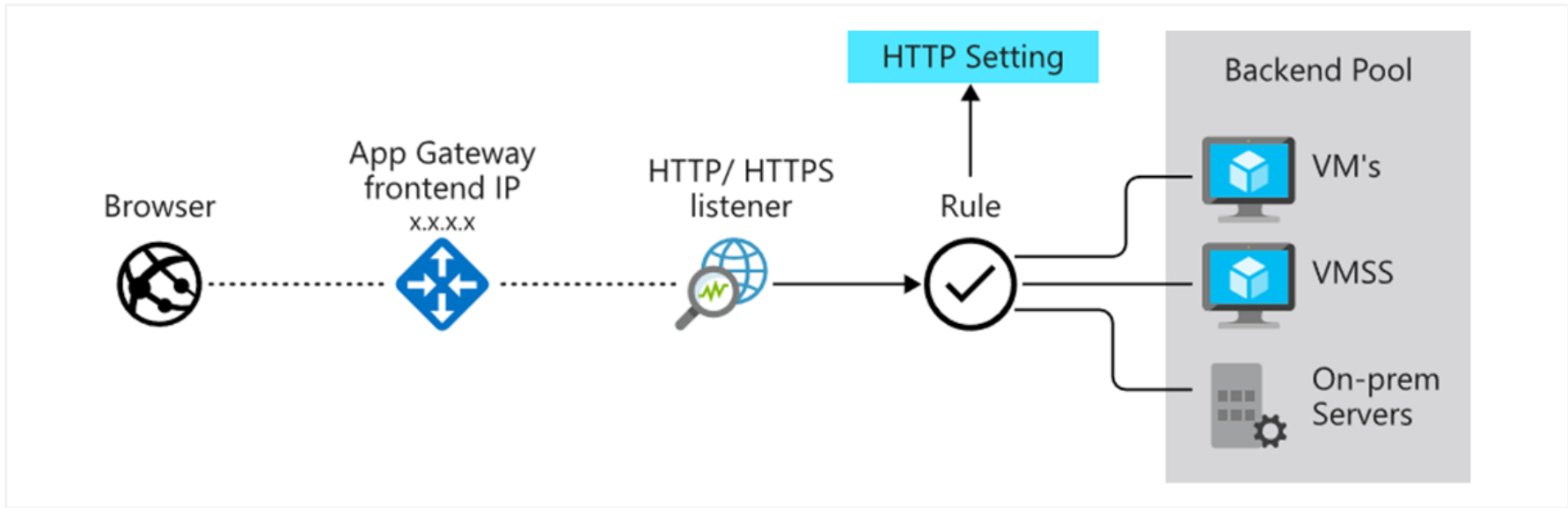


Application Gateway Routing



Application Gateway Configuration

# Application Gateway



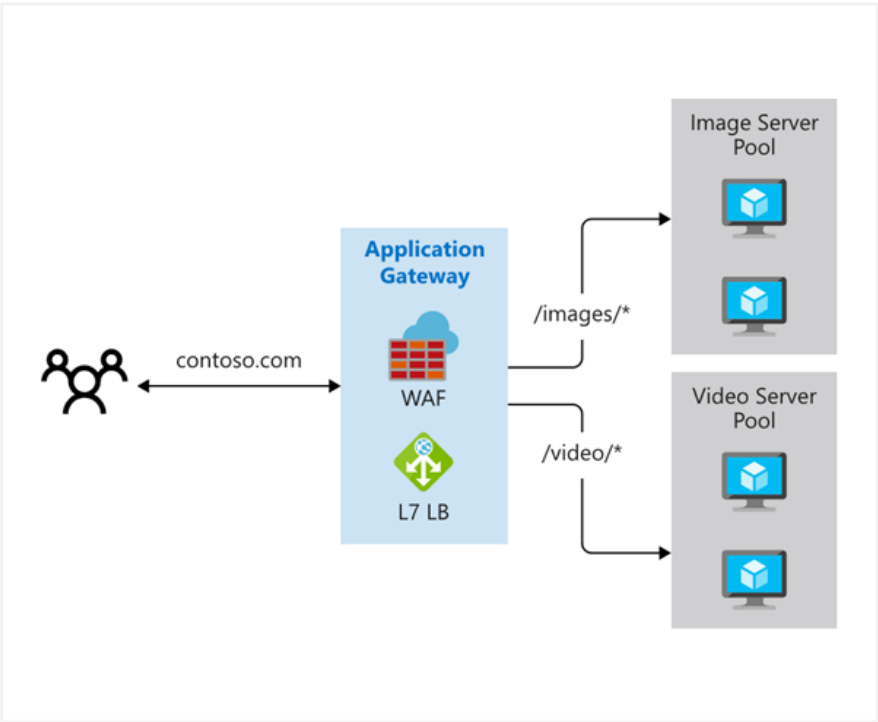
Manages web app requests

Routes traffic to a pool of web servers based on the URL of a request

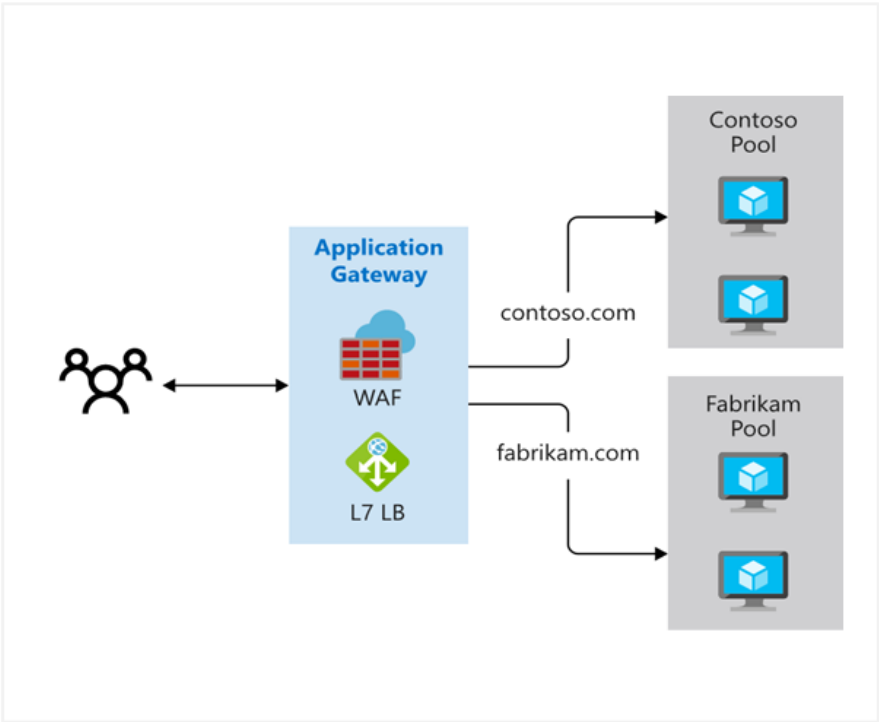
The web servers can be Azure virtual machines, Azure virtual machine scale sets, Azure App Service, and even on-premises servers

# Application Gateway Routing

Path-based routing

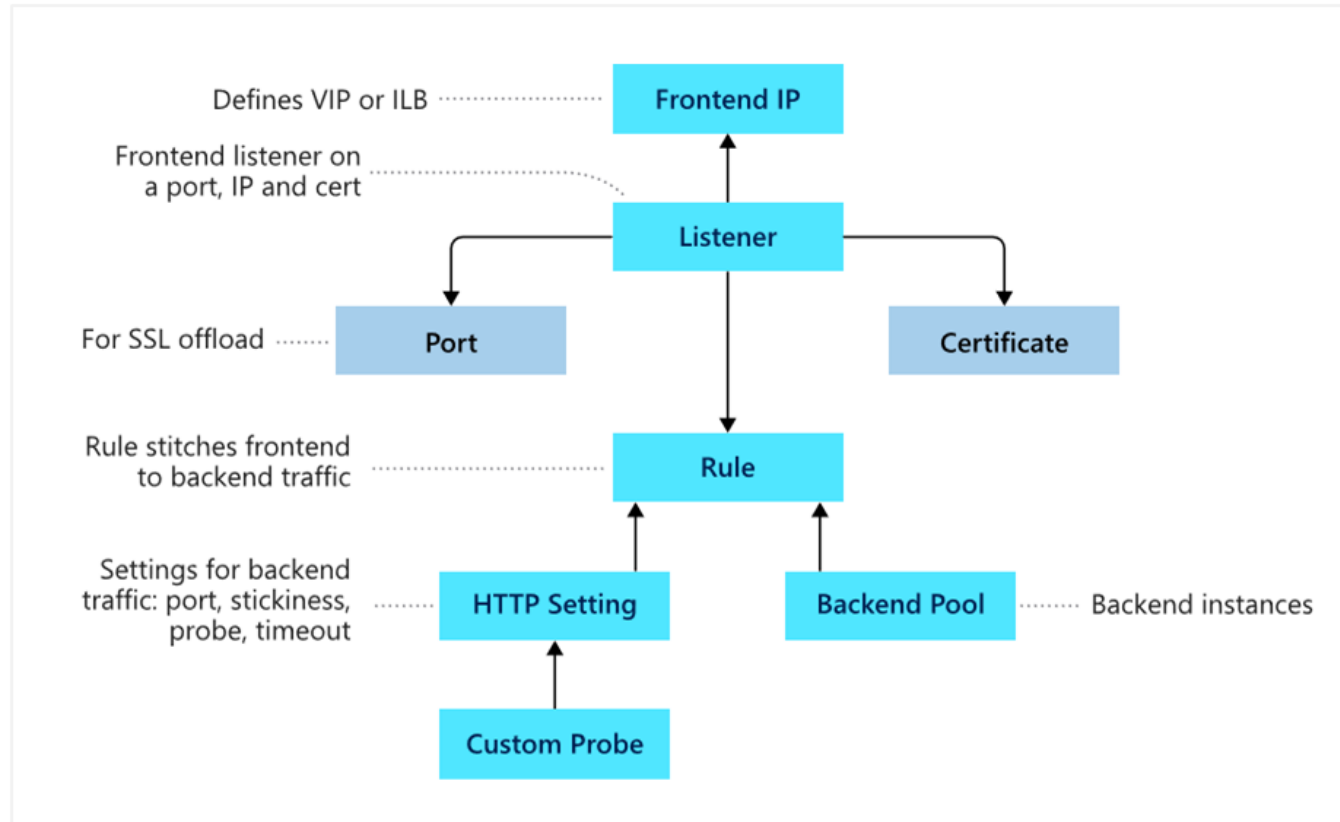


Multiple-site routing

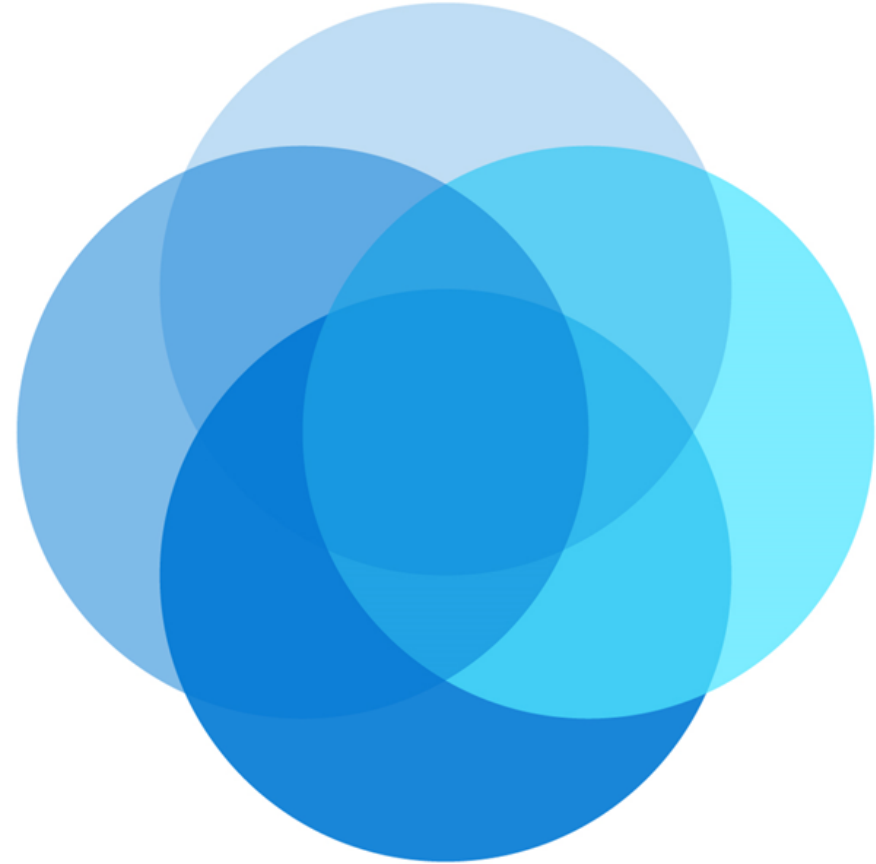


# Application Gateway Components

- Frontend IP
- Listeners
- Routing rules
- Backend pools
- Web application firewall (optional)
- Health probes



# Module 07: Azure Storage



## Module Overview



Lesson 01: Storage Accounts

---



Lesson 02: Blob Storage

---



Lesson 03: Storage Security

---



Lesson 04: Azure Files and File Sync

---



Lesson 05: Managing Storage

---

# Lesson 01: Storage Accounts



## Storage accounts overview



Azure Storage



Azure Storage Services



Storage Account Kinds



Replication Strategies



Accessing Storage



Securing Storage Endpoints

## Azure Storage

A service that you can use to store files, messages, tables, and other types of information

Durable, secure, scalable,  
managed, accessible

Storage for virtual  
machines, unstructured  
data and structured data

Two tiers: Standard (HDD  
magnetic drives) and  
Premium (SSD)

## Azure Storage Services

**Azure Containers:** A massively scalable object store for text and binary data

**Azure Files:** Managed file shares for cloud or on-premises deployments

**Azure Tables:** A NoSQL store for schemaless storage of structured data

**Azure Queues:** A messaging store for reliable messaging between application components



### Containers

Scalable, cost-effective storage for unstructured data

[Learn more](#)



### File shares

Serverless SMB file shares

[Learn more](#)



### Tables

Tabular data storage

[Learn more](#)



### Queues

Effectively scale apps according to traffic

[Learn more](#)

## Storage Account Kinds

Storage account type	Supported services	Supported tiers	Replication options
BlobStorage	Blob (block blobs and append blobs only)	Standard	LRS, GRS, RA-GRS
Storage (general purpose v1)	Blob, File, Queue, Table, and Disk	Standard, Premium	LRS, GRS, RA-GRS
StorageV2 (general purpose v2)	Blob, File, Queue, Table, and Disk	Standard, Premium	LRS, GRS, RA-GRS, ZRS, ZGRS (preview), RA-ZGRS (preview)
Block blob storage	Blob (block blobs and append blobs only)	Premium	LRS, ZRS (limited regions)
File Storage	Files only	Premium	LRS, ZRS (limited regions)



All storage accounts are encrypted using Storage Service Encryption (SSE) for data at rest

## Replication Strategies

Data Replication Options	Description
Locally redundant storage (LRS)	Data is replicated three times within a single facility in a single region
Zone-redundant storage (ZRS)	Data is replicated across multiple Availability Zones within one region
Geo-redundant storage (GRS)	Data is replicated three times within the primary region and replicated three times to the regions pair.
Read access geo-redundant storage (RA-GRS)	Data is replicated three times within the primary region and replicated with read-access to the region pair
Geo-zone-redundant storage (GZRS)	Data is replicated across three Availability Zones and replicated to the region pair
Read-access Geo-zone-redundant storage (RA-GZRS)	Data is replicated across three Availability Zones and replicated with read-access to the region pair

## Accessing Storage

Every object has a unique URL address – based on account name and storage type

CNAME record	Target
blobs.contoso.com	contosoblobs.blob.core.windows.net

Container service: <http://mystorageaccount.blob.core.windows.net>

Table service: <http://mystorageaccount.table.core.windows.net>

Queue service: <http://mystorageaccount.queue.core.windows.net>

File service: <http://mystorageaccount.file.core.windows.net>

If you prefer you can configure a custom domain name

# Securing Storage Account Endpoints

storage987123 | Firewalls and virtual networks  
Storage account

Search (Ctrl+/) Save Discard Refresh

Allow access from  
 All networks  Selected networks

Configure network security for your storage accounts. [Learn more.](#)

Virtual networks  
Secure your storage account with virtual networks. [+ Add existing virtual network](#) [+ Add new virtual network](#)

Virtual Network	Subnet	Address range	Endpoint Status	Resource Group
▼ vnet01	1			Demo
	subnet01	10.1.0.0/24	✓ Enabled	Demo

Firewalls and Virtual Networks allows for restricting access to the Storage Account from specific Subnets on Virtual Networks

Subnets and Virtual Networks must exist in the same Azure Region or Region Pair as the Storage Account

## Lesson 02: Blob Storage



# Blob Storage Overview



Blob Storage



Blob Containers



Blob Access Tiers



Blob Lifecycle Management



Uploading Blobs



Storage Pricing

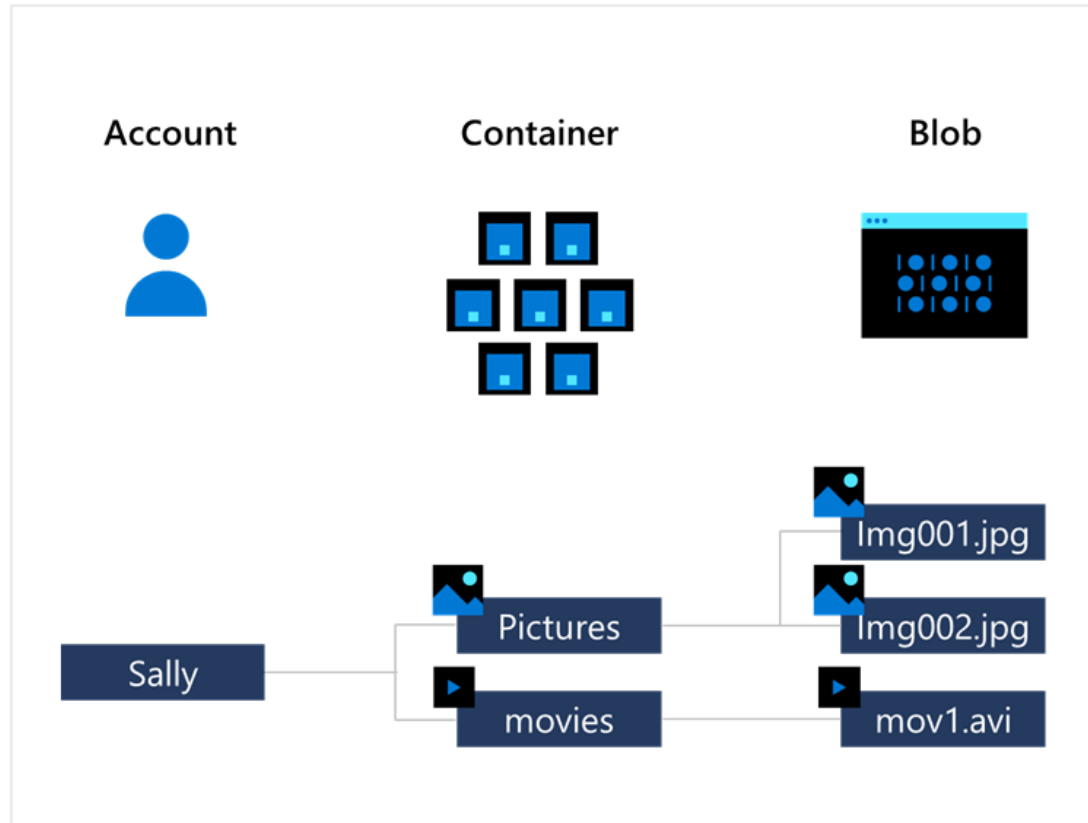
# Blob Storage

Stores unstructured data in the cloud

Can store any type of text or binary data

Also referred to as *object storage*

- Common uses:**
- Serving images or documents directly to a browser
  - Storing files for distributed access
  - Streaming video and audio
  - Storing data for backup and restore, disaster recovery, archiving
  - Storing data for analysis by an on-premises or Azure-hosted service



# Blob Containers

All blobs must be in a container

Accounts have unlimited containers

Containers can have unlimited blobs

**Private blobs** – no anonymous access

**Blob access** – anonymous public read access for blobs only

**Container access** – anonymous public read and list access to the entire container, including the blobs

The screenshot displays the 'New container' dialog in the Azure portal. At the top, there are navigation icons: a plus sign for 'Container', a lock for 'Change access level', a refresh icon for 'Refresh', and a trash can for 'Delete'. The main section is titled 'New container' and contains a 'Name \*' field with the text 'container01' and a green checkmark. Below this is a 'Public access level ⓘ' dropdown menu currently set to 'Private (no anonymous access)'. At the bottom of the dialog are 'OK' and 'Cancel' buttons. Below the dialog, a separate view shows the 'Public access level ⓘ' dropdown menu expanded, listing three options: 'Private (no anonymous access)' (highlighted), 'Blob (anonymous read access for blobs only)', and 'Container (anonymous read access for containers and blobs)'.

## Blob Access Tiers

**Hot tier** – Optimized for frequent access of objects in the storage account

**Cool tier** – Optimized for storing large amounts of data that is infrequently accessed and stored for at least 30 days

**Archive** – Optimized for data that can tolerate several hours of retrieval latency and will remain in the Archive tier for at least 180 days

### Access Tier

Optimize storage costs by placing your data in the appropriate access tier. |

Hot (Inferred) ^
Hot (Inferred)
Cool
Archive



You can switch between these access tiers at any time

# Blob Lifecycle Management

Transitioning of blobs to a cooler storage tier to optimize for performance and cost

Delete blobs at the end of their lifecycle

Apply rules to filtered paths in the Storage Account

Rule name \*  
rule01 ✓

**Blobs**

Move blob to cool storage  
Days after last modification  
30 ✓

Move blob to archive storage  
Days after last modification  
180 ✓

Delete blob  
Days after last modification  
365 ✓

**Snapshots**

Delete snapshot  
Days after blob is created  
30 ✓

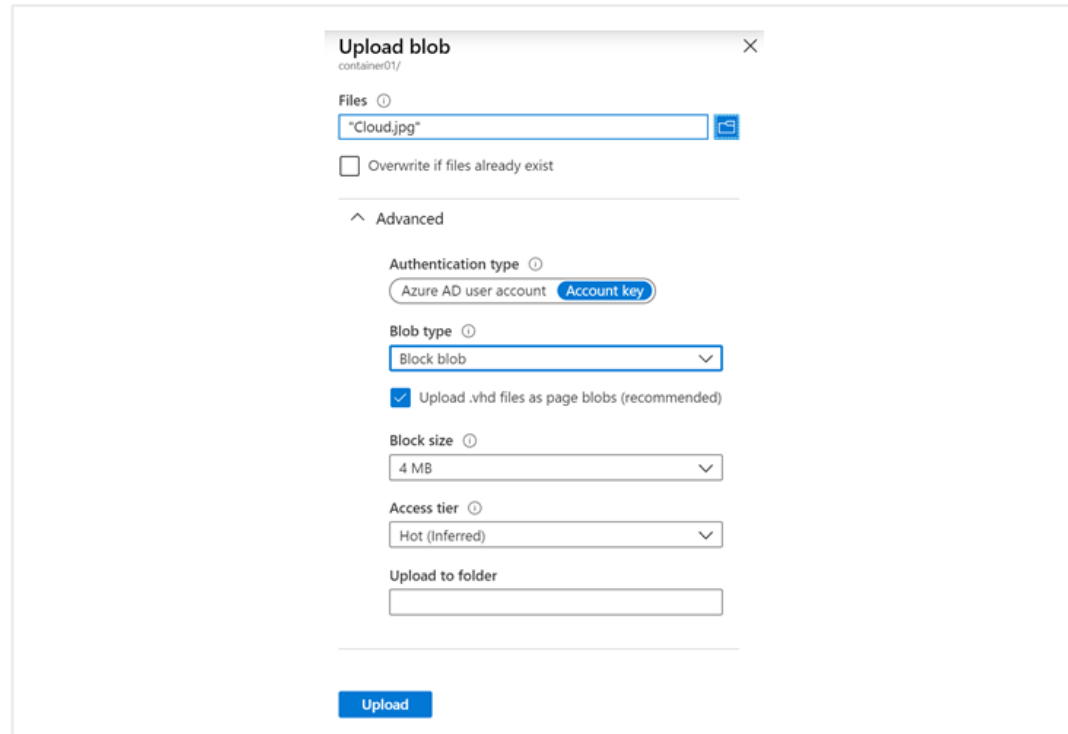
## Uploading Blobs

**Block blobs** (default) – useful for storing text or binary files

**Page blobs** – more efficient for frequent read/write operations

**Append blobs** – useful for logging scenarios

**Access tier** – select either Hot, Cool, or Archive



The screenshot shows the 'Upload blob' dialog box in Azure Storage Explorer. The dialog is titled 'Upload blob' and has a close button (X) in the top right corner. Below the title bar, there is a 'Files' section with a text input field containing the filename 'Cloud.jpg' and a file selection icon. Below the filename, there is a checkbox labeled 'Overwrite if files already exist' which is currently unchecked. The 'Advanced' section is expanded, showing several configuration options: 'Authentication type' is set to 'Account key' (with 'Azure AD user account' also visible); 'Blob type' is set to 'Block blob'; there is a checked checkbox for 'Upload .vhdx files as page blobs (recommended)'; 'Block size' is set to '4 MB'; 'Access tier' is set to 'Hot (Inferred)'; and there is an empty text input field for 'Upload to folder'. At the bottom of the dialog, there is a blue 'Upload' button.



You cannot change a blob type once it has been created

# Storage Pricing

- Storage costs
- Blob storage
- Data access costs
- Transaction costs
- Geo-Replication data transfer costs
- Outbound data transfer costs
- Changing the storage tier

### Block Blobs

Scalable object storage for documents, videos, pictures, and unstructured text or binary data. Choose from Hot, Cool, or Archive tiers.

---

Prices for locally redundant storage (LRS) Archive Block Blob start from:

**\$0.002**/GB per month

[See Pricing >](#)

### Files

Fully managed file shares in the cloud, accessible via standard Server Message Block (SMB) protocol. Enables sharing files between applications using Windows APIs or REST API.

---

Prices for LRS File storage start from:

**\$0.06**/GB per month

[See Pricing >](#)

## Lesson 03: Storage Security



# Storage Security Overview



Storage Security



Storage Service Encryption



Shared Access Signatures



Customer Managed Keys



URI and SAS Parameters



Storage Security Best Practices

## Storage Security



Storage Encryption Services

---



Authentication with Azure AD  
and RBAC

---



Client-side encryption, HTTPS,  
and SMB 3.0 for data in transit

---



Azure disk encryption



Shared Access Signatures –  
delegated access

---



Shared Key – encrypted  
signature string

---



Anonymous access to containers  
and blobs

# Shared Access Signatures

Provides delegated access to resources

Grants access to clients without sharing your storage account keys

The account SAS delegates access to resources in one or more of the storage services

The service SAS delegates access to a resource in just one of the storage services

\* Permissions ⓘ

Read ▼

Start and expiry date/time ⓘ

Start

2019-02-27 📅 7:32:03 AM

Expiry

2019-02-27 📅 3:32:03 PM

(UTC-08:00) --- Current Time Zone --- ▼ (UTC-08:00) --- Current Time Zone --- ▼

Allowed IP addresses ⓘ

for example, 168.1.5.65 or 168.1.5.65-168.1.5.70

Allowed protocols ⓘ

HTTPS  HTTP

Signing key ⓘ

Key 1 ▼

**Generate blob SAS token and URL**

## URI and SAS Parameters

- A SAS is a signed URI that points to one or more storage resources
- Consists of a storage resource URI and the SAS token



```
https://myaccount.blob.core.windows.net/?sp=r&st=2020-05-11T18:31:43Z&se=2020-05-12T02:31:43Z&spr=https&sv=2019-10-10&sr=b&sig=jOqABJZHfUveBQ3yVn7kWiCKl00sxCiK1rzEchfAz8U%3D
```

Includes parameters for resource URI, storage services version, services, resource types, start time, expiry time, resource, permissions, IP range, protocol, signature

# Storage Service Encryption

Protects your data for security and compliance

Automatically encrypts and decrypts your data

Encrypted through 256-bit AES encryption

Is enabled for all new and existing storage accounts and cannot be disabled

Is transparent to users

## Encryption

 Save  Discard

Storage service encryption protects your data at rest. Azure Storage encrypts your data as it's written in our datacenters, and automatically decrypts it for you as you access it.

By default, data in the storage account is encrypted using Microsoft Managed Keys. You may choose to bring your own key.

Please note that after enabling Storage Service Encryption, only new data will be encrypted, and any existing files in this storage account will retroactively get encrypted by a background encryption process.

[Learn More about Azure Storage Encryption](#) 

### Encryption type

- Microsoft Managed Keys
- Customer Managed Keys



You can use your own key (next topic)

# Customer Managed Keys

Use the Azure Key Vault to manage your encryption keys

Create your own encryption keys and store them in a key vault


Use Azure Key Vault's APIs to generate encryption keys

Custom keys give you more flexibility and control

Encryption type

Microsoft Managed Keys

Customer Managed Keys

**i** The storage account named 'storage987123' will be granted access to the selected key vault. Both soft delete and purge protection will be enabled on the key vault and cannot be disabled. [Learn more about customer managed keys](#) 

Encryption key

Enter key URI

Select from Key vault

Key vault and key \*

Key vault: keyvault987123  
Key: storagekey  
[Select a key vault and key](#)

## Storage Best Practices



Always use HTTPS to create or distribute an SAS

---



Reference stored access policies where possible

---



Use near-term expiration times on an ad hoc SAS

---



Have clients automatically renew the SAS if necessary

---



Be careful with SAS start time



Be specific with the resource to be accessed

---



Understand that your account will be billed for any usage

---



Validate data written using SAS

---



Don't assume SAS is always the correct choice

---



Use Storage Analytics to monitor your application

## Lesson 04: Azure Files and File Sync



# Azure Files and File Sync Overview



Files vs Blobs



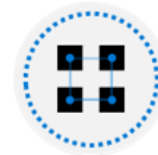
Managing File Shares



File Share Snapshots



Azure File Sync



Azure File Sync  
Components



File Sync Steps

## Files vs Blobs

Feature	Description	When to use
<b>Azure Files</b>	SMB interface, client libraries, and a REST interface that allows access from anywhere to stored files	<ul style="list-style-type: none"><li>• Lift and shift an application to the cloud</li><li>• Store shared data across multiple virtual machines</li><li>• Store development and debugging tools that need to be accessed from many virtual machines</li></ul>
<b>Azure Blobs</b>	Client libraries and a REST interface that allows unstructured data (flat namespace) to be stored and accessed at a massive scale in block blobs	<ul style="list-style-type: none"><li>• Support streaming and random-access scenarios</li><li>• Access application data from anywhere</li></ul>

# Managing File Shares

File share quotas

Windows – ensure port 445 is open

Linux – mount the drive

MacOS – mount the drive

Secure transfer required – SMB 3.0 encryption

Windows Linux macOS




Drive letter

To connect to this Azure file share from Windows, run these PowerShell commands from a normal (not elevated) PowerShell terminal:

```
$connectTestResult = Test-NetConnection -  
ComputerName storage987123.file.core.windows.net -  
Port 445  
if ($connectTestResult.TcpTestSucceeded) {  
    # Save the password so the drive will persist on reboot  
    cmd.exe /C "cmdkey  
/add:"storage987123.file.core.windows.net"
```

This script will check to see if this storage account is accessible via TCP port 445, which is the port SMB uses. If port 445 is available, your Azure file share will be persistently mounted. Your organization or internet service provider (ISP) may block port 445, however you may use Azure [Point-to-Site \(P2S\) VPN](#), Azure [Site-to-Site \(S2S\) VPN](#), or [ExpressRoute](#) to tunnel SMB traffic to your Azure file share over a different port.

## File Share Snapshots

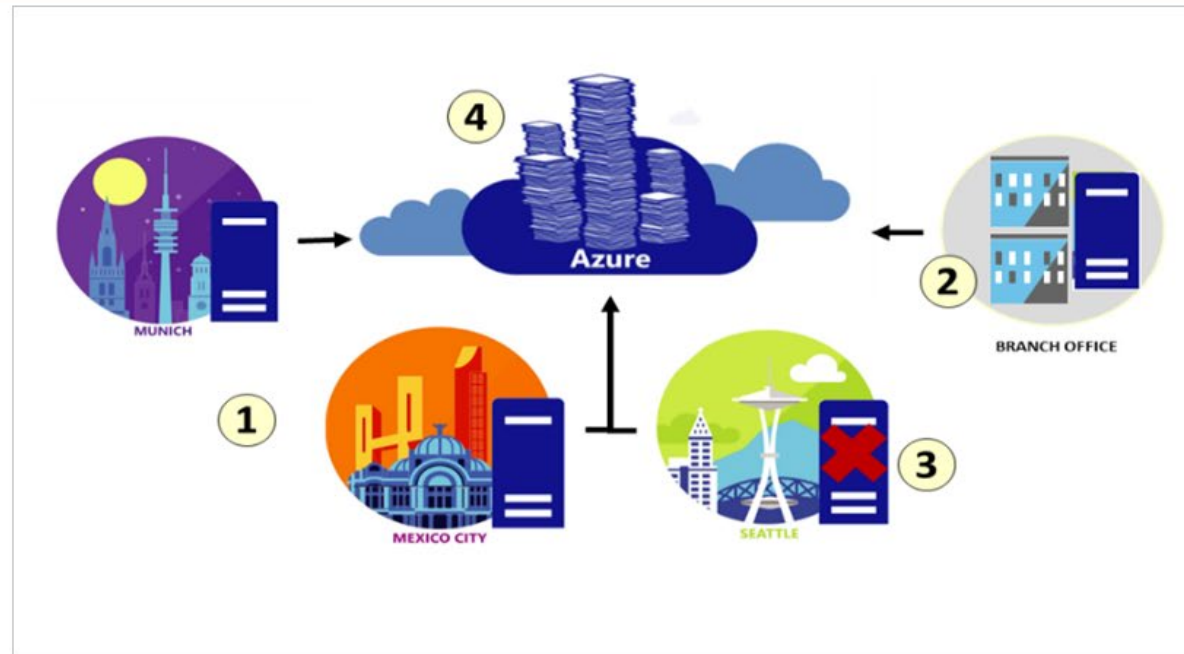
 Add snapshot			 Refresh	 Delete
Name	Date created	Initiator		
<input type="checkbox"/> 2020-03-12T00:58:38.0000000Z	3/11/2020, 8:58:38 PM	-		

Incremental snapshot that captures the share state at a point in time	Is read-only copy of your data	Snapshot at the file share level, and restore at the file level	Uses: <ul style="list-style-type: none"><li>• Protection against application error and data corruption</li><li>• Protection against accidental deletions or unintended changes</li><li>• General backup purposes</li></ul>
---	--------------------------------	---	--

# Azure File Sync

Centralize your organization's file shares in Azure Files, while keeping the flexibility, performance, and compatibility of an on-premises file server

1. Lift and shift
2. Branch Office backups
3. Backup and Disaster Recovery
4. File Archiving



# File Sync Components

The **Storage Sync Service** is the top-level resource

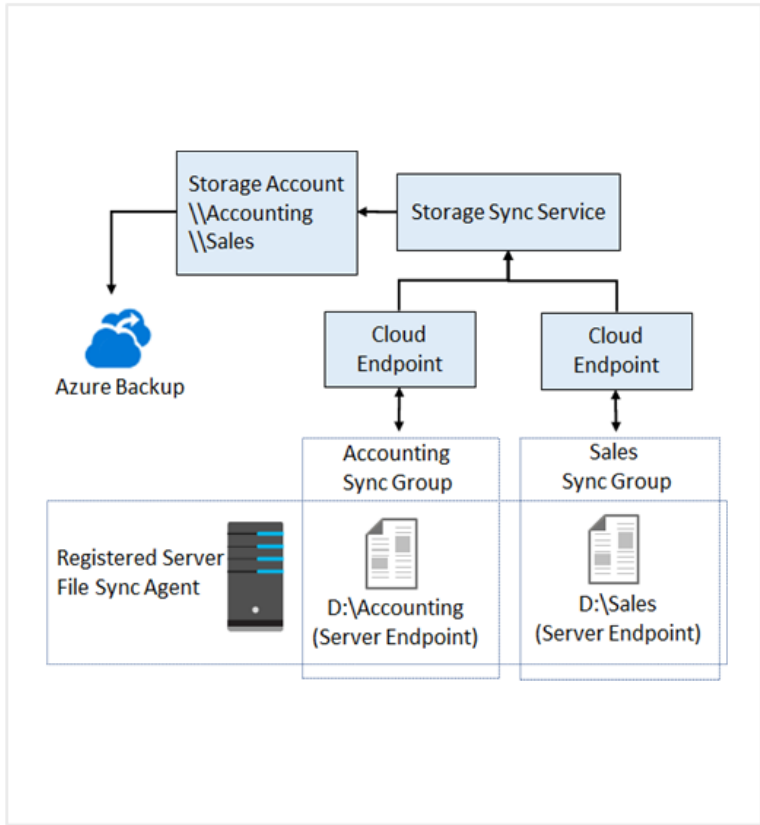
The **registered server** object represents a trust relationship between your server (or cluster) and the Storage Sync Service

The **Azure File Sync agent** is a downloadable package that enables Windows Server to be synced with an Azure file share

A **server endpoint** represents a specific location on a registered server, such as a folder

A **cloud endpoint** is an Azure file share

A **sync group** defines which files are kept in sync



# File Sync Steps



Home > Deploy Storage Sync

### Deploy Storage Sync

\* Name  
StorageSync1 ✓

\* Subscription  
Visual Studio Enterprise

\* Resource group  
ASH

Create new

\* Location  
South Central US

Create Automation options

### Microsoft Azure File Sync - Server Registration

#### Choose a Storage Sync Service

Azure Subscription

Resource Group

Storage Sync Service

Register

# Lesson 05: Managing Storage



## Managing Storage Overview



Storage Explorer



Import and Export Service



AzCopy



Demonstration – Storage Explorer

# Storage Explorer

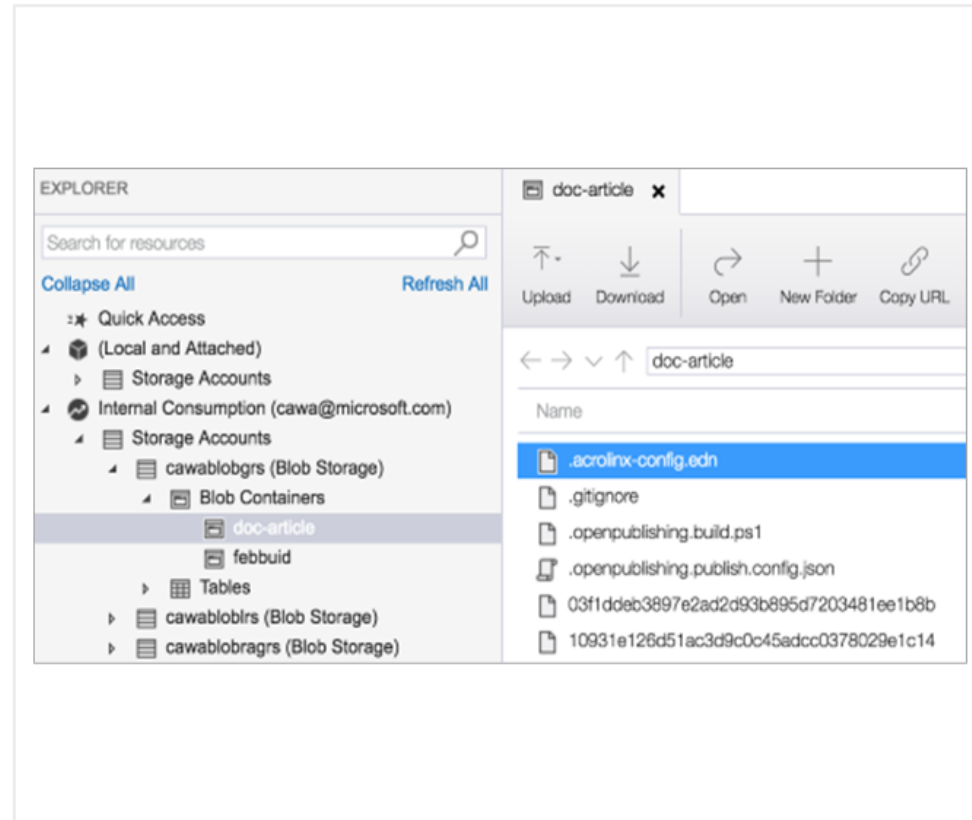
Access multiple accounts and subscriptions

Create, delete, view, edit storage resources

View and edit Blob, Queue, Table, File, Cosmos DB storage and Data Lake Storage

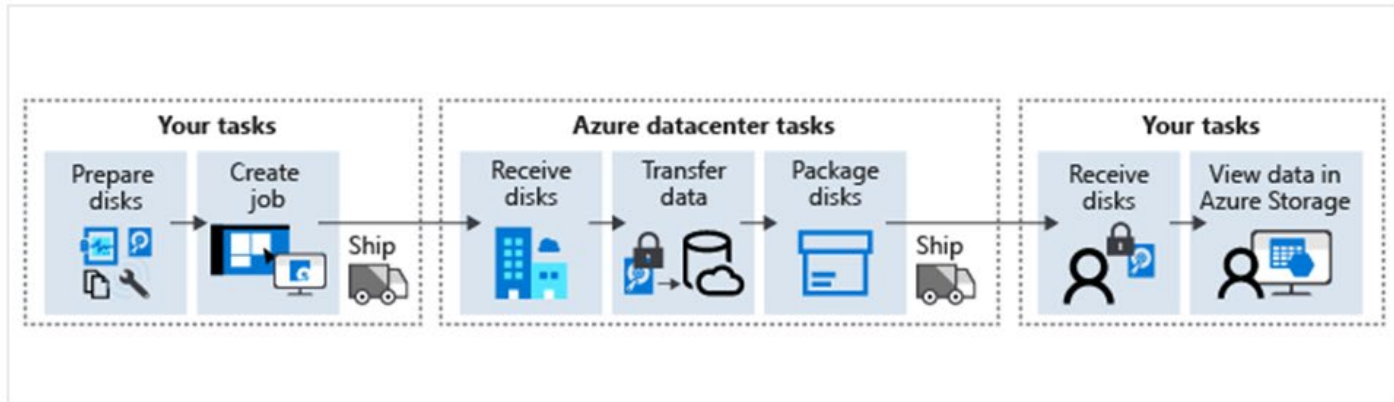
Obtain shared access signature (SAS) keys

Available for Windows, Mac, and Linux

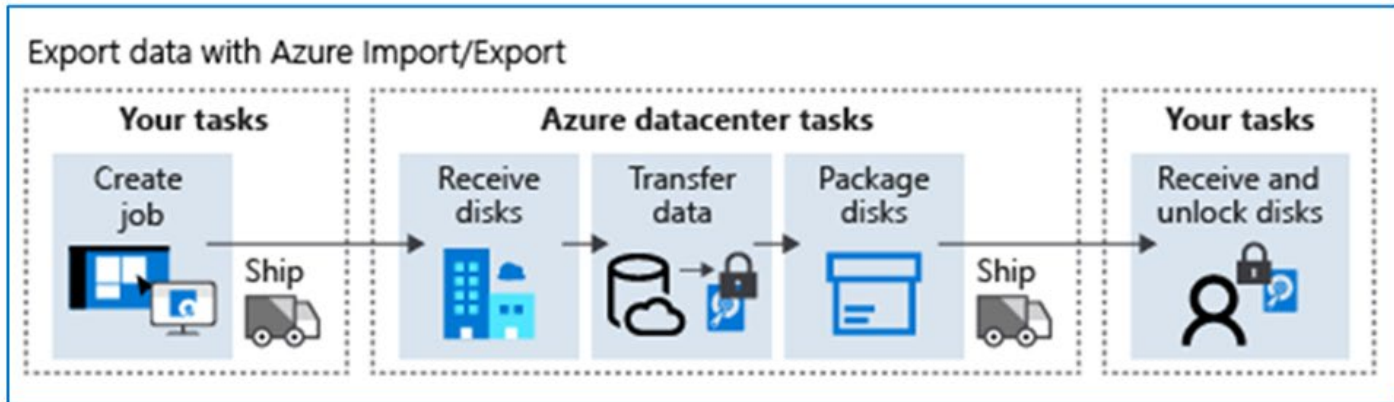


# Import and Export Service

**Import jobs** move large amounts of data to Azure blob storage or files



**Export jobs** move large amounts of data from Azure Storage (not files)



## AzCopy

```
azcopy copy [source] [destination] [flags]
```

Command line utility

Designed for copying data to and from Azure Blob, File, and Table storage

Available on Windows, Linux, and MacOS

Authentication options include Active Directory or SAS token

# Module 08: Azure Virtual Machines



## Module Overview



Lesson 01: Virtual Machine Planning

---



Lesson 02: Creating Virtual Machines

---



Lesson 03: Virtual Machine Availability

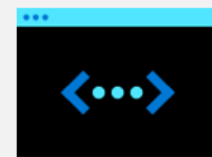
---



Lesson 04: Virtual Machine Extensions

---

# Lesson 01: Virtual Machine Planning



# Virtual Machine Planning Overview



IaaS Cloud Services



Virtual Machine Disks



Planning Checklist



Storage Options



Location and Pricing



Supported Operating  
Systems

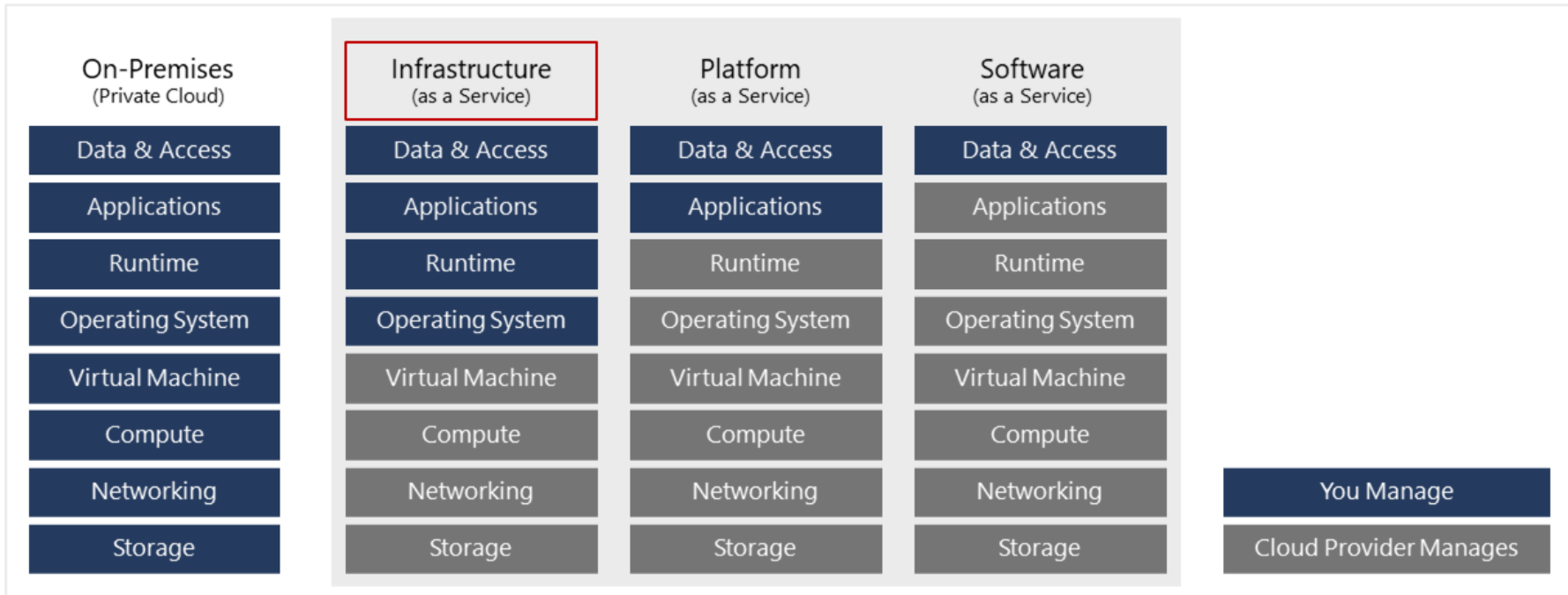


Virtual Machine Sizing



Virtual Machine  
Connections

# IaaS Cloud Services



Test and development, website hosting, storage, backup, recovery, high-performance computing, big data analysis, and extended data center

# Planning Checklist



Start with the network

---



Name the VM

---



Decide the location for the VM

---



Determine the size of the VM



Understand the pricing model

---



Consider storage for the VM

---



Select an operating system

## Location and Pricing

### Location:

Each region has different hardware and service capabilities

Locate Virtual Machines as close as possible to your users

Locate Virtual Machines to ensure compliance and legal obligations

### Pricing:

Compute costs

Storage costs (consumption-based and reserved instances)



60+ Azure regions  
Available in 140 countries

## Virtual Machine Sizing

**A Series** - Entry-level for dev/test

**Bs Series** – Economical bursting

**D Series** – General purpose compute

**Dc Series** – Protect data in use

**E Series** – In-memory hyper-threaded applications optimized

**F Series** – Compute optimized

**G Series** – Memory and storage optimized

**H Series** - High performance computing

**Ls Series** – Storage optimized

**M Series** – Memory optimized

**Mv2 Series** – Largest memory optimized

**N Series** – GPU enabled

## Virtual Machine Disks

NAME	SIZE	STORAGE ACCOUNT...	ENCRYPTION	HOST CACHING
UbuntuServer_OsDisk_1_	30 GiB	Standard_LRS	Not enabled	Read/write

**Operating System Disks** are SATA drives, labeled as C:

**Temporary Disks** provides short term storage

**Data Disks** are SCSI drives and depend on your virtual machine type

## Storage Options



Premium storage offers high-performance, low-latency SSD disk support

---



Use premium storage for Virtual Machines with input/output (I/O)-intensive workloads

---



**Two types of disks: Unmanaged and Managed:**

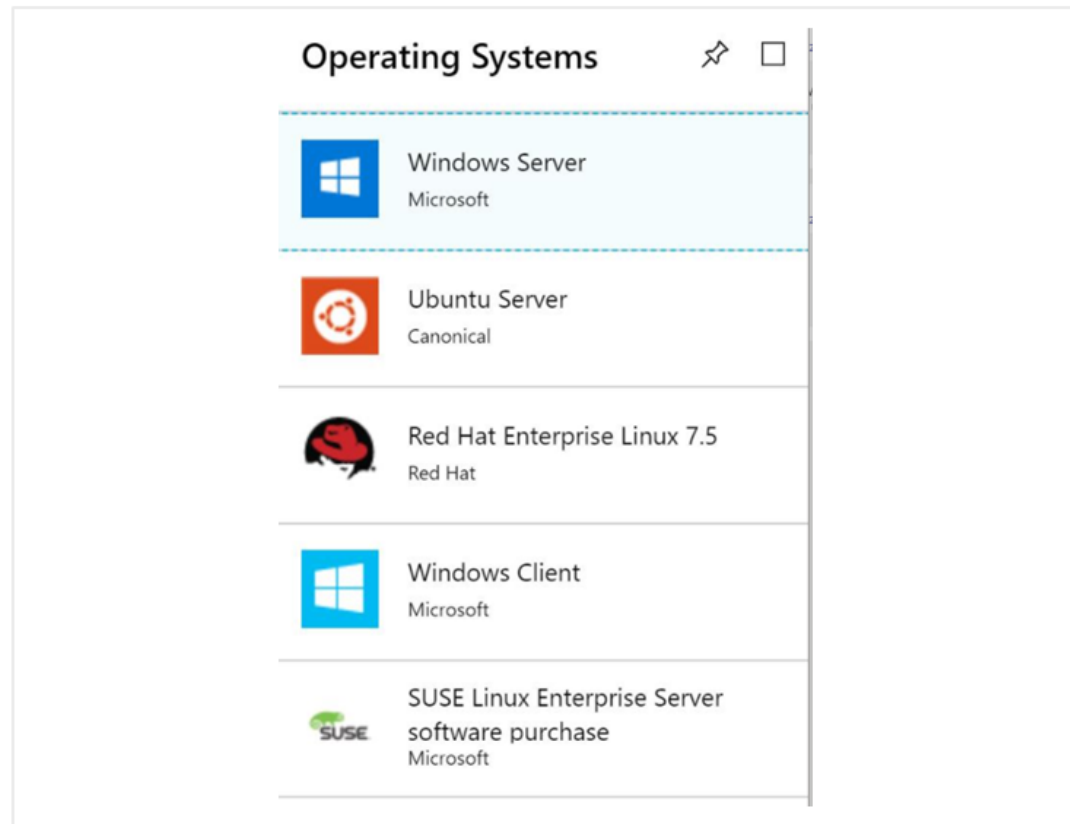
Unmanaged disks require you to manage the storage accounts and VHDs

Managed disks are maintained by Azure (recommended)

## Supported Operating Systems

Windows Server includes many common products, requires a license, doesn't support OS upgrades

Linux distributions are supported, upgrade of the OS is supported

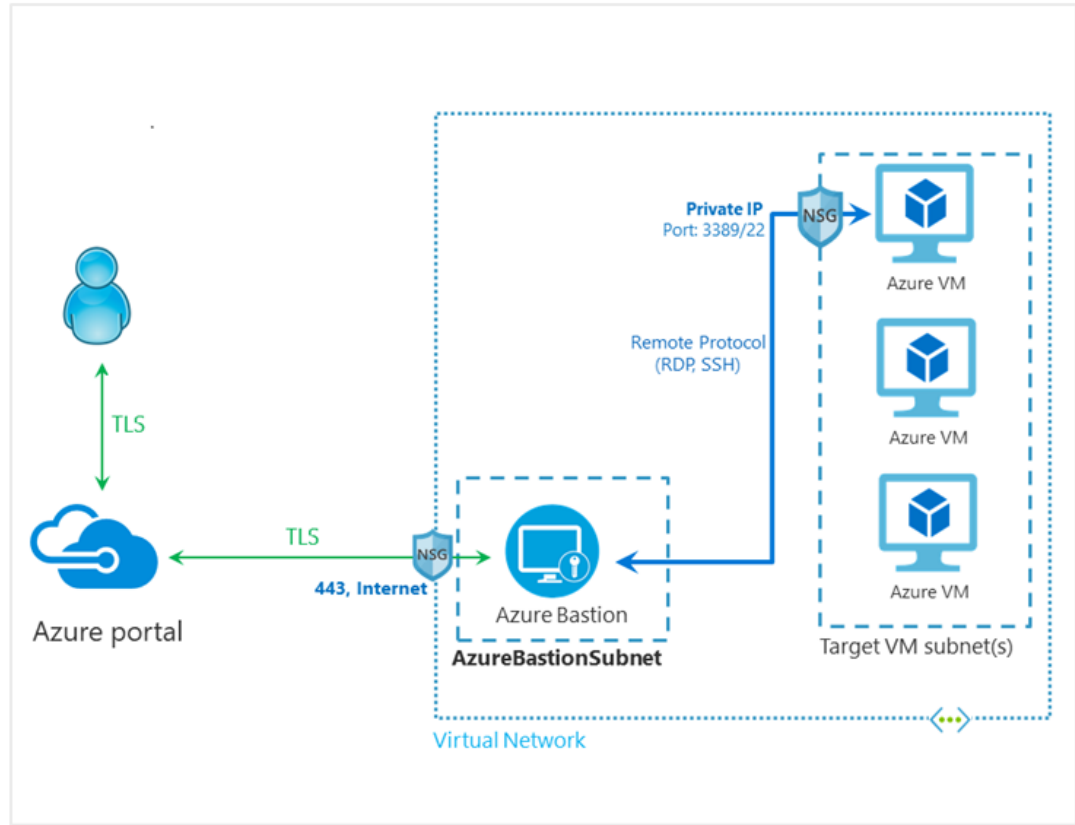


# Virtual Machine Connections

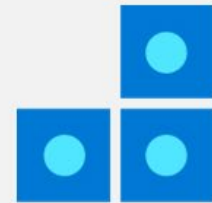
Remote Desktop Protocol for Windows-based Virtual Machines

Secure Shell Protocol for Linux based Virtual Machines

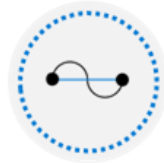
Bastion Subnet for RDP/SSH through the Portal over SSL



## Lesson 02: Creating Virtual Machines



# Creating Virtual Machines Overview



Creating Virtual Machines  
in the Portal



Linux Virtual  
Machines



Windows Virtual Machines



Linux VM  
Connections



Windows VM Connections

# Creating Virtual Machines in the Portal

**Basic (required)** – Project details, Administrator account, Inbound port rules

**Disks** – OS disk type, data disks

**Networking** – Virtual networks, load balancing

**Management** – Monitoring, Auto-shutdown, Backup

**Advanced** – Add additional configuration, agents, scripts or applications

The screenshot shows the 'Create a virtual machine' wizard in a portal. The title is 'Create a virtual machine'. Below the title is a navigation bar with tabs: 'Basics' (selected), 'Disks', 'Networking', 'Management', 'Advanced', 'Tags', and 'Review + create'. The main content area shows a dropdown menu for selecting an operating system. The dropdown is open, showing a list of options: 'Ubuntu Server 18.04 LTS' (highlighted), 'Ubuntu Server 18.04 LTS', 'Red Hat Enterprise Linux 7.7', 'SUSE Enterprise Linux 15 SP1', 'CentOS-based 7.7', 'Debian 10 "Buster" with backports kernel', 'Oracle Linux 7.7', 'Ubuntu Server 16.04 LTS', 'Windows Server 2019 Datacenter', 'Windows Server 2016 Datacenter', 'Windows Server 2012 R2 Datacenter', and 'Windows 10 Pro, Version 1809'.

# Windows Virtual Machines

Unique hybrid capabilities

Advanced multi-layer security

Faster innovation for applications

Unprecedented hyper-converged infrastructure

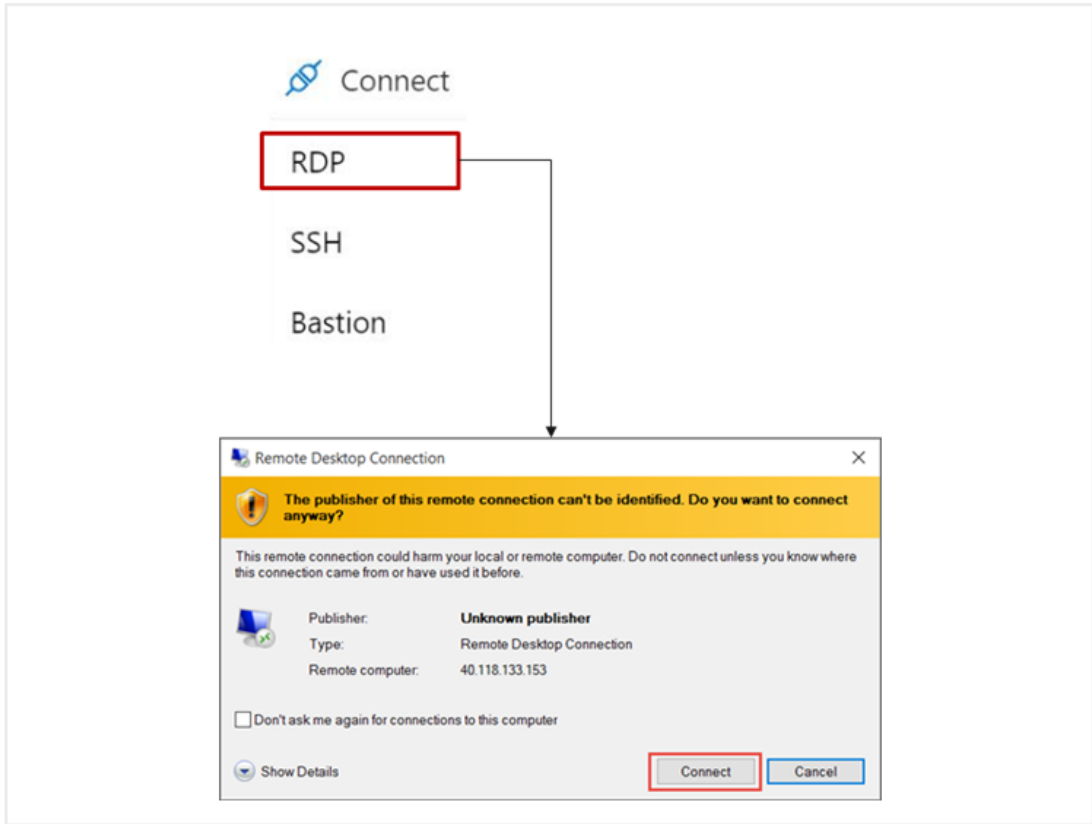
The screenshot displays a grid of four virtual machine (VM) images available for purchase or download. Each image card includes a logo, the product name, the provider, a brief description, a rating (where applicable), and a 'Get it now' button with a heart icon for favorites.

Image Name	Provider	Description	License
Windows Server	Microsoft	Windows Server	Bring your own license
IIS on Windows Server 2016	Apps4rent LLC	PCI DSS v3.1 compliant IIS Server	Bring your own license
SQL Server 2016 SP1 on Windows Server 2016	Microsoft	SQL Server 2016 SP1 Images on windows server 2016	Bring your own license
Pyramid 2018 - Windows Server	Pyramid Analytics	Pyramid 2018 Windows Server2016	Bring your own license





# Windows VM Connections

**Remote Desktop Protocol (RDP)** creates a GUI session and accepts inbound traffic on TCP port 3389

**WinRM** creates a command-line session so can run scripts



# Linux Virtual Machines

 <b>Debian Linux</b> By creativ Debian GNU/Linux for Microsoft Azure provided by creativ.  Software plans start at <b>Free</b>  <a href="#">Get it now</a>	 <b>Clear Linux OS</b> By Clear Linux Project A reference Linux distribution optimized for Intel Architecture.  <b>Bring your own license</b>  <a href="#">Get it now</a>	 <b>SUSE Linux Enterprise Server</b> By SUSE SUSE Linux Enterprise Server  Software plans start at <b>Free</b>  <a href="#">Get it now</a>	 <b>Red Hat Enterprise Linux 7.4</b> By Red Hat Red Hat Enterprise Linux 7 is the world's leading enterprise Linux platform built to meet the needs of toda...  <a href="#">Get it now</a>
--	---	--	--

Hundreds of community-built images in the Azure Marketplace

Linux has the same deployment options as for Windows VMs

Manage Linux VMs with many popular open-source DevOps tools

# Linux VM Connections

Administrator account

Authentication type

Username \* ⓘ

SSH public key \* ⓘ

[i Learn more about creating and using SSH keys in Azure](#)

*Note: A tooltip is present over the Username field with the text: "Provide an RSA public key in the single-line format (starting with "ssh-rsa") or the multi-line PEM format. You can generate SSH keys using ssh-keygen on Linux and OS X, or PuTTYGen on Windows."*

Authenticate with a SSH public key or password

SSH is an encrypted connection protocol that allows secure logins over unsecured connections

There are public and private keys

## Lesson 03: Virtual Machine Availability



# Virtual Machine Availability Overview



Maintenance and Downtime



Availability Sets



Update and Fault Domains



Availability Zones



Scaling Concepts



Scale Sets



Implementing Scale Sets



Autoscale



Implementing Autoscale

## Maintenance vs. Downtime

### Unplanned Hardware Maintenance

When the platform predicts a failure, it will issue an **unplanned hardware maintenance** event

**Action:** Live migration

### Unexpected Downtime

**Unexpected Downtime** is when a virtual machine fails unexpectedly

**Action:** Automatically migrate (heal)

### Planned Maintenance

**Planned Maintenance** events are periodic updates made to the Azure platform

**Action:** No action

# Availability Sets

**Instance details**

Name \* ⓘ

Region \* ⓘ

Fault domains ⓘ

Update domains ⓘ

Use managed disks ⓘ

Two or more instances in Availability Sets = 99.95% SLA

Configure multiple Virtual Machines in an Availability Set

Configure each application tier into separate Availability Sets

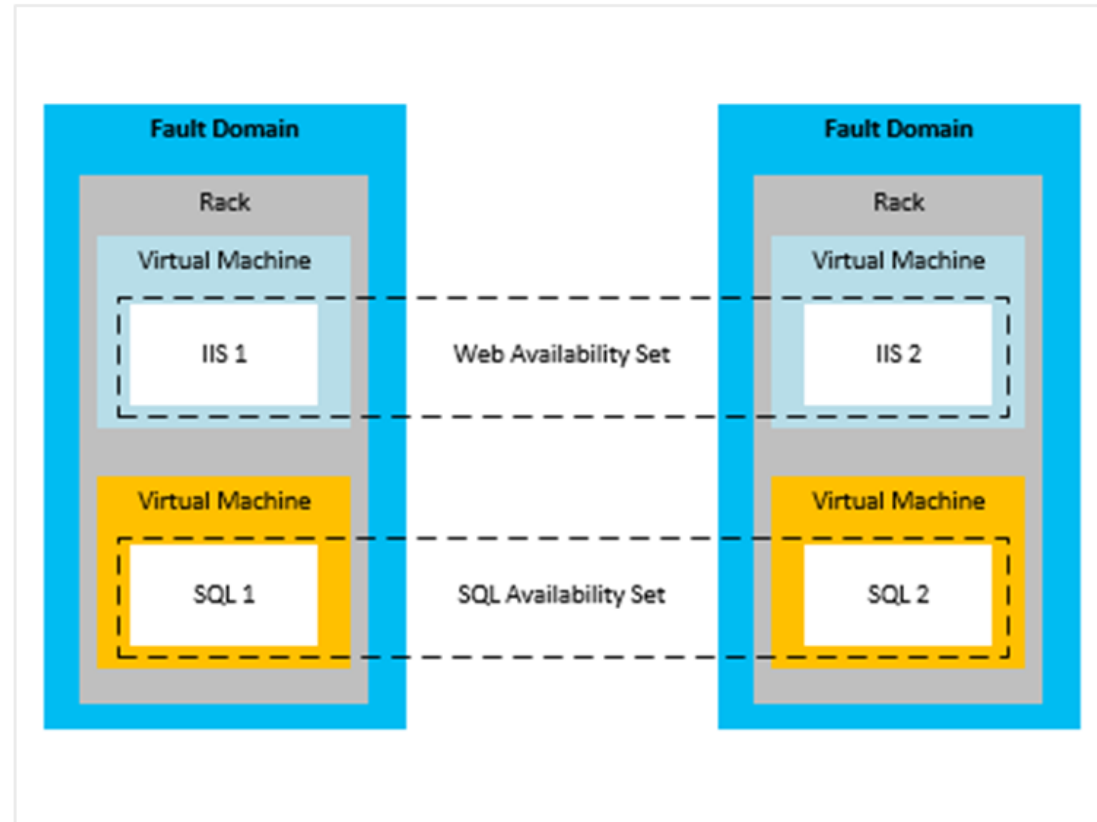
Combine a Load Balancer with Availability Sets

Use managed disks with the Virtual Machines

## Update and Fault Domains

**Update domains** allows Azure to perform incremental or rolling upgrades across a deployment. During planned maintenance, only one update domain is rebooted at a time

**Fault Domains** are a group of Virtual Machines that share a common set of hardware, switches, that share a single point of failure. VMs in an availability set are placed in at least two fault domains



# Availability Zones

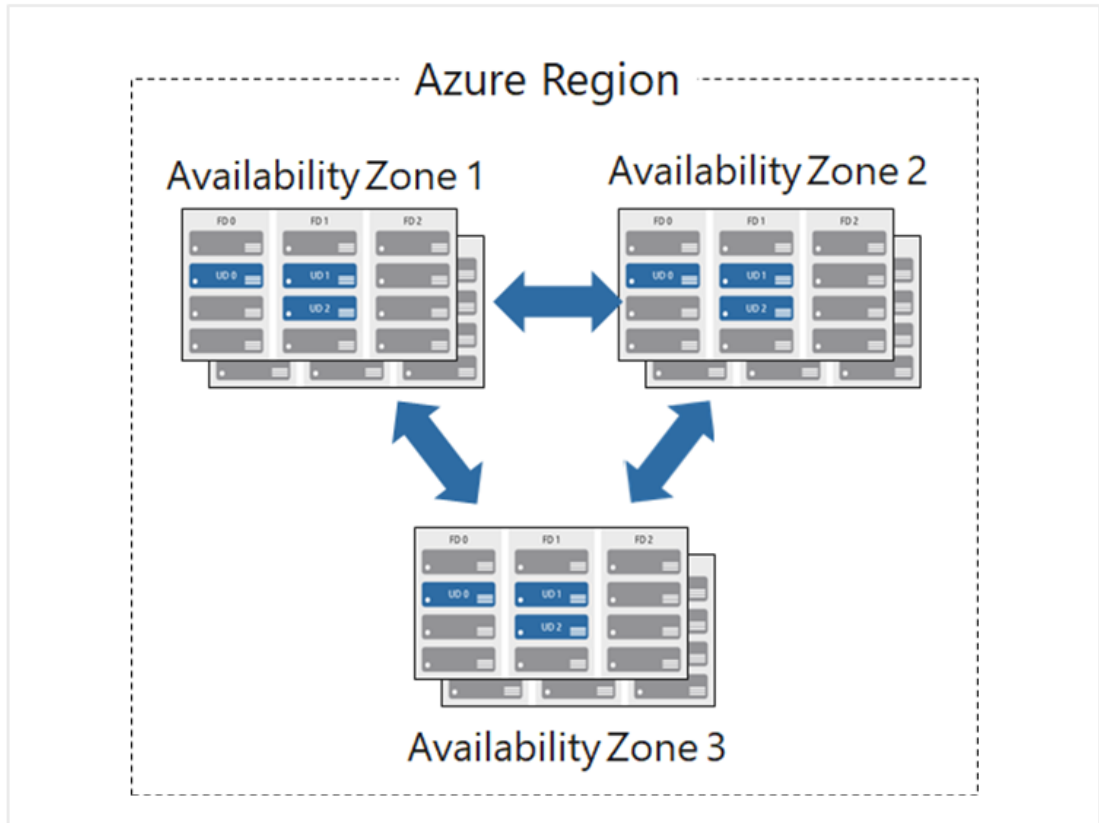
Unique physical locations in a region

Includes datacenters with independent power, cooling, and networking

Protects from datacenter failures

Combines update and fault domains

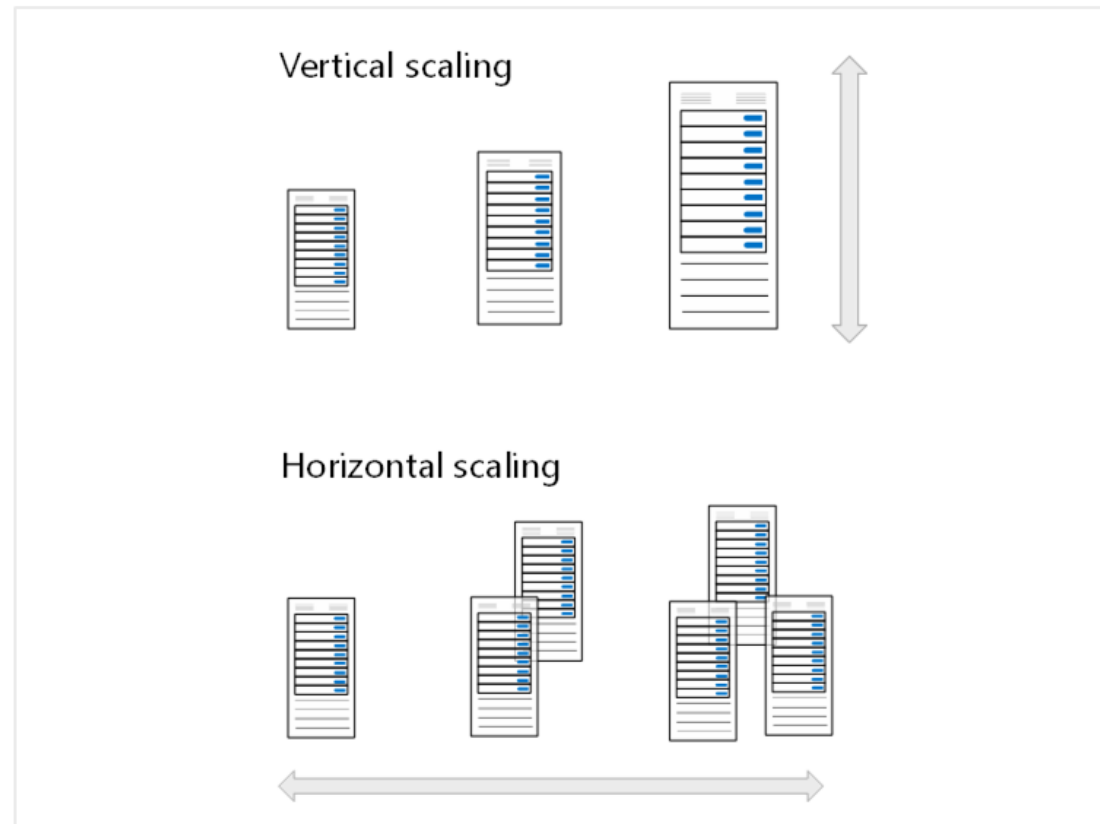
Provides 99.99% SLA



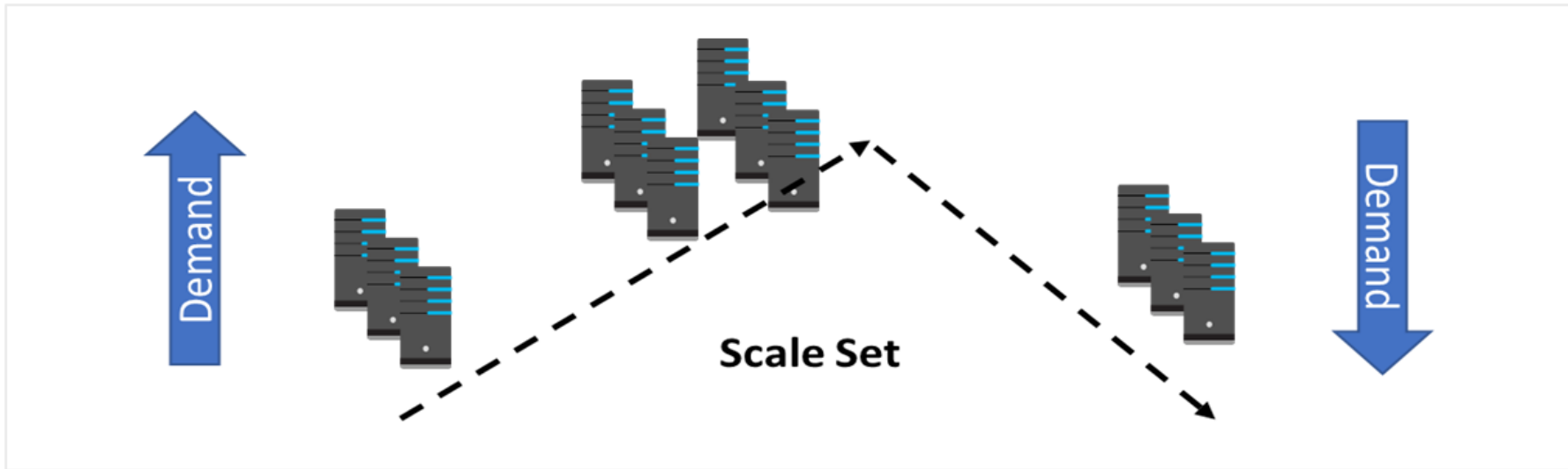
## Scaling Concepts

**Vertical scaling** (scale up and scale down) is the process of increasing or decreasing power to a single instance of a workload; usually manual

**Horizontal scaling** (scale out and scale in) is the process of increasing or decreasing the number of instances of a workload; frequently automated



# Scale Sets



Scale sets deploy a set of identical VMs

No pre-provisioning of VMs is required

As demand goes up VMs are added

As demand goes down VM are removed

The process can be manual, automated, or a combination of both

# Implementing Scale Sets

**Instance count.** Number of VMs in the scale set (0 to 1000)

**Instance size.** The size of each virtual machine in the scale set

**Azure Spot Instance.** Unused capacity at a discounted rate

**Use managed disks**

**Enable scaling beyond 100 instances**

**Instance**

Initial instance count \* ⓘ

Size \* ⓘ **Standard D2s v3**  
2 vcpus, 8 GiB memory (\$85.41/month)  
[Change size](#)

Azure Spot instance ⓘ  Yes  No

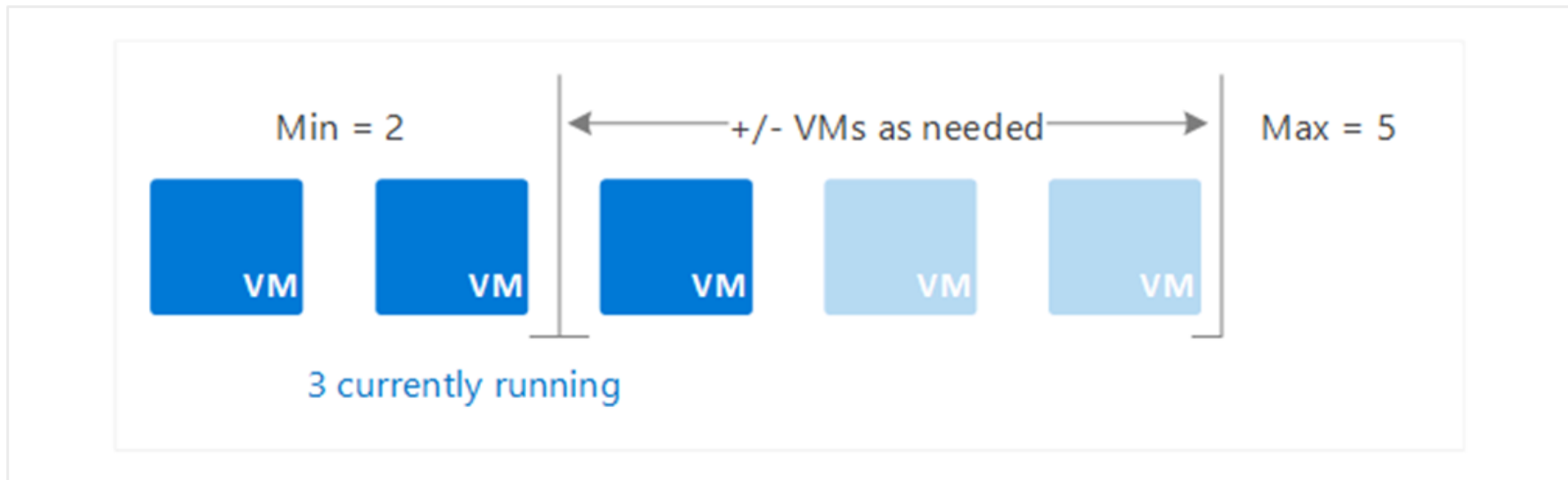
Use managed disks ⓘ  No  Yes

**Allocation policy**

Enable scaling beyond 100 instances ⓘ  No  Yes

Spreading algorithm ⓘ  Max spreading  Fixed spreading (not recommended with zones)

# Autoscale



Define rules to automatically adjust capacity

Scale out (increase) the number of VMs in the set

Scale in (reduce) the number of VMs in the set

Schedule events to increase or decrease at a fixed time

Reduces monitoring and optimizes performance

# Implementing Autoscale

Define a minimum, maximum, and default number of VM instances

Create more advanced scale sets with scale out and scale in parameters

<b>Instance</b>	
Initial instance count * ⓘ	<input type="text" value="2"/>
<b>Scaling</b>	
Scaling policy ⓘ	<input type="radio"/> Manual <input checked="" type="radio"/> Custom
Minimum number of VMs * ⓘ	<input type="text" value="1"/>
Maximum number of VMs * ⓘ	<input type="text" value="10"/>
<b>Scale out</b>	
CPU threshold (%) * ⓘ	<input type="text" value="75"/>
Duration in minutes * ⓘ	<input type="text" value="10"/>
Number of VMs to increase by * ⓘ	<input type="text" value="1"/>
<b>Scale in</b>	
CPU threshold (%) * ⓘ	<input type="text" value="25"/>
Number of VMs to decrease by * ⓘ	<input type="text" value="1"/>

## Lesson 04: Virtual Machine Extensions



# Virtual Machine Extensions Overview



Virtual Machine Extensions



Custom Script Extensions



Desired State Configuration

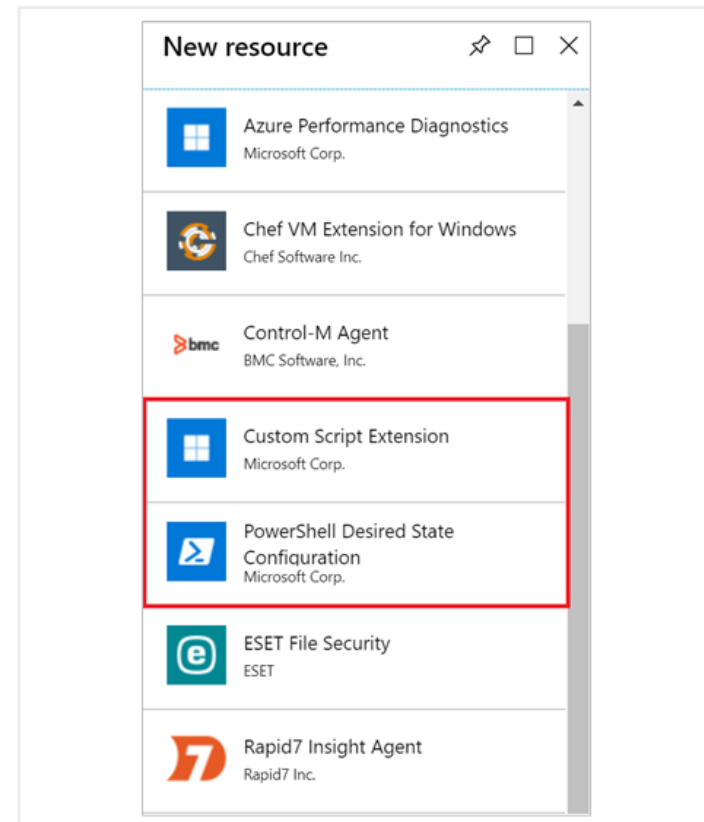
## Virtual Machine Extensions

Extensions are small applications that provide post-deployment VM configuration and automation tasks

Managed with Azure CLI, PowerShell, Azure Resource Manager templates, and the Azure portal

Bundled with a new VM deployment or run against any existing system

Different for Windows and Linux machines



## Custom Script Extensions

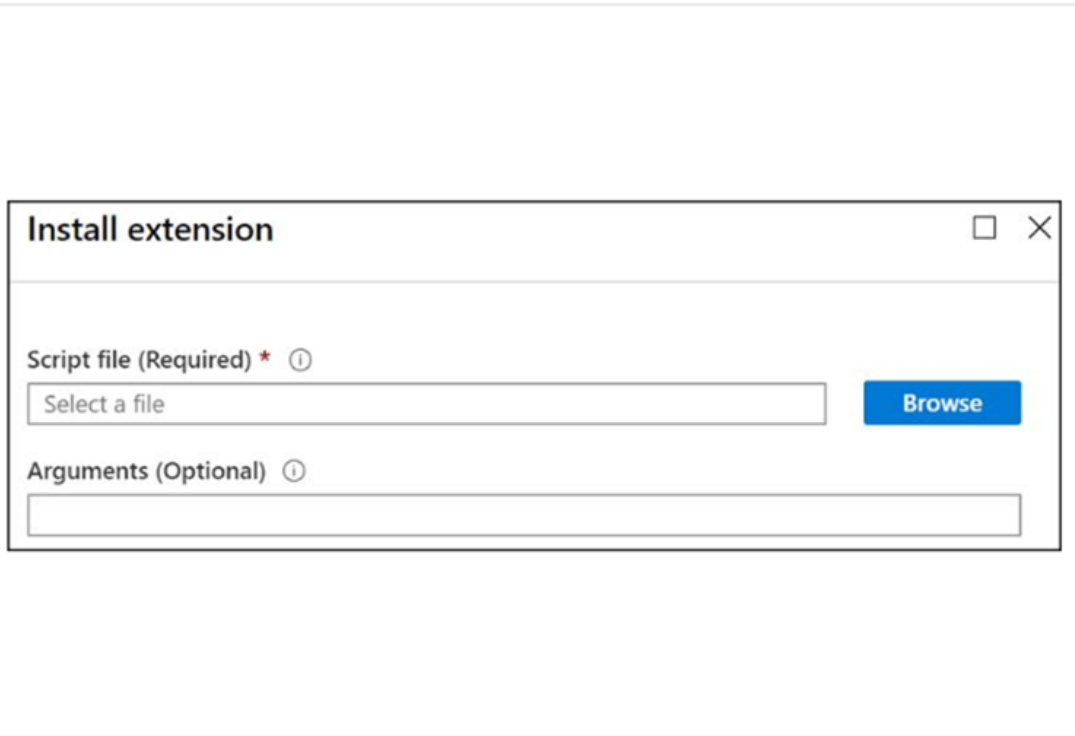
Extension scripts can be simple or complex

Extensions have 90 minutes to run

Double check dependencies to ensure availability

Account for any errors that might occur

Protect/encrypt sensitive information



**Install extension** □ ×

Script file (Required) \* ⓘ

Select a file

Arguments (Optional) ⓘ



For PowerShell use the `Set-AzVmCustomScriptExtension` command

## Desired State Configuration

Configuration block(s) have a name

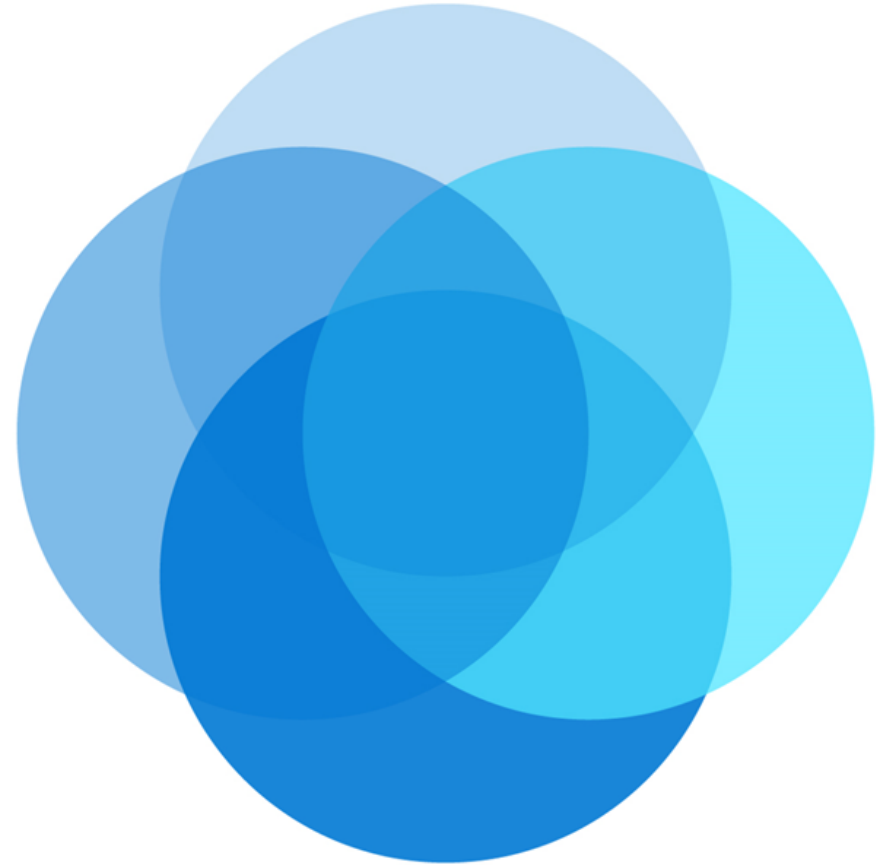
Node blocks define the computers or VMs that you are configuring

Resource block(s) configure the resource and its properties

There are many built-in configuration resources

```
configuration IISInstall
{
  Node "localhost"
  {
    WindowsFeature IIS
    {
      Ensure = "Present"
      Name = "Web-Server"
    }
  }
}
```

# Module 09: Monitoring



## Module Overview



Lesson 01: Azure Monitor

---



Lesson 02: Azure Alerts

---



Lesson 03: Log Analytics

---



Lesson 04: Network Watcher

---

# Lesson 01: Azure Monitor



# Azure Monitor Overview



Azure Monitor Service



Data Types



Key Capabilities



Azure Advisor



Monitoring Data Platform



Activity Log

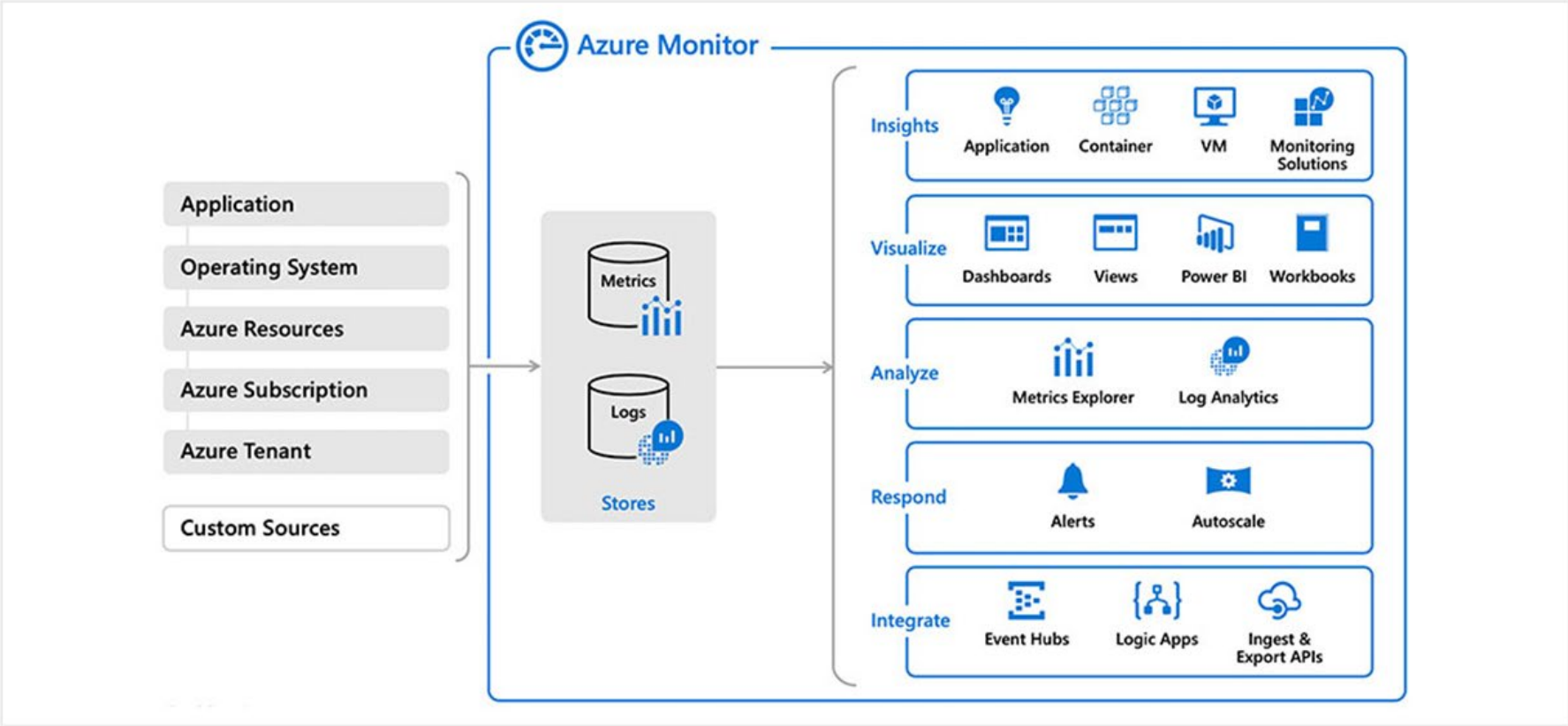


Log Data



Query the Activity Log

# Azure Monitor Service



# Key Capabilities



## Monitor & Visualize Metrics

Metrics are numerical values available from Azure Resources helping you understand the health, operation & performance of your systems.

[Explore Metrics](#)



## Query & Analyze Logs

Logs are activity logs, diagnostic logs and telemetry from monitoring solutions; Analytics queries help with troubleshooting & visualizations.

[Search Logs](#)



## Setup Alert & Actions

Alerts notify you of critical conditions and potentially take corrective automated actions based on triggers from metrics or logs.

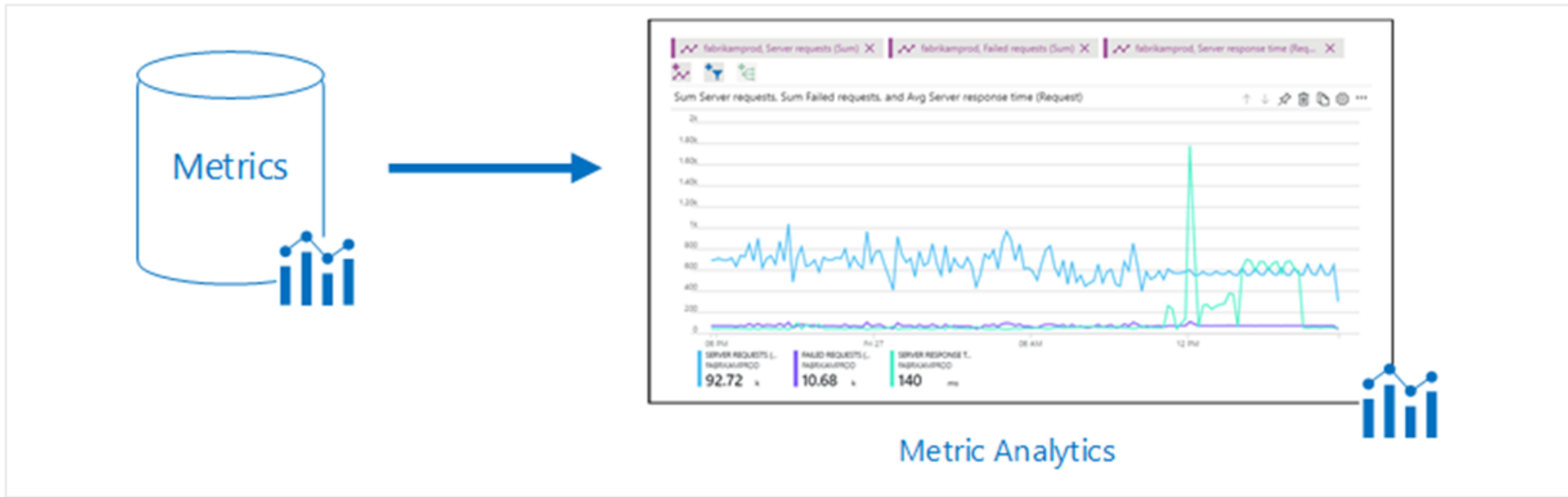
[Create Alert](#)

Core monitoring for Azure services

Collects metrics, activity logs, and diagnostic logs

Use for time critical alerts and notifications

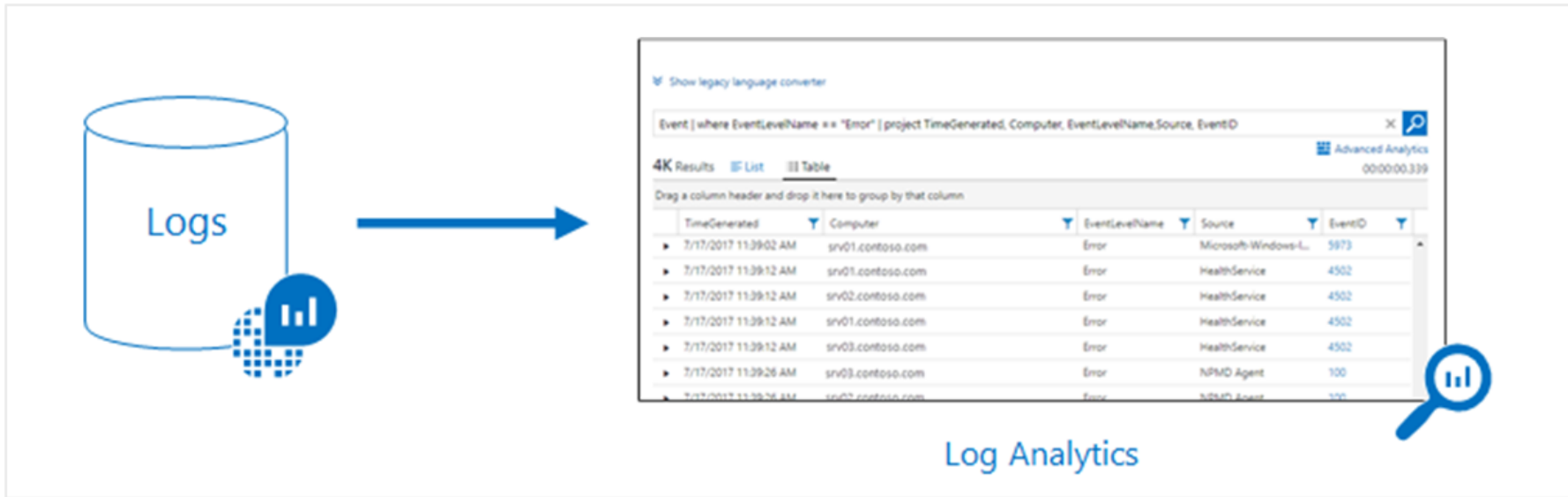
# Monitoring Data Platform



**Metrics** are numerical values that describe some aspect of a system at a point in time. They are lightweight and capable of supporting near real-time scenarios

**Logs** contain different kinds of data organized into records with different sets of properties for each type. Telemetry such as events and traces are stored as logs in addition to performance data so that it can all be combined for analysis

# Log Data



Log data is stored in Log Analytics which includes a rich query language to quickly retrieve, consolidate, and analyze collected data

The Data Explorer query language that is suitable for simple log queries but also includes advanced functionality such as aggregations, joins, and smart analytics

## Data Types



**Application monitoring data** – Performance and functionality of the code you have written, regardless of its platform

---



**Guest OS monitoring** – Azure, another cloud, or on-premises

---



**Azure resource monitoring**

---



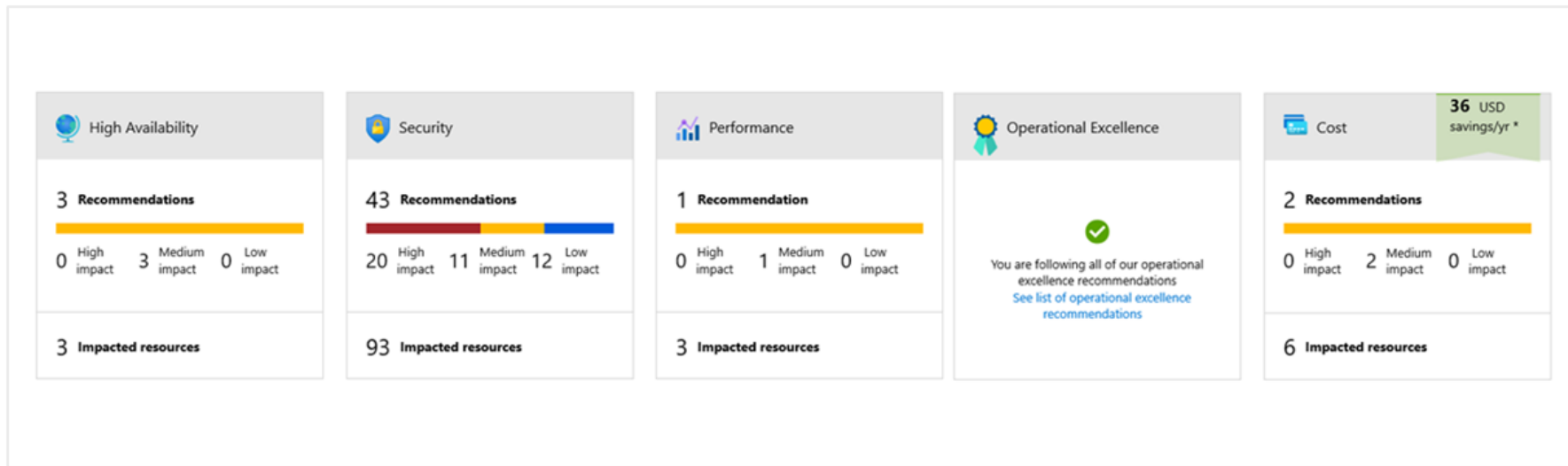
**Azure subscription monitoring** – Operation and management of an Azure subscription, as well as data about the health and operation of Azure itself

---



**Azure tenant monitoring** – Operation of tenant-level Azure services, such as Azure Active Directory

# Azure Advisor



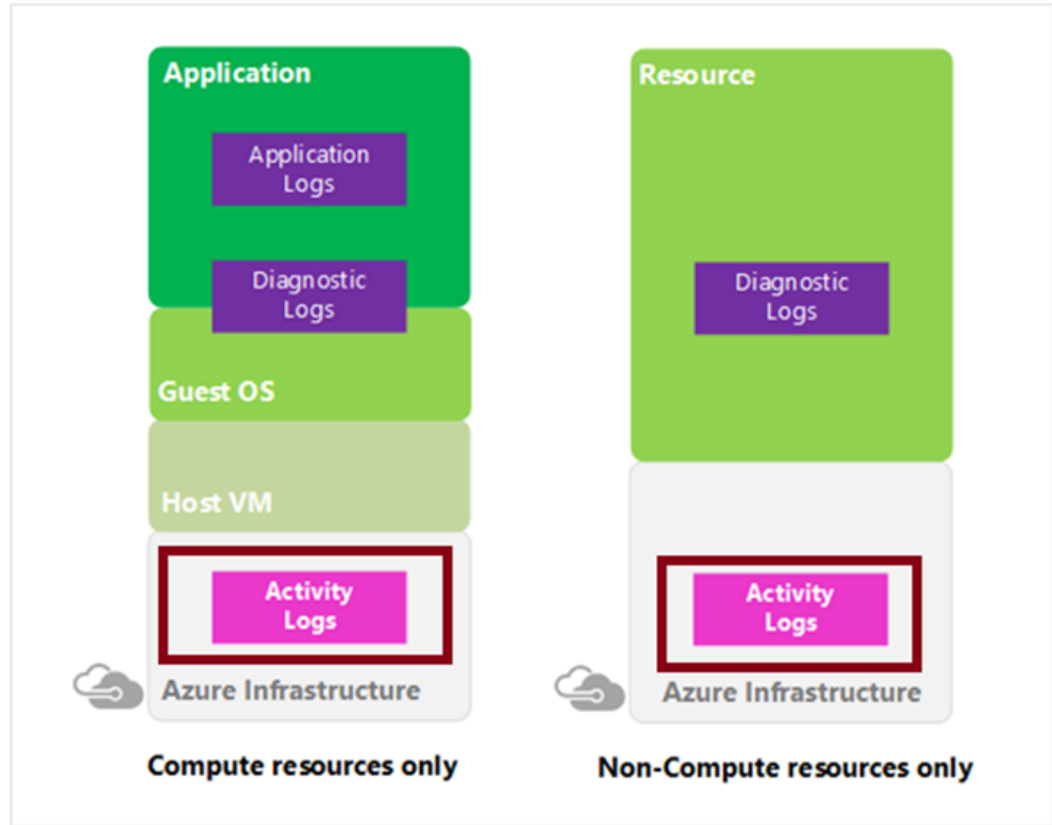
Personalized cloud consultant

Analyzes your configuration and recommends solutions

High Availability, Security, Performance, Operational Excellence, and Cost

# Activity Log

- Send data to Log Analytics for advanced search and alerts
- Query or manage events in the Portal, PowerShell, CLI, and REST API
- Stream information to Event Hub
- Archive data to a storage account
- Analyze data with Power BI



# Query the Activity Log

**Activity log**

☰ Edit columns   ↻ Refresh   ⚙️ Diagnostics settings   ↓ Download as CSV   🗒️ Logs | 📌 Pin current filters

🔍 Search   💡 Quick Insights   + Add Filter

Management Group : **None**   Subscription : **2 selected**   Timespan : **Last 6 hours**   Event severity : **All**

Operation name	Status	Time	Time stamp	Subscription
> <b>!</b> Create or Update Virtual Network Subnet	Failed	a minute ago	Thu Mar 12 ...	<a href="#">ASC DEMO</a>
> <b>i</b> Write GuestConfigurationAssignments	Succeeded	17 minutes ...	Thu Mar 12 ...	<a href="#">ASC DEMO</a>
> <b>i</b> Gets workflow recommend operation groups	Succeeded	29 minutes ...	Thu Mar 12 ...	<a href="#">ASC DEMO</a>

Filter by Management group, Subscription, Timespan, and Event Severity

Add a filter, like Event Category (Security, Recommendations, Alerts)

Pin current filters and download as CSV

## Lesson 02: Azure Alerts



# Azure Alerts Overview



Azure Monitor Alerts

---



Creating Alert Rules

---



Action Groups

---

# Azure Monitor Alerts

**Alerts**

[+ New alert rule](#) [Manage alert rules](#) [Manage actions](#) [View classic alerts](#) [Refresh](#) [Provide feedback](#)

<b>Total alerts</b> <b>1179</b> Since 2/11/2020, 11:07:58 AM	<b>Smart groups (Preview)</b> ⓘ <b>3</b> 99.75% Reduction	<b>Total alert rules</b> <b>9</b> Enabled 7	<b>Action rules (preview)</b> ⓘ <b>0</b> Enabled 0	
Severity	Total Alerts	New	Acknowledged	Closed
Sev 0	0	0	0	0
Sev 1	0	0	0	0
Sev 2	0	0	0	0
Sev 3	1178	1178	0	0
Sev 4	1	1	0	0

Unified authoring experience

Displayed by severity

Categorized by New, Acknowledged, and Closed

# Creating Alert Rules

**Scope:** Target selection, Alert criteria, and Alert logic

**Condition:** Alert rule name, description, and severity (0 to 4)

**Action group:** Notify your team via email and text messages or automate actions using webhooks and runbooks

[Home](#) > [Alerts](#) >

## Create alert rule

Rules management

Create an alert rule to identify and address issues when important conditions are found in your monitoring data. When defining the alert rule, check that your inputs do not contain any sensitive content.

### Scope

Select the target resource you wish to monitor.

Resource

*No resource selected yet*

[Select resource](#)

### Condition

Configure when the alert rule should trigger by selecting a signal and defining its logic.

Condition name

*No condition selected yet*

### Action group

Send notifications or invoke actions when the alert rule triggers, by selecting or creating a new action group

Action group name

*No action group selected yet*

# Action Groups

Notifies a group of users that an alert has been triggered

Is a collection of notification preferences

**Add action group** [Close]

Action group name \* ⓘ  
Sample action group ✓

Short name \* ⓘ  
SampleAG ✓

Subscription \* ⓘ  
Visual Studio Enterprise ▾

Resource group \* ⓘ  
Default-ActivityLogAlerts (to be created) ▾

Actions

Action name *	Action Type *
Unique name for the action	Select an action type ^

- Automation Runbook
- Azure Function
- Email Azure Resource Manager Role
- Email/SMS/Push/Voice
- ITSM
- LogicApp
- Secure Webhook
- Webhook

## Lesson 03: Log Analytics



# Log Analytics Overview



Log Analytics



Log Analytics  
Querying



Create a Workspace



Query Language  
Syntax



Connected Sources



Demonstration – Log  
Analytics



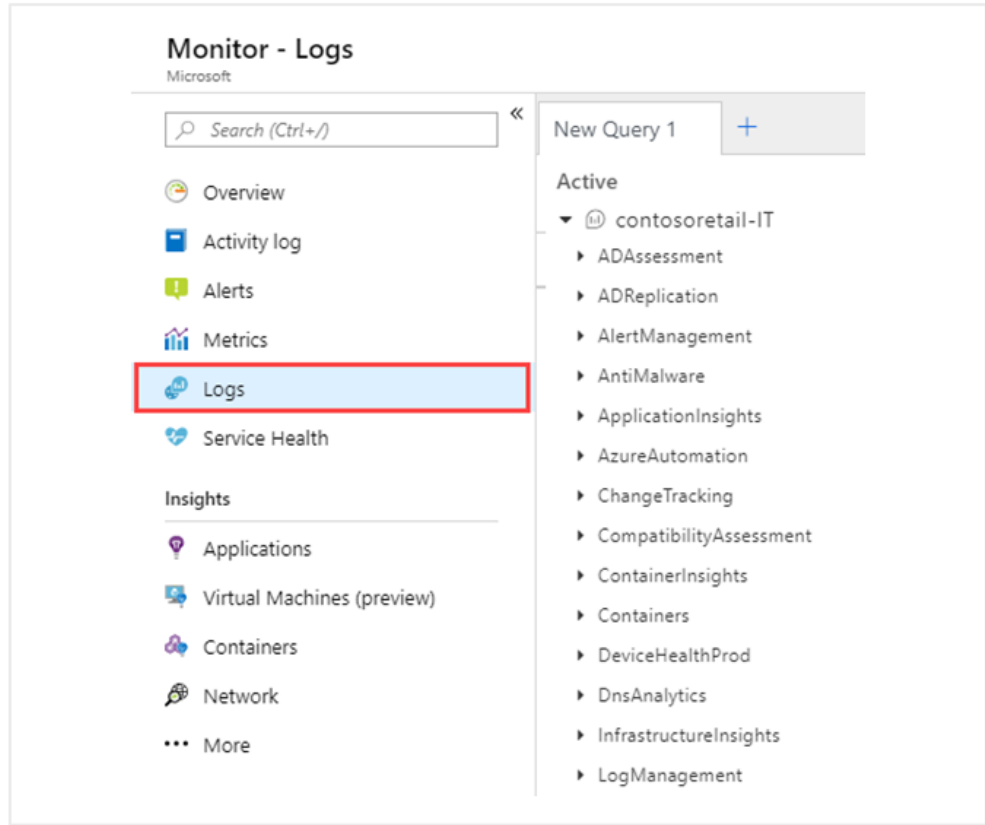
Data Sources

# Log Analytics

A service that helps you collect and analyze data generated by resources in your cloud and on-premises environments

Write log queries and interactively analyze their results

Examples include assessing system updates and troubleshooting operational incidents



## Create a Workspace

A workspace is an Azure resource and is a container where data is collected, aggregated, analyzed, and presented

You can have multiple workspaces per Azure subscription, and you can have access to more than one workspace

A workspace provides a geographic location, data isolation, and scope

### Log Analytics workspace

Create new or link existing workspace

---

Create New  Link Existing

Log Analytics Workspace \* ⓘ

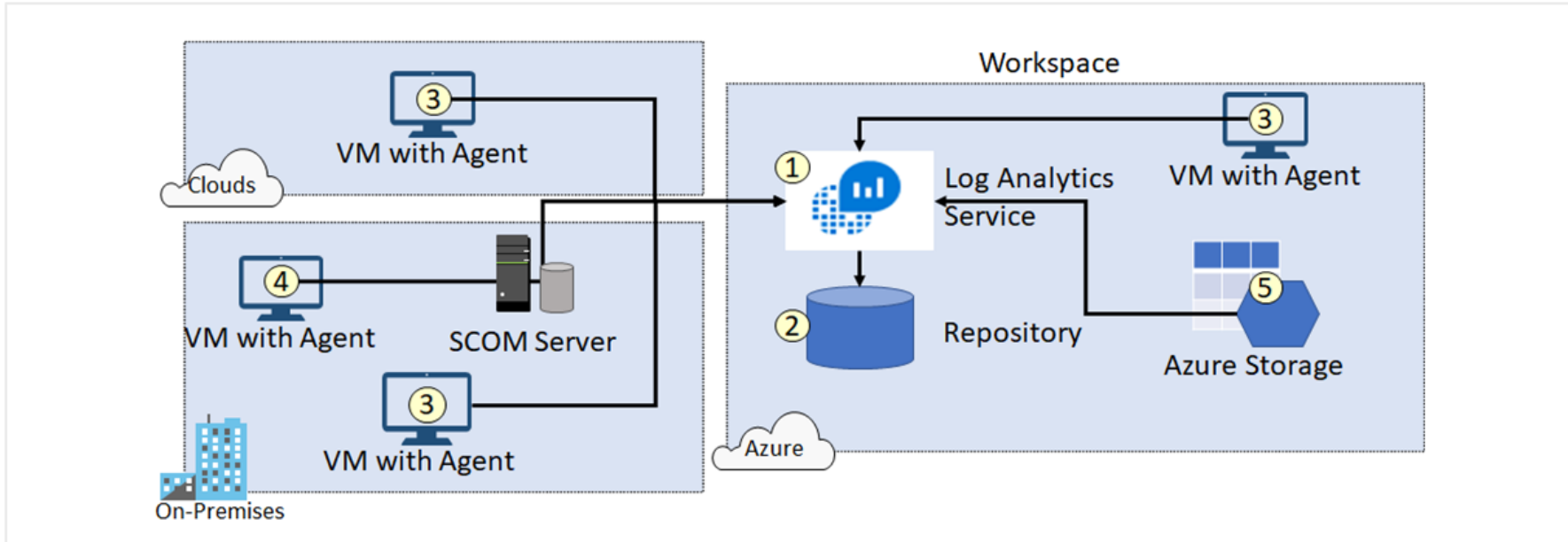
Subscription \*  
 ▼

Resource group \*  
 ▼

[Create new](#)

Location \*  
 ▼

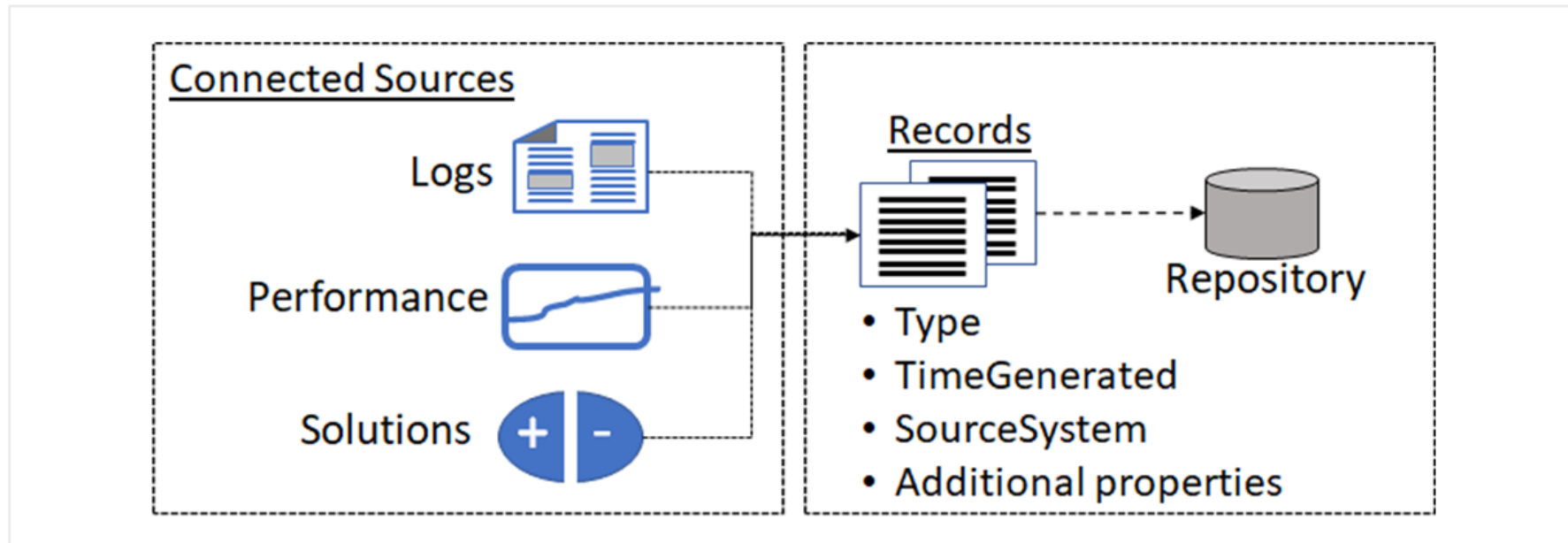
## Connected Sources



Connected Sources generate data

Data can be collected from Windows, Linux, SCOM and Azure Storage

## Data Sources



Data sources include: Windows Event Logs, Windows Performance Counters, Linux Performance Counters, IIS Logs, Custom Fields, Custom Logs, and Syslog

Each data source has additional configuration options

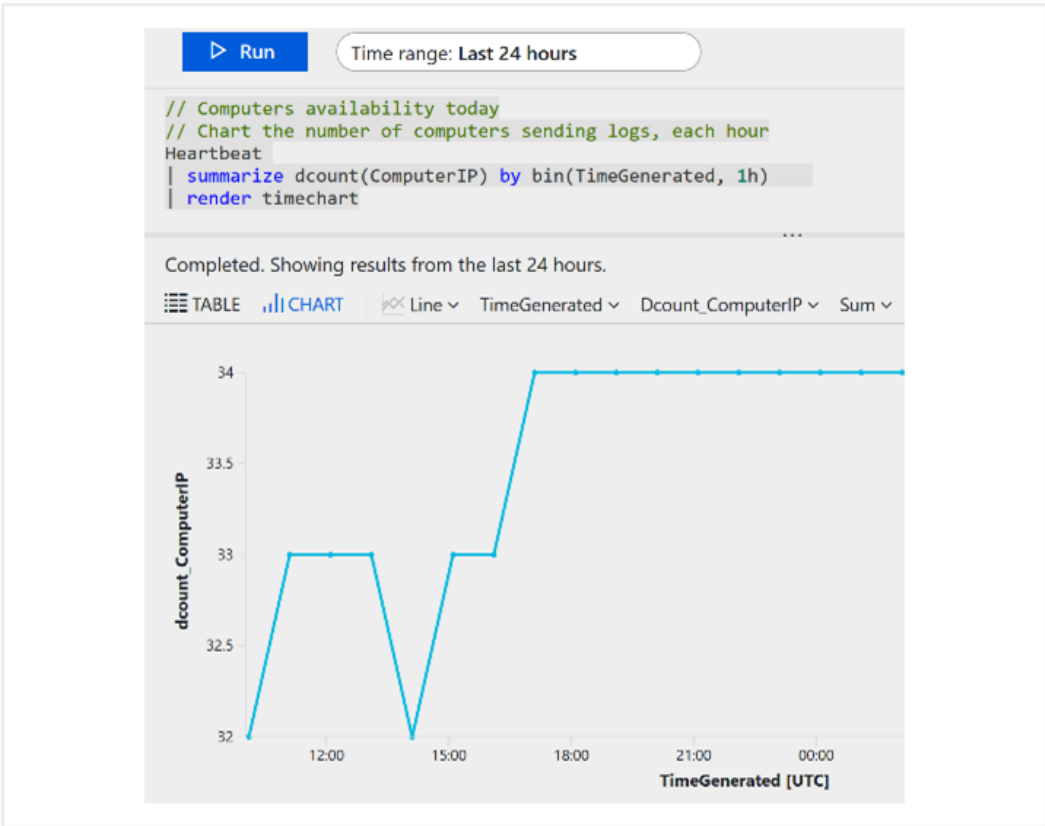
# Log Analytics Querying

Log Analytics provides a query syntax

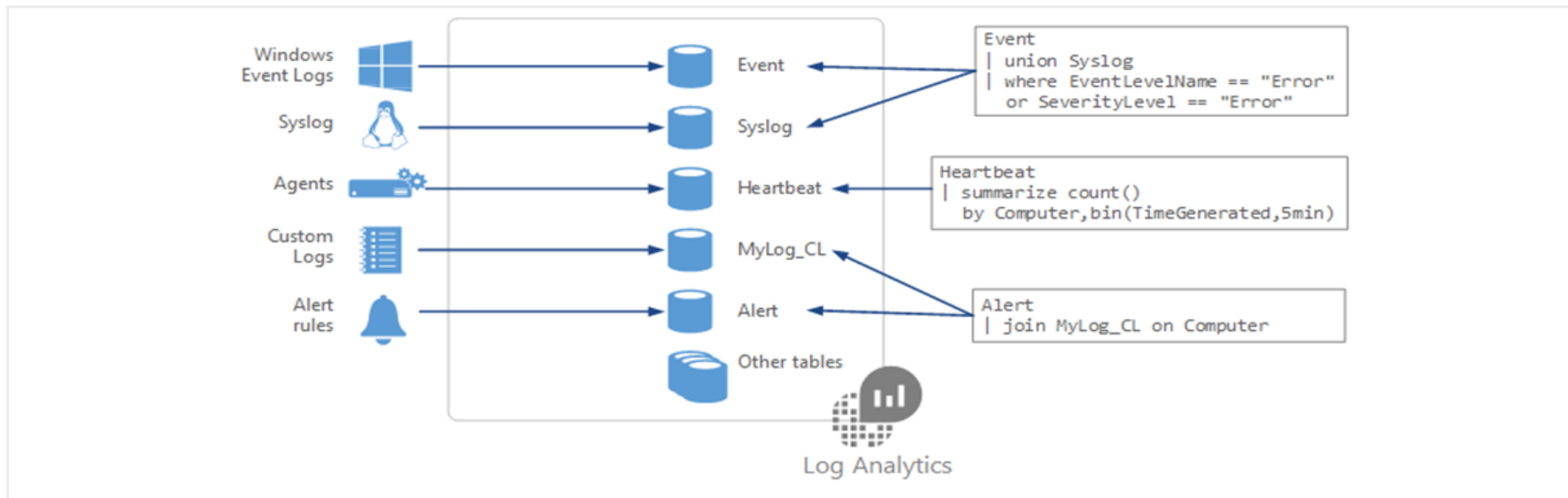
Quickly retrieve and consolidate data in the repository

Save or have log searches run automatically to create an alert

Export the data to Power BI or Excel



# Query Language Syntax



```
Event  
| where (EventLevelName == "Error")  
| where (TimeGenerated > ago(1days))  
| summarize ErrorCount = count() by Computer  
| top 10 by ErrorCount desc
```

# Lesson 04: Network Watcher



# Network Watcher Overview



Network Watcher



Network Watcher  
Diagnostics



Diagnostics – IP Flow  
Verify



Diagnostics – Next Hop



Diagnostics – Effective  
Security Rules



Diagnostics – VPN  
Troubleshoot



Diagnostics – Packet  
Capture



Diagnostics – Connection  
Troubleshoot



Logs – NSG Flow logs



Monitoring – Topology

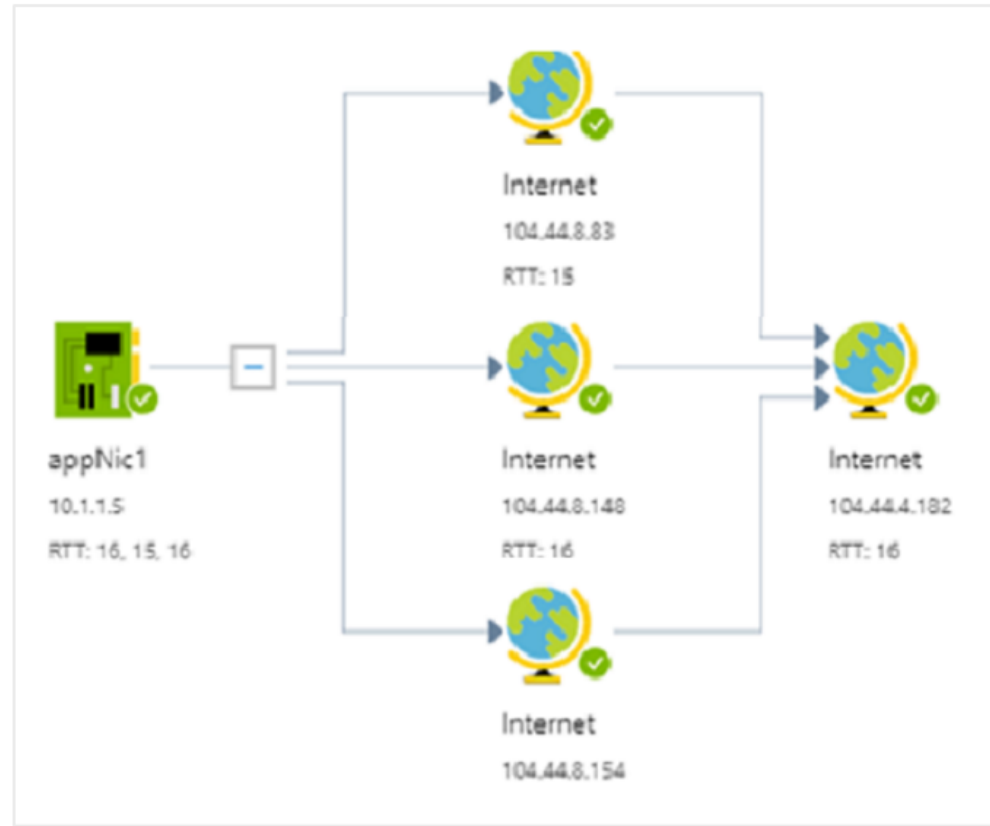
# Network Watcher

Is a regional service

Provides tools to monitor, diagnose, view metrics, and enable or disable logs

Provides scenario level monitoring so you can diagnose problems at an end to end network level view

Provides a visual representation of your networking elements



# Network Watcher Diagnostics

**IP Flow Verify** diagnoses connectivity issues

**Next Hop** determines if traffic is being correctly routed













**VPN Diagnostics** troubleshoots gateways and connections

**NSG Flow Logs** maps IP traffic through a network security group

**Connection troubleshoot** shows connectivity between source VM and destination

**Topology** generates a visual diagram of resources

## Network Watcher

Monitoring	Network diagnostic tools
 Topology	 IP flow verify
 Connection monitor	 Next hop
 Network Performance Monitor	 Effective security rules
<b>Logs</b>	 VPN troubleshoot
 NSG flow logs	 Packet capture
 Diagnostic logs	 Connection troubleshoot
 Traffic Analytics	

# Diagnostics – IP Flow Verify

Diagnose connectivity issues from or to the internet and from or to the on-premises environment. Ideal for ensuring security rules are being correctly applied

The screenshot shows the 'IP flow verify' tool interface. On the left, a sidebar lists 'Network diagnostic tools' with 'IP flow verify' selected, and 'Metrics' with 'Usage + quotas'. Below that, 'Logs' includes 'NSG flow logs', 'Diagnostic logs', and 'Traffic Analytics'. The main area is titled 'Packet details' and contains the following configuration:

- Protocol:  TCP  UDP
- Direction:  Inbound  Outbound
- Local IP address: 10.1.1.4
- Local port: 3389
- Remote IP address: 13.24.35.46
- Remote port: 3389

A blue 'Check' button is located below the input fields. Below the button, a light blue error message box displays a red 'X' icon and the text 'Access denied'. At the bottom, the 'Security rule' is identified as 'DenyAllInBound'.

## Diagnostics – Next Hop

Helps with determining whether traffic is being directed to the intended destination by showing the next hop

Subscription \* ⓘ  
MSDN Platforms Subscription

Resource group \* ⓘ  
Demo

Virtual machine \* ⓘ  
vm01

Network interface \*  
vm01165

Source IP address \* ⓘ  
10.1.1.4

Destination IP address \* ⓘ  
13.24.35.46

**Next hop**

Result  
Next hop type  
**None**

IP address  
**10.1.1.100**

Route table ID  
/subscriptions/2301e3a0-8420-... 📄

## Diagnostics – Effective Security Rules

nsg01

Inbound rules

Name	↑↓	Priority	↑↓	Source	Source Ports	↑↓	Destination	Destination Ports	↑↓	Protocol	↑↓	Access	↑↓
RDP_Inbound		100		13.23.34.45/32	0-65535		0.0.0.0/0	3389-3389		TCP		✔ Allow	
AllowVnetInBound		65000		Virtual network (1 prefixes)	0-65535		Virtual network (1 prefixes)	0-65535		All		✔ Allow	
AllowAzureLoadBalancerInBound		65001		Azure load balancer (2 prefixes)	0-65535		0.0.0.0/0,0.0.0.0/0	0-65535		All		✔ Allow	
DenyAllInBound		65500		0.0.0.0/0,0.0.0.0/0	0-65535		0.0.0.0/0,0.0.0.0/0	0-65535		All		✘ Deny	

Outbound rules

Name	↑↓	Priority	↑↓	Source	Source Ports	↑↓	Destination	Destination Ports	↑↓	Protocol	↑↓	Access	↑↓
AllowVnetOutBound		65000		Virtual network (1 prefixes)	0-65535		Virtual network (1 prefixes)	0-65535		All		✔ Allow	
AllowInternetOutBound		65001		0.0.0.0/0,0.0.0.0/0	0-65535		Internet (216 prefixes)	0-65535		All		✔ Allow	
DenyAllOutBound		65500		0.0.0.0/0,0.0.0.0/0	0-65535		0.0.0.0/0,0.0.0.0/0	0-65535		All		✘ Deny	

Details the Effective Security Rules (inbound and outbound) of the Network Interface card of a Virtual Machine

# Diagnostics – VPN Troubleshoot

Subscription ⓘ MSDN Platforms Subscription

Resource group ⓘ Demo

Location ⓘ East US

---

\*Storage account <https://samcteusvmdiagnosics.blob.core.windows.net/vpn>

	Name	Troubleshooting s...	Resource status	Resource Group	Location
<input checked="" type="checkbox"/>	vng01	Running	Succeeded	Demo	East US
<input checked="" type="checkbox"/>	cn01	-	Succeeded	Demo	East US

Helps you troubleshoot gateways and connections

Provides summary information and detailed information

Can troubleshoot multiple gateways or connections simultaneously

# Diagnostics – Packet Capture

Captures inbound and outbound traffic from a Virtual Machine

Saves data to a storage account, a local file, or both

### Add packet capture

---

Subscription \*  
MSDN Platforms Subscription

Resource group \*  
Demo

Target virtual machine \*  
vm01

Packet capture name \*  
capture01

Capture configuration  
The packet capture output file (.cap) can be stored in a storage account and/or on the target VM.

Storage account  File  Both

Storage accounts \*  
samcteusvmdiagnosics

Maximum bytes per packet ⓘ default: 0 (entire packet)

Maximum bytes per session ⓘ default: 1073741824

Time limit (seconds) ⓘ default: 18000

+ Add filter

# Diagnostics – Connection Troubleshoot

Check connectivity between source VM and destination

Identify configuration issues that are impacting reachability

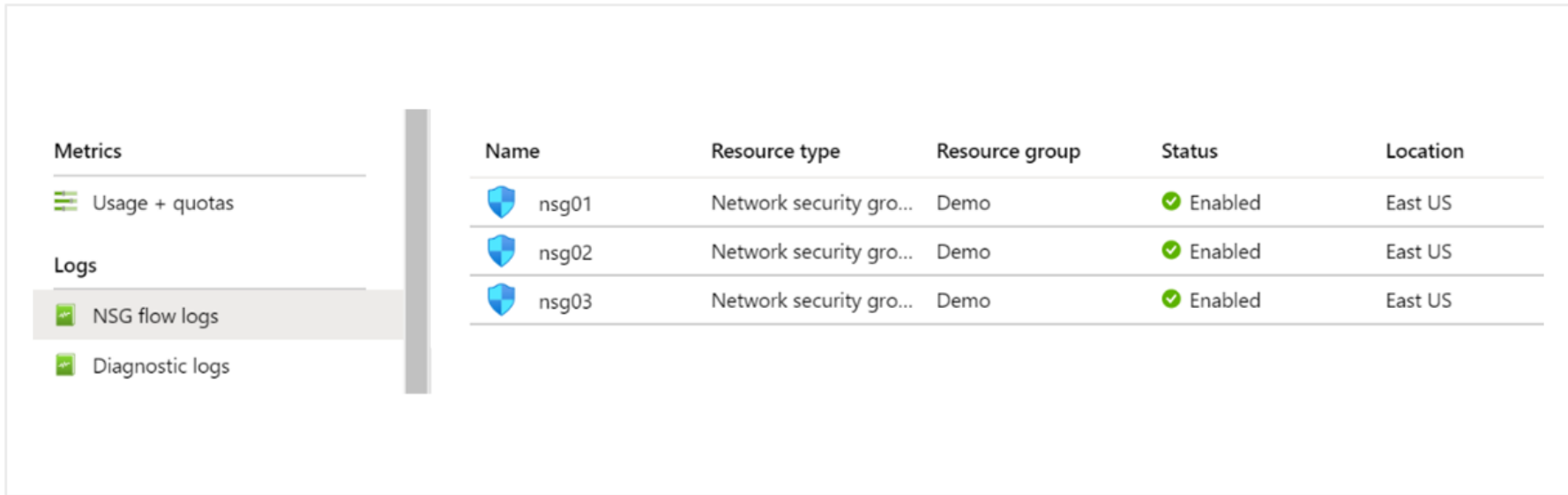
Provide all possible hop by hop paths from the source to destination

Review hop by hop latency – min, max, and average between source and destination

View a graphical topology from your source to destination

The screenshot shows a configuration form for a connection troubleshoot tool. It includes several sections: 'Source' with dropdowns for 'Subscription' (MSDN Platforms Subscription), 'Resource group' (Demo), and 'Source type' (Virtual machine); a '\*Virtual machine' dropdown (vm01); 'Destination' with radio buttons for 'Select a virtual machine' and 'Specify manually' (selected); a 'URI, FQDN or IPv4' text field (13.24.35.46); 'Probe Settings' with a 'Protocol' dropdown (TCP selected) and 'ICMP' option; a 'Destination port' text field (3389); an 'Advanced settings' section with a 'Source port' text field (3389); and a blue 'Check' button at the bottom.

## Logs – NSG Flow Logs



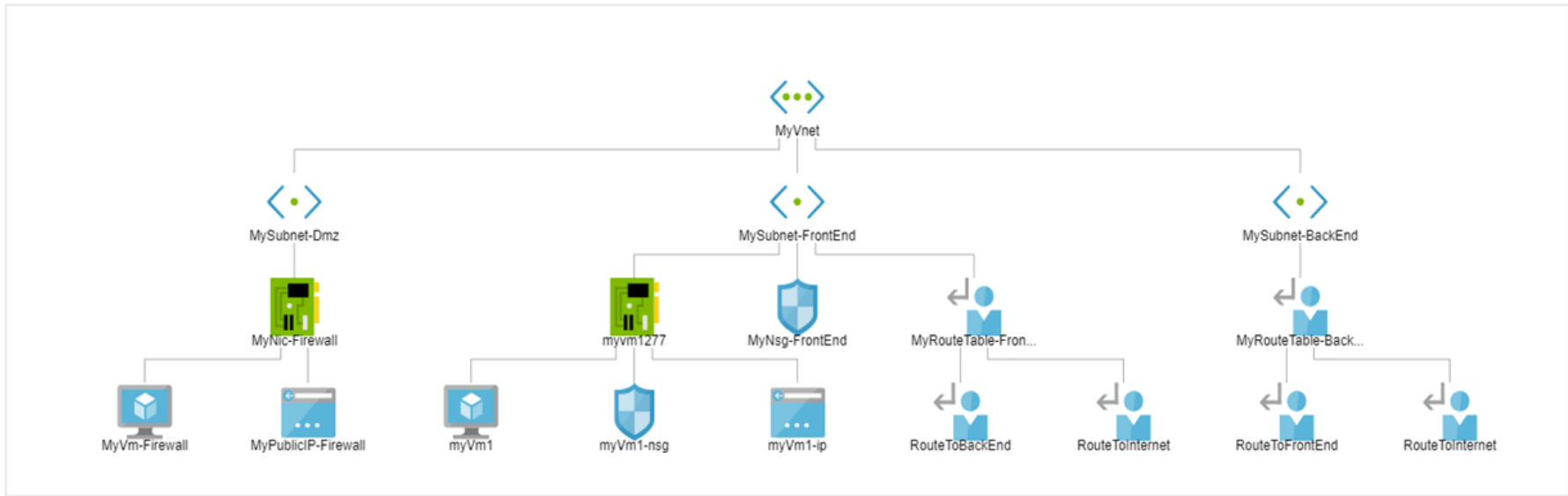
Name	Resource type	Resource group	Status	Location
nsg01	Network security gro...	Demo	✔ Enabled	East US
nsg02	Network security gro...	Demo	✔ Enabled	East US
nsg03	Network security gro...	Demo	✔ Enabled	East US

View information about ingress and egress IP traffic through an NSG

Flow logs are written in JSON format and show outbound and inbound flows on a per rule basis

The JSON format can be visually displayed in Power BI or third-party tools like Kibana

# Monitoring – Topology



Provides a visual representation of your networking elements

View all the resources in a virtual network, resource to resource associations, and relationships between the resources

The Network Watcher instance in the same region as the virtual network

# Final Summary – 2 Days Azure Webinar



Module 01: Identity

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Module 02: Governance and Compliance

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Module 03: Azure Administration

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Module 04: Virtual Networking

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Module 05: Intersite Connectivity

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Module 06: Network Traffic Management



Module 07: Azure Storage

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Module 08: Azure Virtual Machines

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Module 09: Monitoring

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# Final Summary – 2 Days Azure Webinar

## Administrator certification path

The administrator certification path is organized into 3 levels: Fundamentals, Associate and Expert.

View by:

An optional start for those new to Azure

Complete an associate certification

Requires an associate certification on the path

**FUNDAMENTALS CERTIFICATION**  
Microsoft Certified: Azure Fundamentals

**ASSOCIATE CERTIFICATION**  
Microsoft Certified: Azure Administrator Associate

**EXPERT CERTIFICATION**  
Microsoft Certified: DevOps Engineer Expert

## Administrator certifications

Explore administrator certifications most sought after by employers

**Microsoft Certified: Azure Administrator Associate**  
Requirements: Exam AZ-104  
Azure Administrators implement, manage, and monitor an organization's Microsoft Azure environment.

**Microsoft Certified: Azure for SAP Workloads Specialty**  
Requirements: Exam AZ-120  
Architects or engineers for Microsoft Azure for SAP Workloads have extensive experience and knowledge of the SAP system landscape and industry standards that are specific to the long-term operation of an SAP solution on Azure.

**Microsoft 365 Certified: Messaging Administrator Associate**  
Requirements: Exam MS-203  
Microsoft 365 Messaging Administrators deploy, configure, manage, troubleshoot, and monitor recipients, permissions, mail protection, mail flow, and public folders in hybrid and cloud enterprise environments.

**Microsoft 365 Certified: Modern Desktop Administrator Associate**  
Requirements: Exam MD-100, MD-101  
Modern Desktop Administrators deploy, configure, secure, manage, and monitor devices and client applications in an enterprise environment.

**Microsoft 365 Certified: Security Administrator Associate**  
Requirements: Exam MS-500  
Microsoft 365 Security Administrators proactively secure Microsoft 365 enterprise and hybrid environments, implement and manage security and compliance solutions, respond to threats, and enforce data governance.

**Microsoft 365 Certified: Enterprise Administrator Expert**  
Requirements: Exam MS-100, MS-101  
Microsoft 365 Enterprise Administrators evaluate, plan, migrate, deploy, and manage Microsoft 365 services.

**Microsoft 365 Certified: Teams Administrator Associate**  
Requirements: Exam MS-700  
Microsoft Teams Administrators configure, deploy, and manage Office 365 workloads for Microsoft Teams that focus on efficient and effective collaboration and communication in an enterprise environment.

**End of presentation**

Thanks for your attention