



Course Introduction

Welcome ! We're starting in 2 minutes !

- We're going to prepare for
Microsoft Azure Administrator AZ-104 Exam
- This course will be 18+ hours long
 - Video lectures
 - Hands-on Labs
 - Quizzes
 - Audiobook
 - Course PDF's slide deck
- Basic IT Knowledge is necessary



Welcome ! We're starting in 2 minutes !



VM



vNET



NSG



ASG



LB



Traffic Manager



Container



App Service



Storage



Blob



Disks



Queues



Cosmos DB



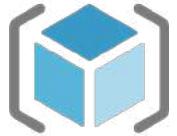
SQL DB



MySQL DB



PostgreSQL DB



RGs



Policy



Blueprint



Advisor



Monitor



Security Center



AD



and MORE



Microsoft Azure Administrator



Module 1 – Course Introduction

Create Your Free Azure Account

Path to Microsoft Azure Administrator Exam

- ❑ Microsoft Azure Administrator AZ-104 – theoretical exam, no labs or practical activities included
- ❑ Goals of this course:
 - ❑ Prepare you for the AZ-104 exam
 - ❑ Become a knowledgeable Azure Administrator
- ❑ The best way to learn Azure cloud is to practice ! Period !
- ❑ We will need an account in Microsoft Azure cloud platform



Microsoft Azure Free Account

- ❑ FAQ: I have an account already, do I need a new one ?
- ❑ What's included in the free account?
 - ❑ \$200 credit to use in the first 30 days
 - ❑ 12 months of popular free services
 - ❑ 25+ Azure services that are always free
- ❑ Where to start ?
 - ❑ <https://azure.microsoft.com/free/>
- ❑ Let's create our account !





Module 1 – Course Introduction

AZ-104 Exam Format & Official Blueprint

Microsoft AZ-104 Exam Overview

- ❑ Exam Format
 - ❑ ~ 50 questions, single or multiple-choice answers
- ❑ Exam Time
 - ❑ 180 minutes
- ❑ Exam Cost
 - ❑ \$165 USD* (based on the country where exam is taken)
- ❑ Pearson VUE Exam Test Centers



Microsoft AZ-104 Exam – Pearson VUE Options

In-person or Remote

Select exam options

AZ-104: Microsoft Azure Administrator

All fields are required.

How do you want to take your exam? [Exam delivery option descriptions](#)

- At a local test center
- At my home or office
- I have a Private Access Code

Next



Microsoft Azure Administrator

Microsoft AZ-104 – Skills Measured

- ❑ Skills measured:
 - ❑ Manage Azure identities and governance (15-20%)
 - ❑ Implement and manage storage (10-15%)
 - ❑ Deploy and manage Azure compute resources (25-30%)
 - ❑ Configure and manage virtual networking (30-35%)
 - ❑ Monitor and back up Azure resources (10-15%)
- ❑ Official Exam landing page:
 - ❑ <https://docs.microsoft.com/en-us/learn/certifications/exams/az-104>





Module 1 – Course Introduction

Module Completion & Exam Hints

Module Completion & Exam Hints

- ❑ This concludes Module 1 – Course Introduction
- ❑ Module Completion & Exam Hints lecture:
 - ❑ Summary of topics in the respective module
 - ❑ Exam hints (hot topics!)
- ❑ Please make sure you cover:
 - ❑ Module Completion & Exam Hints lectures
 - ❑ Quizzes and practice tests
- ❑ What's Next : Module 2 – Azure Cloud Introduction



Module 1 – Course Introduction

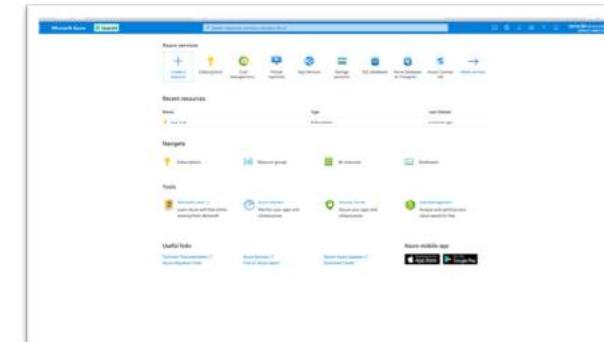
Upgrade Subscription from Free Trial to Pay-as-you-Go

Upgrade Subscription: Free Trial to Pay-as-you-Go

- ❑ Included in the free account:
 - ❑ \$200 credit to use in the first 30 days
 - ❑ 12 months of popular free services
 - ❑ 25+ Azure services that are always free
- ❑ After the first 30 days:
 - ❑ Upgrade subscription from Free Trial to Pay-as-you-Go



<https://portal.azure.com>



Microsoft Azure Administrator



Module 2 – Azure Cloud Introduction

Introduction to Cloud Computing

What is Cloud Computing ?

- Cloud computing is the delivery of computing services – including servers, storage, databases, networking, software, analytics and intelligence – over the Internet (“the cloud”) to offer faster innovation, flexible resources and economies of scale (Microsoft)
- Cloud computing really represents renting resources (i.e. CPU, RAM, storage) from a cloud provider (Azure) and only paying for what you use – “pay-as-you-go”



Running Applications and Services

- ❑ Applications and IT services are typically run on servers, which are comprised of CPU - processor, RAM – memory and storage – HDD, SSD.
 - ❑ Email Server, Web server, DBs, FTP server, etc.
- ❑ Q: How can you run these services ?
- ❑ Either in your company DC – Data Center ... or
- ❑ You can RENT the compute power and move to Azure



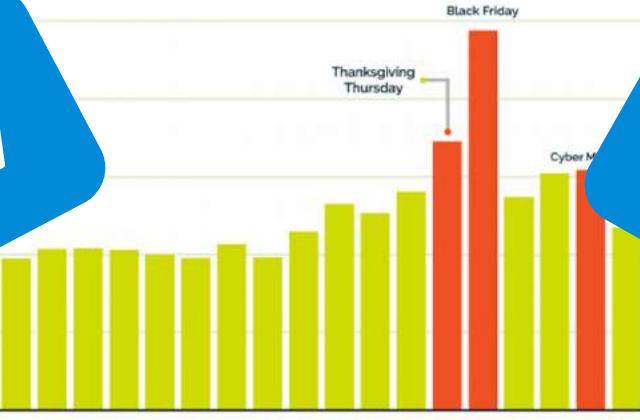
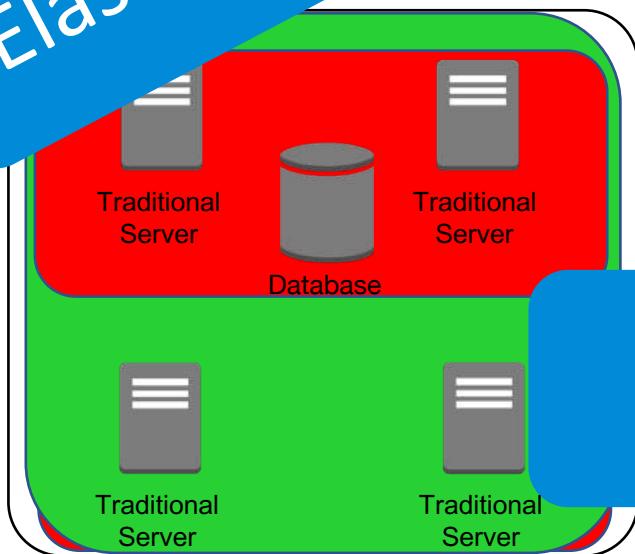
Running Your Apps in Azure Cloud

- With Azure, you don't need to make large upfront investments in hardware and spend a lot of time provisioning the hardware
- You provision the right type and size of computing resources you need to power and run your services
- You can run one server or thousands of servers in minutes, as you need, almost instantly, and only pay for what you use



Stop Guessing - Black Friday Campaign

Elasticity, Adaptability



Scalable - up or down



Pay-as-you-go



Microsoft Azure Administrator



Module 2 – Azure Cloud Introduction

Cloud Deployment Models

Cloud Deployment Models

- ❑ There are three different cloud deployment models:
 - ❑ Public Cloud
 - ❑ Private Cloud
 - ❑ Hybrid Cloud
- ❑ Questions:
 - ❑ How are these different ? Which should I choose ?
 - ❑ Where is the data stored ?
 - ❑ Do I need my current on-premises infrastructure ?
 - ❑ Where will my Apps run ?



Cloud Deployment Models - Public Cloud

- ❑ Azure Public Cloud is owned and operated by Microsoft and computing resources (i.e. servers, storage) are delivered through internet
- ❑ Why Azure Public Cloud ?
 - ❑ Pay-as-you-go pricing
 - ❑ No hardware maintenance or updates
 - ❑ Elastic, Agile, Highly scalable and Adaptable
 - ❑ Start immediately and go global in minutes



Cloud Deployment Models - Public Cloud

- ❑ Why not Azure Public Cloud ?
 - ❑ Don't have 100% flexibility over hardware
 - ❑ Legacy applications running on older/specific HW
 - ❑ Potential legal constraints related to data location
 - ❑ Potential security standards or conditions, that can't be met in public cloud environments



Cloud Deployment Models - Private Cloud

- ❑ AKA "traditional on-premises", resources are deployed in your on-premises DC, using virtualization and resource management tools – VMware, Hyper-V, OpenStack
- ❑ Why Private Cloud ?
 - ❑ Full control over infrastructure (you are responsible for management and OS patching)
 - ❑ Meet strict security, compliance or legal requirements
 - ❑ Accommodate legacy apps
 - ❑ Full flexibility over desired configuration



Cloud Deployment Models - Hybrid Cloud

- ❑ Hybrid clouds combine public and private clouds, allowing data and apps to be shared between them
- ❑ Why Hybrid Cloud?
 - ❑ Greatest flexibility - run apps both in public cloud and continue to run legacy or sensitive apps on-prem
 - ❑ Use on-prem servers in order to meet security, compliance and strict regulations
 - ❑ Continue to run apps on out-of-date hardware or OS, until redesign is possible for running in the cloud



Cloud Deployment Models - Hybrid Cloud

- ❑ Why not Hybrid Cloud?
 - ❑ Related to on-prem cloud deployment model: specialized IT personnel, money and pricing model – potential large upfront investment





Module 2 – Azure Cloud Introduction

Cloud Computing Models

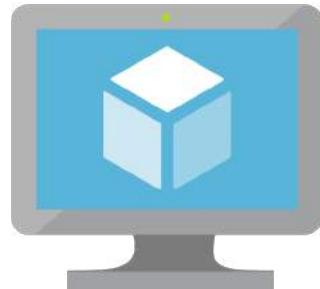
Cloud Computing Models

- ❑ There are three major types of cloud services available:
 - ❑ IaaS – Infrastructure as a Service
 - ❑ PaaS – Platform as a Service
 - ❑ SaaS – Software as a Service
- ❑ Differences between them:
 - ❑ Flexibility and management
 - ❑ Tasks' ownership
 - ❑ Pricing model
 - ❑ Address different business needs



Infrastructure as a Service - IaaS

- ❑ IaaS - rent IT infrastructure – servers and virtual machines (VMs), storage, networks, OSs – from Azure Cloud, on a pay-as-you-go basis
- ❑ IaaS provides the highest level of flexibility and management control over the infrastructure



Virtual Machine



Platform as a Service - PaaS

- ❑ PaaS offers an on-demand environment for developing, testing, delivering and managing software applications
- ❑ Mostly used by developers; quickly create web or mobile apps, without taking care of the underlying infrastructure of servers, storage, network, DBs, etc.



App Services



Microsoft Azure Administrator

Software as a Service - SaaS

- Software as a Service is a method for delivering software applications over the Internet, on demand and typically on a subscription basis (monthly/yearly)
- With SaaS you do not have to think about how the service is maintained or how the underlying infrastructure is managed; you only need to think about how you will use the App



Office365



Gmail



IaaS | PaaS | SaaS Example

YOU OWN THE CAR = ON-PREM DC



YOU GET A TAXI = PaaS



YOU LEASE THE CAR = IaaS



YOU GET THE BUS = SaaS





Module 2 – Azure Cloud Introduction

7 Advantages of Microsoft Azure Cloud Computing



Azure Cloud is Cost-Effective

Azure Cloud is Cost-Effective

- Azure Cloud offers a pay-as-you-go pricing model (aka consumption-based pricing model)
- Key aspects to remember:
 - No upfront costs
 - Pay extra for resources only when needed (elasticity)
 - No infrastructure to purchase and manage





Azure Cloud is Scalable

Azure Cloud is Scalable

- Azure Cloud is highly scalable and can accommodate any business growth; manual or automatic.
- Azure cloud can adapt to your business by scaling either vertically or horizontally



Vertical Scaling



Horizontal Scaling

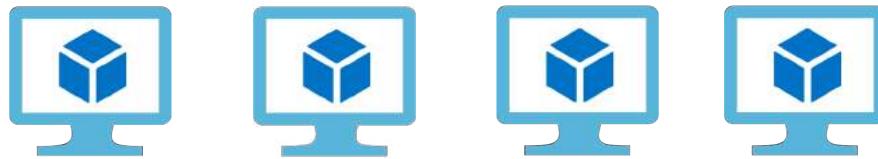




Azure Cloud is Elastic

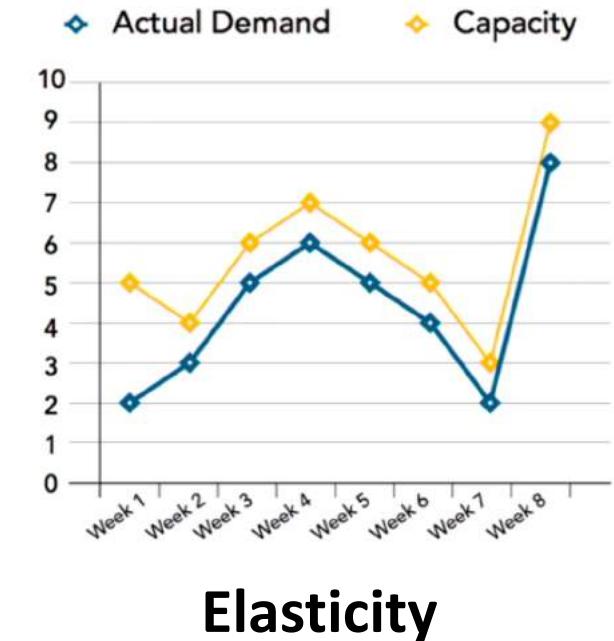
Azure Cloud is Elastic

- Azure Cloud is highly elastic and can adapt to demand changes, adding or removing resources



Usual Traffic

Unexpected Heavy Traffic





Azure Cloud is Current

Azure Cloud is Current

- Azure Cloud is always up to date, running on most current and recommended HW and SW versions
- Microsoft Azure is responsible for:
 - Hardware configuration
 - Software patching
 - SW and HW upgrades
 - Replace faulty equipment



... and everything is transparent to you !





Azure Cloud is Global

Azure Cloud is Global

- With Azure Cloud you can really go global in minutes; easily deploy your application in multiple regions around the world with just a few clicks
- This means you can provide lower latency and a better experience to your customers at minimal cost
- Azure Global Infrastructure





Azure Cloud is Secure

Azure Cloud is Secure

- ❑ Azure Cloud is Secure, enforcing strict security policies at both physical and digital layers
- ❑ Physical security is Azure Cloud's responsibility: secure DCs, cameras, locks, specialized security personnel, etc.
- ❑ Digital security: Azure provides access to resources in the cloud only to authorized users





Azure Cloud is Reliable

Azure Cloud is Reliable

- Azure Cloud is highly reliable, providing redundancy and fault tolerance to resources
- Azure Cloud infrastructure is built in order to accommodate disasters; if one component fails, a backup component will seamlessly take ownership, assuring service availability
- Data in your Azure storage account is replicated to ensure durability and high availability (min. 11 9s)





Module 2 – Azure Cloud Introduction

Understanding CapEx versus OpEx. Economies of Scale



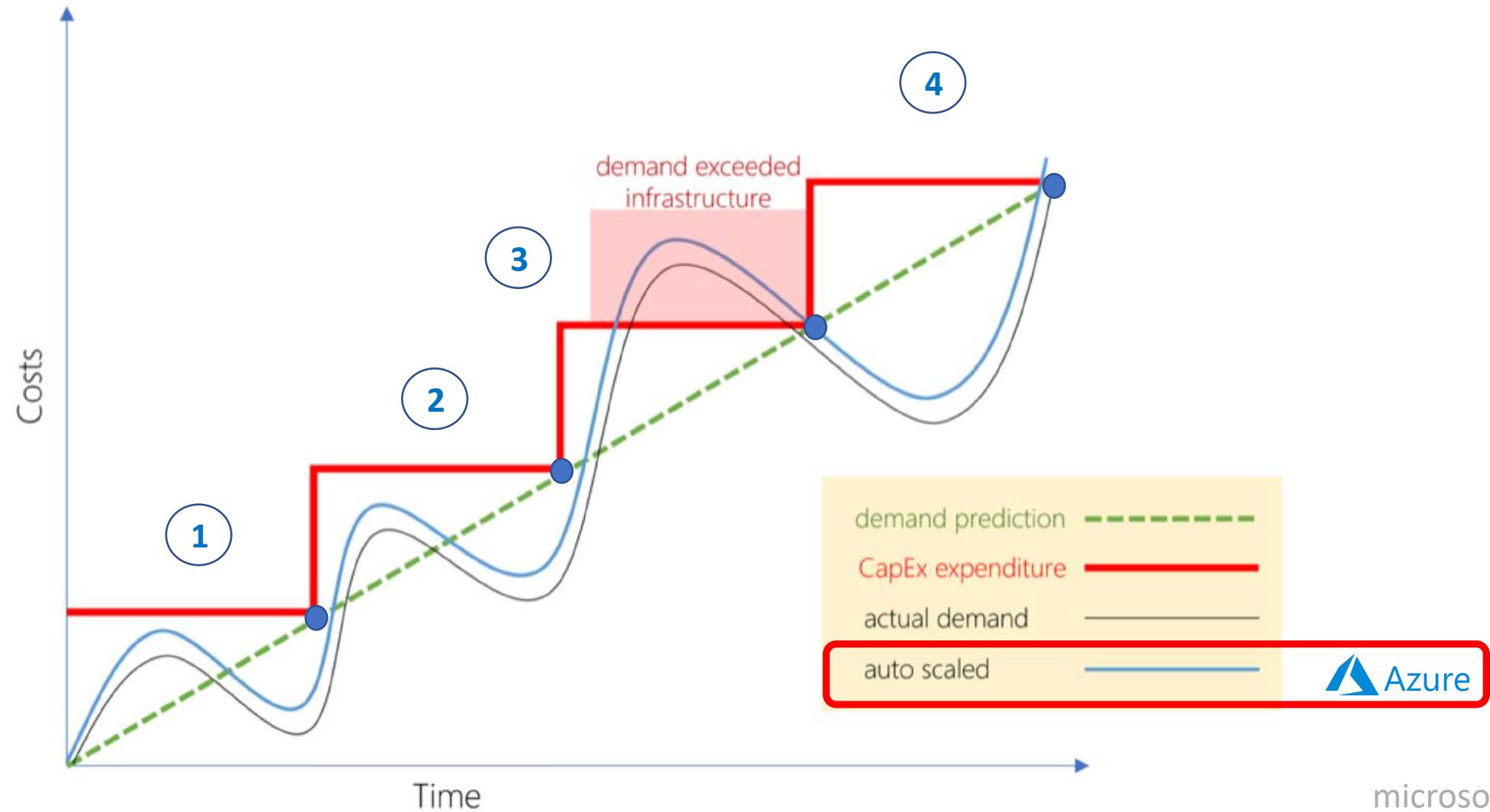
CapEx versus OpEx

CapEx and OpEx

- CapEx and OpEx represent two approaches to how you make an investment; time and money
- CapEx – Capital Expenditure
 - Spend money upfront
 - Upfront cost for the company
 - Value reduced over time (tax)
- OpEx – Operational Expenditure
 - No upfront cost; pay-as-you-use; same year tax deduction



CapEx vs OpEx





Economies of Scale

Economies of Scale

- ☐ Economies of scale - ability to operate more efficiently or at a lower-cost / unit when operating at a larger scale
- ☐ By using Azure cloud computing, you can achieve a lower variable cost than you can get on your own
- ☐ Usage from customers is aggregated in the cloud, providers such as Azure can achieve higher economies of scale, which translates into lower pay-as-you-go prices





Module 2 – Azure Cloud Introduction

Azure Global Infrastructure

Azure Global Infrastructure Overview

- ❑ Azure Global Infrastructure's building blocks are:
 - ❑ Regions
 - ❑ Availability Zones
 - ❑ Geographies
 - ❑ Region pairs
- ❑ Next: what they are & why should we care about it?





Azure Regions

Azure Regions

- ❑ A region is a set of datacenters deployed within a latency-defined perimeter and connected through a dedicated regional low-latency network
- ❑ When deploying resources in Azure we need to select:
 - ❑ Region
 - ❑ High Availability options

Instance details

Virtual machine name * ⓘ

Region * ⓘ (US) Central US

Availability options ⓘ No infrastructure redundancy required



What's inside an Azure Datacenter ?

□ What's inside the “box” ?

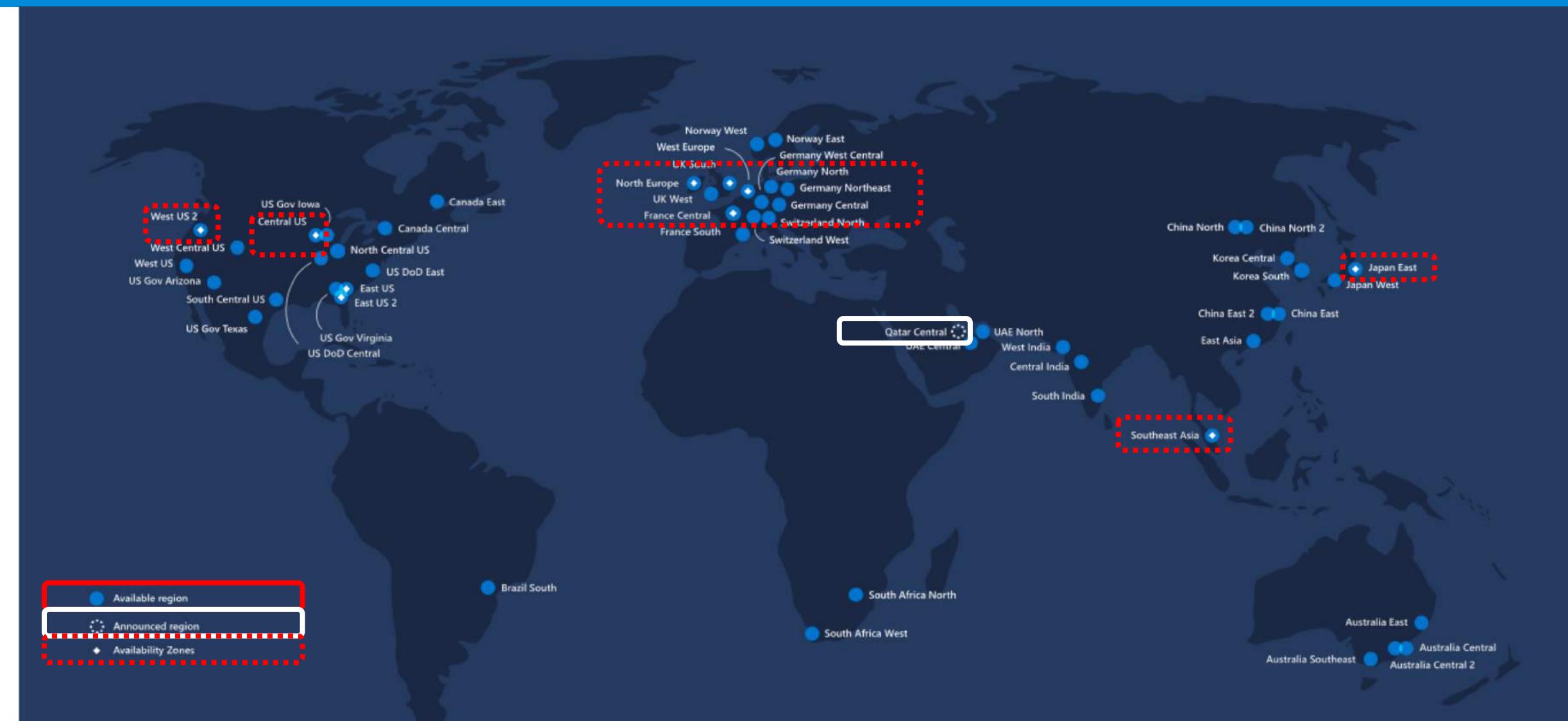
- Servers
- Networking
- Storage
- Security
- Balancers
- Etc.



- <https://news.microsoft.com/en-gb/2019/04/09/microsoft-has-doubled-size-of-uk-azure-regions-increasing-compute-capacity-by-more-than-1500-as-country-embraces-digital-transformation/>



Azure Cloud Global Infrastructure



Azure Cloud Global Infrastructure

- ❑ Azure Cloud in numbers:
 - ❑ 60+ Azure regions
 - ❑ Available in 140 countries
 - ❑ Up to 1.6 Pbps of bandwidth in a region (inter-DC)
 - ❑ Three Azure Government Secret region locations undisclosed
- ❑ Azure Global Infrastructure - Locations:
 - ❑ <https://azure.microsoft.com/en-us/global-infrastructure/locations/>
- ❑ List is constantly updated – please check latest info





Geographies in Azure Cloud

Geographies in Azure Cloud

- Azure Cloud regions are organized into geographies
- A geography is a discrete market, typically containing two or more regions, that preserves data residency and compliance boundaries
- Each region is part of a single geography and specific service availability, compliance and data residency apply
- Azure Global Infrastructure – Geographies
 - <https://azure.microsoft.com/en-us/global-infrastructure/geographies/>

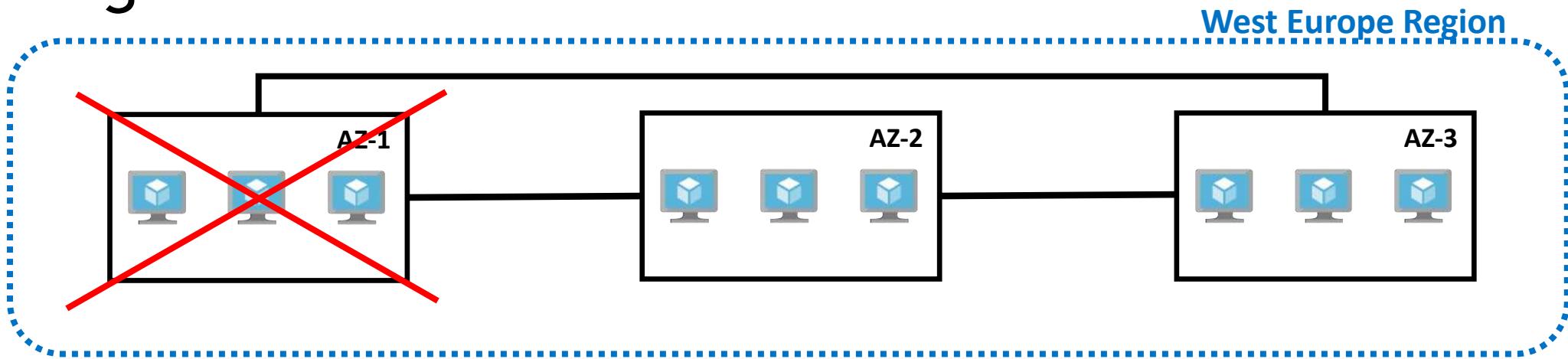




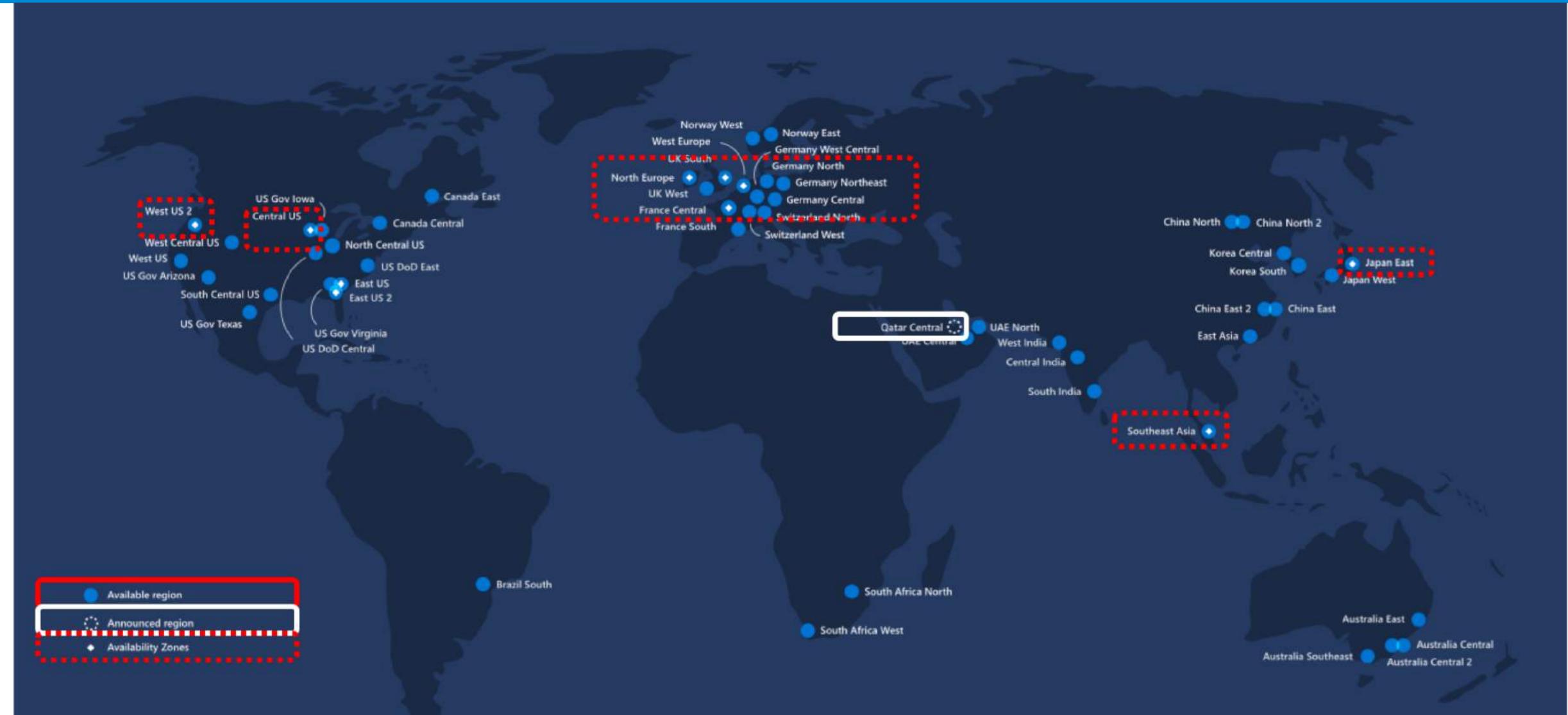
Azure Availability Zones

Azure Availability Zones

- When deploying highly available, mission-critical apps, it's a good idea to use Azure Availability Zones
- Availability Zones are physically separate datacenters within an Azure region, with independent power, network and cooling



Azure Availability Zones – 11 Regions offer AZs

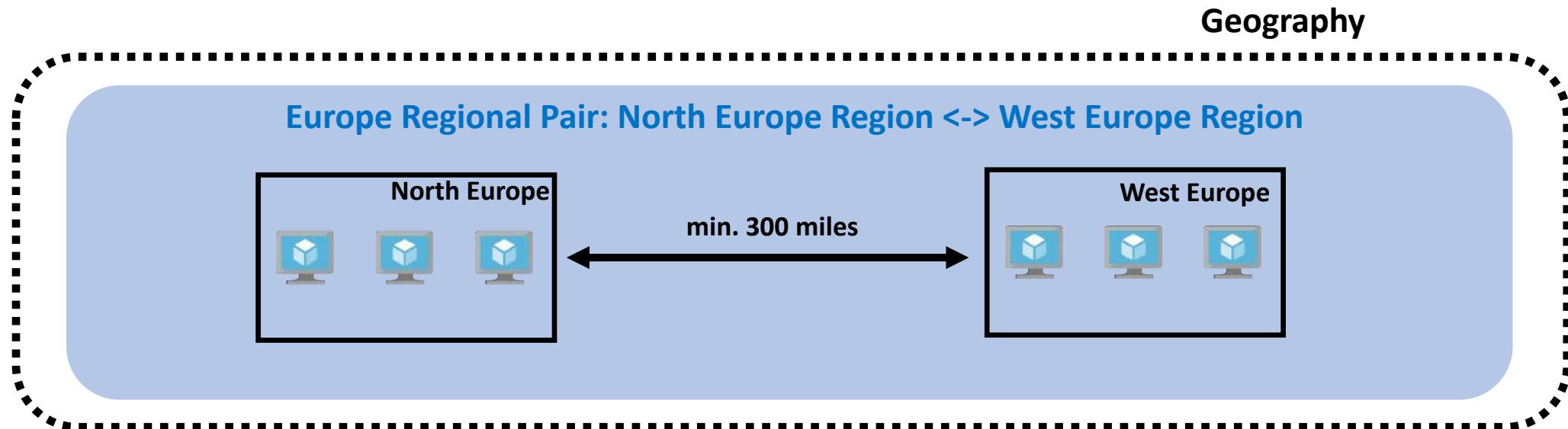




Azure Region Pairs

Region Pairs in Azure

- What if an entire Azure Region goes down ?
- Azure Region Pairs can help in this case, providing business continuity and disaster recovery (in the cloud)





Module 2 – Azure Cloud Introduction

Azure Management Interfaces – Manage Azure Cloud Platform

Azure Management Interfaces Overview

- Azure provides multiple distinct options in order to interact with the Azure Cloud Platform:
 - Azure Portal
 - Azure Command Line Interface (CLI)
 - Azure PowerShell module
 - Azure Cloud Shell
 - Azure SDKs
 - Azure Mobile app





Azure Portal

Azure Portal Overview

- The Azure Portal is a graphical user interface for accessing a wide range of Azure Cloud services and managing compute, storage, and other cloud resources
- Azure Portal is a web application that comprises and refers to a broad collection of service consoles for managing Azure Cloud
- Accessing the Azure Portal
 - <https://portal.azure.com>



Azure Portal Overview

≡

Search resources, services, and docs (G+)

Create a resource

Home

Dashboard

All services

FAVORITES

All resources

Resource groups

App Services

SQL databases

Azure Cosmos DB

Virtual machines

Load balancers

Storage accounts

Virtual networks

Azure Active Directory

Monitor

Advisor

Security Center

Help + support

Cost Management + Billing

Azure services

[Create a resource](#) [Resource groups](#) [Network Watcher](#) [Virtual machines](#) [Storage accounts](#) [Storage explorer](#) [Virtual networks](#) [Subscriptions](#) [Azure Active Directory](#) [More services](#)

Recent resources

Name	Type	Last Viewed
NetworkWatcherRG	Resource group	1 d ago
X-A-A-S Primary	Subscription	4 mo ago
cloud-shell-storage-westeurope	Resource group	6 mo ago
Pay-As-You-Go	Subscription	6 mo ago
csbbe630251a44cx470axada	Storage account	6 mo ago

Navigate

[Subscriptions](#) [Resource groups](#) [All resources](#) [Dashboard](#)

Tools





Azure CLI & Azure PowerShell

Azure CLI & Azure PowerShell

- Cross-platform options (Windows, Mac and Linux) that enable you to connect to your Azure Cloud tenant (account) and manage resources from CLI
- Why to use CLI or PowerShell ?
 - Optimize and automate your work through scripts

Azure CLI

```
az vm create \
  --resource-group myResourceGroupVM \
  --name myVM \
  --image UbuntuLTS \
  --admin-username azureuser \
  --generate-ssh-keys
```

Azure PowerShell

```
New-AzVm
  -ResourceGroupName "myResourceGroup"
  -Name "myVM"
  -Location "East US"
  -VirtualNetworkName "myVnet"
  -SubnetName "mySubnet"
  -SecurityGroupName "myNetworkSecurityGroup"
  -PublicIpAddressName "myPublicIpAddress"
  -OpenPorts 80,3389
```





Azure Cloud Shell

Azure Cloud Shell

- Azure Cloud Shell offers a browser-accessible, pre-configured shell experience for managing Azure resources without the overhead of installing, versioning and maintaining a machine yourself
- Azure Cloud Shell is your Microsoft-managed admin machine in Azure, for Azure
- You get a modern web-based command line experience which can be accessed from several places like the Azure Portal, <https://shell.azure.com> and the Azure mobile app





Azure SDKs

Azure SDKs

- Interesting option for Developers 😊
- The Azure SDKs are collections of libraries for programming languages; they help you build applications that manage and interact with Azure services

Go

[Install SDK](#)

[API reference](#)

Java

[Install SDK](#)

[API reference](#)

PHP

[Install SDK](#)

[API reference](#)

Python

[Install SDK](#)

[API reference](#)

.NET

[Download Visual Studio 2019](#)

[Download Visual Studio 2019 for Mac](#)

[Install SDK](#)

[API reference](#)

TypeScript/JavaScript

[Install SDK](#)

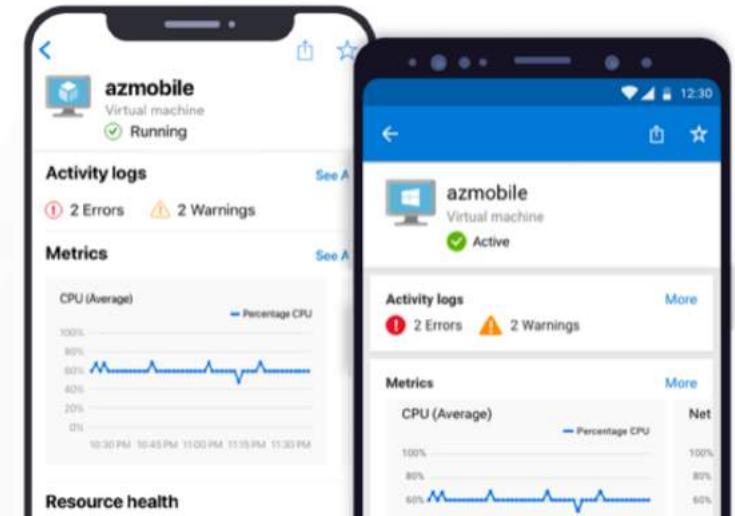




Azure Mobile App

Azure Mobile App

- App available on both Apple and Google Play stores
- Can be an interesting option in order to:
 - Monitor the health and status of your Azure resources
 - Quickly diagnose and fix issues
 - Run commands to manage your Azure resources





Module 2 – Azure Cloud Introduction

Module Completion & Exam Hints



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Cloud Deployment Models

Cloud Deployment Models

- ❑ There are three different cloud deployment models:
 - ❑ Public Cloud
 - ❑ Private Cloud
 - ❑ Hybrid Cloud





Cloud Computing Models

Cloud Computing Models

- ❑ There are three major types of cloud services available:
 - ❑ IaaS – Infrastructure as a Service
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 - ❑ SaaS – Software as a Service
- ❑ Differences between them:
 - ❑ Flexibility and management
 - ❑ Tasks' ownership
 - ❑ Pricing model





Benefits of Microsoft Azure Cloud Computing

Azure Cloud Advantages

- Azure Cloud is:
- Cost-effective
- Scalable
- Elastic
- Current
- Global
- Secure
- Reliable





CapEx versus OpEx

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Economies of Scale

Economies of Scale

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Azure Global Infrastructure

Azure Global Infrastructure

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Azure Management Interfaces

Azure Management Interfaces

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Azure Cloud Introduction - Quiz



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Module 3 – Azure VMs Fundamentals

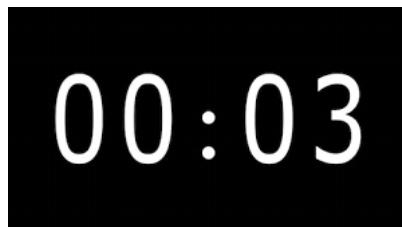
Microsoft Azure Compute Options Overview

Azure Compute Overview

- ❑ Azure compute is the *on-demand* computing service for running cloud-based applications



- ❑ Fast on-demand resources



- ❑ Pay-as-you-go Pricing



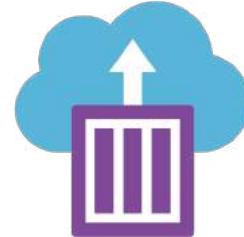
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



Containers



Azure App Service



Serverless Computing

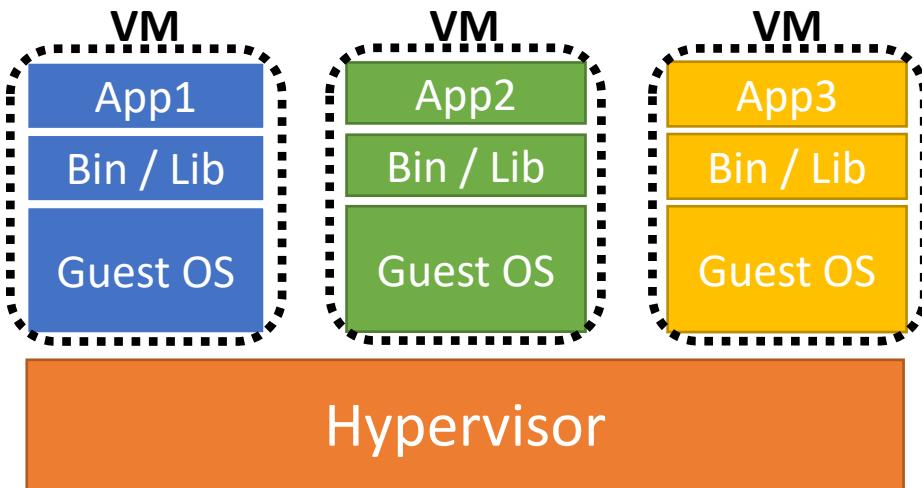


Azure Virtual Machines Introduction

- Virtual machines, or VMs, are software emulations of physical computers



Containers, VMs vs Containers



i.e. VMware Workstation, ESXi

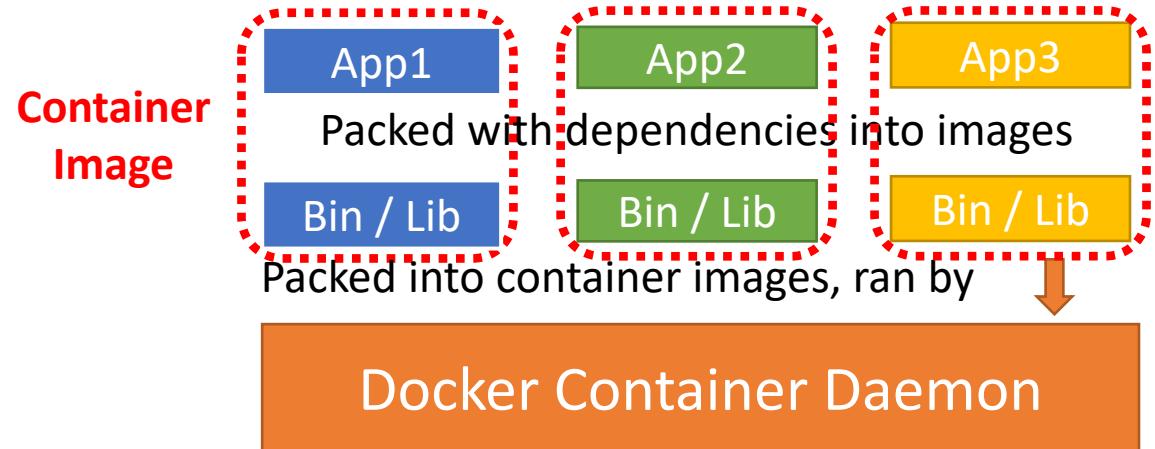
Host Operating System

i.e. Windows, Mac, Linux

Infrastructure

i.e. Laptop, server in DC

Virtual Machines



Installed in OS, manages and runs containers

Host Operating System

Any OS that can run containers; i.e. Linux

Infrastructure

Containers



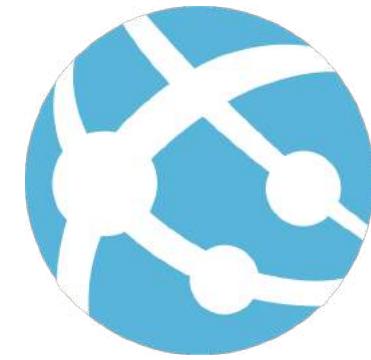
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Azure App Service Introduction

- HTTP-based service for hosting web applications, REST APIs and mobile back ends
- Available programming languages:



Custom Windows container (Preview)



App Service

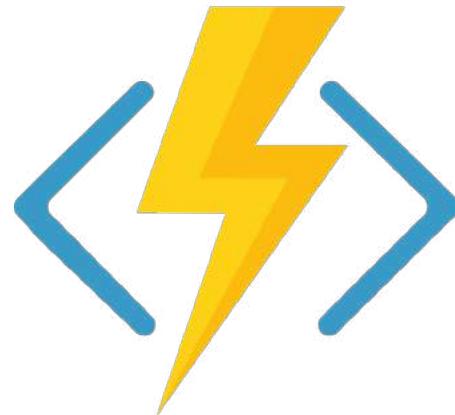
- Azure App Service – Azure PaaS offering
- Pricing – based on App Service Plan



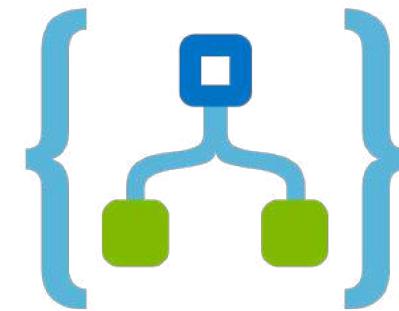
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Azure Serverless Computing Services

- ❑ Most popular Azure serverless computing services:



Azure Functions



Azure Logic App

- ❑ Serverless computing not part of AZ-104 blueprint!



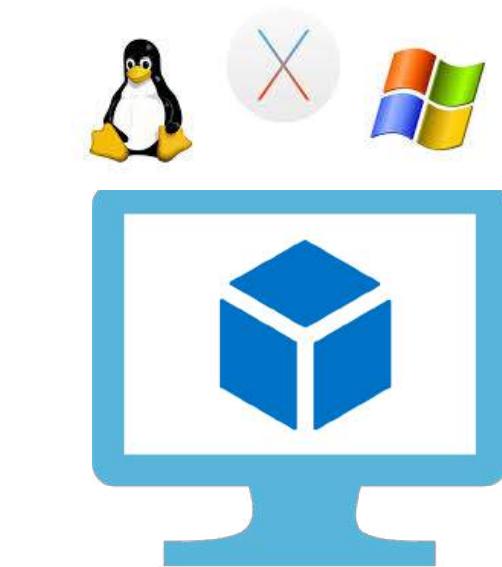


Module 3 – Azure VMs Fundamentals

Azure Virtual Machines Fundamentals 101

What's a Virtual Machine (VM) ?

- Virtual machines, or VMs, are software emulations of physical computers



What's a Virtual Machine (VM) ?

- ☐ Virtual machines, or VMs, are software emulations of physical computers



USER STATION or SERVER



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VMs Use Cases

□ Azure VMs - Infrastructure as a Service (IaaS)

□ VMs are great choice when:

① Total control over the OS



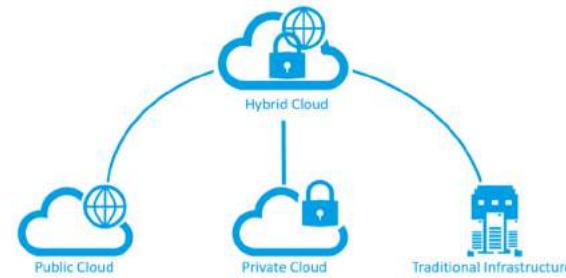
② Run custom software



③ Development and testing



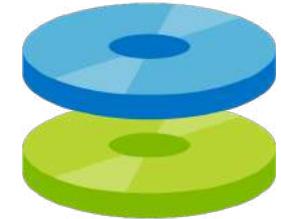
④ Extend your datacenter



Storage for VMs

- ❑ Azure managed disks are block-level storage volumes that are managed by Azure and used with Azure VMs

- ❑ Managed Disks VS Unmanaged Disks



Disks

- ❑ Disk available options:

- ❑ Standard HDD
 - ❑ Premium SSD

- ❑ Standard SSD
 - ❑ Ultra disk

- ❑ Differences: Throughput and IOPS

<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/disks-types>



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Module 3 – Azure VMs Fundamentals

Azure Virtual Machines (VMs) - Types and Sizes

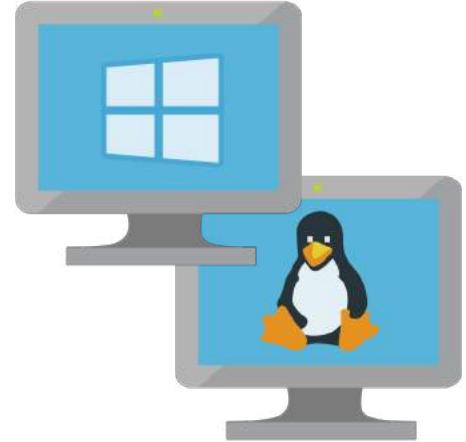
Azure VMs Types and Sizes

- Multiple Azure VMs types & sizes – workload dependent
 - Same for Windows and Linux VMs
- VM types categories:
 - General purpose
 - Compute optimized
 - Memory optimized
 - Storage Optimized
 - GPU
 - High performance compute



Azure VMs – General purpose

- ❑ Use case:
 - ❑ Testing and development
 - ❑ Small and medium databases
 - ❑ Small web servers
- ❑ VM configuration:
 - ❑ Balanced CPU-to-memory ratio
- ❑ VM family sizes – B & D



Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs – Compute optimized

- ❑ Use case:
 - ❑ Medium traffic web servers
 - ❑ Network appliances
 - ❑ Application servers
- ❑ VM configuration:
 - ❑ High CPU-to-memory ratio
- ❑ VM type - Fsv2



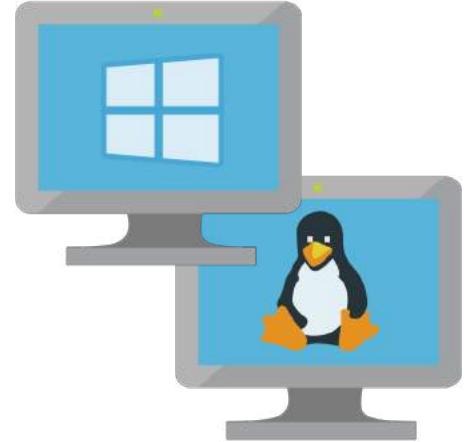
Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs – Memory optimized

- ❑ Use case:
 - ❑ Relational database servers
 - ❑ Medium to large caches
 - ❑ In-memory analytics
- ❑ VM configuration:
 - ❑ High memory-to-CPU ratio
- ❑ VM family sizes – E, M, D



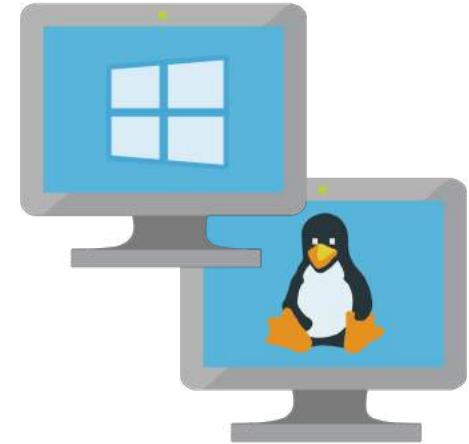
Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs – Storage optimized

- ❑ Use case:
 - ❑ Big Data, SQL, NoSQL databases
 - ❑ Data warehousing
 - ❑ Large transactional databases
- ❑ VM configuration:
 - ❑ High disk throughput and IO
- ❑ VM type – Lsv2



Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs – GPU

- ❑ Use case:
 - ❑ Heavy graphic rendering and video editing
 - ❑ Deep learning (ML)
- ❑ VM configuration:
 - ❑ single or multiple GPUs
- ❑ VM family sizes – N



Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs – High Performance Compute

- ❑ Use case:
 - ❑ High performance compute
- ❑ VM configuration:
 - ❑ Most powerful CPU
 - ❑ High-throughput NICs - RDMA
- ❑ VM family sizes – H



Learn more: <https://docs.microsoft.com/en-gb/azure/virtual-machines/windows/sizes>



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Azure VMs Overview – Types and Sizes

	Use Case	VM Configuration	Sizes
General purpose	<ul style="list-style-type: none">Testing and developmentSmall and medium DBsSmall web servers	<ul style="list-style-type: none">Balanced CPU-to-memory ratio	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2, Dv4, Dsv4, Ddv4, Ddsv4
Compute optimized	<ul style="list-style-type: none">Medium traffic web serversNetwork appliancesApplication servers	<ul style="list-style-type: none">High CPU-to-memory ratio	Fsv2
Memory optimized	<ul style="list-style-type: none">Relational DB serversMedium to large cachesIn-memory analytics	<ul style="list-style-type: none">High memory-to-CPU ratio	Esv3, Ev3, Easv4, Eav4, Ev4, Esv4, Edv4, Edsv4, Mv2, M, DSv2, Dv2
Storage optimized	<ul style="list-style-type: none">Big Data, SQL, NoSQLData warehousingLarge transactional DB	<ul style="list-style-type: none">High disk throughput and IO	Lsv2
GPU	<ul style="list-style-type: none">Heavy graphicsDeep learning (ML)	<ul style="list-style-type: none">Single or multiple GPUs	NC, NCv2, NCv3, ND, NDv2, NV, NVv3, NVv4
HPC	<ul style="list-style-type: none">High performance compute	<ul style="list-style-type: none">Most powerful CPUHigh-throughput NICs – RDMA	HB, HBv2, HC, H





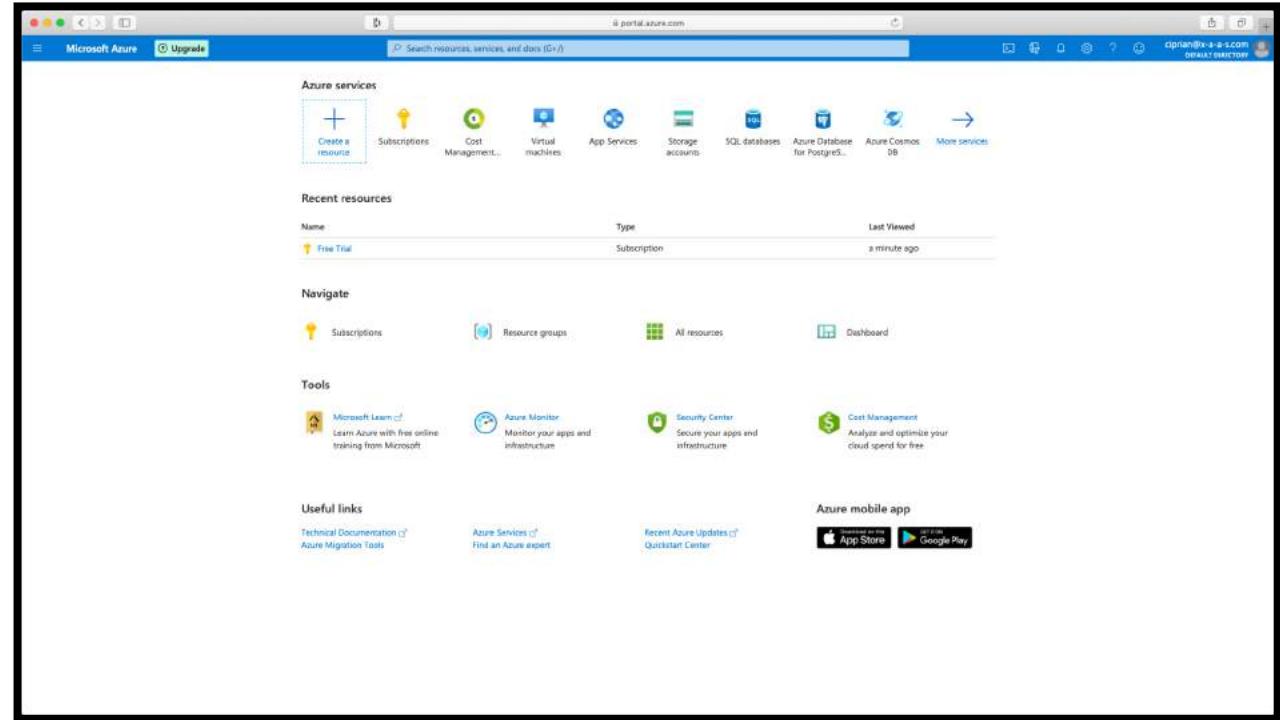
Module 3 – Azure VMs Fundamentals

Hands-on Lab – Azure Portal Overview

Hands-on Lab Overview



<https://portal.azure.com>



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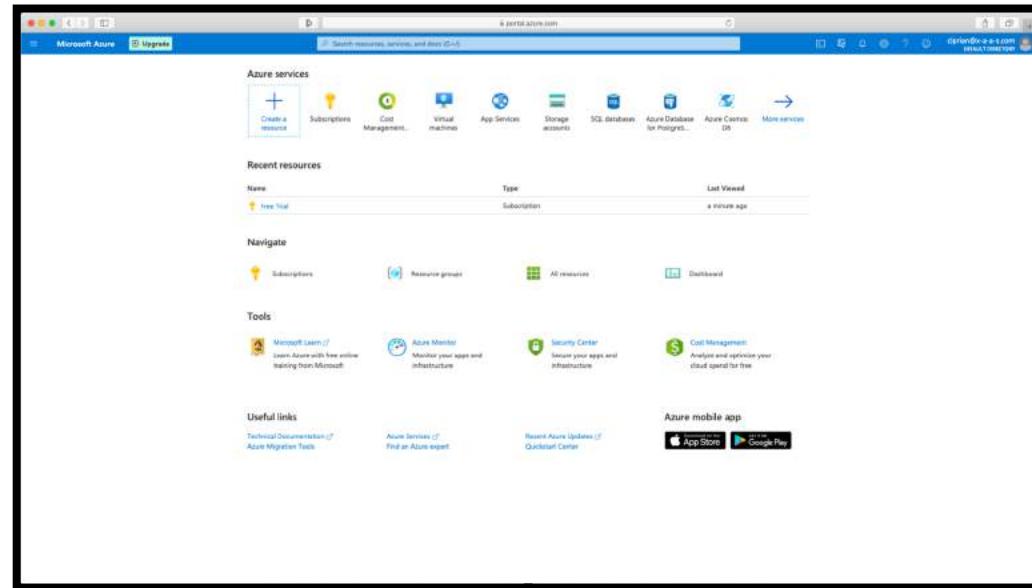
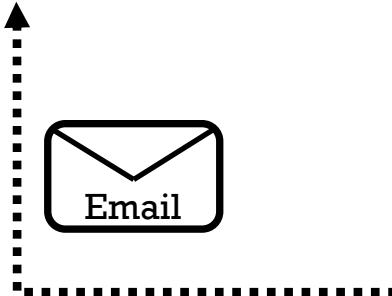
Module 3 – Azure VMs Fundamentals

Hands-on Lab - Create a Billing Alarm for Your Azure Account

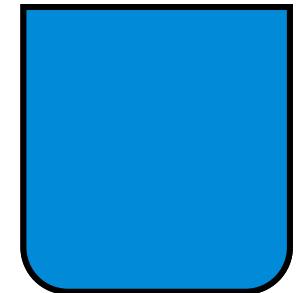
Hands-on Lab Overview



<https://portal.azure.com>



100%



Monthly Budget



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Module 3 – Azure VMs Fundamentals

Hands-on Lab - Launch Linux VM in Azure Cloud

Hands-on Lab Overview

☐ Launch Linux VM in Azure Cloud – Basic setup



<https://portal.azure.com>



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Module 3 – Azure VMs Fundamentals

Secure Shell (SSH) Overview

What is SSH?

- ❑ SSH - Secure Shell is a protocol
- ❑ Method for secure remote login from one computer to another
- ❑ Communication is encrypted

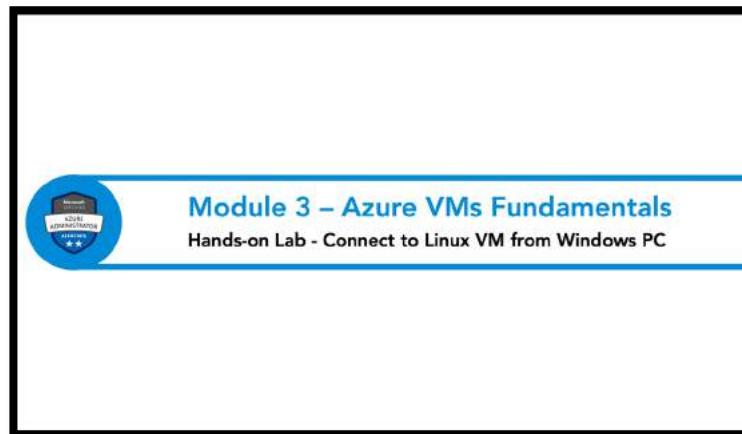
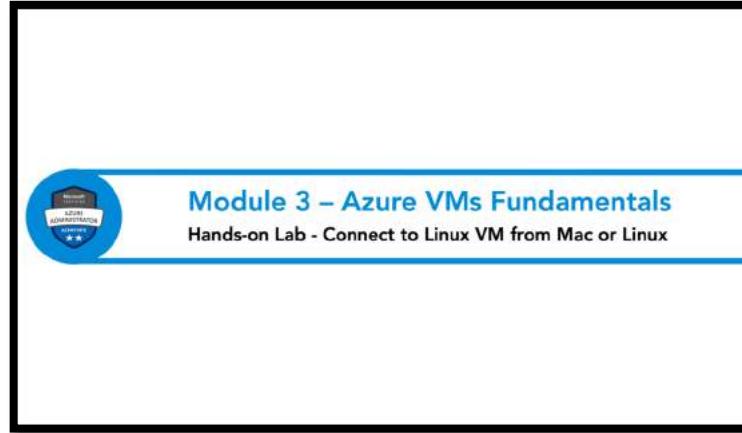
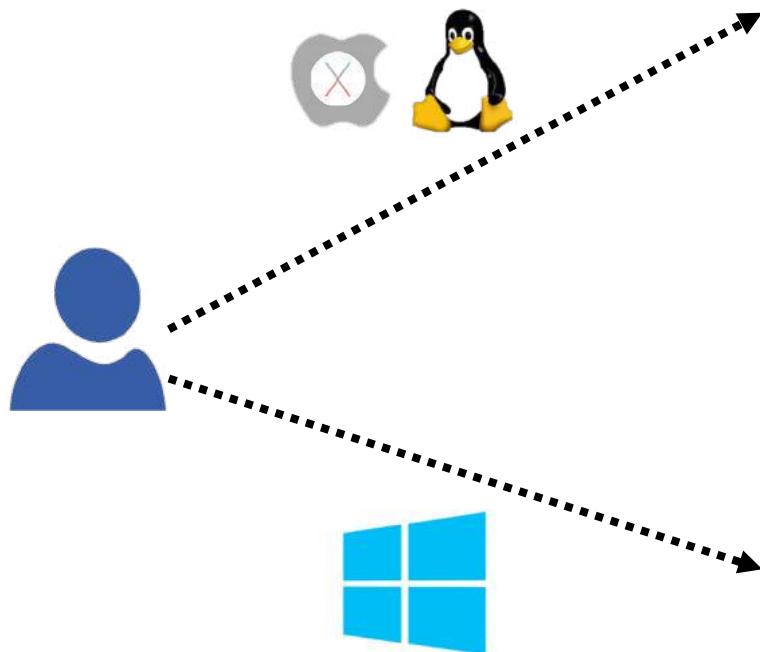


SSH Connect Options

	SSH	PUTTY
Mac OS	✓	
Linux OS	✓	
Windows OS < 10		✓
Windows OS >= 10	✓	✓



Where to Go Next ?



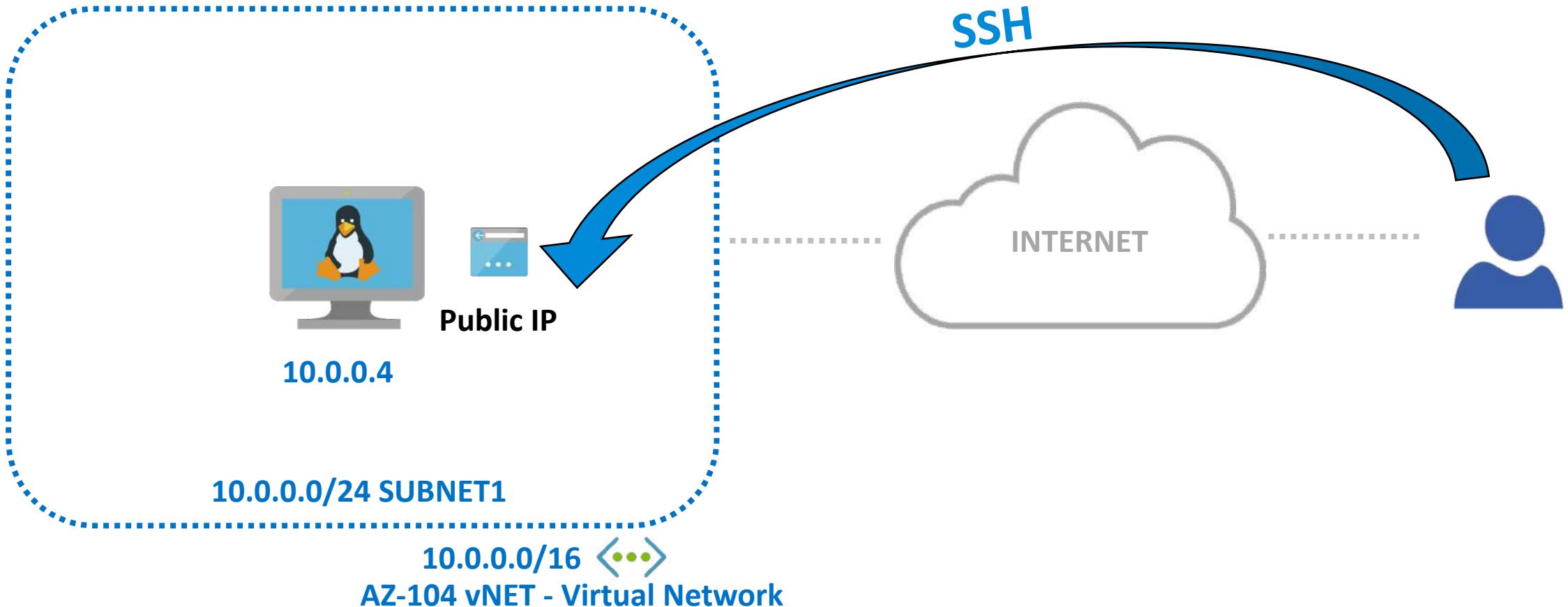


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Connect to Linux VM from Mac or Linux

Hands-on Lab Overview

☐ Connect to Linux VM from Mac or Linux



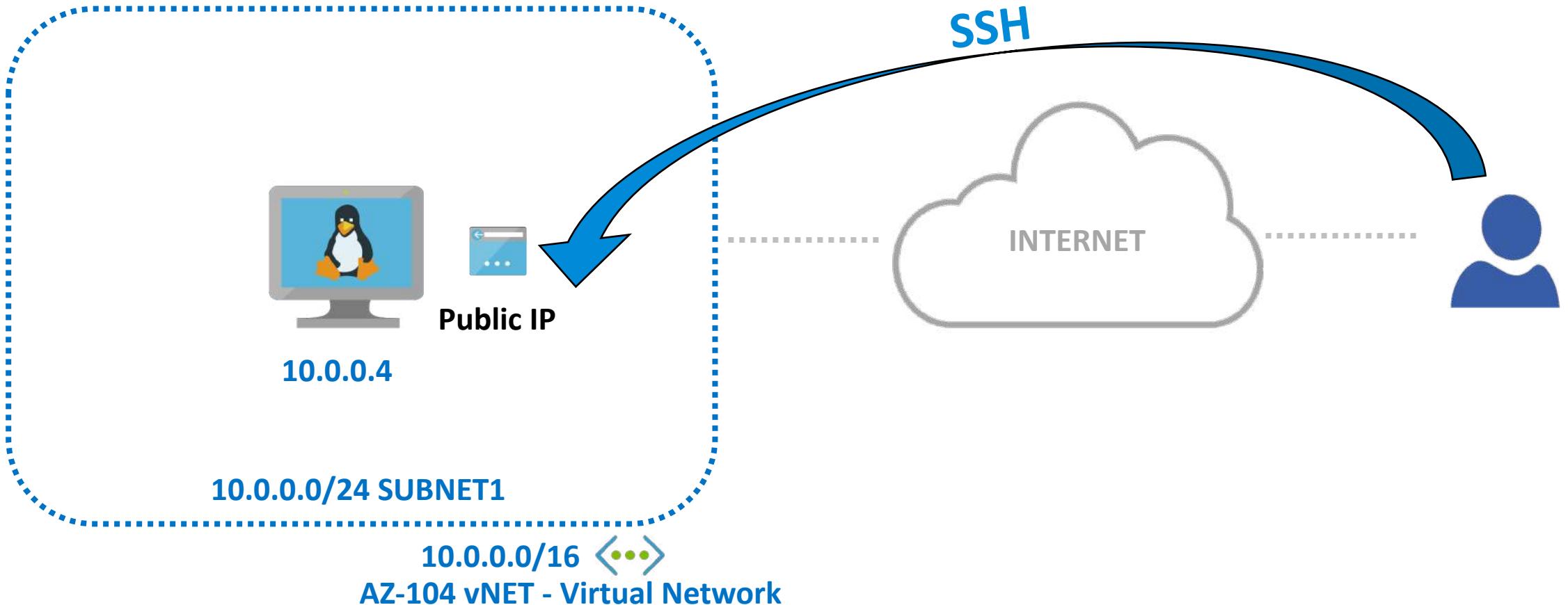


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Connect to Linux VM from Windows PC

Hands-on Lab Overview

☐ Connect to Linux VM from Mac or Linux



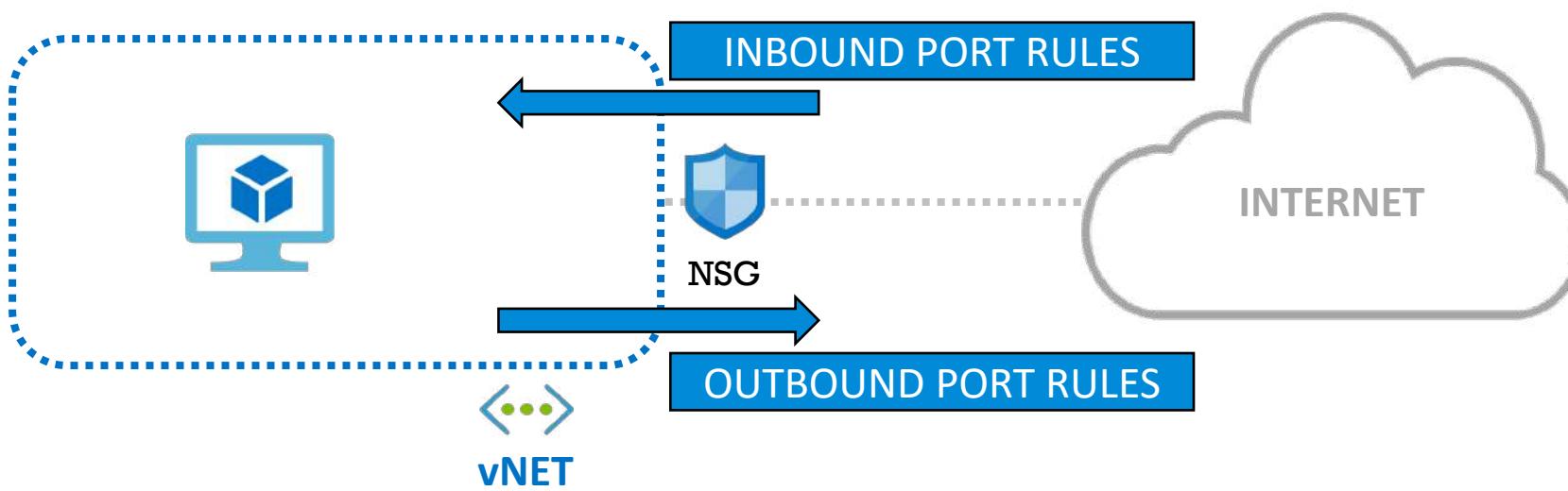


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Network Security Groups Fundamentals 101

NSGs Overview

- Network Security Groups (NSGs) – fundamental building block in Azure security
- NSGs are used to filter network traffic to and from Azure resources, such as VMs



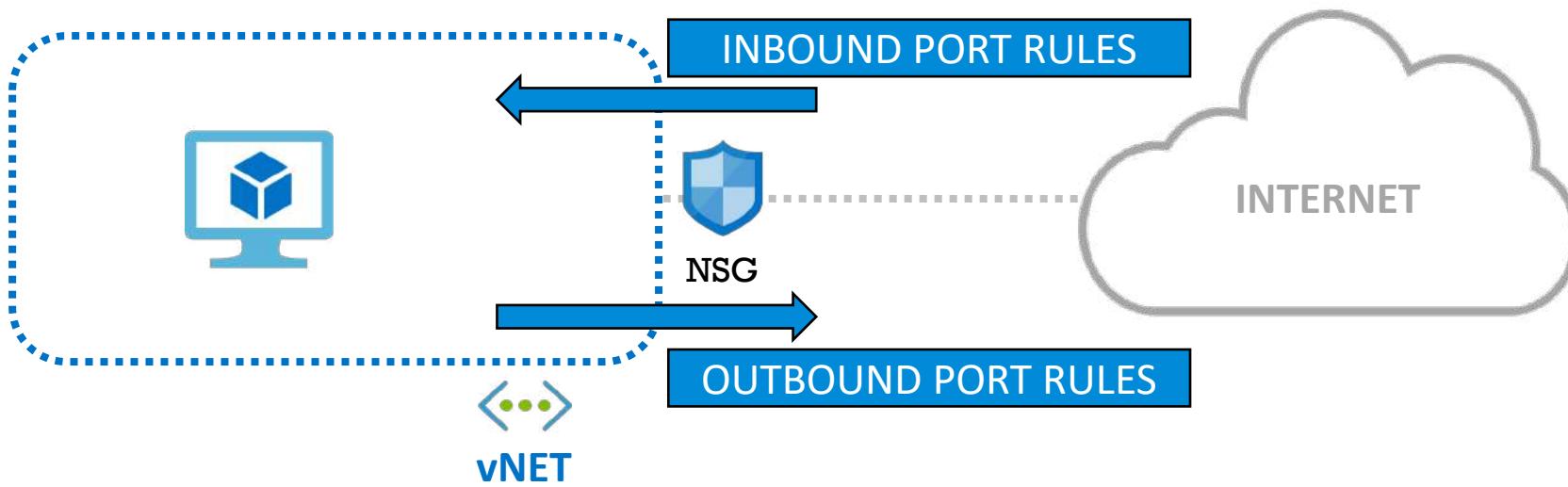


Module 3 – Azure VMs Fundamentals

Network Security Groups Deep Dive

NSGs Overview

- NSGs are used to filter network traffic to and from Azure resources, such as VMs – virtual firewall
- NSG security rules are evaluated by priority



Rule Priority - Traffic Evaluation in NSGs

- ☐ NSG security rules are evaluated by priority using the 5-tuple information – source, source port, destination, destination port and protocol
- ☐ Rules are processed and evaluated top-down, first match wins;



NSG

Inbound port rules Outbound port rules Application security groups Load balancing

Network security group **Webserver01-nsg** (attached to network interface: [webserver01228](#))
Impacts 0 subnets, 1 network interfaces

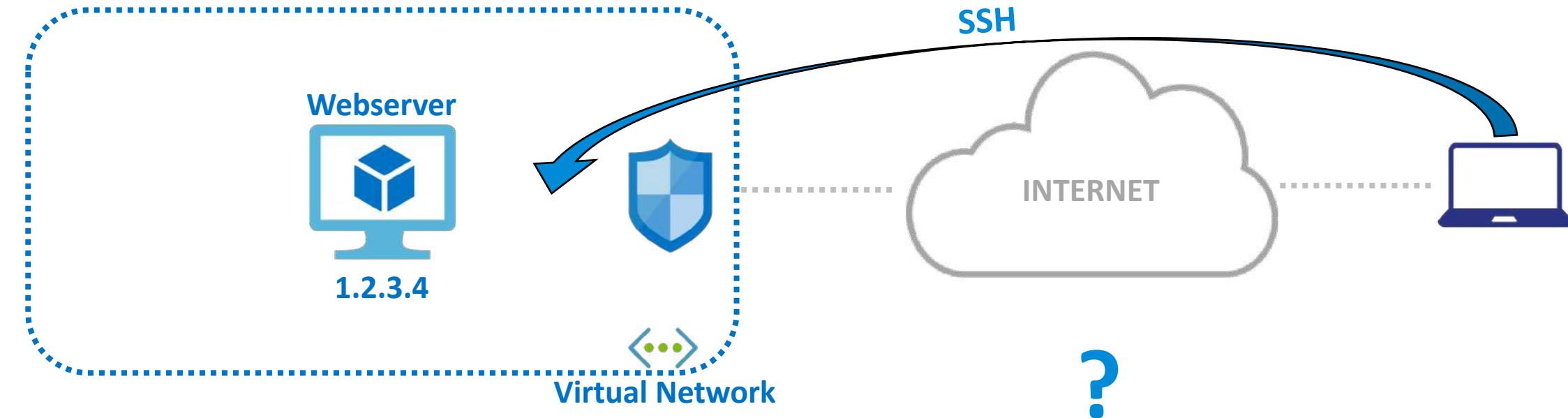
[Add inbound port rule](#)

Priority	Name	Port	Protocol	Source	Destination	Action	...
300	⚠ SSH	22	TCP	Any	Any	Allow	...
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	...
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	...
65500	DenyAllInBound	Any	Any	Any	Any	Deny	...



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Rule Priority - Traffic Evaluation Example



Priority	Name	Port	Protocol	Source	Destination	Action
1000	⚠ SSH_Rule_1	22	TCP	Any	1.2.3.4	✗ Deny
2000	⚠ SSH_Rule_2	22	TCP	Any	Any	✓ Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	✓ Allow
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	✓ Allow
65500	DenyAllInBound	Any	Any	Any	Any	✗ Deny



NSGs – Default Inbound Security Rules

□ Default rules in every NSG:

- 65000 – ALLOW traffic inside vNET
- 65001 – ALLOW traffic from Azure LoadBalancer
- 65500 – if not matched already, then DENY

Inbound port rules							Outbound port rules	Application security groups	Load balancing	
Priority	Name	Port	Protocol	Source	Destination	Action	Add inbound port rule			
300	⚠ SSH	22	TCP	Any	Any	Allow	...			
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	...			
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	...			
65500	DenyAllInBound	Any	Any	Any	Any	Deny	...			



NSGs – Default Outbound Security Rules

□ Default rules in every NSG:

- 65000 – ALLOW traffic inside vNET
- 65001 – ALLOW traffic from Azure LoadBalancer
- 65500 – if not matched already, then DENY

Inbound port rules **Outbound port rules** Application security groups Load balancing

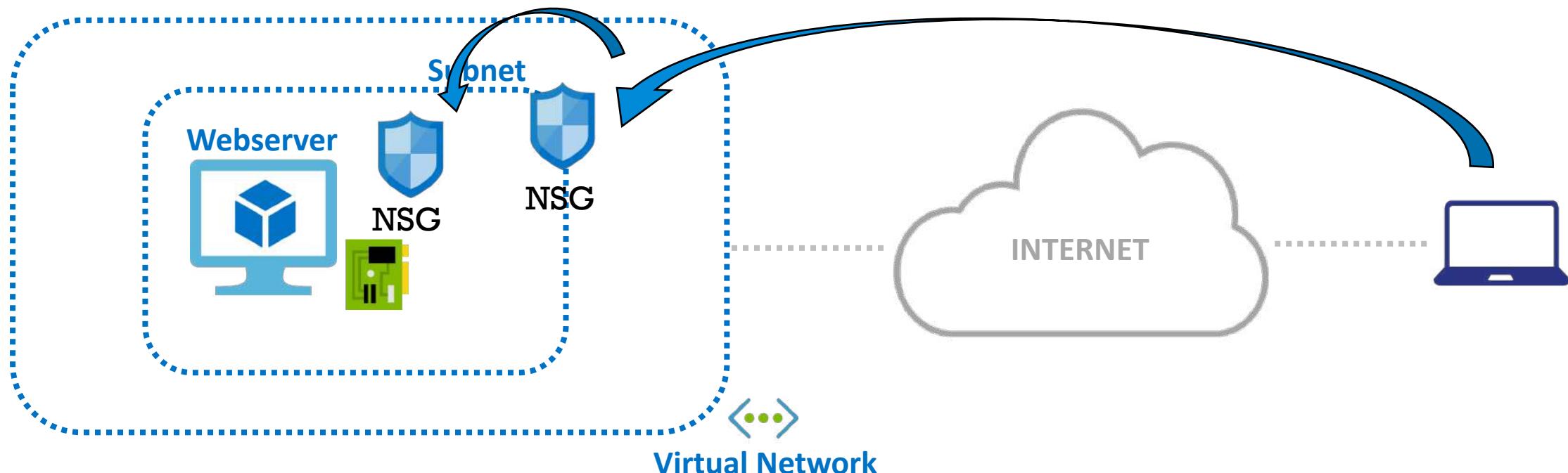
Network security group [Webserver01-nsg](#) (attached to network interface: [webserver01228](#)) Impacts 0 subnets, 1 network interfaces [Add outbound port rule](#)

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	...



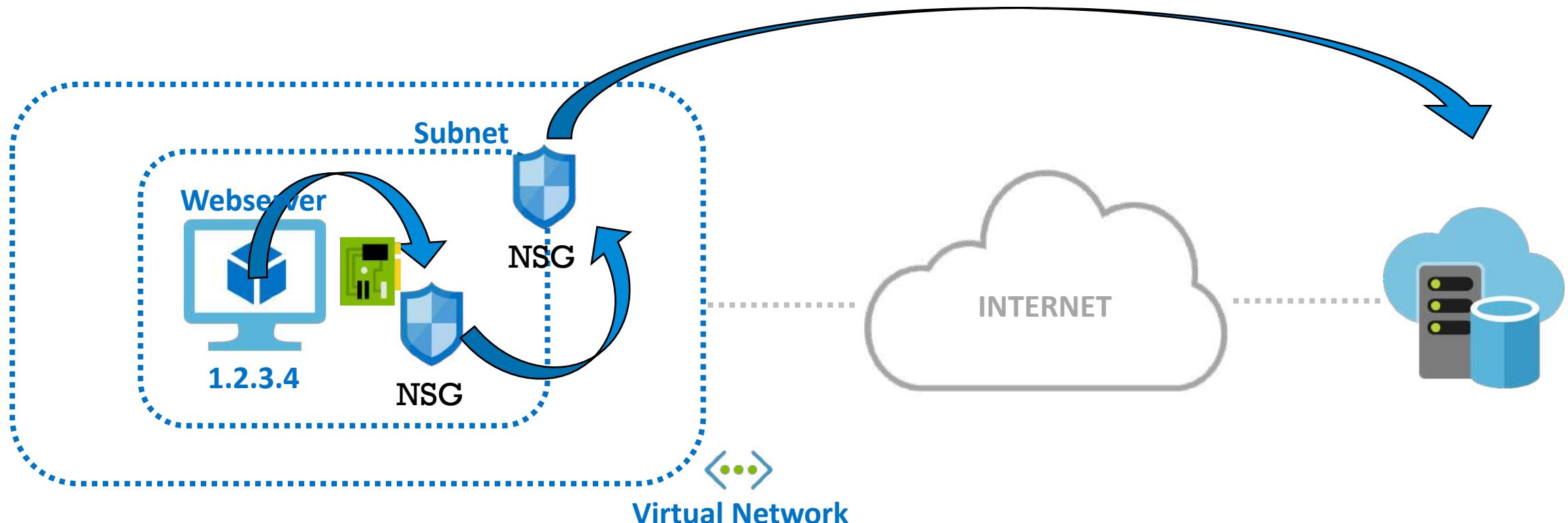
NSGs Order – Inbound Traffic Evaluation

- NSGs can be associated at two different levels:
 - Subnet level
 - NIC card level



NSGs Order – Outbound Traffic Evaluation

- NSGs can be associated at two different levels:
 - Subnet level
 - NIC card level



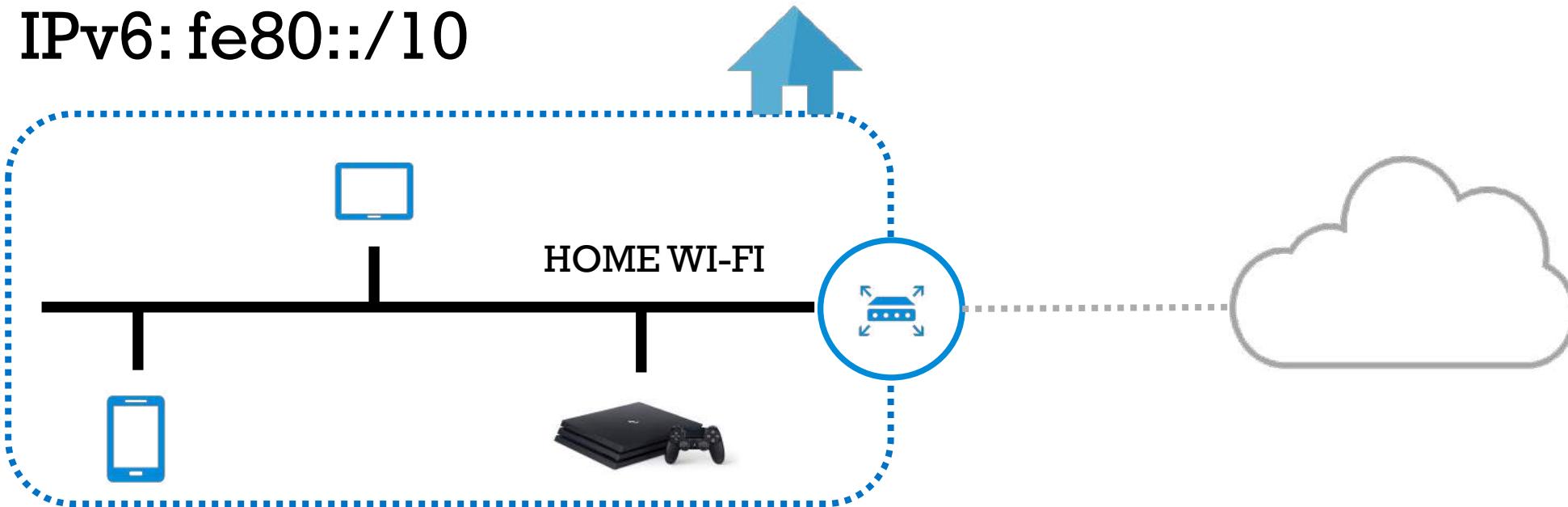


Module 3 – Azure VMs Fundamentals

IP Addressing Fundamentals - Private IP vs Public IP

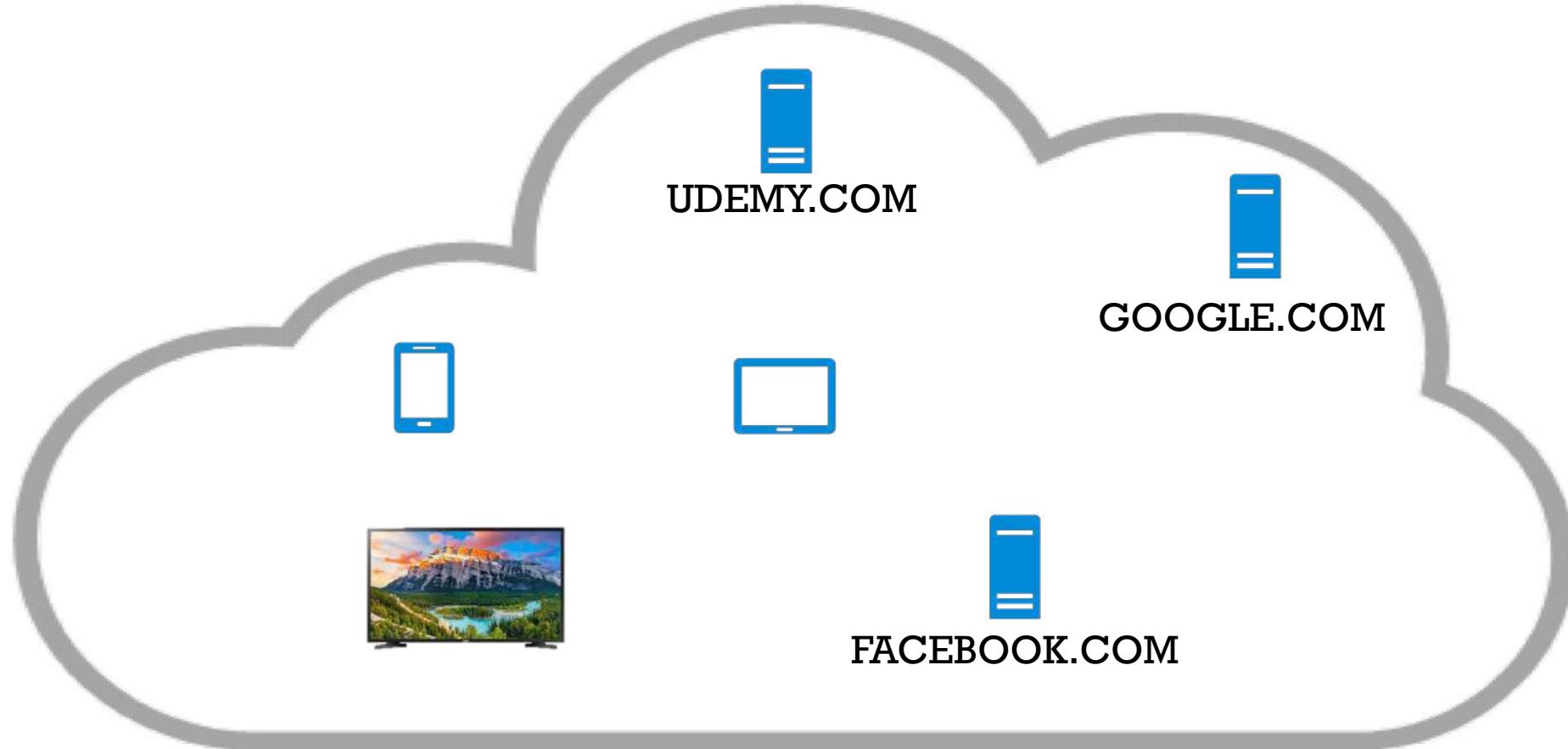
Private IP Addresses Overview

- ❑ Private network = Private IP address space
- ❑ Two options are available: IPv4 and IPv6
 - ❑ IPv4: 192.168.0.1
 - ❑ IPv6: fe80::/10



Public IP Addresses Overview

- Public IP address = Globally unique



Static vs Dynamic IP addresses

- ❑ Static IP addresses don't change
- ❑ Dynamic IP addresses change over time
- ❑ 192.168.0.10 vs 192.168.0.20



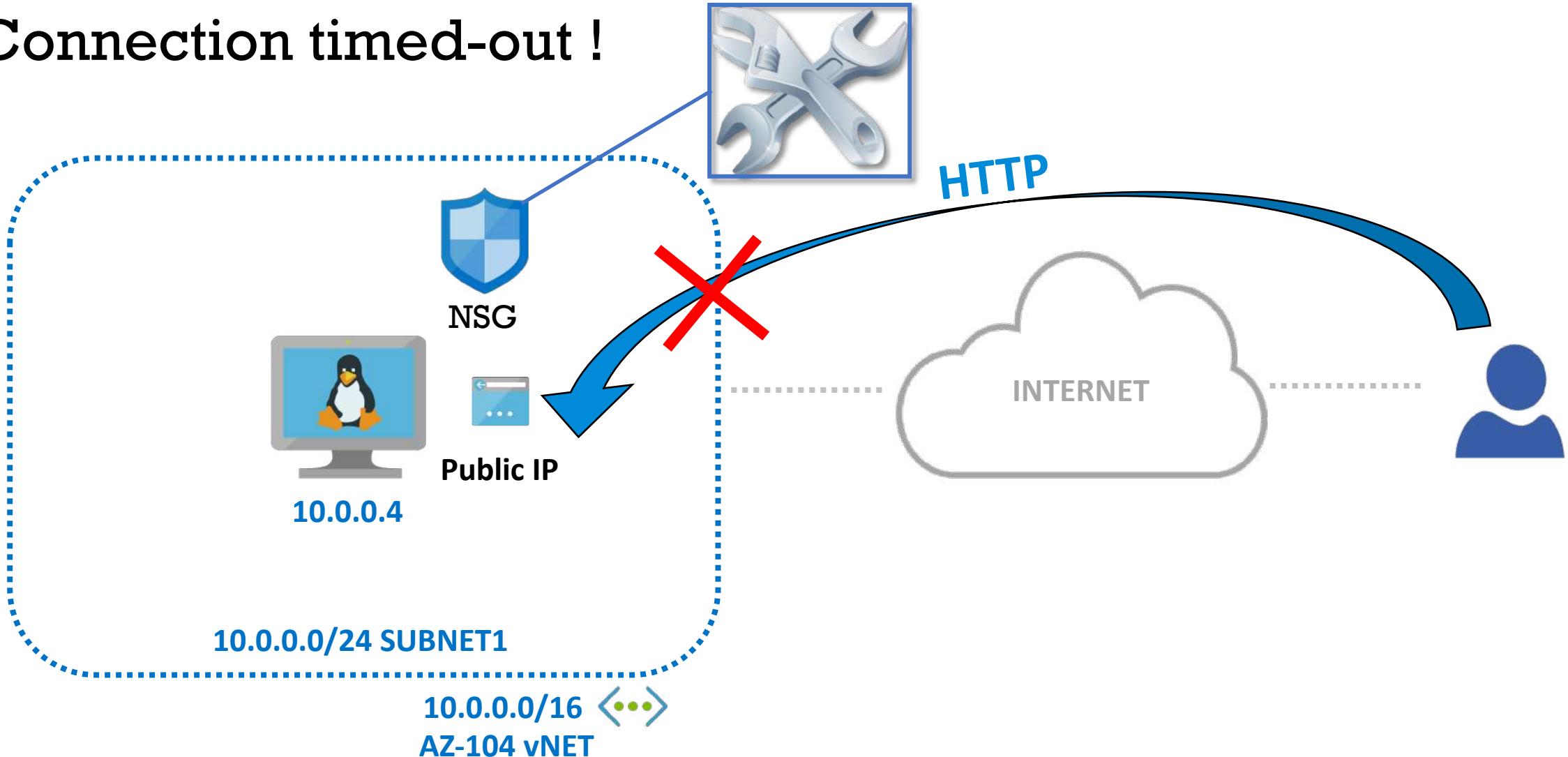


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Modify NSG to Permit HTTP Traffic

Hands-on Lab Overview

□ Connection timed-out !





Module 3 – Azure VMs Fundamentals

Hands-on Lab - Create Azure Load Balancer

Load Balancing Introduction

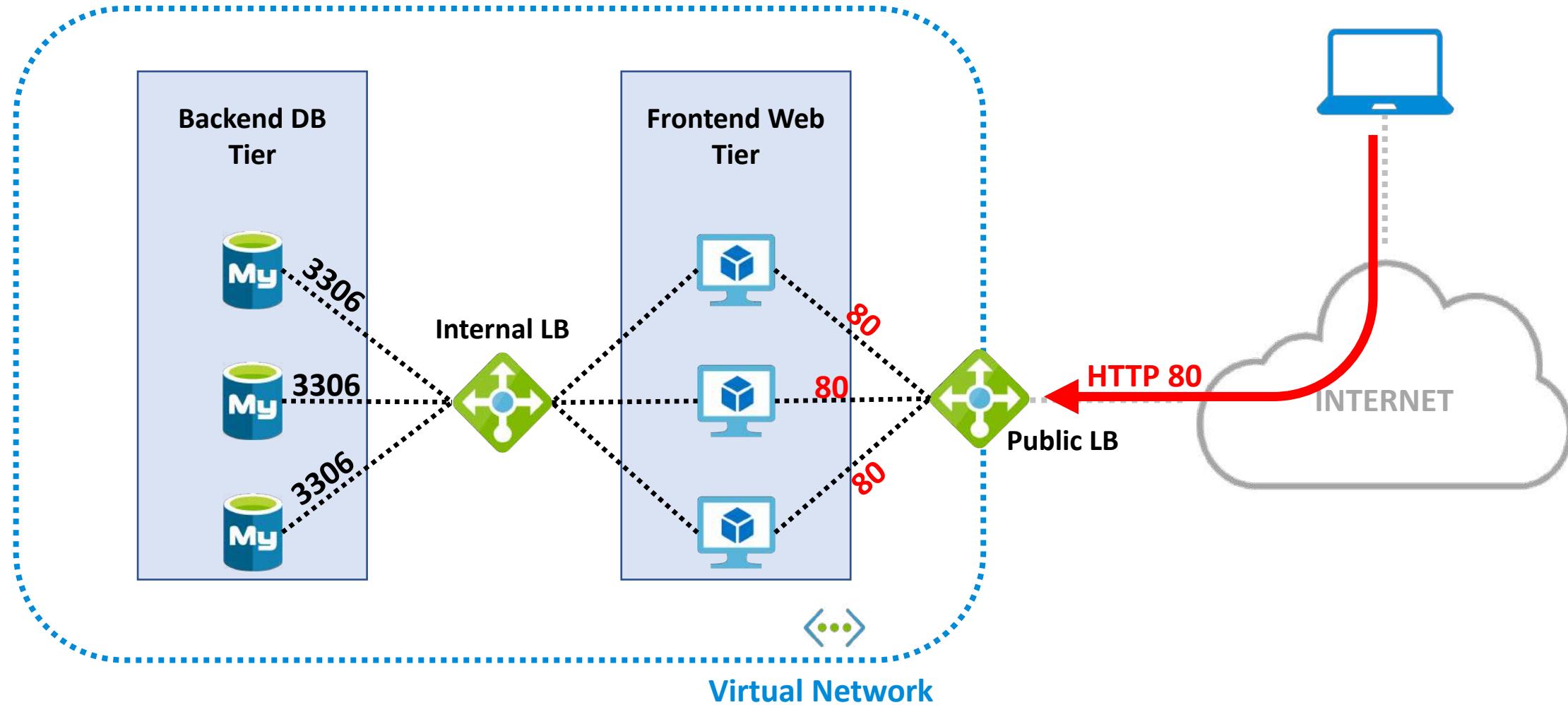
- Load balancing means equally distributing load (incoming traffic) to a group of servers (backend pool)
- The LB is the single point of contact for its clients; it distributes incoming traffic to backend pool of VMs
- Two types of LBs are available:
 - Internal LB
 - Public LB



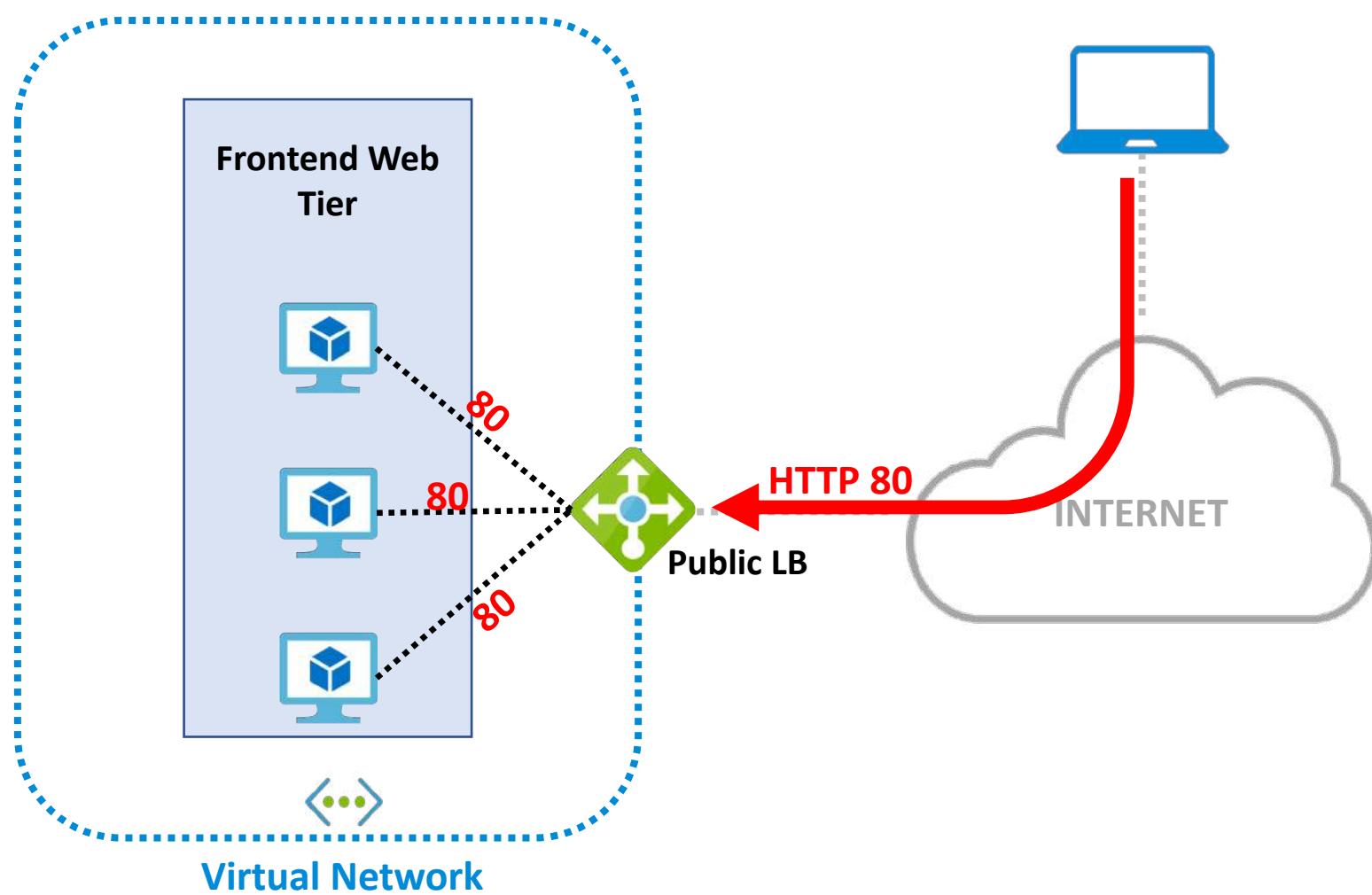
Load Balancer



Load Balancing Introduction



Azure Load Balancer – Configuration steps



Configuration steps:

1. Load Balancer
2. Backend Pool
3. Health Probe
4. LB Rule



Load Balancer



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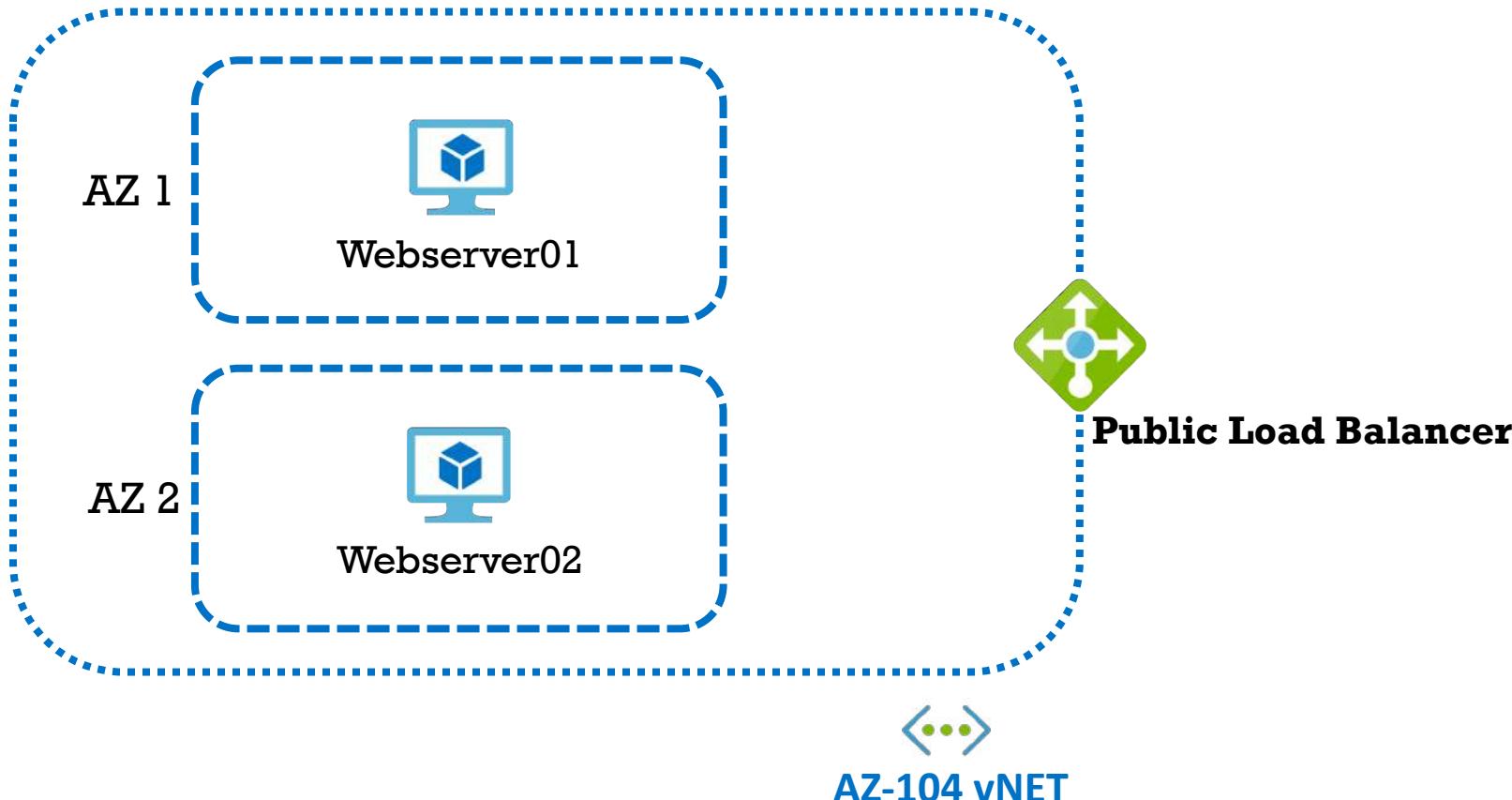


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Create Azure Load Balancer

Hands-on Lab Overview

Configure a Standard Azure Load Balancer



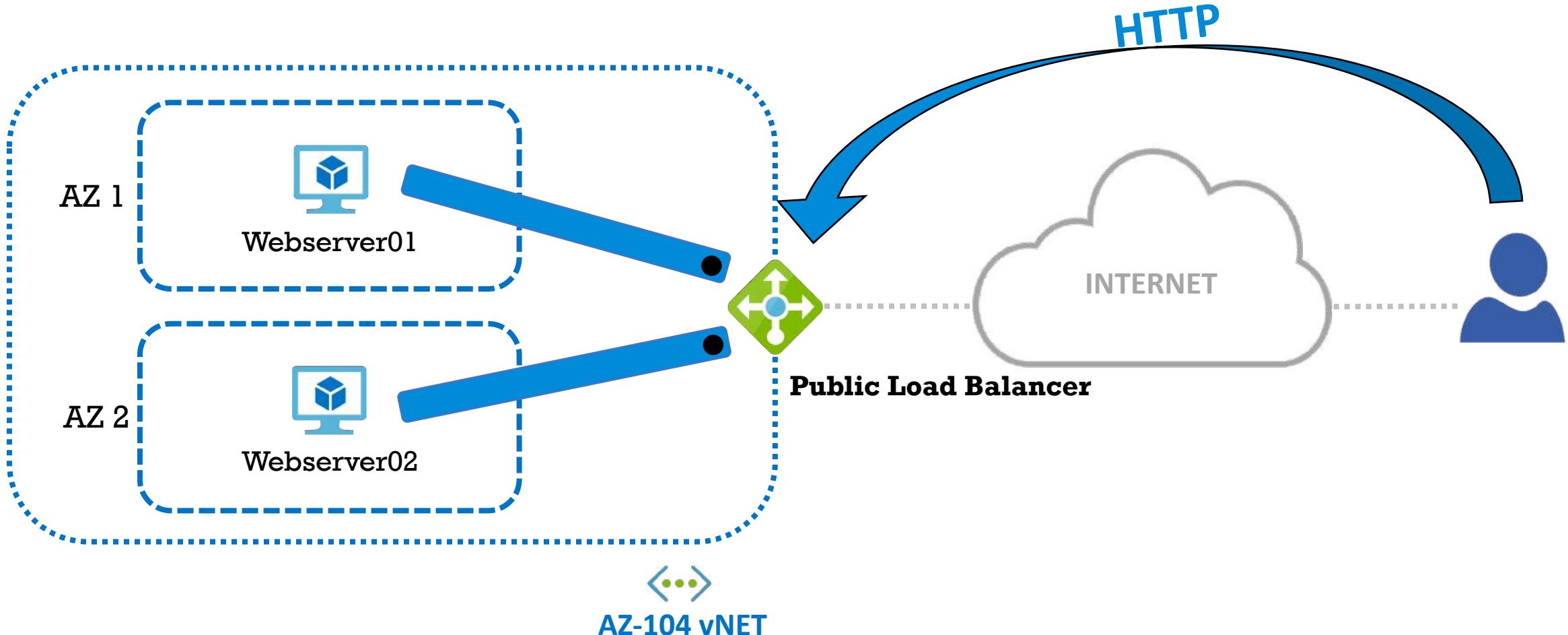


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Configure Two New Webservers

Hands-on Lab Overview

Configure the new Webservers



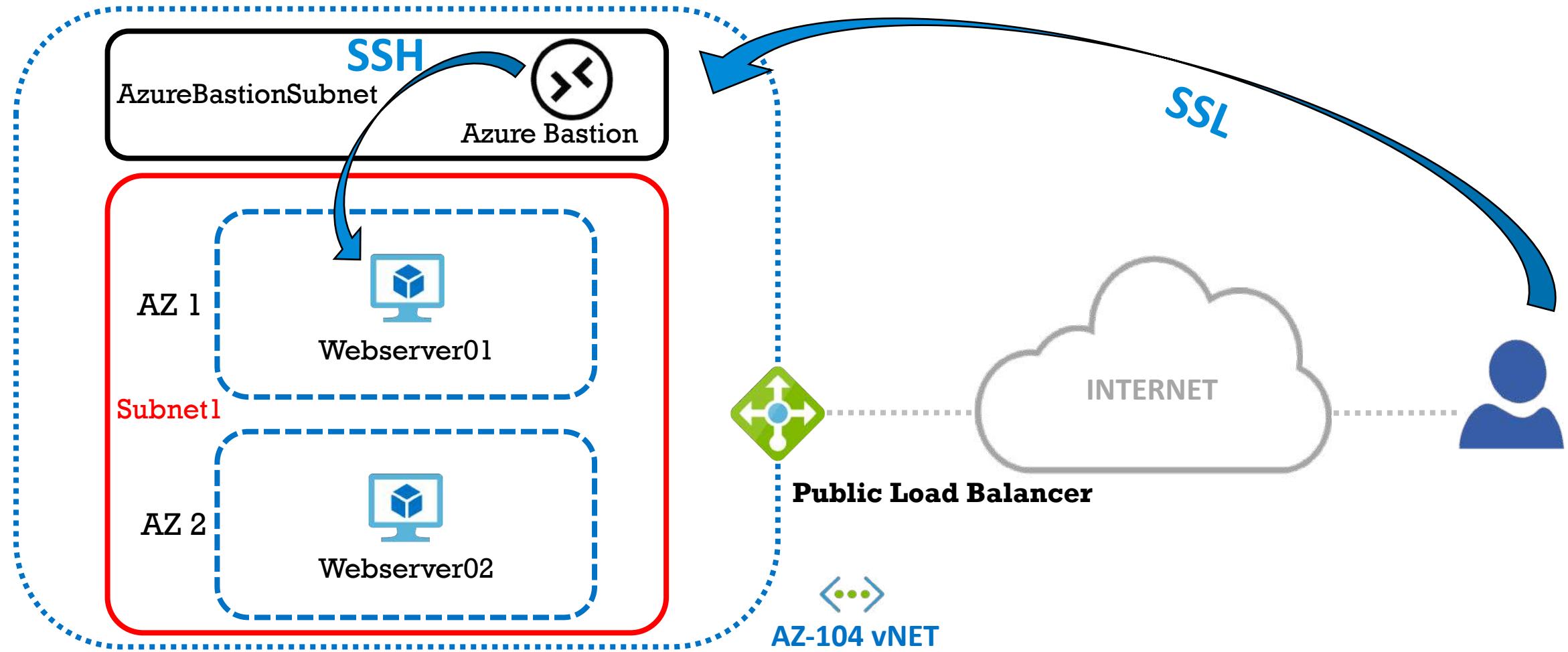


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Connect to Webservers using Azure Bastion

Hands-on Lab Overview

☐ Use Azure Bastion to connect to VMs' private IP address



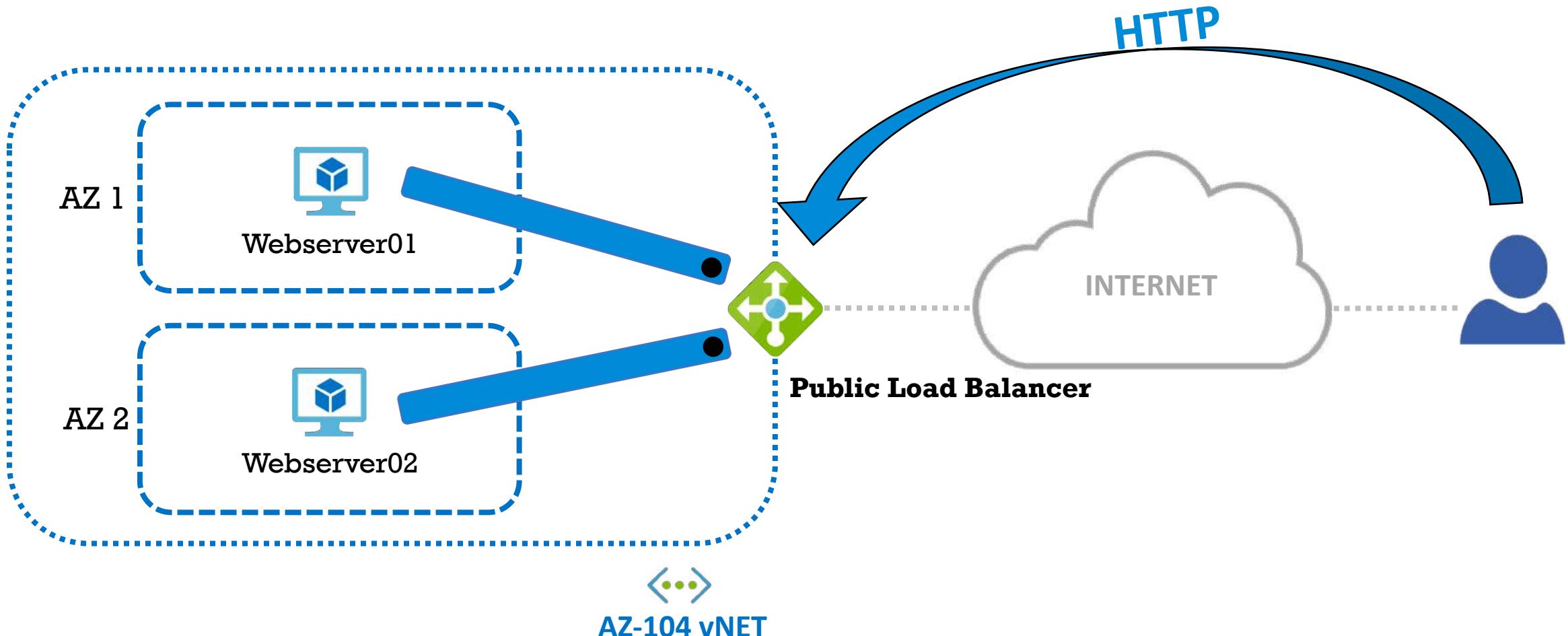


Module 3 – Azure VMs Fundamentals

Hands-on Lab - Load Balancing Testing and Wrap-up

Hands-on Lab Overview

□ Load balancing testing & wrap-up





Module 3 – Azure VMs Fundamentals

Module Completion & Exam Hints



Azure Compute Options

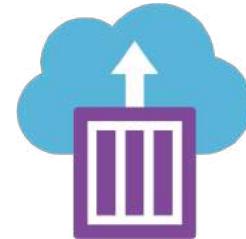
Azure Compute Options

□ Azure compute is delivered through:

□ Virtual Machines



□ Containers



□ Azure App Service



□ Serverless Computing

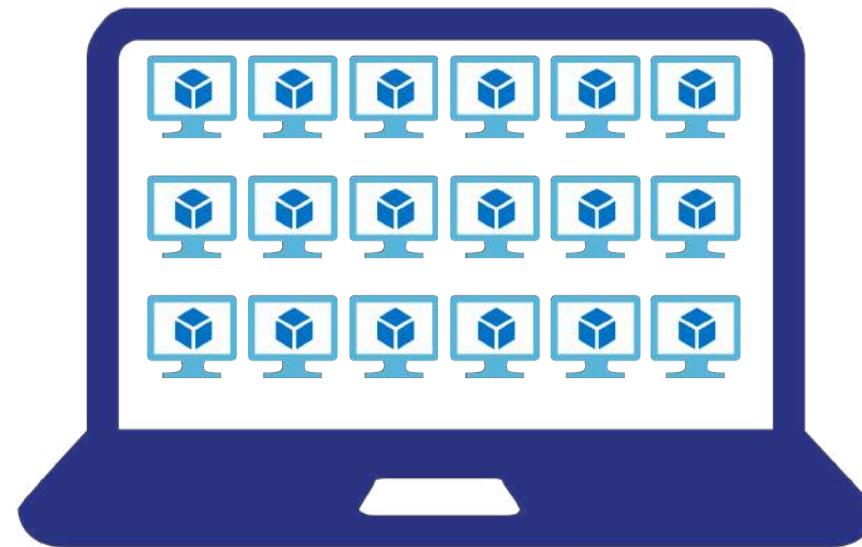




Azure VMs Fundamentals

What's a Virtual Machine (VM) ?

- ☐ Virtual machines, or VMs, are software emulations of physical computers



Hardware Equipment



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VMs Use Cases

□ Azure VMs - Infrastructure as a Service (IaaS)

□ VMs are great choice when:

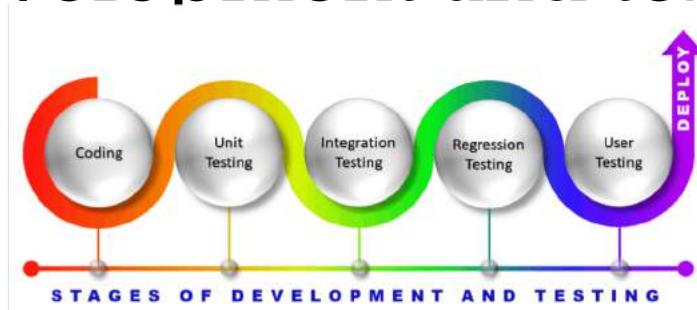
① Total control over the OS



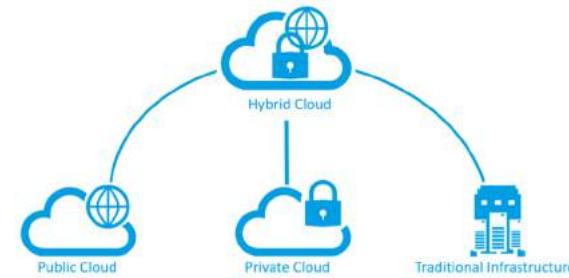
② Run custom software



③ Development and testing



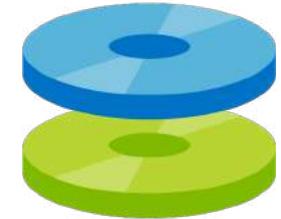
④ Extend your datacenter



Storage for VMs

- ❑ Azure managed disks are block-level storage volumes that are managed by Azure and used with Azure VMs

- ❑ Managed Disks VS Unmanaged Disks



Disks

- ❑ Disk available options:

- ❑ Standard HDD
 - ❑ Premium SSD

- ❑ Standard SSD
 - ❑ Ultra disk

- ❑ Differences: Throughput and IOPS

<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/disks-types>



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Azure VMs Overview – Types and Sizes

	Use Case	VM Configuration	Sizes
General purpose	<ul style="list-style-type: none">Testing and developmentSmall and medium DBsSmall web servers	<ul style="list-style-type: none">Balanced CPU-to-memory ratio	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2, Dv4, Dsv4, Ddv4, Ddsv4
Compute optimized	<ul style="list-style-type: none">Medium traffic web serversNetwork appliancesApplication servers	<ul style="list-style-type: none">High CPU-to-memory ratio	Fsv2
Memory optimized	<ul style="list-style-type: none">Relational DB serversMedium to large cachesIn-memory analytics	<ul style="list-style-type: none">High memory-to-CPU ratio	Esv3, Ev3, Easv4, Eav4, Ev4, Esv4, Edv4, Edsv4, Mv2, M, DSv2, Dv2
Storage optimized	<ul style="list-style-type: none">Big Data, SQL, NoSQLData warehousingLarge transactional DB	<ul style="list-style-type: none">High disk throughput and IO	Lsv2
GPU	<ul style="list-style-type: none">Heavy graphicsDeep learning (ML)	<ul style="list-style-type: none">Single or multiple GPUs	NC, NCv2, NCv3, ND, NDv2, NV, NVv3, NVv4
HPC	<ul style="list-style-type: none">High performance compute	<ul style="list-style-type: none">Most powerful CPUHigh-throughput NICs – RDMA	HB, HBv2, HC, H

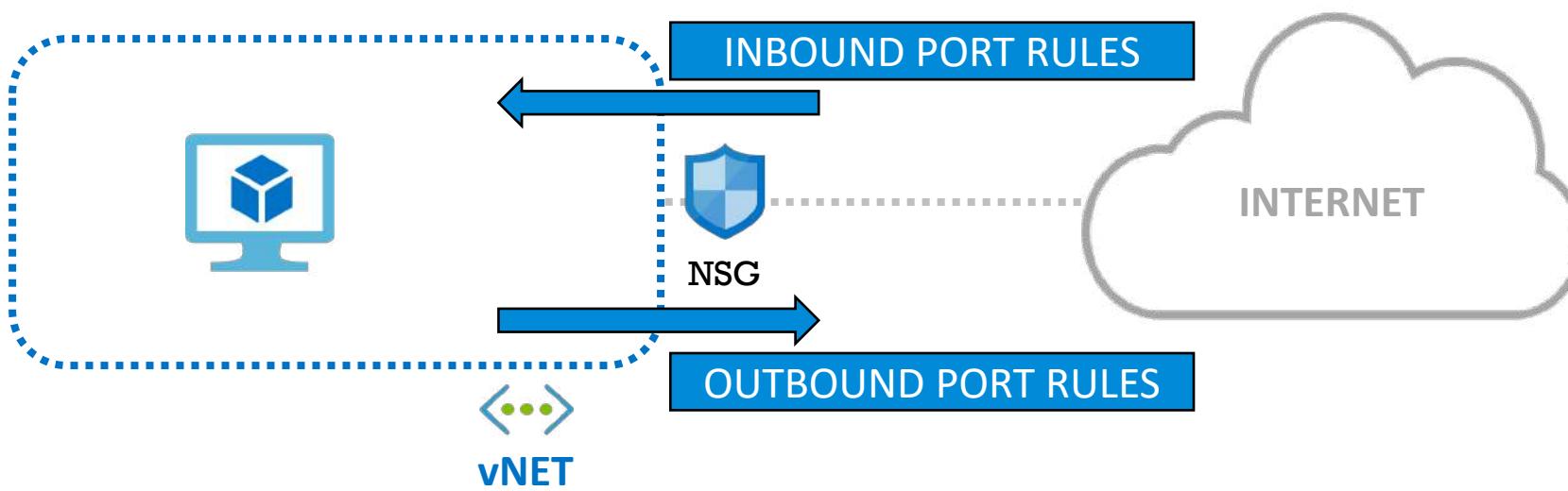




Network Security Groups

NSGs Overview

- Network Security Groups (NSGs) – fundamental building block in Azure security
- NSGs are used to filter network traffic to and from Azure resources, such as VMs



Rule Priority - Traffic Evaluation in NSGs

- ☐ NSG security rules are evaluated by priority using the 5-tuple information – source, source port, destination, destination port and protocol
- ☐ Rules are processed and evaluated top-down, first match wins;



NSG

Inbound port rules Outbound port rules Application security groups Load balancing

Network security group **Webserver01-nsg** (attached to network interface: [webserver01228](#))
Impacts 0 subnets, 1 network interfaces

Add inbound port rule

Priority	Name	Port	Protocol	Source	Destination	Action	
300	⚠ SSH	22	TCP	Any	Any	Allow	...
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	...
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	...
65500	DenyAllInBound	Any	Any	Any	Any	Deny	...



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NSGs – Default Inbound Security Rules

□ Default rules in every NSG:

- 65000 – ALLOW traffic inside vNET
- 65001 – ALLOW traffic from Azure LoadBalancer
- 65500 – if not matched already, then DENY

Inbound port rules							Outbound port rules	Application security groups	Load balancing	
Priority	Name	Port	Protocol	Source	Destination	Action	Add inbound port rule			
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65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	...			
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	...			
65500	DenyAllInBound	Any	Any	Any	Any	Deny	...			



NSGs – Default Outbound Security Rules

□ Default rules in every NSG:

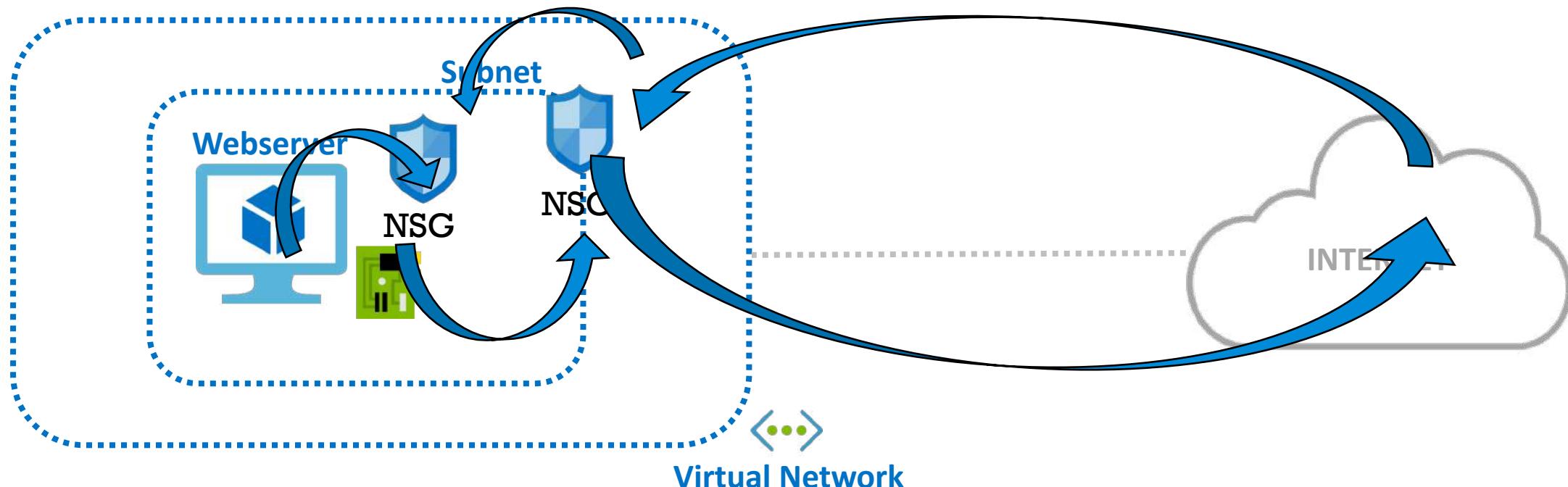
- 65000 – ALLOW traffic inside vNET
- 65001 – ALLOW traffic from Azure LoadBalancer
- 65500 – if not matched already, then DENY

Outbound port 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



NSGs Order –Traffic Evaluation

- NSGs can be associated at two different levels:
 - Subnet level
 - NIC card level

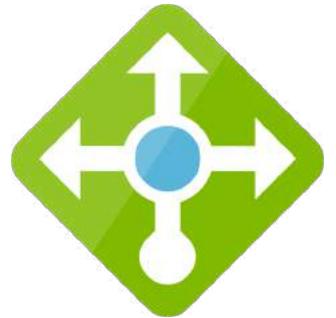




Azure Load Balancer

Load Balancing Introduction

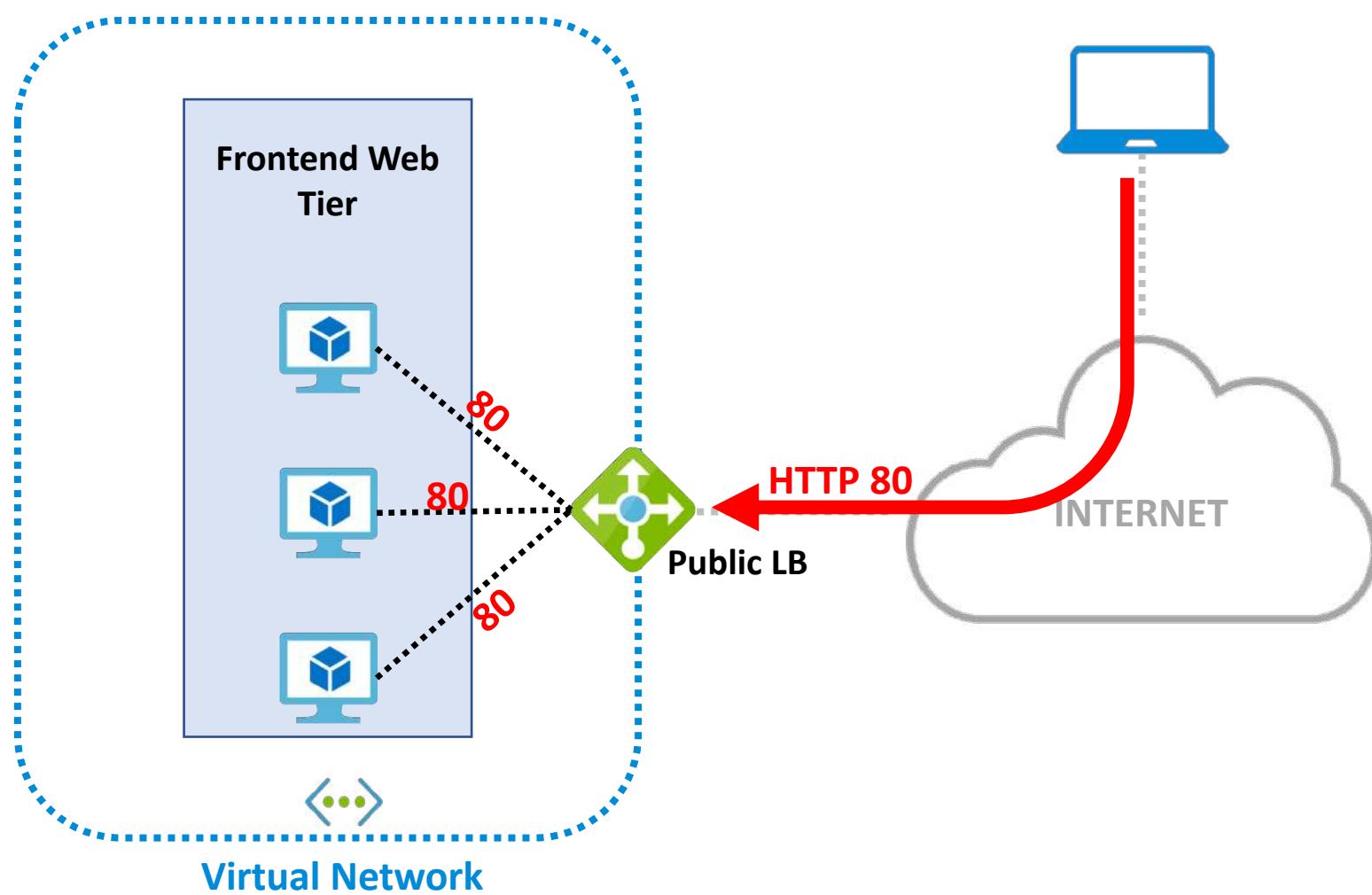
- Load balancing means equally distributing load (incoming traffic) to a group of servers (backend pool)
- Two types of LBs are available:
 - Internal LB
 - Public LB



Load Balancer



Azure Load Balancer – Configuration steps



Configuration steps:

1. Load Balancer
2. Backend Pool
3. Health Probe
4. LB Rule

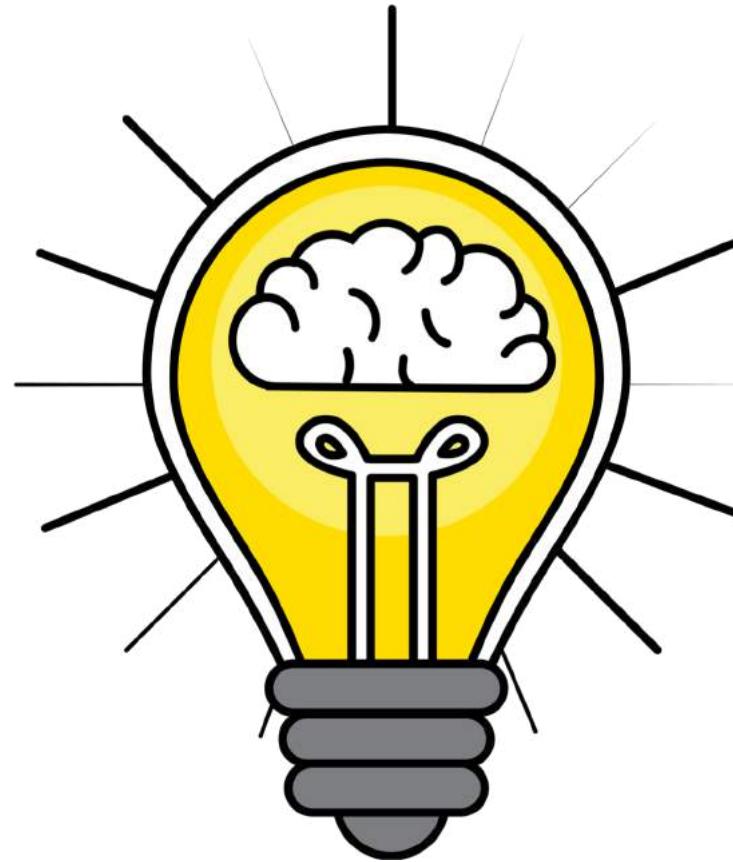


Load Balancer



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Azure VMs Fundamentals - Quiz



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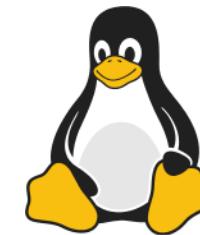
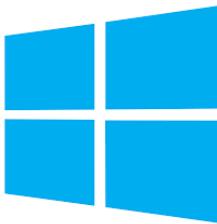


Module 4 – Azure CLI Tool

Introduction to Azure CLI

Introduction to Azure CLI

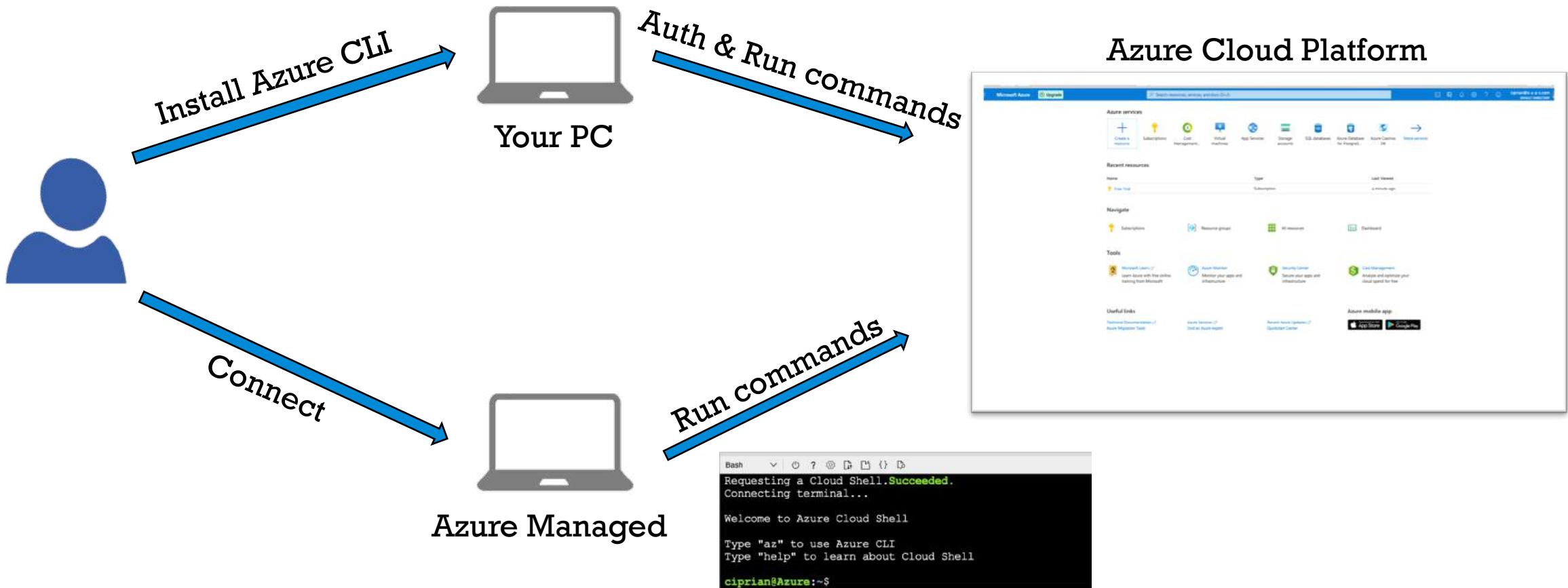
- ❑ Azure CLI – command line program used to create, manage and interact with Azure cloud platform
- ❑ Azure CLI - cross-platform command-line tool – run local



- ❑ Azure CLI – 2nd option - run from Cloud Shell



Azure CLI - Local vs Cloud Shell



- Local install: keep Azure CLI up-to-date, secure host PC; multiple hosts means extra work/time/\$



Why Azure CLI ?

- Azure CLI usage – interactively or scripted
 - Best for repetitive tasks
- Scripting – think about automation
 - Put together commands – script
 - Run the script

```
#!/bin/bash

# Update for your admin password
AdminPassword=ChangeYourAdminPassword1

# Create a resource group.
az group create --name myResourceGroup --location westeurope

# Create a virtual network.
az network vnet create --resource-group myResourceGroup --name myVnet --subnet-name mySubnet
```

Quick Create VM



Microsoft Azure Administrator



Module 4 – Azure CLI Tool

Hands-on Lab - Install Azure CLI on Windows OS

Hands-on Lab Overview

- ❑ Start here:
 - ❑ <https://docs.microsoft.com/en-us/cli/azure/install-azure-cli-windows?view=azure-cli-latest&tabs=azure-cli>
- ❑ Verify installation:
 - ❑ Run *az --version* command – check Azure CLI version
 - ❑ Run *az login* command - authenticate to Azure





Module 4 – Azure CLI Tool

Hands-on Lab - Install Azure CLI on Mac OS

Hands-on Lab Overview

- ❑ Start here:
 - ❑ <https://docs.microsoft.com/en-us/cli/azure/install-azure-cli-macos?view=azure-cli-latest>
- ❑ Verify installation:
 - ❑ Run *az --version* command – check Azure CLI version
 - ❑ Run *az login* command - authenticate to Azure





Module 4 – Azure CLI Tool

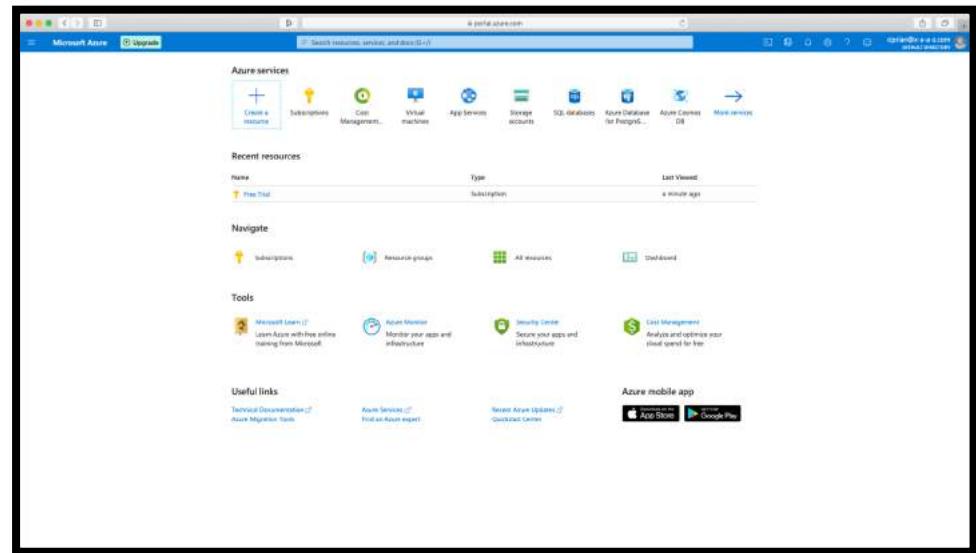
Working in Azure CLI Overview

Hands-on Lab Overview

- ☐ Working with Azure CLI:
 - ☐ Locally on your PC – Command Prompt/Terminal app
 - ☐ Directly in Azure Portal
 - ☐ <https://shell.azure.com>



<https://portal.azure.com>



Microsoft Azure Administrator



Module 4 – Azure CLI Tool

Hands-on Lab - Deploy a Linux VM from Azure CLI

Hands-on Lab Overview



<https://portal.azure.com>



The screenshot shows a terminal window titled 'Bash'. It displays the following text:
Requesting a Cloud Shell. **Succeeded**.
Connecting terminal...
Welcome to Azure Cloud Shell
Type "az" to use Azure CLI
Type "help" to learn about Cloud Shell
ciprian@Azure:~\$

☐ Create virtual machine:

```
az vm create \
--resource-group RG-04-Azure-CLI \
--name UbuntuVM-CLI \
--image UbuntuLTS \
--admin-username adminuser \
--admin-password adminadmin123!
```



Microsoft Azure Administrator

Options to write commands

□ One single “long” command

```
az vm create --resource-group RG-04-Azure-CLI --name UbuntuVM-  
CLI --image UbuntuLTS --admin-username adminuser --admin-  
password adminadmin123!
```

□ One line – one argument – use backslash “\” end-of-line

```
az vm create \  
--resource-group RG-04-Azure-CLI \  
--name UbuntuVM-CLI \  
--image UbuntuLTS \  
--admin-username adminuser \  
--admin-password adminadmin123!
```





Module 4 – Azure CLI Tool

Hands-on Lab - Change VM size from Azure CLI

Hands-on Lab Overview



<https://portal.azure.com>



Bash Requesting a Cloud Shell. **Succeeded.**
Connecting terminal...

Welcome to Azure Cloud Shell

Type "az" to use Azure CLI
Type "help" to learn about Cloud Shell

ciprian@Azure:~\$

☐ Check the list of available VM sizes

```
az vm list-vm-resize-options --resource-group RG-04-Azure-CLI  
--name UbuntuVM-CLI --output table
```

☐ Resize the VM with *az vm resize*

```
az vm resize --resource-group RG-04-Azure-CLI --name  
UbuntuVM-CLI --size Standard_B1s
```





Module 4 – Azure CLI Tool

Module Completion & Exam Hints

Azure CLI Tool Wrap-up

- The Azure CLI is a good choice for anyone new to Azure command line and scripting
- Why to use ?
 - reduce the risk of errors
 - automate your work through scripts
- Cross-platform tool !
- Run Azure CLI by : local install or Azure Cloud Shell (portal or direct – <https://shell.azure.com>)



Azure CLI - Quiz



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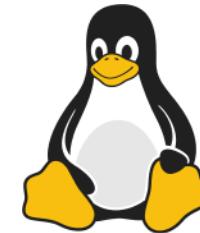


Module 5 – Azure PowerShell Tool

Introduction to Azure PowerShell

Introduction to Azure PowerShell (PS)

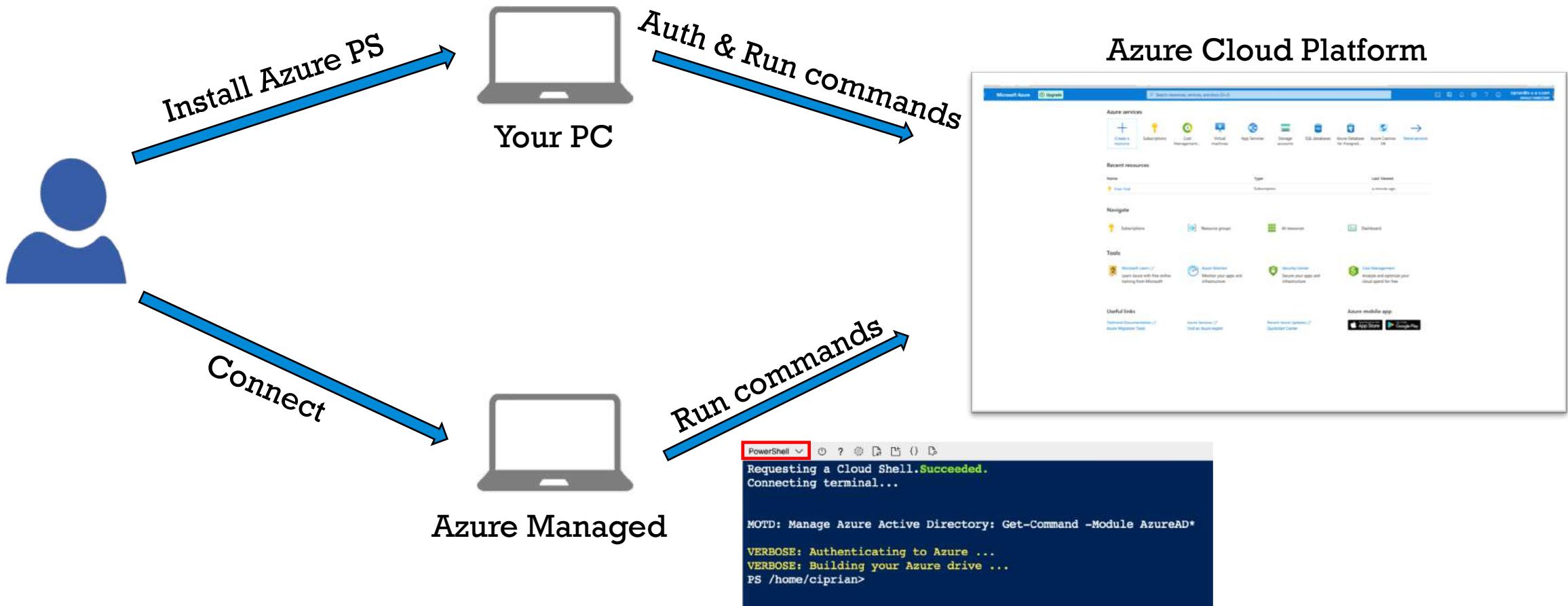
- Azure PS – module that you add to Windows PowerShell or PowerShell Core (Mac or Linux)
- Azure PS - cross-platform command-line tool – run local



- Azure PS – 2nd option - run from Cloud Shell



Azure PS - Local vs Cloud Shell

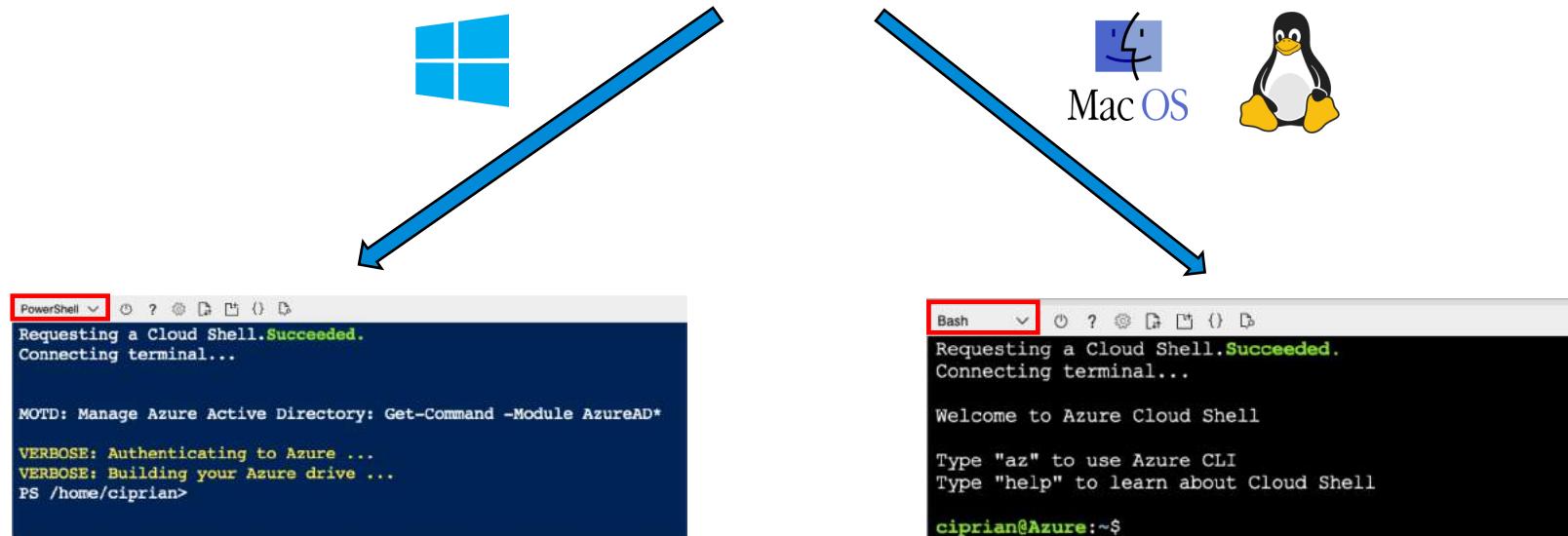


- Local install: keep Azure PS up-to-date, secure host PC; multiple hosts means extra work/time/\$

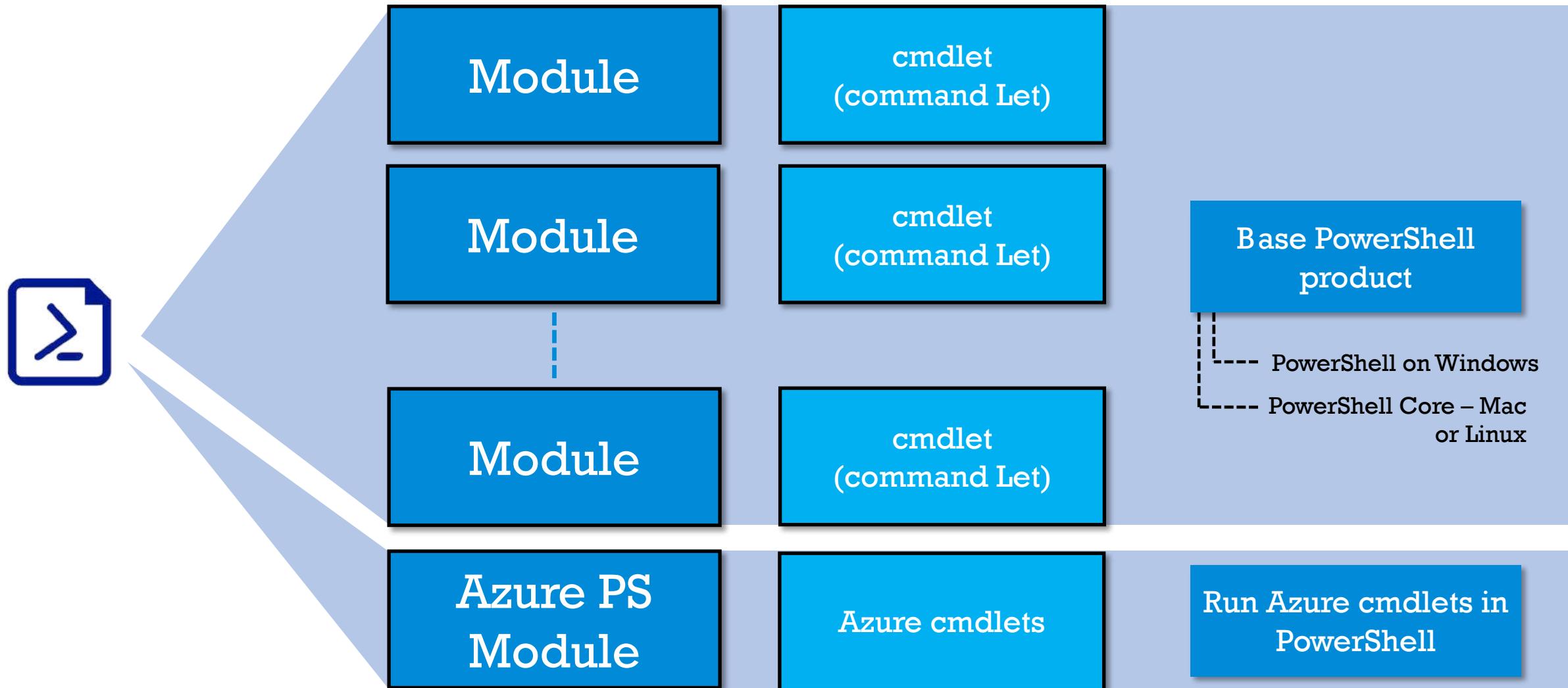


Why and When Azure PowerShell ?

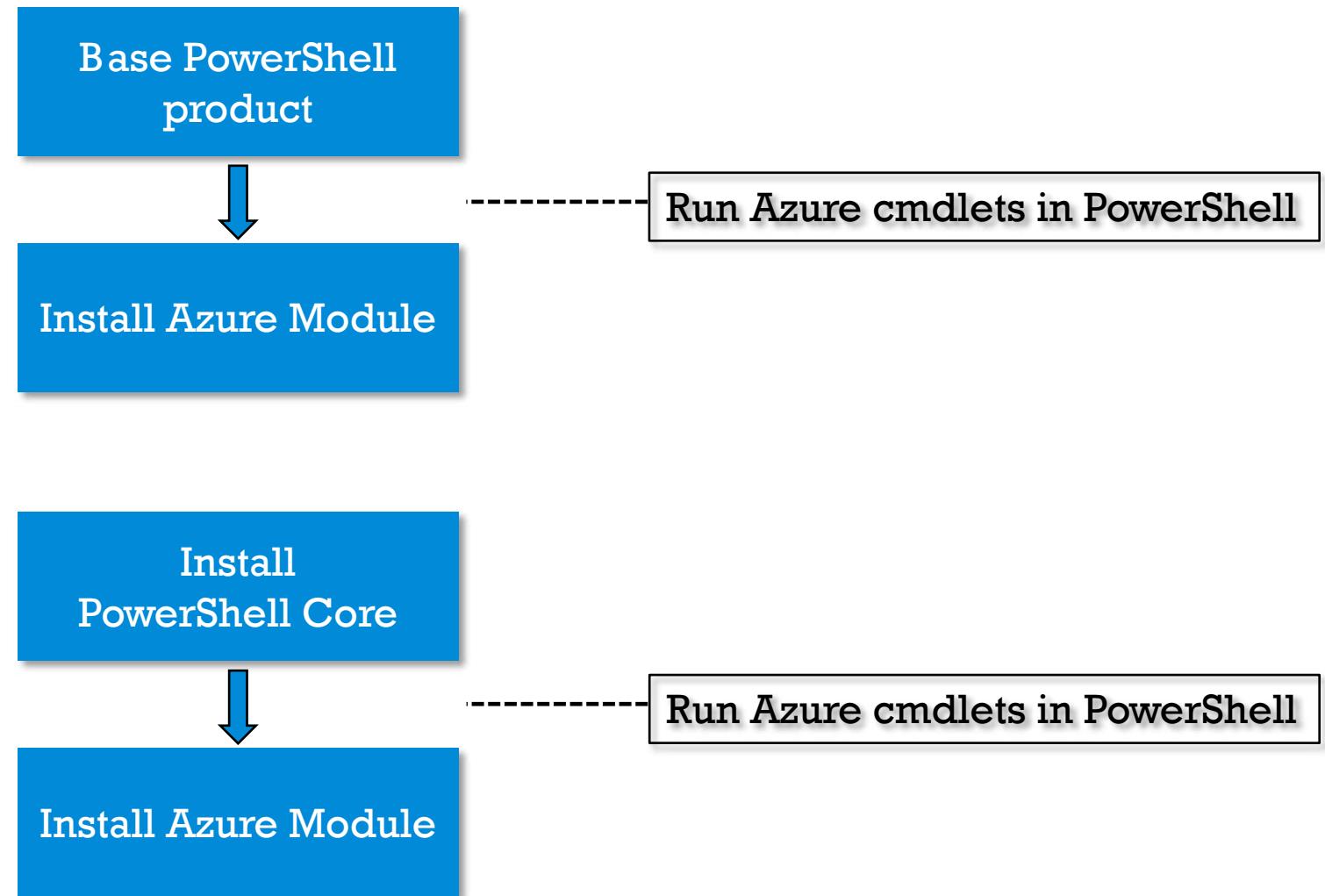
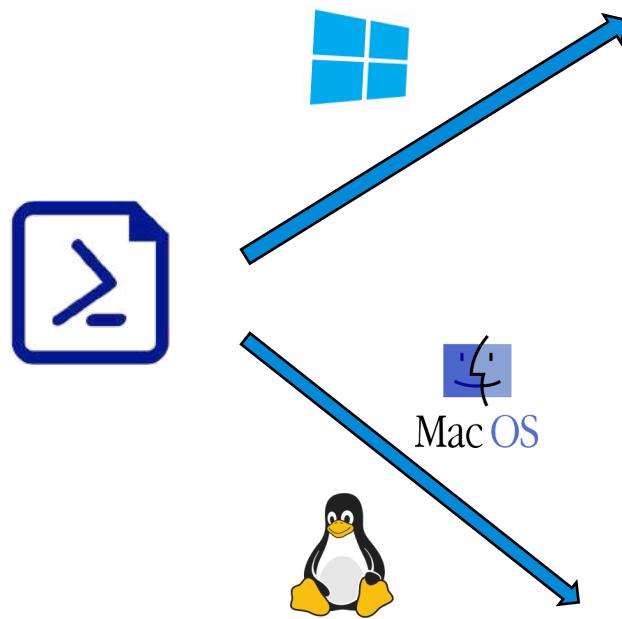
- Azure PS usage – interactively or scripted
- When Azure PS (or CLI)?
 - Do you need to automate complex or repetitive tasks?
 - Are you familiar with PS (or Bash CLI) ?



PowerShell Structure – Modules and Cmdlets



Azure PowerShell – Installation Steps



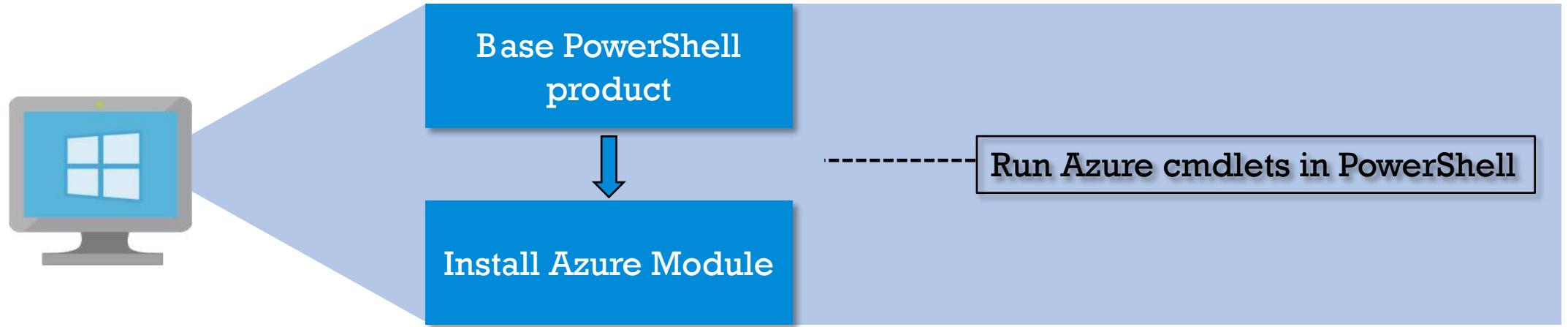


Module 5 – Azure PowerShell Tool

Hands-on Lab - Install Azure PowerShell on Windows OS

Hands-on Lab Overview

☐ Add Azure module to Windows PowerShell



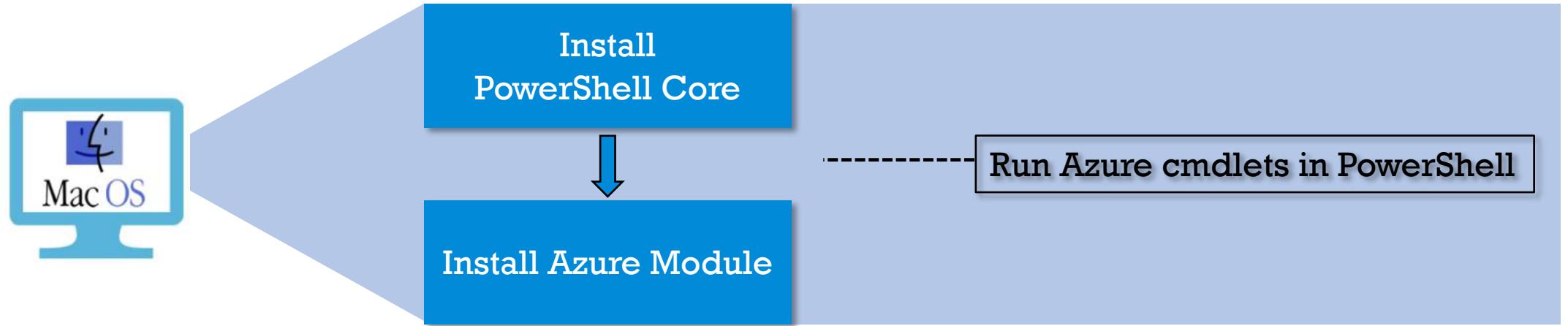


Module 5 – Azure PowerShell Tool

Hands-on Lab - Install Azure PowerShell on Mac OS

Hands-on Lab Overview

- Install PowerShell Core on Mac OS
- Add Azure module to PowerShell Core





Module 5 – Azure PowerShell Tool

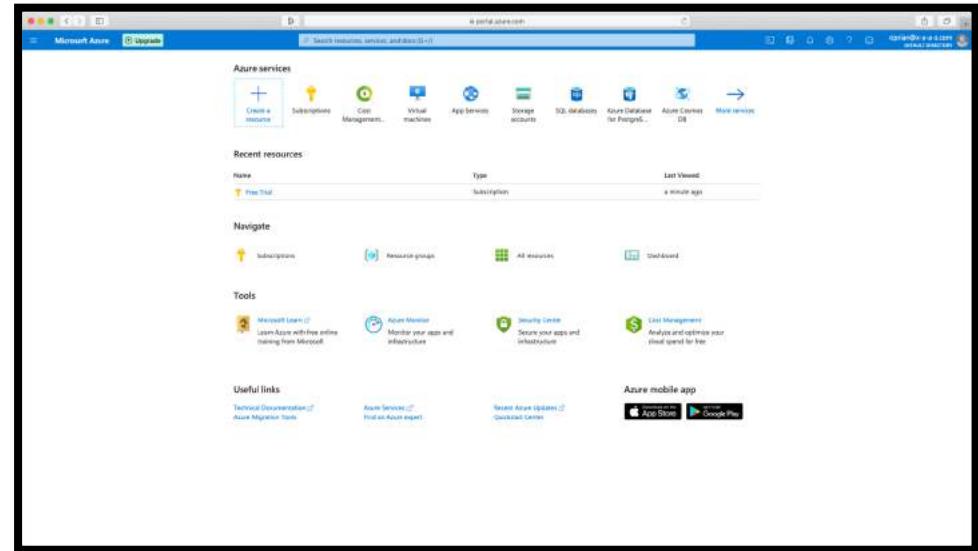
Hands-on Lab - Working in Azure PowerShell Overview

Hands-on Lab Overview

- Working with Azure PowerShell:
 - Locally on your PC – PowerShell/Terminal app
 - Directly in Azure Portal – Azure Cloud Shell



<https://portal.azure.com>



Microsoft Azure Administrator



Module 5 – Azure PowerShell Tool

Hands-on Lab - Deploy a Linux VM in Azure PowerShell

Hands-on Lab Overview



<https://portal.azure.com>



```
PowerShell v | ⚡ ? ⚙️ 🔍 🔍 {} 🔍
Type "help" to learn about Cloud Shell

MOTD: Connect to a remote Azure VM: Enter-AzVM

VERBOSE: Authenticating to Azure ...
VERBOSE: Building your Azure drive ...
PS /home/ciprian> █
```

Define Auth Credentials:

```
$password = ConvertTo-SecureString "adminadmin123!" -AsPlainText -Force
$cred = New-Object System.Management.Automation.PSCredential ("adminuser", $password)
```

Create the VM:

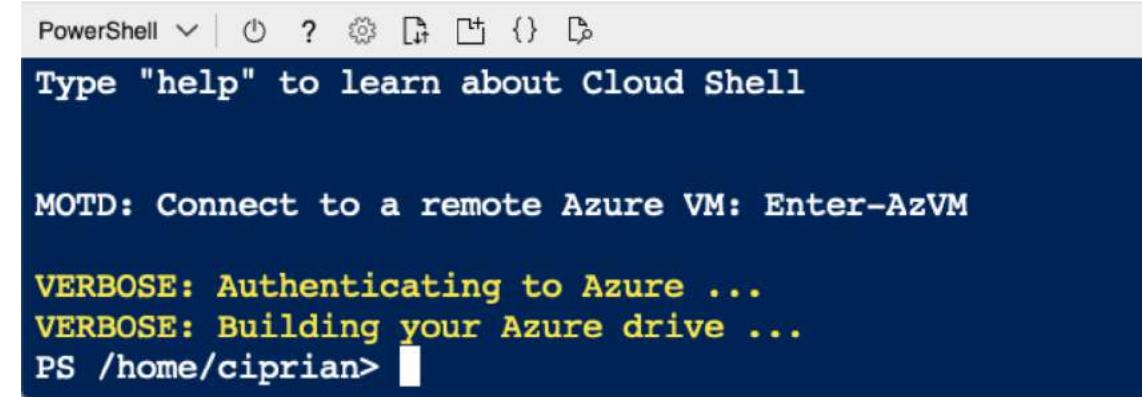
```
New-AzVM -Name UbuntuVM-PS -Credential $cred -ResourceGroupName RG-05-Azure-PowerShell  
-Location westeurope -Image UbuntuLTS -OpenPorts 22
```



Hands-on Lab Overview



<https://portal.azure.com>



A screenshot of the Azure Cloud Shell interface. The title bar says "PowerShell". The main area displays the following text:

```
Type "help" to learn about Cloud Shell
MOTD: Connect to a remote Azure VM: Enter-AzVM
VERBOSE: Authenticating to Azure ...
VERBOSE: Building your Azure drive ...
PS /home/ciprian>
```

☐ Create Auth Credential:

```
$password = ConvertTo-SecureString "adminadmin123!" -AsPlainText -Force
$cred = New-Object System.Management.Automation.PSCredential ("adminuser", $password)
```

☐ Create the VM:

```
New-AzVM -Name UbuntuVM-PS
-Location westeurope
-Credential $cred
-Image UbuntuLTS -OpenPorts 22
-ResourceGroupName RG-05-Azure-PowerShell
```



Microsoft Azure Administrator



Module 5 – Azure PowerShell Tool

Hands-on Lab - Change VM size from Azure PowerShell

Hands-on Lab Overview



<https://portal.azure.com>



Check the list of available VM sizes

```
Get-AzVMSize -ResourceGroupName RG-05-Azure-PowerShell –VMName UbuntuVM-PS
```

Name	NumberOfCores	MemoryInMB	MaxDataDiskCount	OSDiskSizeInMB	ResourceDiskSizeInMB
Standard_B1s	1	512	2	1047552	4096
Standard_B1ms	1	2048	2	1047552	4096
Standard_B1s	1	1024	2	1047552	4096
Standard_B2ms	2	8192	4	1047552	16384
Standard_B2s	2	4096	4	1047552	8192



Hands-on Lab Overview

☐ List the properties of our VM

```
Get-AzVM -ResourceGroupName RG-05-Azure-PowerShell -VMName UbuntuVM-PS
```

```
ResourceGroupName : RG-05-Azure-PowerShell
Id              :
/subscriptions/73aeb018-2e2e-489a-a21b-244dc7319226/resourceGroups
VmId           : e239613f-53a2-4550-8ea9-21fa575ad510
Name            : UbuntuVM-PS
Type            : Microsoft.Compute/virtualMachines
Location        : westeurope
Tags            : {}
HardwareProfile : {VmSize}
NetworkProfile  : {NetworkInterfaces}
OSProfile       : {ComputerName, AdminUsername, LinuxConfigurati
ProvisioningState : Succeeded
StorageProfile  : {ImageReference, OsDisk, DataDisks}
```

☐ Next steps:

- ☐ \$vm = `Get-AzVM -ResourceGroupName RG-05-Azure-PowerShell -VMName UbuntuVM-PS`
- ☐ `$vm.HardwareProfile.VmSize = "Standard_B1s"`
- ☐ `Update-AzVM -VM $vm -ResourceGroupName RG-05-Azure-PowerShell`





Module 5 – Azure PowerShell Tool

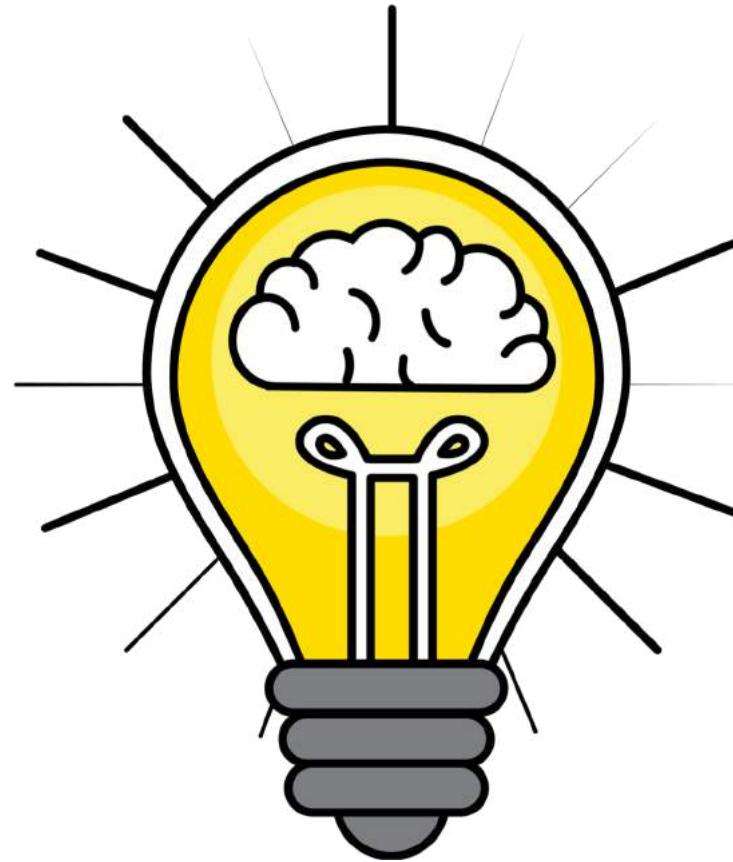
Module Completion & Exam Hints

Azure PowerShell Tool Wrap-up

- ❑ Azure PowerShell is a good automation choice for admins with PowerShell experience
- ❑ Why to use ?
 - ❑ time-consuming and error-prone tasks
 - ❑ reduce admin time and increase quality - scripts
- ❑ Cross-platform tool !
- ❑ Run Azure PS: local install or Azure Cloud Shell (portal)



Azure PowerShell - Quiz



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Module 6 – Deploy HA Apps on Azure VMs

Azure VMs Availability Options

Azure VMs Availability Options

- ❑ Apps deployment options:
 - ❑ Single VM
 - ❑ Multiple VMs

- ❑ HA config options for VMs in Azure:
 - ❑ Availability zones
 - ❑ Availability sets
 - ❑ Fault domains
 - ❑ Update domains
 - ❑ Virtual machine scale sets (VMSS)



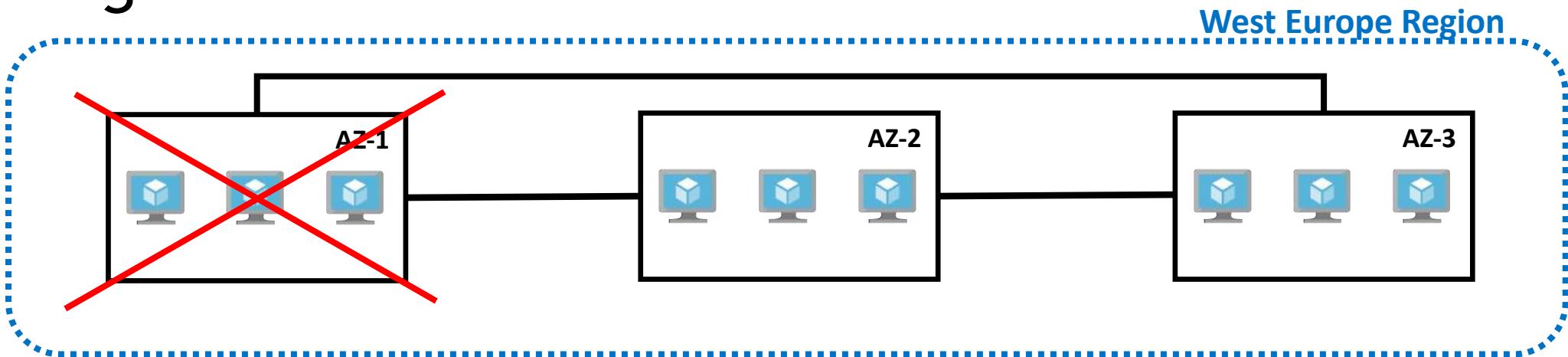
High Availability



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VMs High Availability – Availability Zones

- ☐ Mission-critical app? Think HA
 - ☐ Azure Availability Zones is an option
- ☐ Availability Zones are physically separate datacenters within an Azure region, with independent power, network and cooling

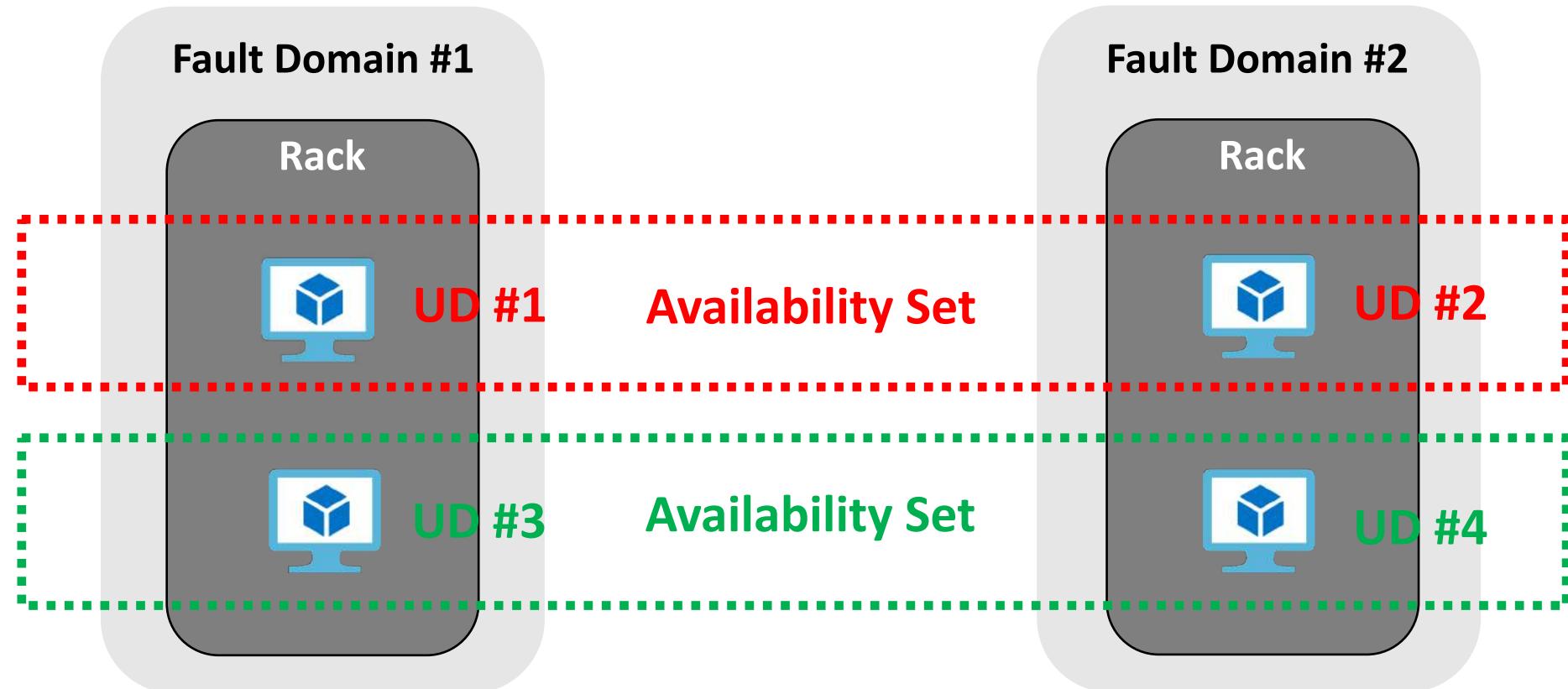


VMs High Availability – Availability Sets, FD, UD

- ❑ Availability set:
 - ❑ logical grouping of two or more VMs within a DC
 - ❑ redundancy and availability
- ❑ Fault domains
 - ❑ different racks of servers
 - ❑ prevents app outage in case of unplanned maintenance events (i.e. power or hw failure)
- ❑ Update domains - prevent app outage in case of planned maintenance windows in Azure

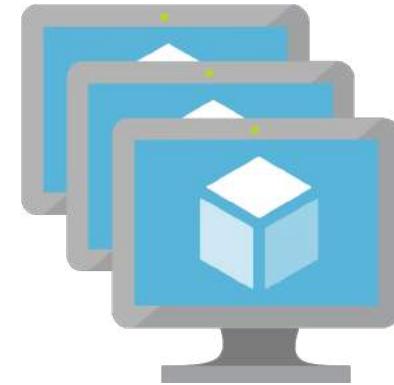


VMs High Availability – Availability Sets, FD, UD



VMs High Availability – Availability Sets, FD, UD

- Azure VMSS - create & manage a group of identical load balanced VMs
- The number of VM instances can automatically increase or decrease, based on traffic demand or defined schedule (automatic or manual)
- For HA purposes, a minimum of 2 VMs should be placed in a VMSS; 99,95% Azure SLA met

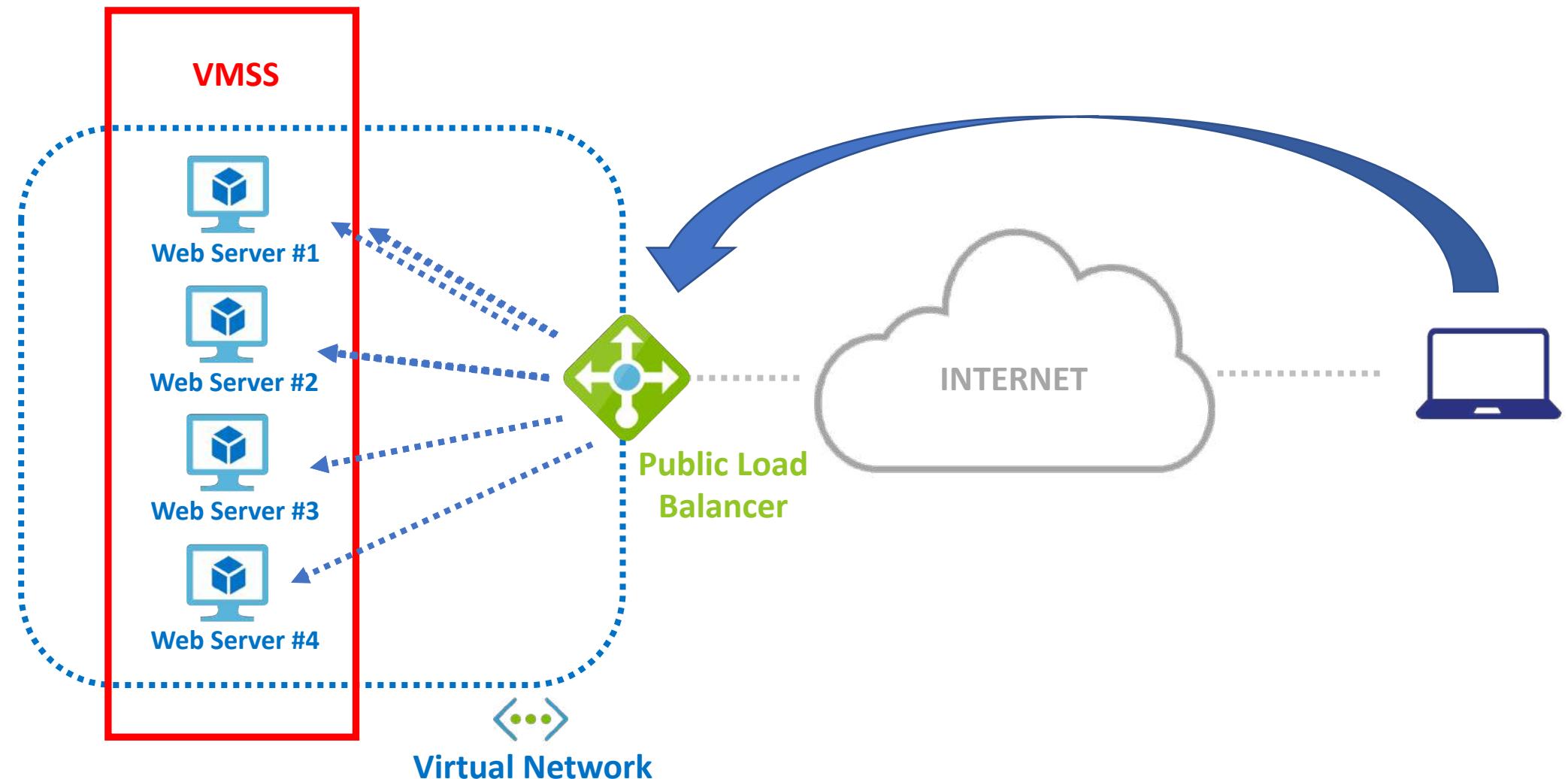




Module 6 – Deploy HA Apps on Azure VMs

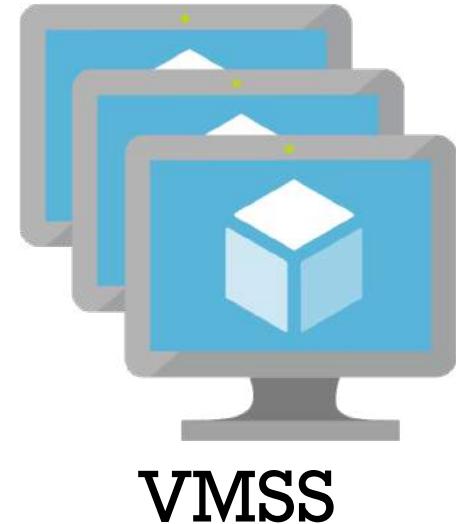
Azure VMSS Fundamentals

Virtual Machine Scale Sets (VMSS) Overview



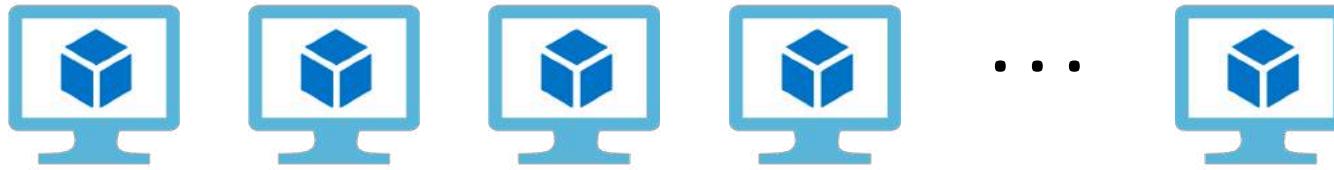
VMSS - HA Deployment Options

- ❑ VMs in a scale set can be deployed:
 - ❑ Single AZ
 - ❑ Regionally – multi-AZ
- ❑ Maximize availability and resilience to outages (planned or unplanned):
 - ❑ multiple fault domains
 - ❑ multiple update domains



Scaling Options – Vertical & Horizontal Scaling

- Horizontal scaling – add or remove VMs in scale set



- Vertical scaling – add resources to existing VMs



- Vertical vs Horizontal | When to choose ... what ?



Scale Set Scaling – In or Out

☐ Types of scaling for a scale set:

☐ Scheduled scaling

☐ Autoscaling

☐ Scheduled scaling

Schedule Specify start/end dates Repeat specific days

Repeat every Monday Tuesday Wednesday Thursday Friday
 Saturday Sunday

Timezone

Start time

End time

☐ Autoscaling

Criteria

* Time aggregation

* Metric namespace Metric name 1 minute time grain

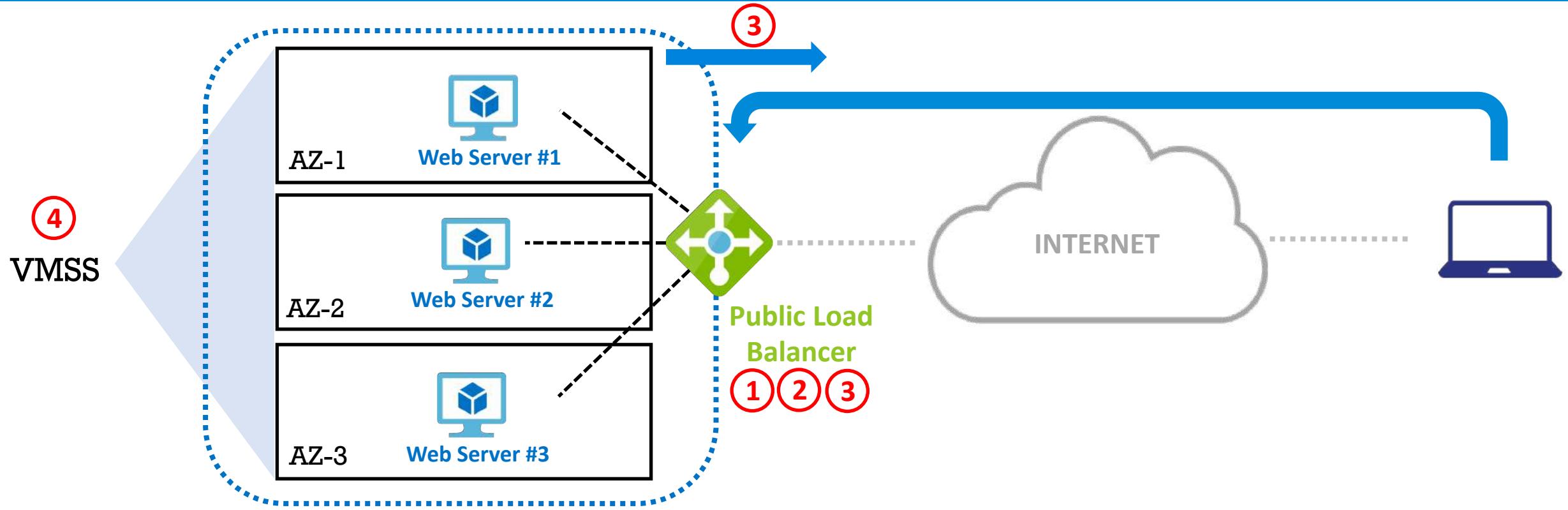




Module 6 – Deploy HA Apps on Azure VMs

Hands-on Lab - Deploy Azure VMSS from Azure Portal

Hands-on Lab Overview



- 1. Deploy LB
- 2. Configure LB Rule
- 3. Configure Outbound Rule
- 4. Deploy VMSS





Module 6 – Deploy HA Apps on Azure VMs

Hands-on Lab - Deploy Azure VMSS from Azure CLI

Hands-on Lab Overview

- Steps to deploy VMSS from Azure CLI:
 - Create custom data script – bash scripting

```
#!/bin/bash
apt update -y && apt upgrade -y
apt install apache2 -y
echo "Welcome AZ-104 Training Bootcamp - Host " $HOSTNAME "!" > index.html
```

- Initialize the script
- Update and upgrade VM
- Install Apache2 web service
- Define index.html file



Hands-on Lab Overview

☐ Create VMSS and add load balancing rule to route HTTP traffic to the instances in the scale set:

```
☐ az vmss create \
  --resource-group RG-06-HA \
  --name HA-VMSS-CLI \
  --image UbuntuLTS \
  --vm-sku Standard_B1s \
  --custom-data bashscript.txt \
  --upgrade-policy-mode automatic \
  --admin-username adminuser \
  --admin-password adminadmin123!
```

```
☐ az network lb rule create \
  --resource-group RG-06-HA \
  --name HA-Load-Balancing-Rule-CLI \
  --lb-name HA-VMSS-CLILB \
  --backend-pool-name HA-VMSS-CLILBBEPool \
  --backend-port 80 \
  --frontend-ip-name loadBalancerFrontEnd \
  --frontend-port 80 \
  --protocol tcp
```





Module 6 – Deploy HA Apps on Azure VMs

Hands-on Lab - Deploy Azure VMSS from Azure PowerShell

Custom Script Extension Overview

- ❑ Extensions are small applications that provide post-deployment configuration and automation on Azure VMs
- ❑ The Custom Script Extension downloads and executes scripts on Azure virtual machines
 - ❑ post-deployment configuration
 - ❑ software installation
 - ❑ configuration or management tasks
- ❑ Next: download script from GitHub and run it in PowerShell



Hands-on Lab Overview

- ❑ Steps to deploy VMSS from Azure PowerShell:
 - ❑ <https://docs.microsoft.com/en-us/azure/virtual-machine-scale-sets/quick-create-powershell>
- ❑ 1. Create a new Resource Group
- ❑ 2. Create the VMSS
- ❑ 3. Deploy IIS on Windows web servers
- ❑ 4. Allow HTTP traffic to website – VMSS





Module 6 – Deploy HA Apps on Azure VMs

Hands-on Lab - Configure VMSS Autoscaling in Azure Portal

Autoscaling Overview

- ❑ Azure VMSS can automatically increase or decrease the number of VM instances that run your application
- ❑ Why ?
 - ❑ Reduce the management overhead to monitor and optimize the performance of your application
- ❑ How ?
 - ❑ Define rules to automatically (autoscale) adjust the capacity of your scale set, up or down; scheduled scaling is also possible



Hands-on Lab Overview

☐ Define scaling conditions based on VM CPU load

Default* Auto created scale condition 

 Delete warning  The very last or default recurrence rule cannot be deleted. Instead, you can disable autoscale to turn off autoscale.

Scale mode Scale based on a metric Scale to a specific instance count

Rules

Total VMs: 1 (existing) + 2 (autoscale) = 3

Scale out

When HA-VMSS (Average) Percentage CPU > 70 Increase count by 2

Scale in

When HA-VMSS (Average) Percentage CPU <= 50 Decrease count by 1

[+ Add a rule](#) **Total VMs: 3 (existing) - 1 (autoscale) = 2**

Instance limits

Minimum 	Maximum 	Default 
<input type="text" value="1"/> 	<input type="text" value="3"/> 	<input type="text" value="1"/> 

Schedule

This scale condition is executed when none of the other scale condition(s) match





Module 6 – Deploy HA Apps on Azure VMs

Module Completion & Exam Hints



Azure VMs Availability Options

Azure VMs Availability Options

- ❑ HA config options for VMs in Azure:
 - ❑ Availability zones
 - ❑ Availability sets
 - ❑ Fault domains
 - ❑ Update domains
 - ❑ Virtual machine scale sets (VMSS)



High Availability



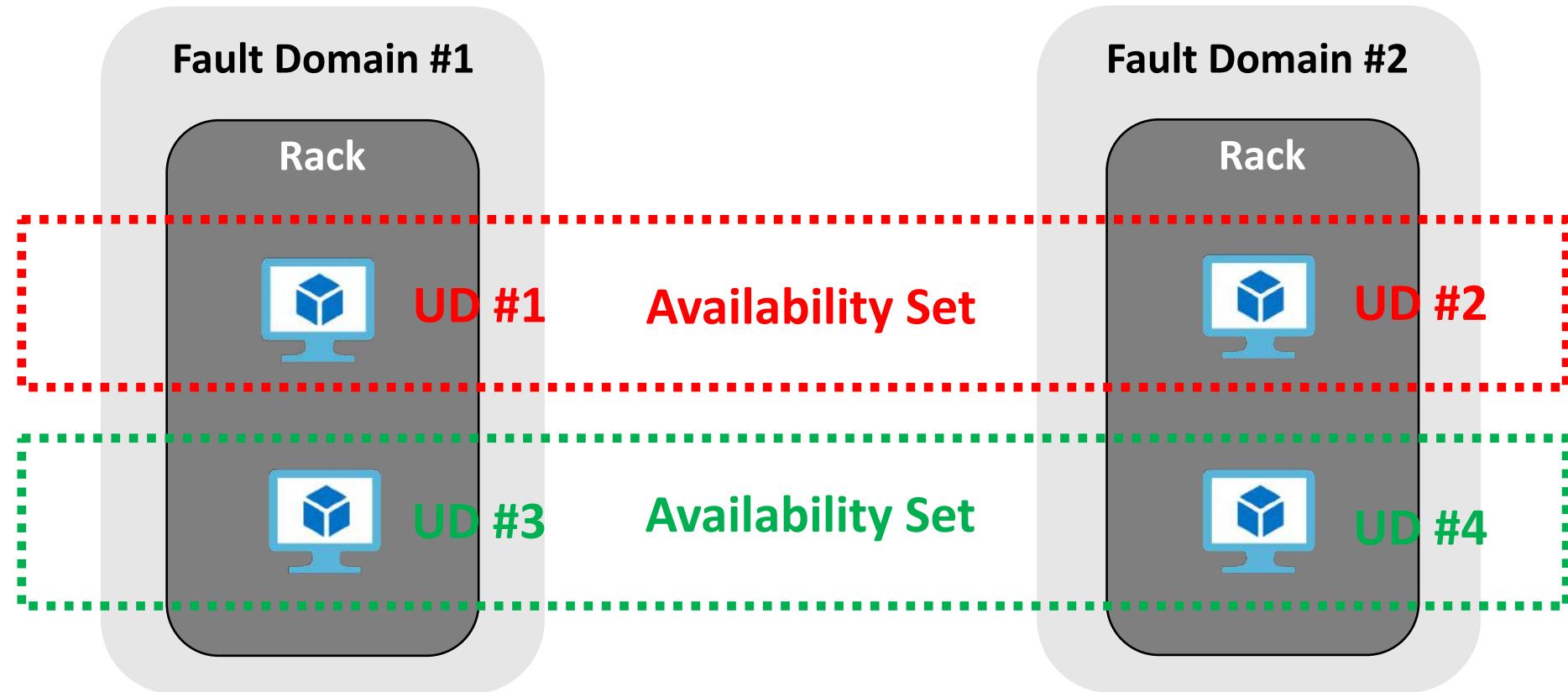
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VMs High Availability – Availability Sets, FD, UD

- ❑ Availability set:
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- ❑ Update domains - prevent app outage in case of planned maintenance windows in Azure



VMs High Availability – Availability Sets, FD, UD

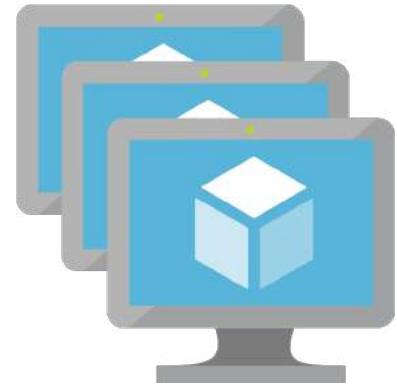




Azure VMSS Fundamentals

Virtual Machine Scale Sets (VMSS) Overview

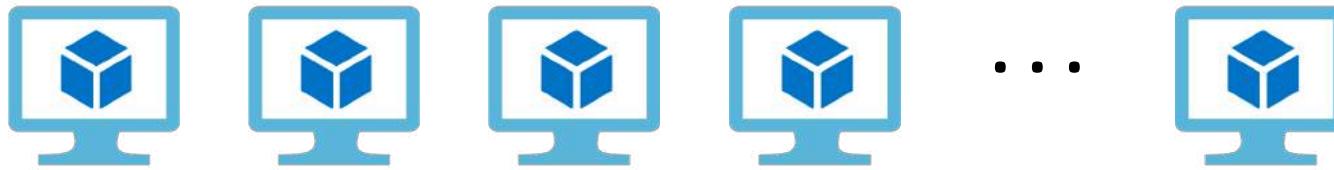
- Azure VMSS - create & manage a group of identical load balanced VMs
- The number of VM instances can automatically increase or decrease, based on traffic demand or defined schedule (automatic or manual)
- For HA purposes, a minimum of 2 VMs should be placed in a VMSS; 99,95% Azure SLA met



VMSS

Scaling Options – Vertical & Horizontal Scaling

- Horizontal scaling – add or remove VMs in scale set



- Vertical scaling – add resources to existing VMs

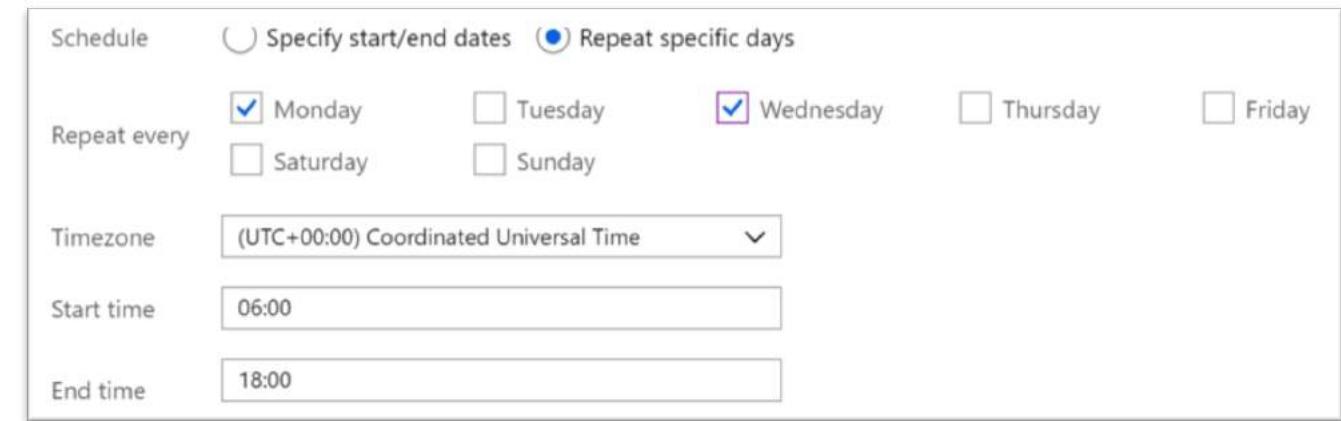


Scale Set Scaling – In or Out

☐ Types of scaling for a scale set:

- ☐ Manual scaling
- ☐ Scheduled scaling
- ☐ Autoscaling

☐ Scheduled scaling



Schedule

Specify start/end dates Repeat specific days

Repeat every

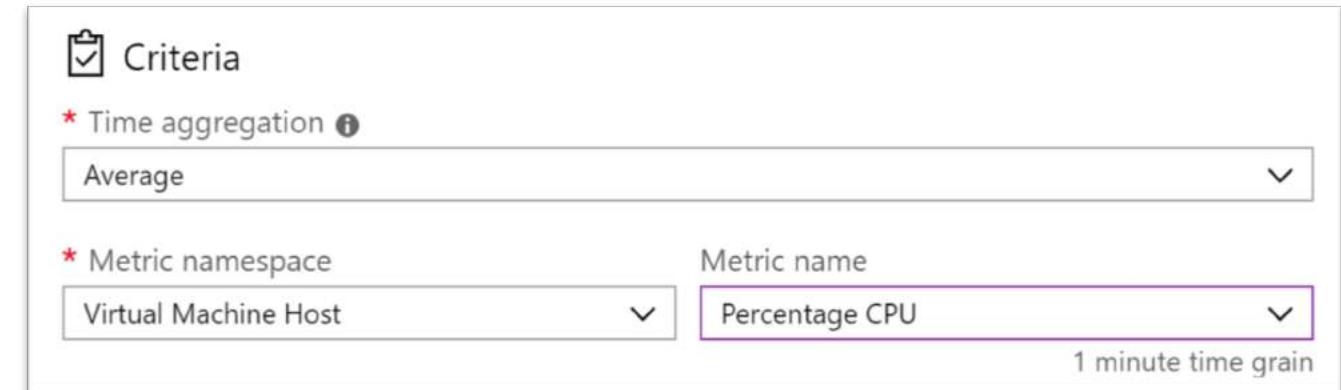
Monday Tuesday Wednesday Thursday Friday
 Saturday Sunday

Timezone: (UTC+00:00) Coordinated Universal Time

Start time: 06:00

End time: 18:00

☐ Autoscaling



Criteria

* Time aggregation i

Average

* Metric namespace

Virtual Machine Host

Metric name

Percentage CPU

1 minute time grain





Deploy Azure VMSS from CLI & PS

Deploy VMSS from Azure CLI

- Create VMSS and add load balancing rule to route HTTP traffic to the instances in the scale set:

```
□ az vmss create \
  □ --resource-group RG-06-HA \
  □ --name HA-VMSS-CLI \
  □ --image UbuntuLTS \
  □ --vm-sku Standard_B1s \
  □ --custom-data bashscript.txt \
  □ --upgrade-policy-mode automatic \
  □ --admin-username adminuser \
  □ --admin-password adminadmin123!
```

```
□ az network lb rule create \
  □ --resource-group RG-06-HA \
  □ --name HA-Load-Balancing-Rule-CLI \
  □ --lb-name HA-VMSS-CLILB \
  □ --backend-pool-name HA-VMSS-CLILBBEPool \
  □ --backend-port 80 \
  □ --frontend-ip-name loadBalancerFrontEnd \
  □ --frontend-port 80 \
  □ --protocol tcp
```



Deploy VMSS from Azure PS

- Create VMSS and add load balancing rule to route HTTP traffic to the instances in the scale set:

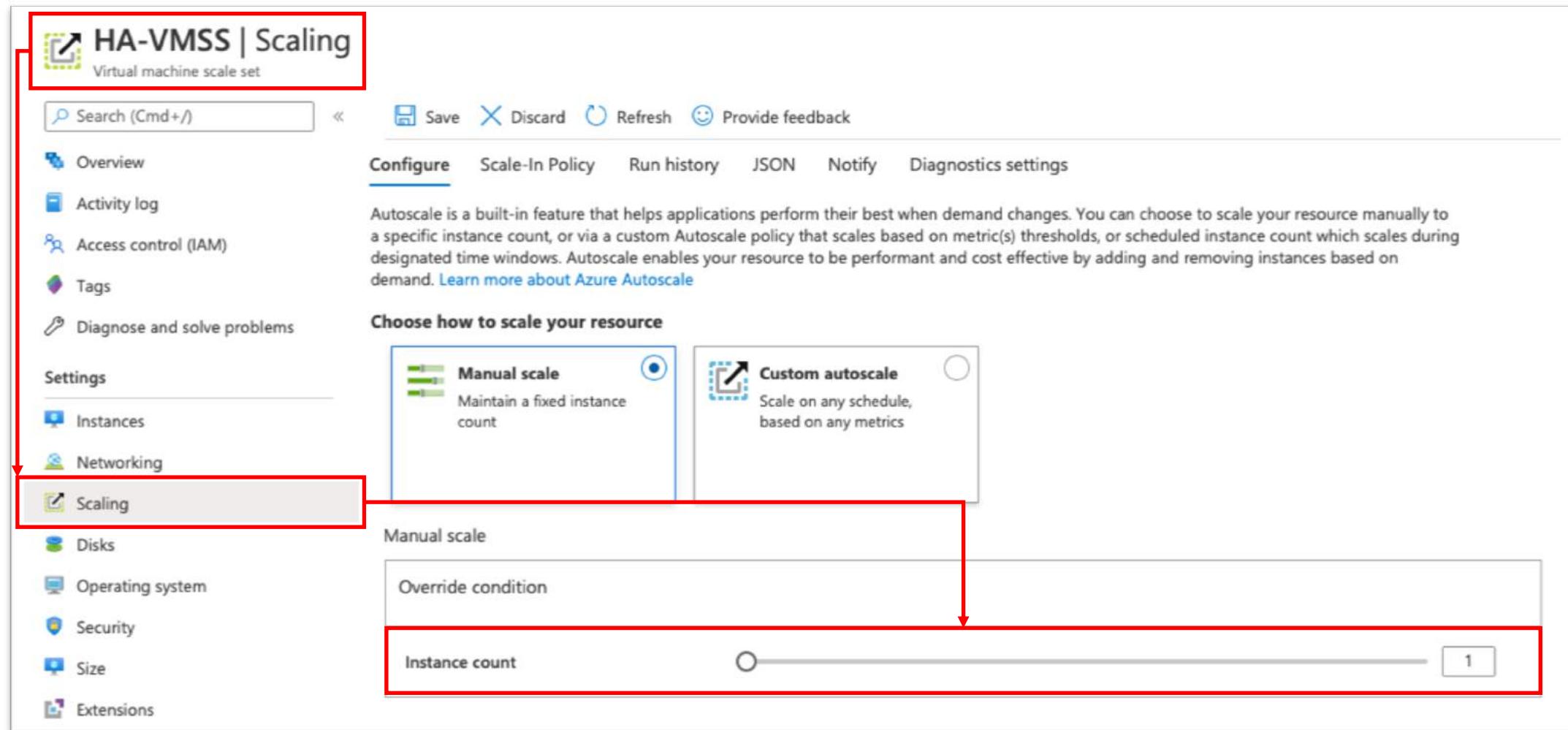
- New-AzVmss`
 - -ResourceGroupName "myResourceGroup" `
 - -Location "EastUS" `
 - -VMSScaleSetName "myScaleSet" `
 - -VirtualNetworkName "myVnet" `
 - -SubnetName "mySubnet" `
 - -PublicIpAddressName "myPublicIPAddress" `
 - -LoadBalancerName "myLoadBalancer" `
 - -UpgradePolicyMode "Automatic"
- Add-AzVmssExtension
- Update-AzVmss
- New-AzNetworkSecurityRuleConfig
- New-AzNetworkSecurityGroup





VMSS Manual Scaling

Manual Scaling in Azure Portal



HA-VMSS | Scaling

Virtual machine scale set

Search (Cmd +/)

Save Discard Refresh Provide feedback

Configure Scale-In Policy Run history JSON Notify Diagnostics settings

Autoscale is a built-in feature that helps applications perform their best when demand changes. You can choose to scale your resource manually to a specific instance count, or via a custom Autoscale policy that scales based on metric(s) thresholds, or scheduled instance count which scales during designated time windows. Autoscale enables your resource to be performant and cost effective by adding and removing instances based on demand. [Learn more about Azure Autoscale](#)

Choose how to scale your resource

Manual scale

Maintain a fixed instance count

Custom autoscale

Scale on any schedule, based on any metrics

Manual scale

Override condition

Instance count 1

Scaling

Instances Networking

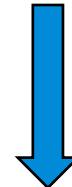
Disks Operating system Security Size Extensions



Manual Scaling in Azure CLI

☐ One command to run:

- ☐ az vmss scale --name <VMSS-Name> --capacity <New-Capacity> -g <RG-Name>



```
ciprian@Azure:~$ az vmss scale --name HA-VMSS-CLI --new-capacity 3 -g RG-06-HA
{- Finished ..
  "additionalCapabilities": null,
  "automaticRepairsPolicy": null,
  "doNotRunExtensionsOnOverprovisionedVms": false,
```

☐ Monitor the progress live:

- ☐ watch az vmss list-instances --name <VMSS-Name> -g <RG-Name> -o table



Manual Scaling in Azure PS

☐ Steps to complete:

☐ # Get current scale set

- ☐ \$vmss = **Get-AzVmss** -ResourceGroupName "myResourceGroup" -VMSScaleSetName "myScaleSet"

☐ # Set and update the capacity of your scale set

- ☐ \$vmss.sku.capacity = 3
- ☐ **Update-AzVmss** -ResourceGroupName "myResourceGroup" -Name "myScaleSet" -VirtualMachineScaleSet \$vmss

```
PS /home/ciprian> $vmss = Get-AzVmss -ResourceGroupName myResourceGroup -VMSScaleSetName myScaleSet
PS /home/ciprian>
PS /home/ciprian>
PS /home/ciprian>
PS /home/ciprian>
PS /home/ciprian> $vmss.sku.capacity = 3
PS /home/ciprian>
PS /home/ciprian>
PS /home/ciprian> Update-AzVmss -ResourceGroupName myResourceGroup -name myScaleSet -VirtualMachineScaleSet $vmss
```





VMSS Autoscaling

Configure VMSS autoscaling in Azure Portal

☐ Define scaling conditions based on VM CPU load

Default* Auto created scale condition 

 Delete warning (i) The very last or default recurrence rule cannot be deleted. Instead, you can disable autoscale to turn off autoscale.

Scale mode Scale based on a metric Scale to a specific instance count

Rules

Total VMs: 1 (existing) + 2 (autoscale) = 3

Scale out
When HA-VMSS (Average) Percentage CPU > 70 Increase count by 2
Scale in
When HA-VMSS (Average) Percentage CPU <= 50 Decrease count by 1

[+ Add a rule](#) **Total VMs: 3 (existing) - 1 (autoscale) = 2**

Instance limits

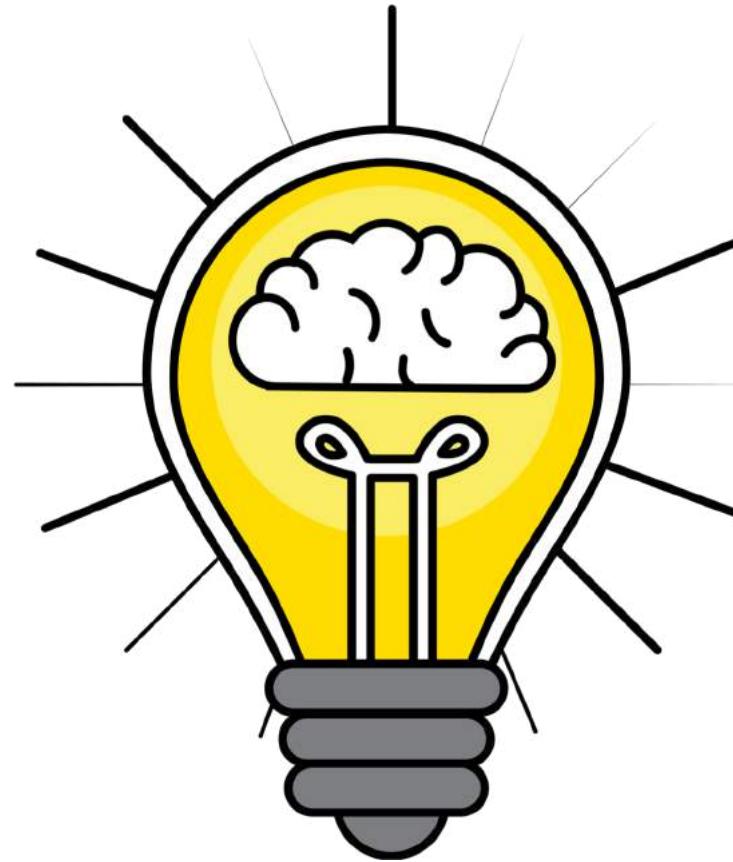
Minimum 	Maximum 	Default 
1 	3 	1 

Schedule

This scale condition is executed when none of the other scale condition(s) match



Deploy HA Apps on Azure VMs - Quiz



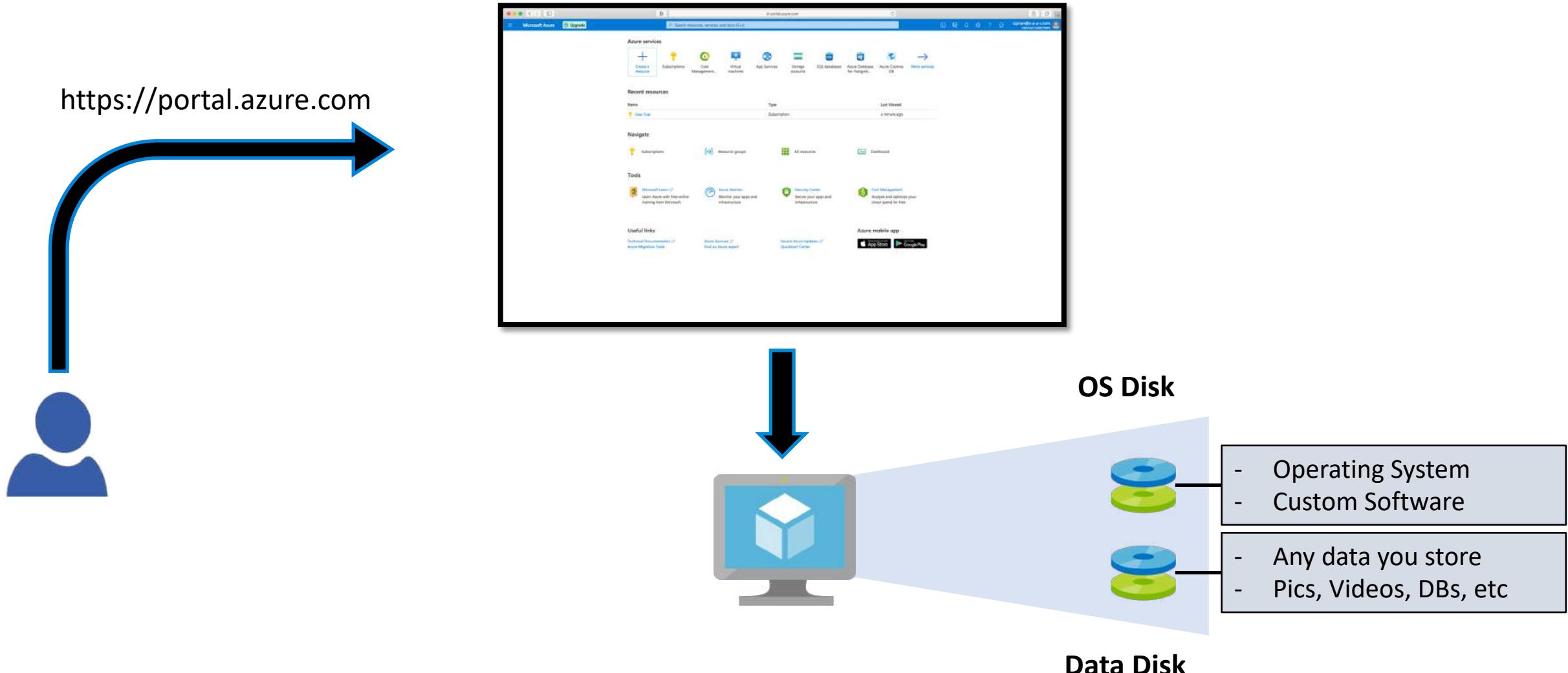
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Module 7 - Azure VMs Automation

Azure Custom VM Images Fundamentals

Azure VMs – Deployment Overview



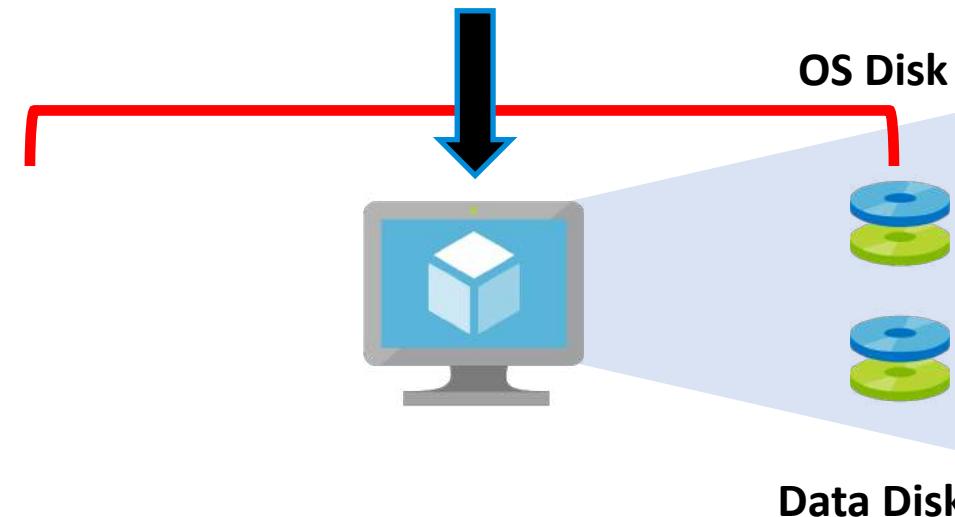
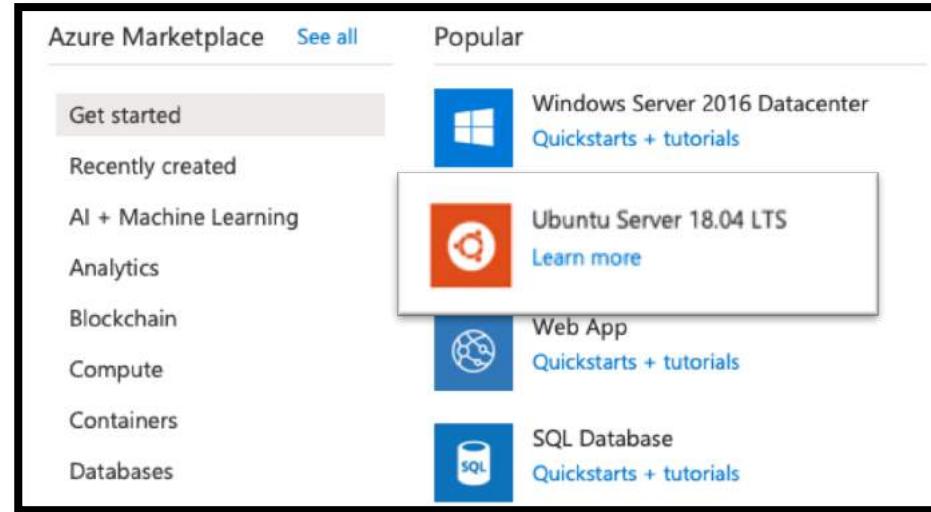
Azure VHDs vs Classic Physical Disks

- Virtual hard disks(VHD) are similar to classic hard disks; VHDs are stored as virtual files in Azure
- VHDs advantages:
 - 1.High Availability
 - 2. Physical security
 - 3. Durability
 - 4. Scalability
 - 5. Cost & Performance



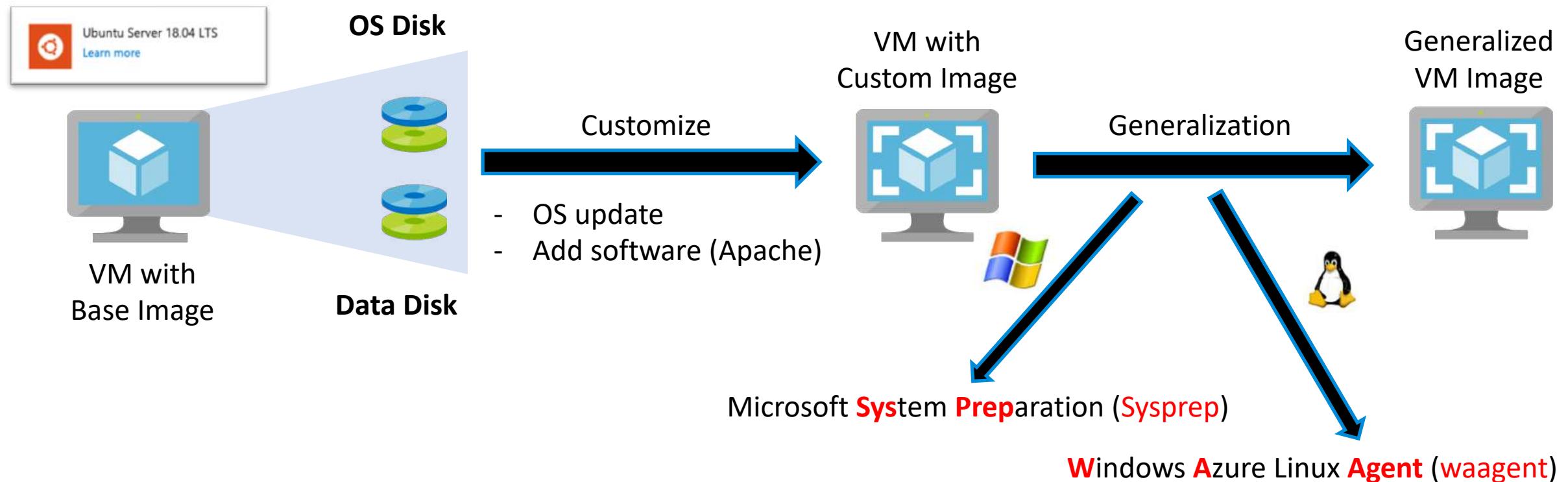
Azure VMs Image Overview

<https://portal.azure.com>



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Azure VMs – Generalized (Custom) Image





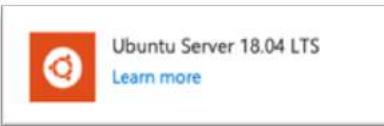
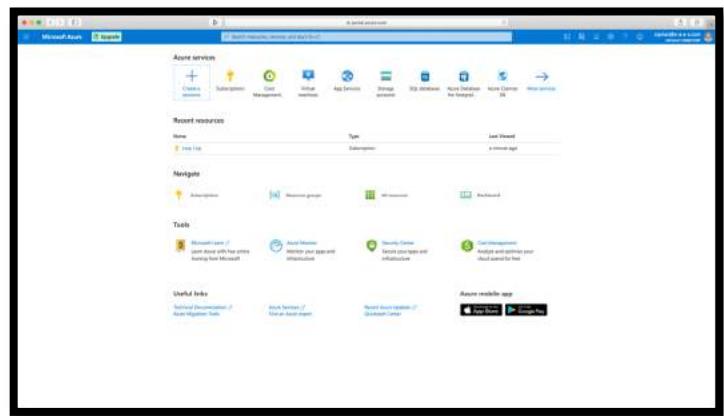
Module 7 - Azure VMs Automation

Hands-on Lab - Generalize an Azure Linux VM

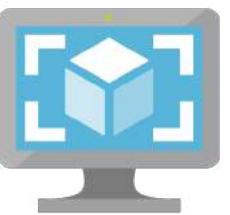
Hands-on Lab Overview



<https://portal.azure.com>



VM with
Base Image



Generalized
VM



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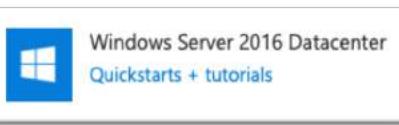
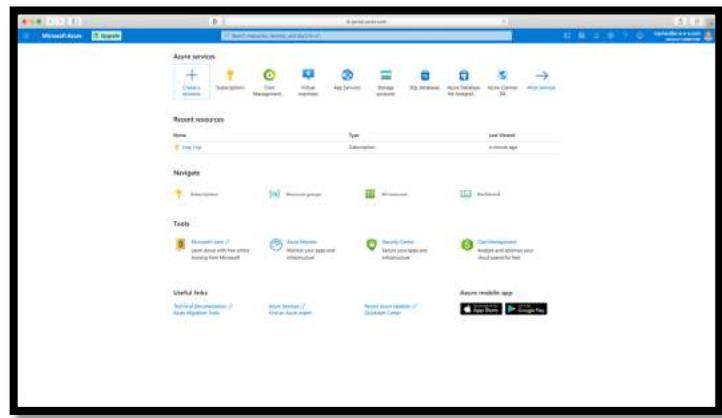
Module 7 - Azure VMs Automation

Hands-on Lab - Generalize an Azure Windows VM

Hands-on Lab Overview



<https://portal.azure.com>



VM with
Base Image



Generalized
VM



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Module 7 - Azure VMs Automation

Hands-on Lab - Deploy Azure VM from Generalized VM

Hands-on Lab Overview

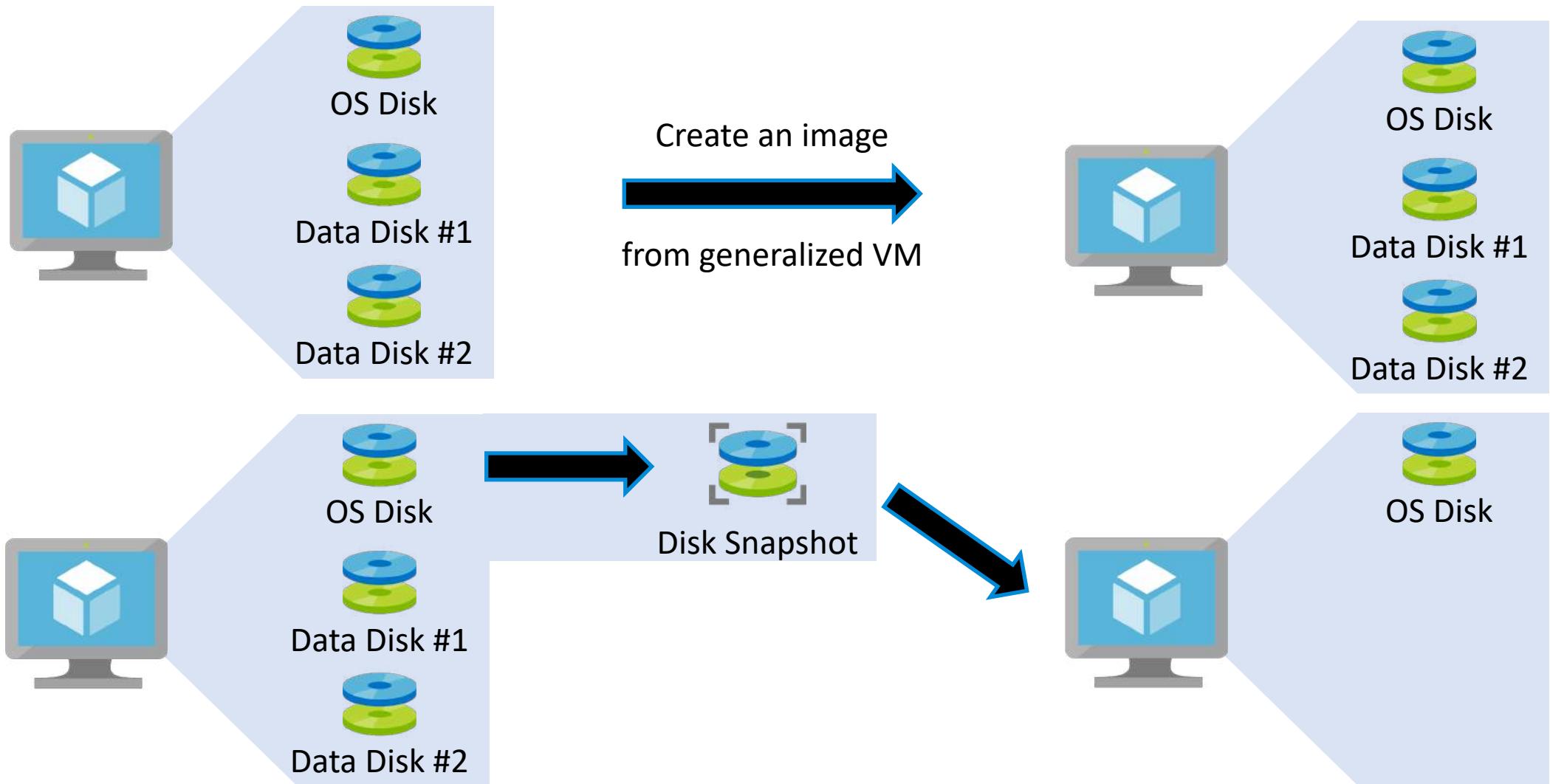




Module 7 - Azure VMs Automation

Hands-on Lab - Create a snapshot of a VHD

Hands-on Lab Overview





Module 7 - Azure VMs Automation

Hands-on Lab - Deploy VM from VHD Snapshot

Hands-on Lab Overview



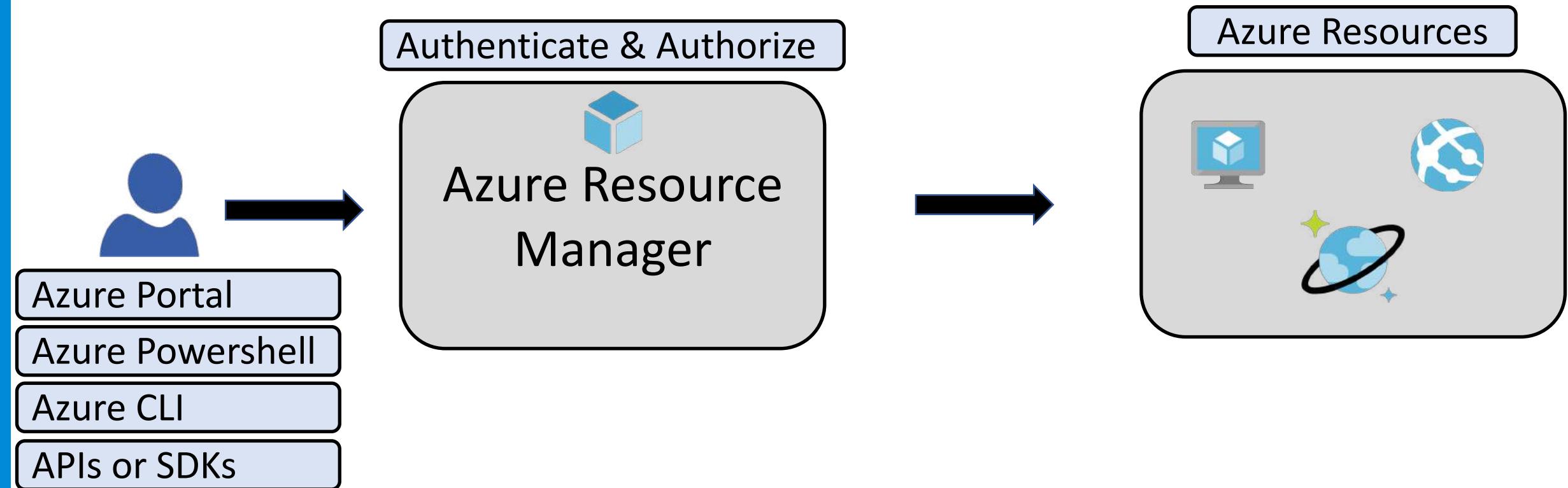


Module 7 - Azure VMs Automation

Azure Resource Manager and ARM Templates Fundamentals

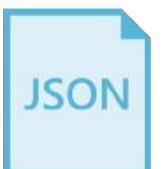
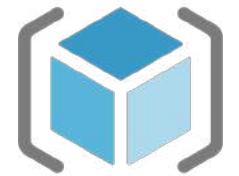
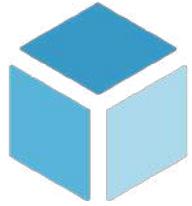
Azure Resource Manager (ARM) Overview

- ❑ Azure Resource Manager is the deployment and management service for Azure; it's a management layer that enables you to create, update and delete resources



Azure Resource Manager Key Terminology

- **Resource** – service available in Azure Cloud
 - e.g. VMs, databases, storage accounts, etc.
- **Resource groups** – container that includes multiple related resources
- **Resource provider** – family of related Azure resources
 - e.g. Microsoft.Compute – VMs and VMSS
- **Resource Manager Template** – JSON file that defines resources to be deployed



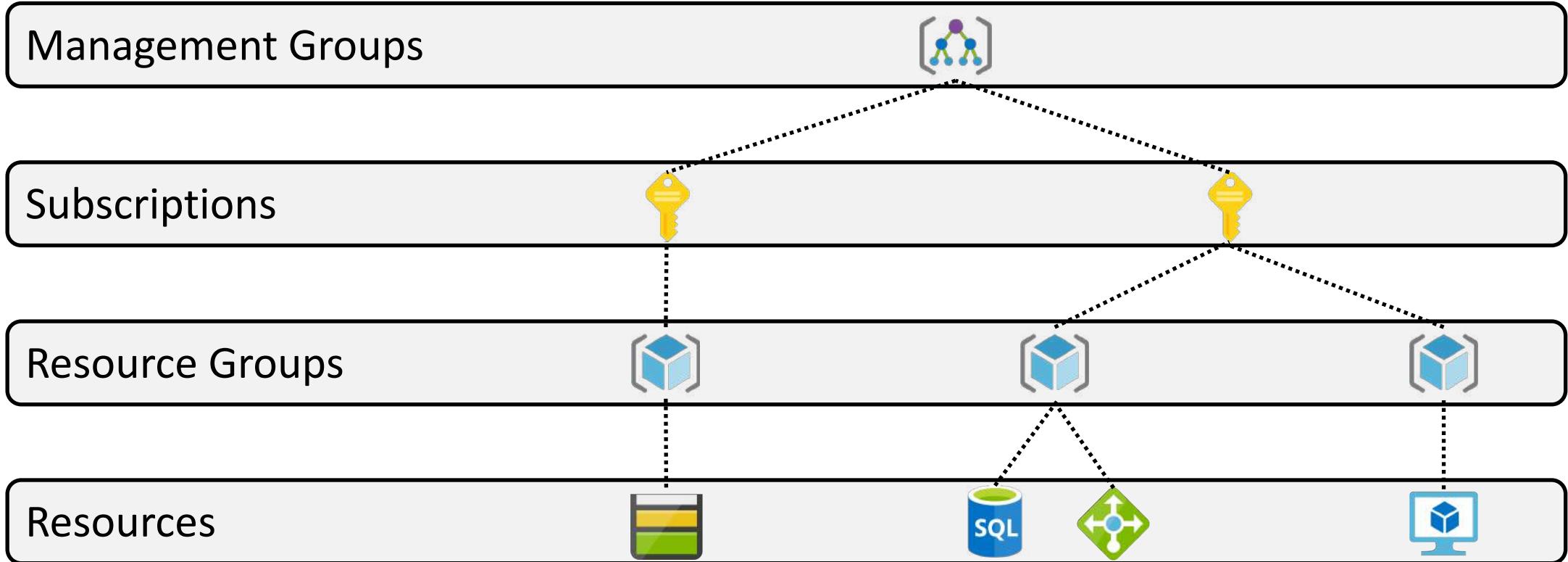
Azure Resource Manager Benefits

- Manage your infrastructure through templates – JSON file includes the properties for the infrastructure to deploy
- Deploy resources in the correct order - dependencies between Azure resources
- Centrally deploy, manage and monitor all your resources
- Apply tags to resources to logically organize them
- Clear billing and costs at the organization level – tags



Management Levels in Azure

- Management settings can be applied at multiple levels



Azure Resource Manager Templates Overview

- ❑ Questions:
 - ❑ Is it possible to make mistakes while manually deploying resources in Azure? (Yes)
 - ❑ Is it time consuming to deploy resources in Azure? (Yes)
 - ❑ Do all your team members have the same knowledge to deploy resources and work in Azure? (No)
- ❑ Solution: Deployments can be automated through infrastructure as code; in the actual code you can define the infrastructure that will be deployed and how it will be deployed (order of deployment, resources' properties, etc.)



Infrastructure as Code (IaC) Examples

- Automate infrastructure deployment through proprietary or 3rd party tools



- Azure -> Azure Resource Manager



- AWS -> AWS CloudFormation



- GCP -> Google Cloud Deployment Manager

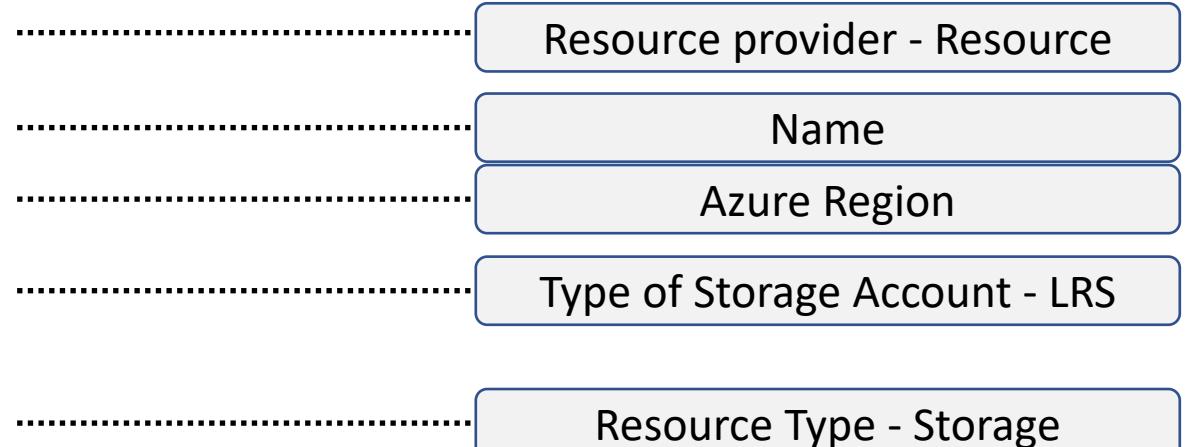


- 3rd vendor agnostic:

- Terraform, Chef, Ansible, Puppet

Azure Template - Create a Storage Account

```
"resources": [  
  {  
    "type": "Microsoft.Storage/storageAccounts",  
    "apiVersion": "2016-01-01",  
    "name": "mystorageaccount",  
    "location": "westus",  
    "sku": {  
      "name": "Standard_LRS"  
    },  
    "kind": "Storage",  
    "properties": {}  
  }  
]
```





Module 7 - Azure VMs Automation

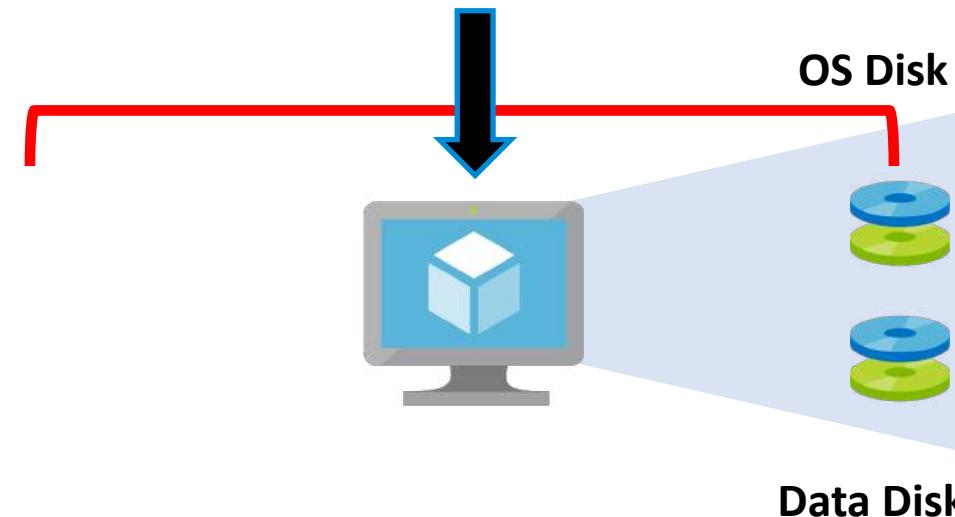
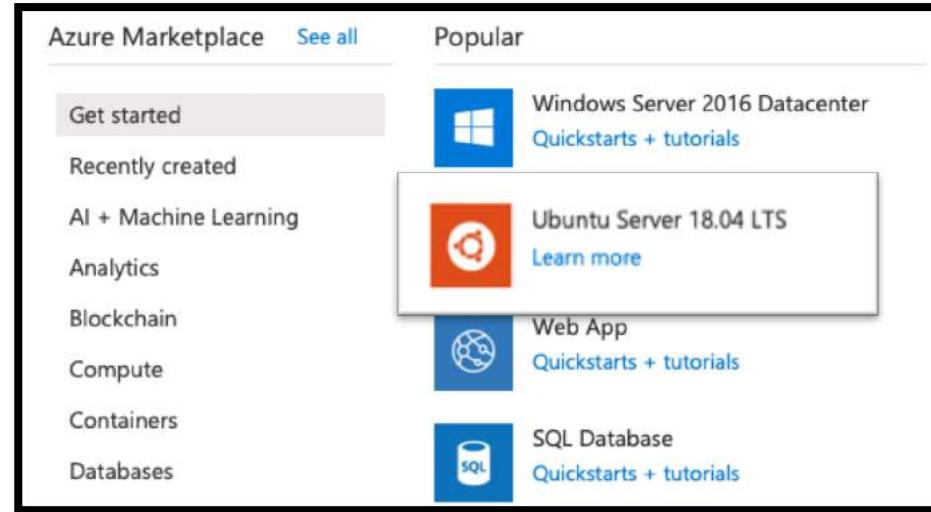
Module Completion & Exam Hints



Azure VMs Custom Images

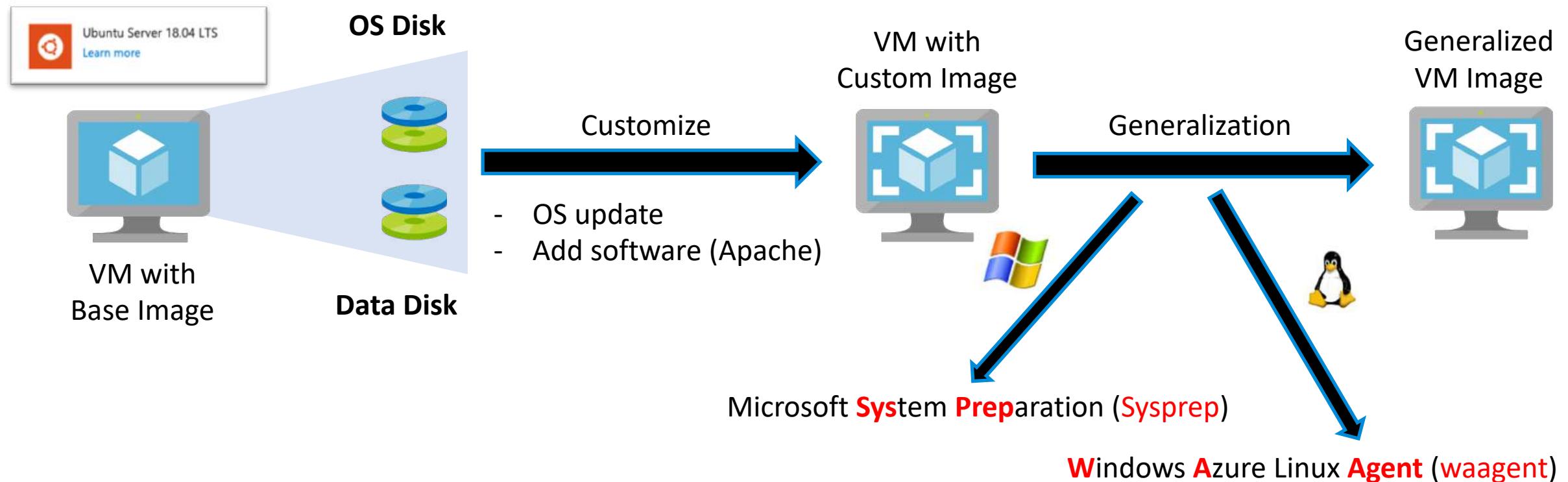
Azure VMs Image Overview

<https://portal.azure.com>



Microsoft Azure Administrator

Azure VMs – Generalized (Custom) Image





Azure VMs Generalization

Generalize an Azure Linux VM

```
root@Webserver-Linux-VM:/home/adminuser# waagent -deprovision+user
WARNING! The waagent service will be stopped.
WARNING! Cached DHCP leases will be deleted.
WARNING! root password will be disabled. You will not be able to log in.
WARNING! /etc/resolv.conf will NOT be removed, this is a behavior change.
WARNING! adminuser account and entire home directory will be deleted.
Do you want to proceed (y/n)
```



```
ciprian@Azure:~$ az vm deallocate -g RG-07-Automation-Linux-VM --name Webserver-Linux-VM
[- Running] ..
```

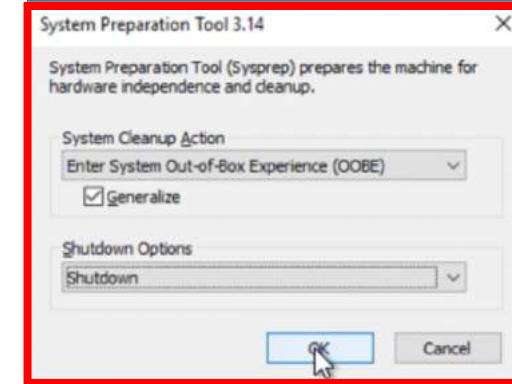
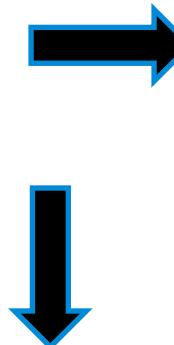


```
ciprian@Azure:~$ az vm generalize -g RG-07-Automation-Linux-VM --name Webserver-Linux-VM
```



Generalize an Azure Windows VM

```
C:\Users\adminuser>cd /windows/system32/sy...  
C:\Windows\System32\Sy...  
C:\Windows\System32\Sy...  
C:\Windows\System32\Sy...sysprep.exe
```



```
PS /home/ciprian> Stop-AzVM -ResourceGroupName RG-07-Automation-Ws-VM -Name Windows-VM -Force
```



```
PS /home/ciprian> Set-AzVM -ResourceGroupName RG-07-Automation-Ws-VM -Name Windows-VM -Generalize
```

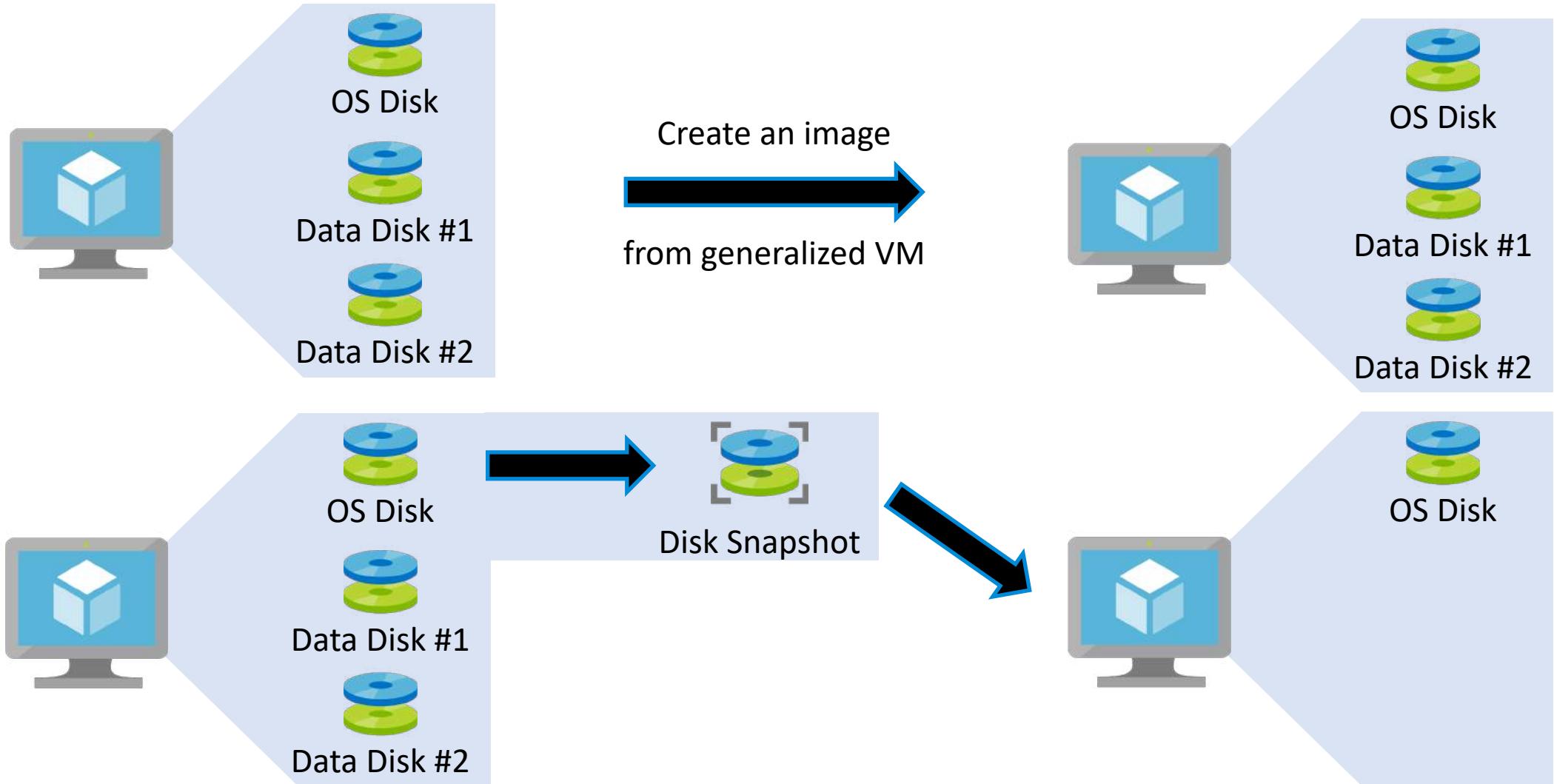
```
OperationId :  
Status       : Succeeded  
StartTime    : 8/26/2020 9:36:09 AM  
EndTime      : 8/26/2020 9:36:10 AM  
Error        :
```





Azure Disk Snapshots

Azure Disk Snapshots

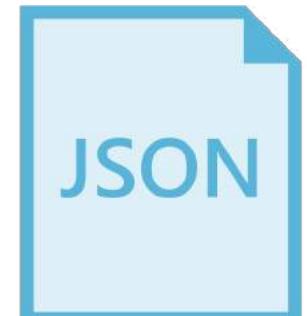




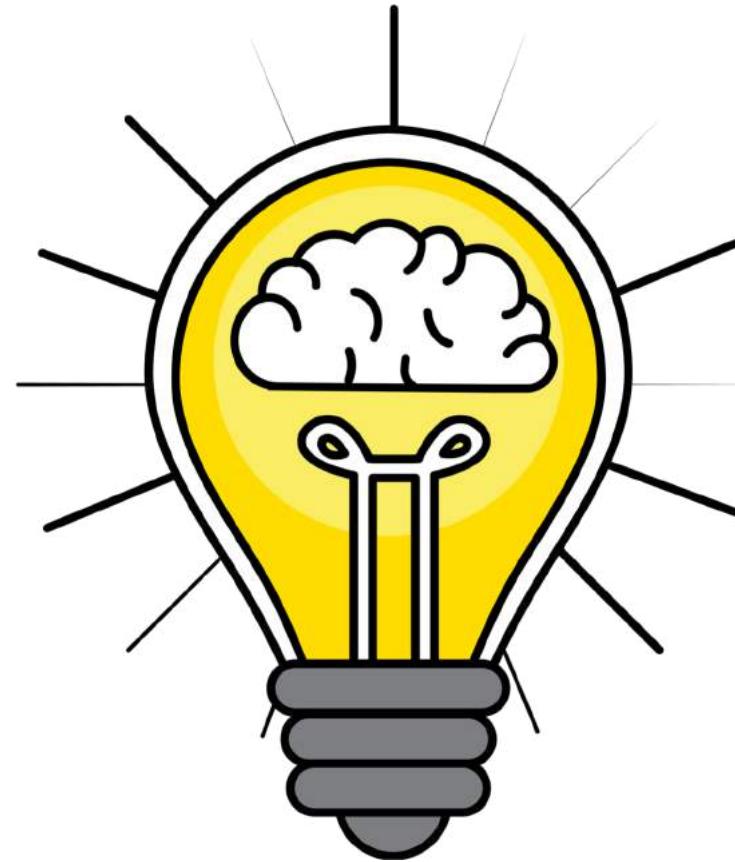
Azure Resource Manager

Azure Resource Manager (ARM) Overview

- ❑ Azure Resource Manager is the deployment and management service for Azure; it's a management layer that enables you to create, update and delete resources
- ❑ Deployments can be automated through infrastructure as code
 - ARM templates
 - ❑ resources to be deployed
 - ❑ properties for resources
 - ❑ deployment order
- ❑ ARM templates are written in JSON format !



Azure VMs Deployment Automation - Quiz



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Module 8 - Azure Containers - ACI and AKS

Introduction to Docker Containers

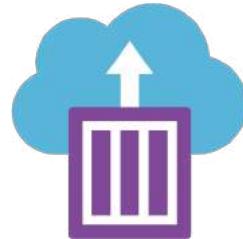
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



Containers



Azure App Service



Serverless Computing



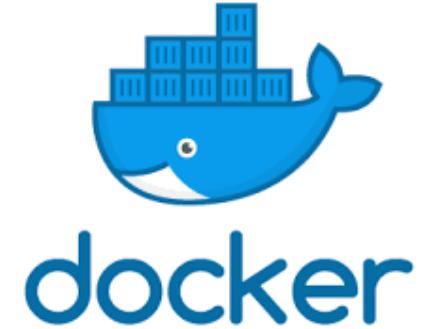
Docker Platform Overview

- ❑ Docker is an open platform for developing, shipping, and running applications; you can significantly reduce the time between writing code and running it in production
- ❑ Docker provides the ability to package and run an app in an isolated environment = container
- ❑ Run many containers simultaneously on a given host: hardware or VM
- ❑ Containers are lightweight – no OS to install

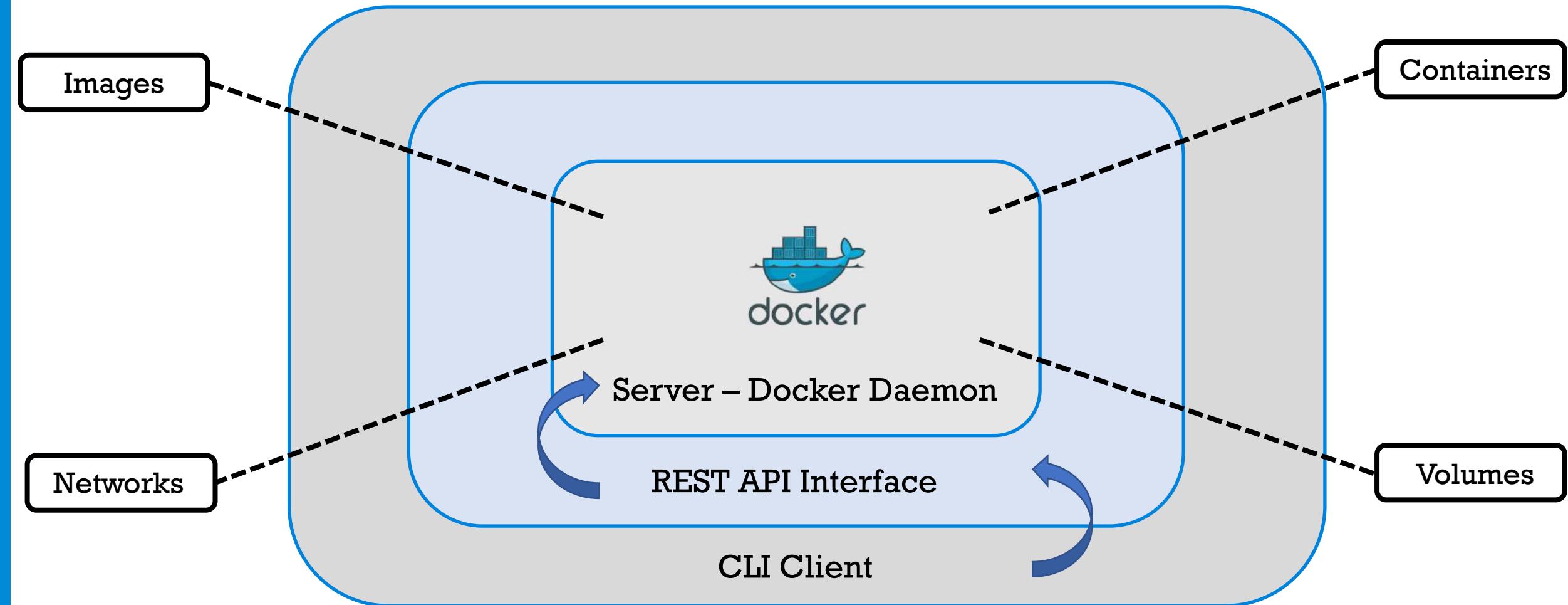


Docker Platform Overview

- ❑ Docker provides the tools and a platform to manage the lifecycle of your containers
- ❑ Develop your application and its supporting components using containers
- ❑ The container becomes the unit for distributing and testing your application
- ❑ Deploy your application into your production environment, as a container or an orchestrated service

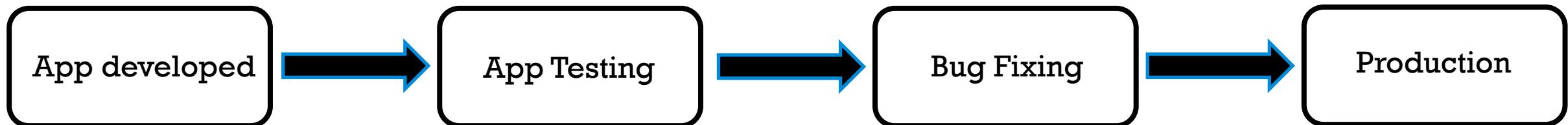


Docker Engine Overview



Docker Advantages

- 1. Running more apps on the same hardware
- 2. Deploy highly portable apps that scale dynamically
- 3. Fast and consistent delivery of your apps



Docker Objects – Images

- ❑ Docker Images - read-only template with instructions for creating a Docker container
 - ❑ based on another image, but customized
- ❑ Use existing images or build your own:
 - ❑ Dockerfile - simple syntax for defining the steps needed to create the image and run it



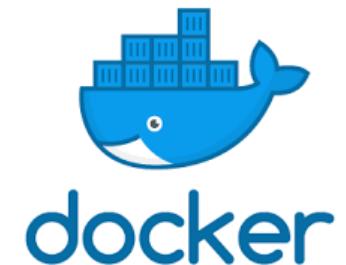
```
FROM ubuntu:18.04
COPY . /app
RUN make /app
CMD python /app/app.py
```

FROM creates a layer from the ubuntu:18.04 Docker image
COPY adds files from your Docker client's current directory
RUN builds your application with make
CMD specifies what command to run within the container.

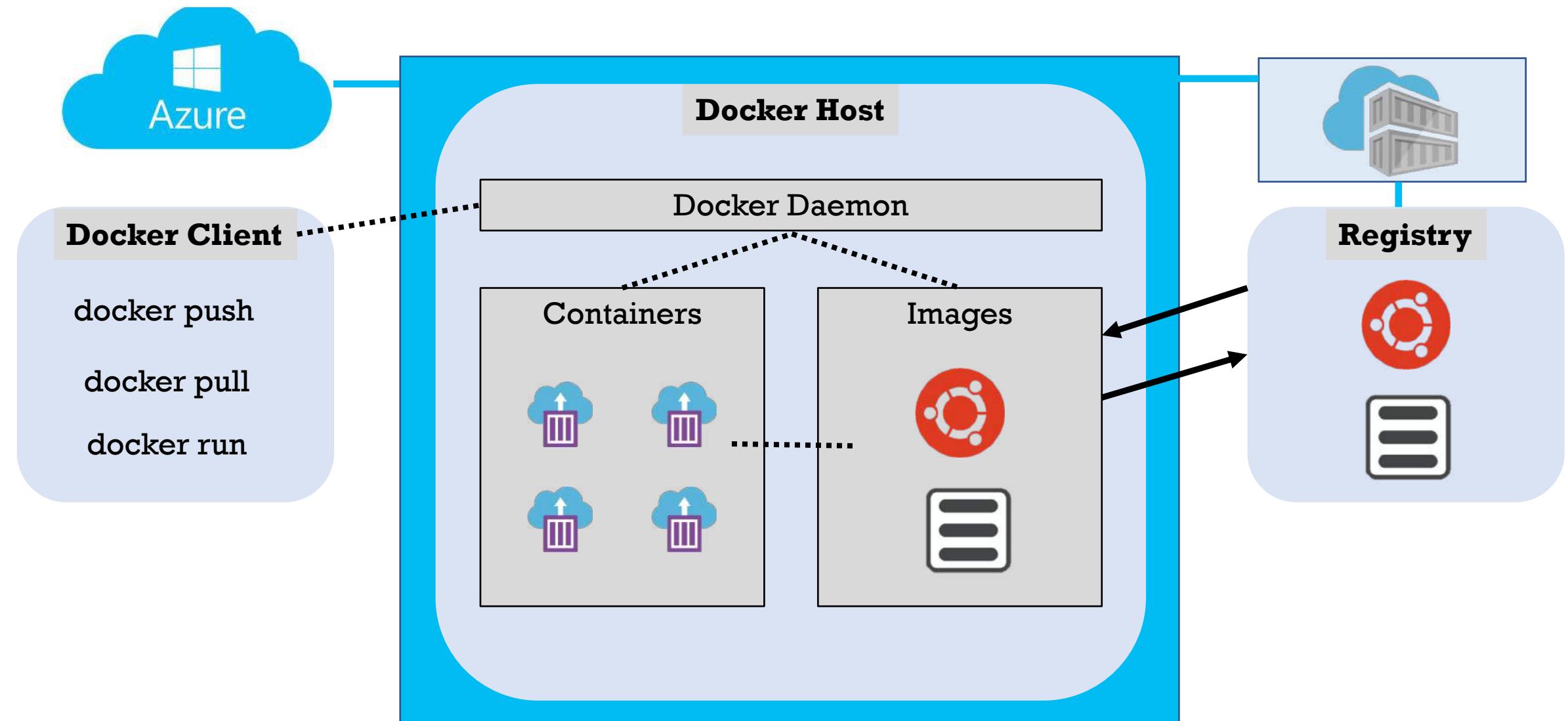


Docker Objects – Containers

- ❑ Docker Container – it's a runnable instance of an image
- ❑ Operations on containers:
 - ❑ create, start, stop, move, or delete a container
 - ❑ connect a container to one or more networks
 - ❑ attach storage
 - ❑ create a new image based on current one
- ❑ Containers are defined by:
 - ❑ image
 - ❑ configuration options



Docker Architecture – How things work



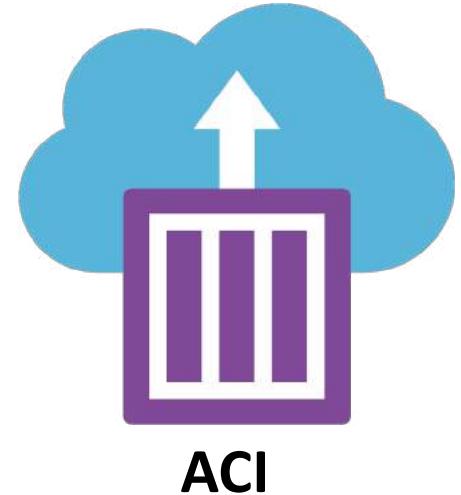


Module 8 - Azure Containers - ACI and AKS

Azure Container Instances (ACI) Overview

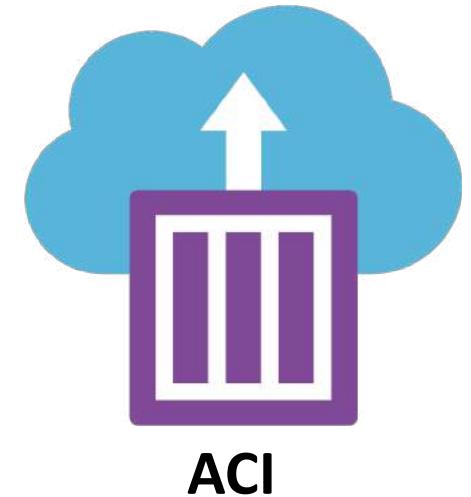
Azure Containers Instances (ACI) Overview

- Azure Container Instances offers the fastest and simplest way to run a container in Azure
 - No VM or infrastructure to manage !
- ACI use cases:
 - Simple apps
 - Task automation
 - Build jobs
- Orchestration needed ? -> Azure Kubernetes Service (AKS)



ACI Benefits

- 1. Fast startup times – with ACI, start in seconds
- 2. Container access
- 3. Compliant Deployments
 - Hypervisor-level security
 - Customer data
 - Custom sizes
 - Persistent storage
 - vNET deployment
 - Linux and Windows available



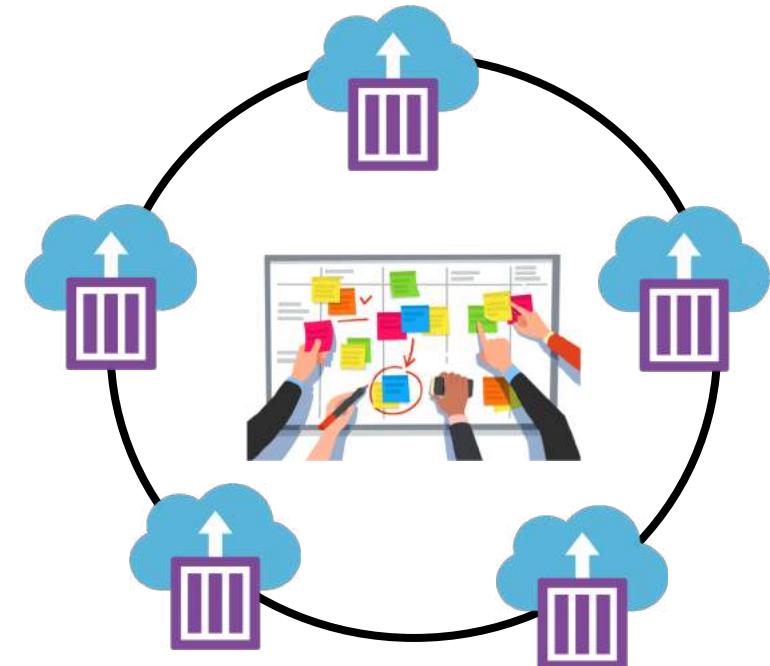


Module 8 - Azure Containers - ACI and AKS

Azure Kubernetes Service (AKS) Overview

Container Management Introduction

- ❑ Containers have a distinct life cycle vs. VMs
 - ❑ deploy -> start -> stop -> destroy
- ❑ Management challenges to consider:
 - ❑ containers' lifecycle
 - ❑ automatic and consistent scaling
 - ❑ updating the containers
- ❑ Run a system to help you manage your container deployment !



What is Kubernetes?

- ❑ Kubernetes(K8S) is an open-source container orch. system for automating application deployment, scaling, and management

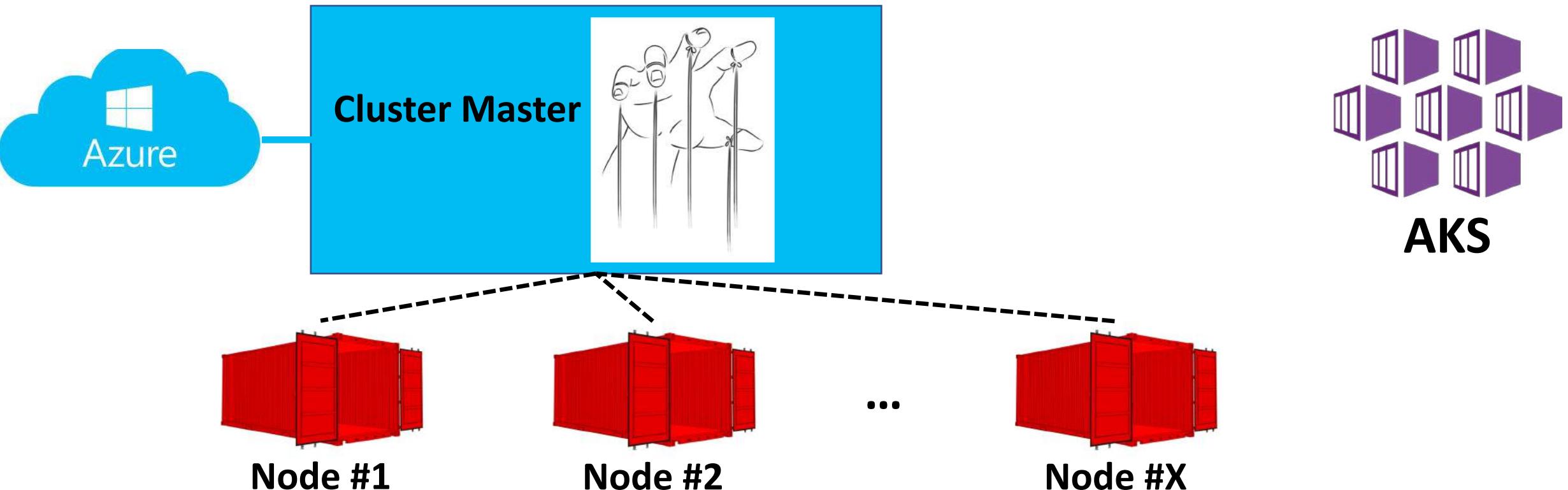


- ❑ Things to know:
 - ❑ You are responsible for deployment, scaling, load balancing, logging, etc.
 - ❑ Kubernetes doesn't provide DBs or storage
 - ❑ A Kubernetes deployment is configured as a cluster:
 - ❑ one master machine
 - ❑ one or multiple worker machines = (agent) nodes

Kubernetes

What is Azure Kubernetes Service (AKS)?

- Azure Kubernetes Service (AKS) manages your hosted Kubernetes environment and makes it simple to deploy and manage containerized apps in Azure



Deploying an AKS Cluster

- ❑ AKS cluster is a cloud hosted Kubernetes cluster; increases speed and ease of the installation process
- ❑ Minimum basic information required:
 - ❑ Kubernetes cluster name
 - ❑ version of Kubernetes to install
 - ❑ a DNS prefix for master node
 - ❑ initial node pool size





Module 8 - Azure Containers - ACI and AKS

Module Completion & Exam Hints



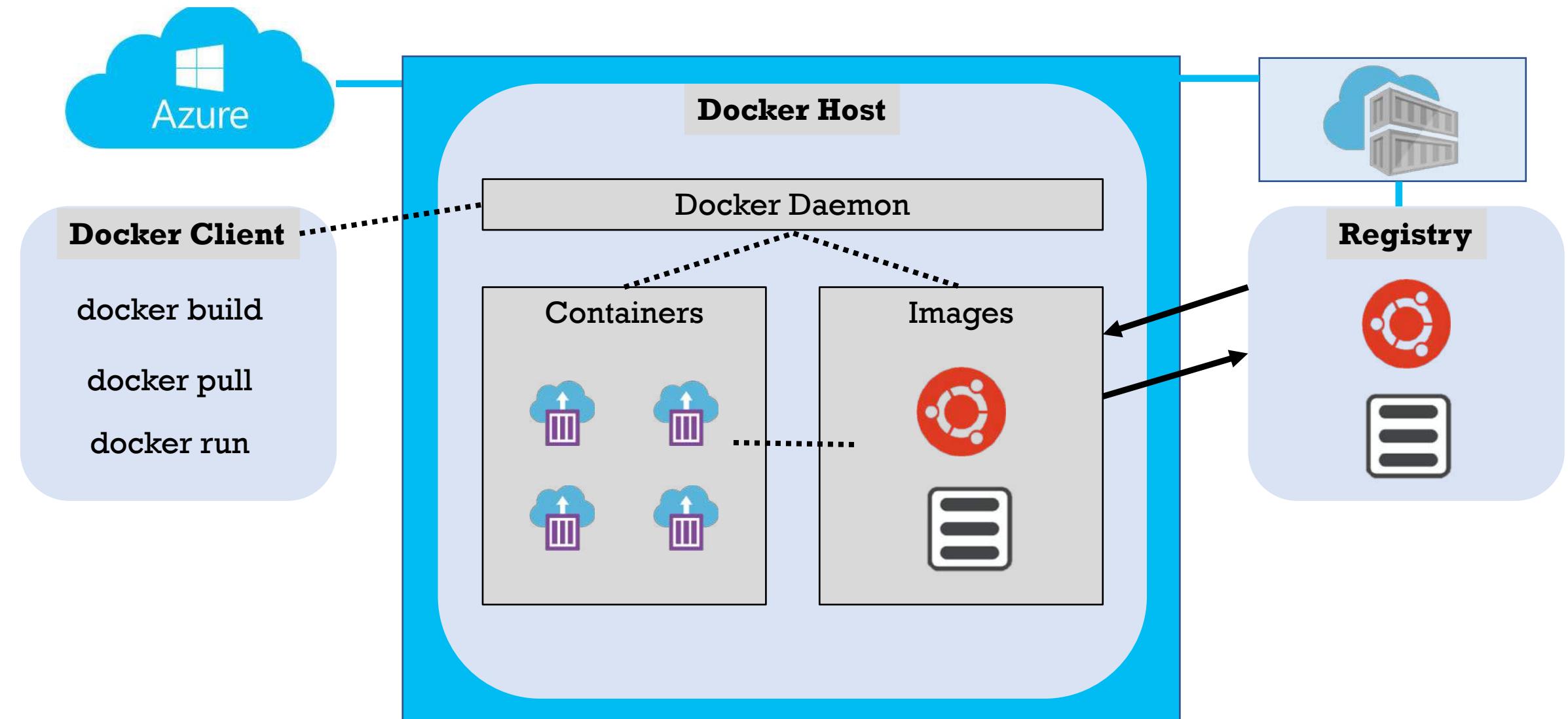
Introduction to Docker

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Docker Architecture

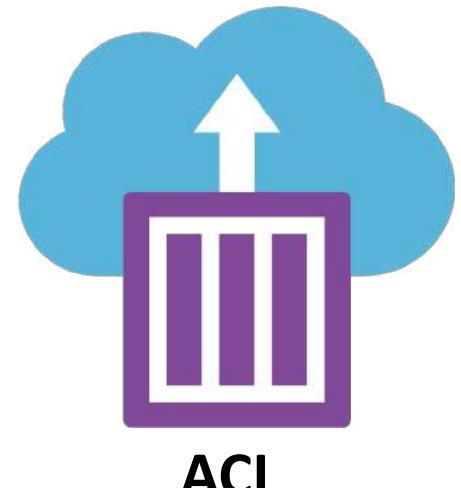




Azure Container Instances (ACI)

Azure Containers Instances (ACI) Overview

- ❑ Azure Container Instances offers the fastest and simplest way to run a container in Azure
- ❑ No VM or infrastructure to manage !
- ❑ ACI use cases:
 - ❑ Simple apps, Task automation, Build jobs



az104-container

Container instances

Search (Cmd+ /) < > Start ⏪ Restart ⏪ Stop ⏪ Delete ⏪ Refresh

Overview Activity log Access control (IAM) Tags

Resource group (change) : RG-08-Containers OS type : Linux
Status : Running IP address : 51.105.144.44 (Public)
Location : West Europe FQDN : az104-container-1234554321.westeuropewest.azurecontainer.io
Subscription (change) : X-A-A-S Container count : 1

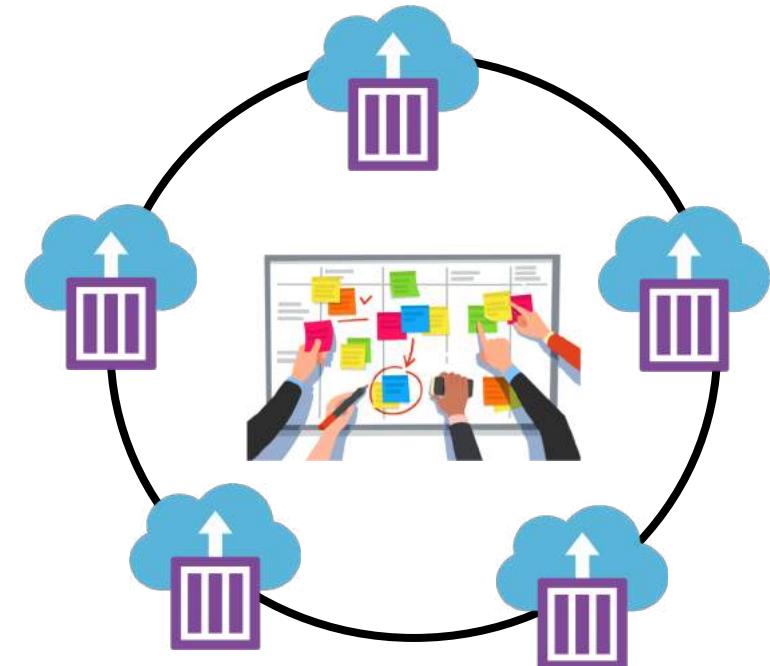




Azure Kubernetes Service (AKS)

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 - ❑ automatic and consistent scaling
 - ❑ updating the containers
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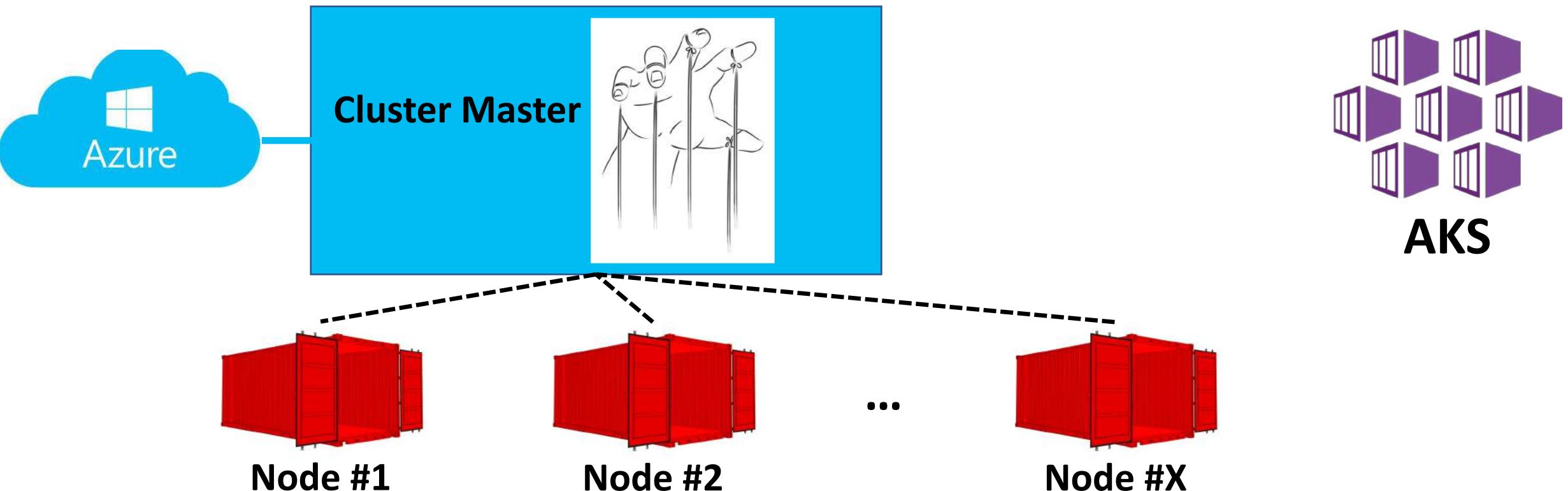
Kubernetes



Microsoft Azure Administrator

What is Azure Kubernetes Service (AKS)?

- Azure Kubernetes Service (AKS) manages your hosted Kubernetes environment and makes it simple to deploy and manage containerized apps in Azure



Deploy AKS Cluster

```
ciprian@Azure:~$ az aks get-credentials -g RG-08-Containers --name az104-kubernetes-cluster
Merged "az104-kubernetes-cluster" as current context in /home/ciprian/.kube/config
```



```
ciprian@Azure:~$ kubectl get nodes
NAME                               STATUS  ROLES   AGE    VERSION
aks-agentpool-13636235-vmss000000  Ready   agent   5m36s  v1.16.13
```



```
ciprian@Azure:~$ kubectl apply -f azure-vote.yaml
deployment.apps/azure-vote-back created
service/azure-vote-back created
deployment.apps/azure-vote-front created
service/azure-vote-front created
```



```
ciprian@Azure:~$ kubectl get service azure-vote-front
NAME           TYPE      CLUSTER-IP      EXTERNAL-IP      PORT(S)        AGE
azure-vote-front  LoadBalancer  10.0.139.185  51.105.191.104  80:31404/TCP  59s
```



Deploy AKS Cluster

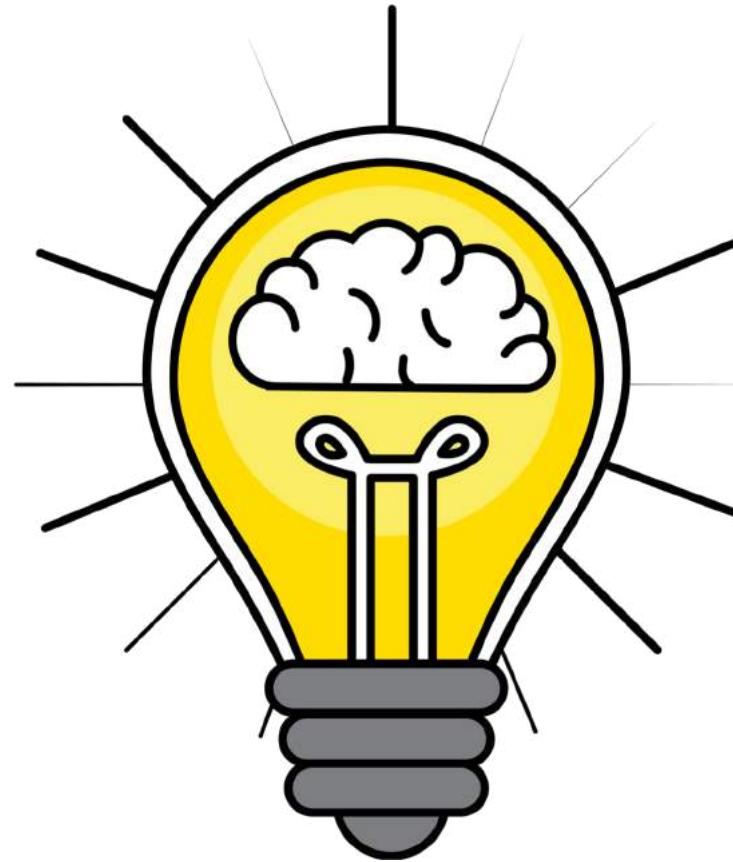
```
ciprian@Azure:~$ kubectl get nodes
NAME                               STATUS  ROLES   AGE   VERSION
aks-agentpool-13636235-vmss00000  Ready   agent   16m   v1.16.13
aks-agentpool-13636235-vmss00001  Ready   <none>  17s   v1.16.13
```



```
ciprian@Azure:~$ az aks delete -g RG-08-Containers --name az104-kubernetes-cluster
Are you sure you want to perform this operation? (y/n): y
[- Running ..
```



Azure Containers - Quiz



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Module 9 - Azure App Service

Introduction to Azure App Service

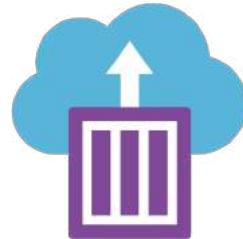
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



Containers



Azure App Service



Serverless Computing



App Service Overview

- Azure App Service is an HTTP-based service for hosting web applications, REST APIs and mobile back ends
- Available programming languages:



.NET



Node.js



PHP



Java



Python (on Linux)



HTML



Custom Windows container (Preview)



App Service

- Azure App Service – Azure PaaS offering
- Pricing – based on App Service Plan



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App Service Key Features

- 1. Multiple languages and frameworks
- 2. Managed production environment
- 3. Containerize app and run in App Service
- 4. Global scale with high availability
- 5. DevOps optimized
- Azure Docs: <https://docs.microsoft.com/en-us/azure/app-service/overview>



App Service



Microsoft Azure Administrator



Module 9 - Azure App Service

Introduction to GitHub

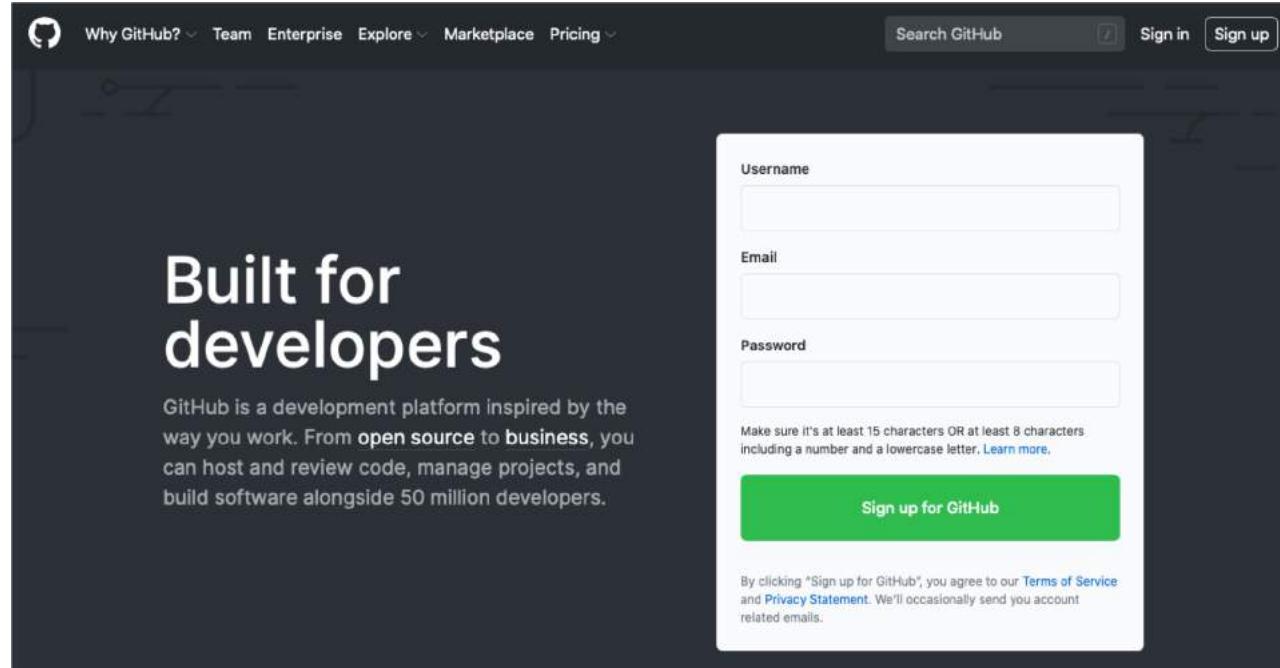
What is Git?

- Git is an open-source version control system that was started by Linus Torvalds - who created Linux as well
- Version control systems keep the app revisions straight, storing the modifications in a repository
- Git is the preferred version control system of most developers, since it has multiple advantages over the other systems available



What is GitHub?

- ❑ Git is a command-line tool, GitHub is a website – GUI



- ❑ Repository (“repo”) - location where all the files for a particular project are stored – access by URL



GitHub Actions for Azure Overview

- ❑ GitHub & Azure - build and deploy apps
- ❑ GitHub Actions enables you to create custom software development life cycle (SDLC) workflows directly in your GitHub repository
- ❑ With GitHub Actions you can build end-to-end continuous integration (CI) and continuous deployment (CD) capabilities directly in your repository (CI/CD)
- ❑ Further learning: <https://docs.github.com/en/actions>





Module 9 - Azure App Service

App Service Plans Overview

App Service Plan Overview

- An app always runs in an *App Service plan* - defines a set of compute resources for a web app to run

- An App Service Plan defines:

- An Azure region
- Number of VM instances
- Size of VM instances – small, medium, large
- Pricing tier
 - shared compute
 - dedicated compute
 - isolated



App Service Plan



App Service Plans - Pricing Tiers

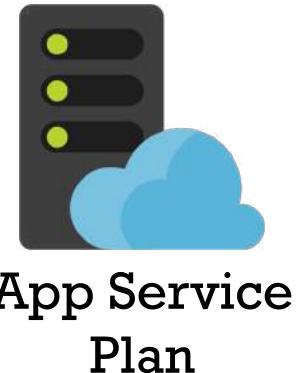
- ❑ Shared compute – Free and Shared
 - ❑ Multiple apps run on same VM
- ❑ Dedicated compute – basic, standard, premium (v2)
 - ❑ Apps run on dedicated VMs
 - ❑ Apps in same App Service Plan share compute
- ❑ Isolated
 - ❑ runs dedicated VMs on dedicated vNETs
- ❑ Not all App Service features are available to all plans !



App Service Plan

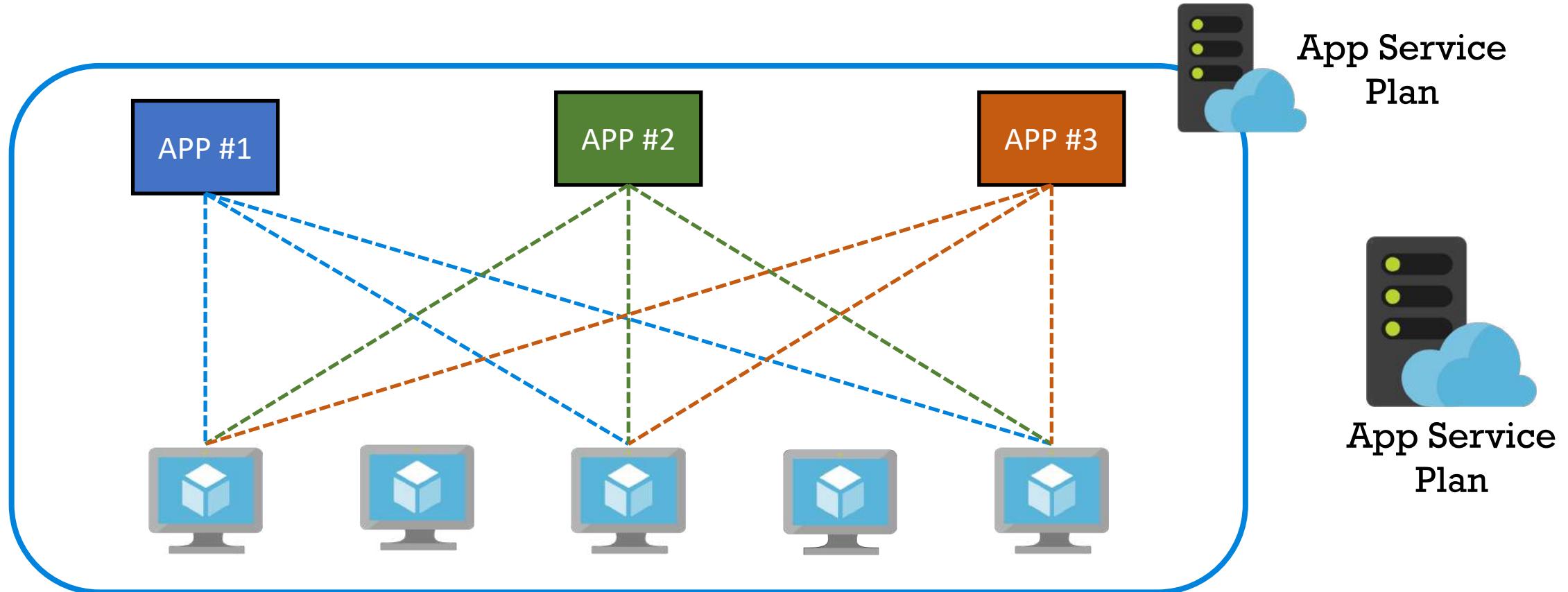
App Service Plans - VMs

- An App Service Plan defines:
 - Number of VM instances
 - Size of VM instances – small, medium, large
- Three VM sizes are available:
 - Small – 1 CPU, 3.5GB memory
 - Medium – 2 CPU, 7GB memory
 - Large – 4 CPU, 14 GB memory



App Service Plans – App Scaling

- ☐ Not available for Shared compute tiers (Free & Shared)



App Service Plans - Pricing

- ❑ Pricing is based on the compute resources that the App Service plan uses
- ❑ Free Tier – 60 min CPU – free ☺
- ❑ Shared tier
 - ❑ App receives and is charged on CPU quota
- ❑ Dedicated compute tier
 - ❑ Pay for VM(s) that run



App Service
Plan





Module 9 - Azure App Service

Azure Deployment Slots Overview

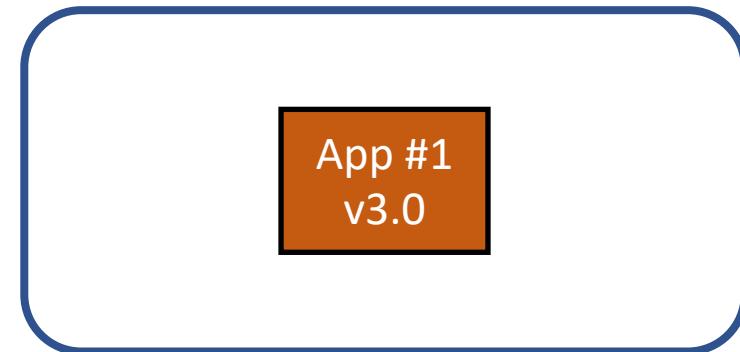
Deployment Slots Overview

- Deployment slots are live apps with their own, distinct host names
- Deploy app to staging deployment slot -> production !

Production Deployment Slot



Staging Deployment Slot





Module 9 - Azure App Service

Module Completion & Exam Hints



Introduction to App Service

App Service Overview

- ❑ Azure App Service is an HTTP-based service for hosting web applications, REST APIs and mobile back ends
- ❑ Available programming languages:



Custom Windows container (Preview)



App Service

- ❑ Azure App Service – Azure PaaS offering
- ❑ Pricing – based on App Service Plan



Microsoft Azure Administrator



App Service Plans Overview

App Service Plan Overview

- An app always runs in an App Service plan - defines a set of compute resources for a web app to run
- An App Service Plan defines:
 - An Azure region
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App Service
Plan



App Service Plan – Pricing Tiers

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- ❑ Isolated
 - ❑ runs dedicated VMs on dedicated vNETs



App Service
Plan



App Service Plan – Cost & Scaling

- ❑ Pricing is based on the compute resources that the App Service plan uses
- ❑ Shared Tier
 - ❑ charged on CPU quota
- ❑ Dedicated compute tier
 - ❑ Pay for VM(s) that run(s)
- ❑ Scaling app (App Service plan)
 - ❑ Scale up
 - ❑ Upgrade App Service Plan
 - ❑ Scale out
 - ❑ Add more VM instances



App Service Plan



Azure Deployment Slots

Deployment Slots Overview

- Deployment slots are live apps with their own, distinct host names

The image shows two screenshots from the Azure portal. The left screenshot is titled 'Deployment Slots' and contains the text: 'Deployment slots are live apps with their own hostnames slot.' Below this is a table with two rows:

NAME	STATUS
webapp-cars PRODUCTION	Running
webapp-cars-Staging-Deployment-Slot	Running

The right screenshot shows a list of resources with a 'Type' column on the far right, highlighted with a red box:

Name	Type
webapp-cars/Staging-Deployment-Slot	slot
WebApp-Cars	app

Below these screenshots is a diagram illustrating the deployment slot architecture. It features two rounded rectangular boxes representing environments. The left box is labeled 'Production Deployment Slot' and contains a blue box labeled 'App #1 v2.3'. The right box is labeled 'Staging Deployment Slot' and contains an orange box labeled 'App #1 v3.0'. A thick red horizontal arrow points from the Production slot to the Staging slot, and another red arrow points back from the Staging slot to the Production slot, indicating a bidirectional relationship.

Production Deployment Slot

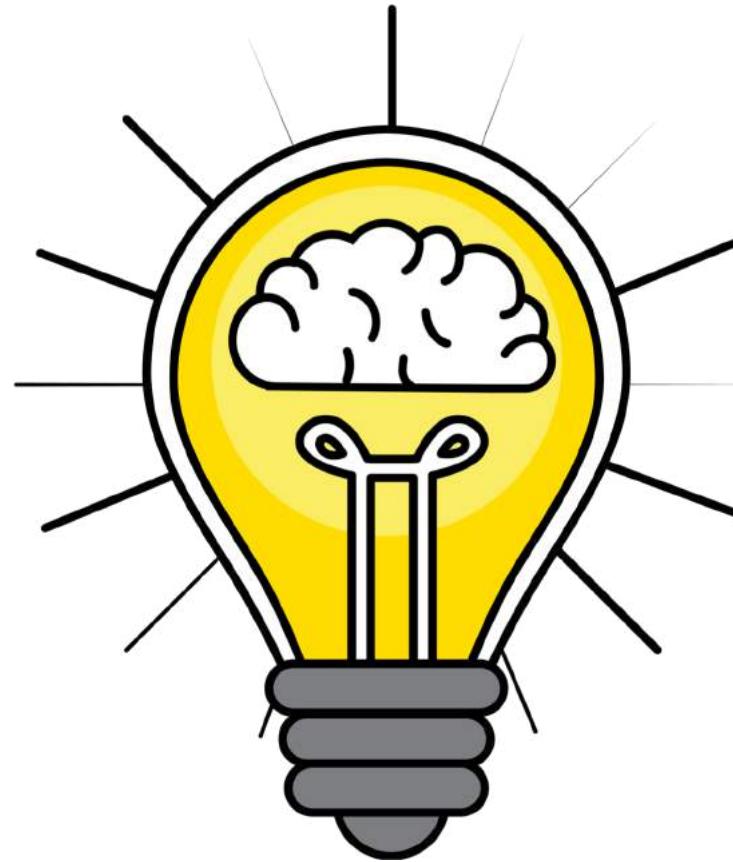
App #1
v2.3

Staging Deployment Slot

App #1
v3.0



Azure App Service - Quiz



Microsoft Azure Administrator

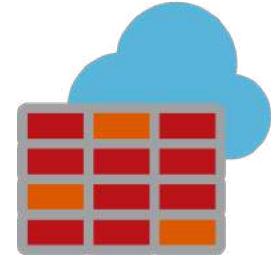


Module 10 – vNETs Security & Routing

Azure Firewall Fundamentals

Azure Firewall Overview

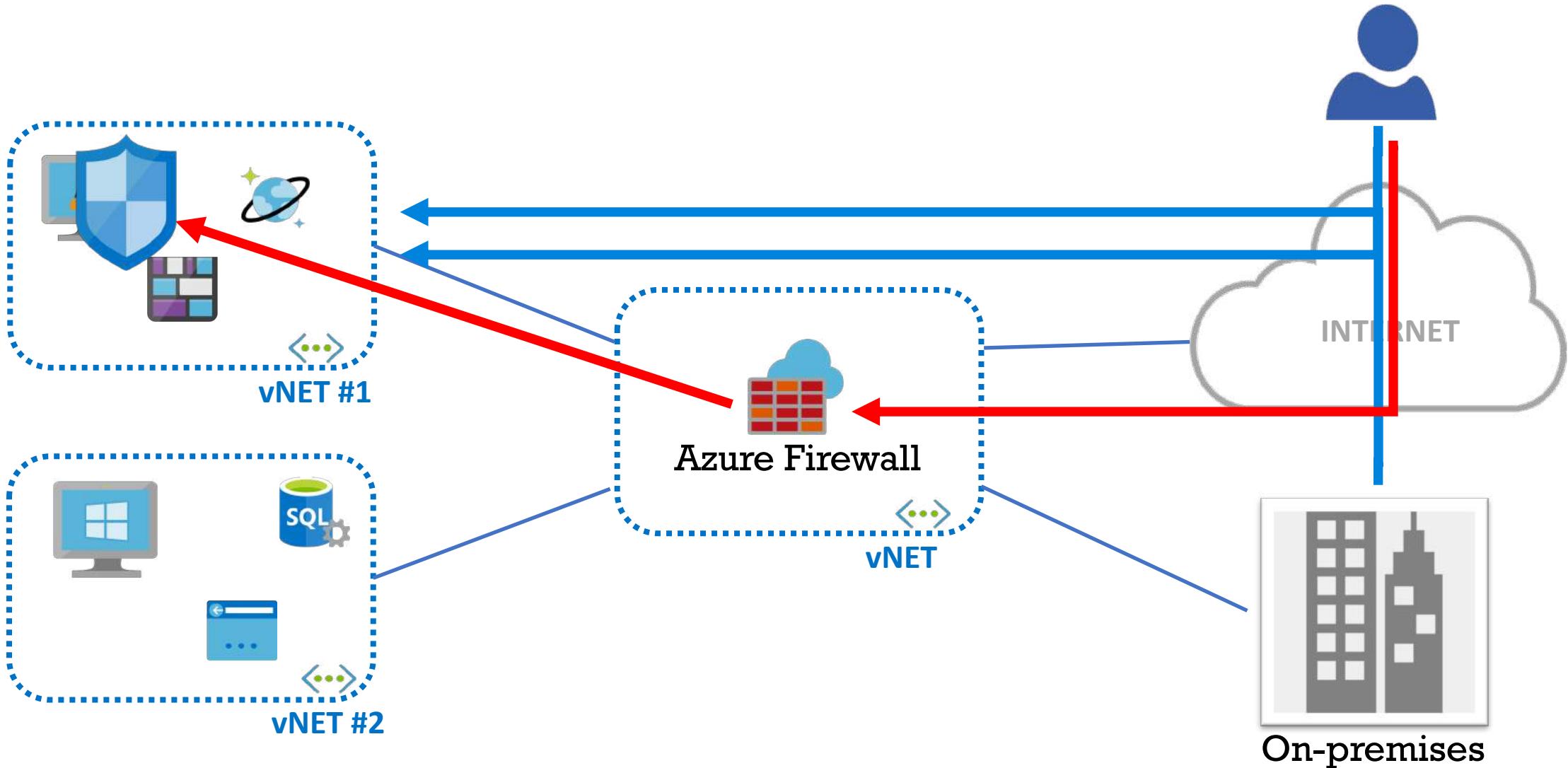
- ❑ Azure Firewall is a managed network security service that protects your Azure Virtual Network resources
- ❑ Azure Firewall - perimeter firewall
- ❑ Azure Firewall vs NSGs ?!
- ❑ Together is better
 - ❑ Azure Firewall at the perimeter
 - ❑ NSGs at subnet and/or VM level



Azure Firewall

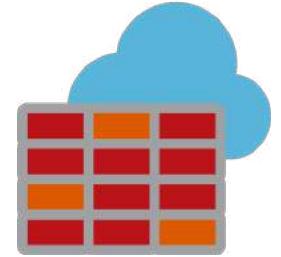


Azure Firewall Architecture



Azure Firewall Features

- 1. Built-in high availability
- 2. Multiple Availability Zones reach
- 3. Scalability
- 4. Create Firewall rules
- 5. Outbound SNAT and Inbound DNAT



Azure Firewall

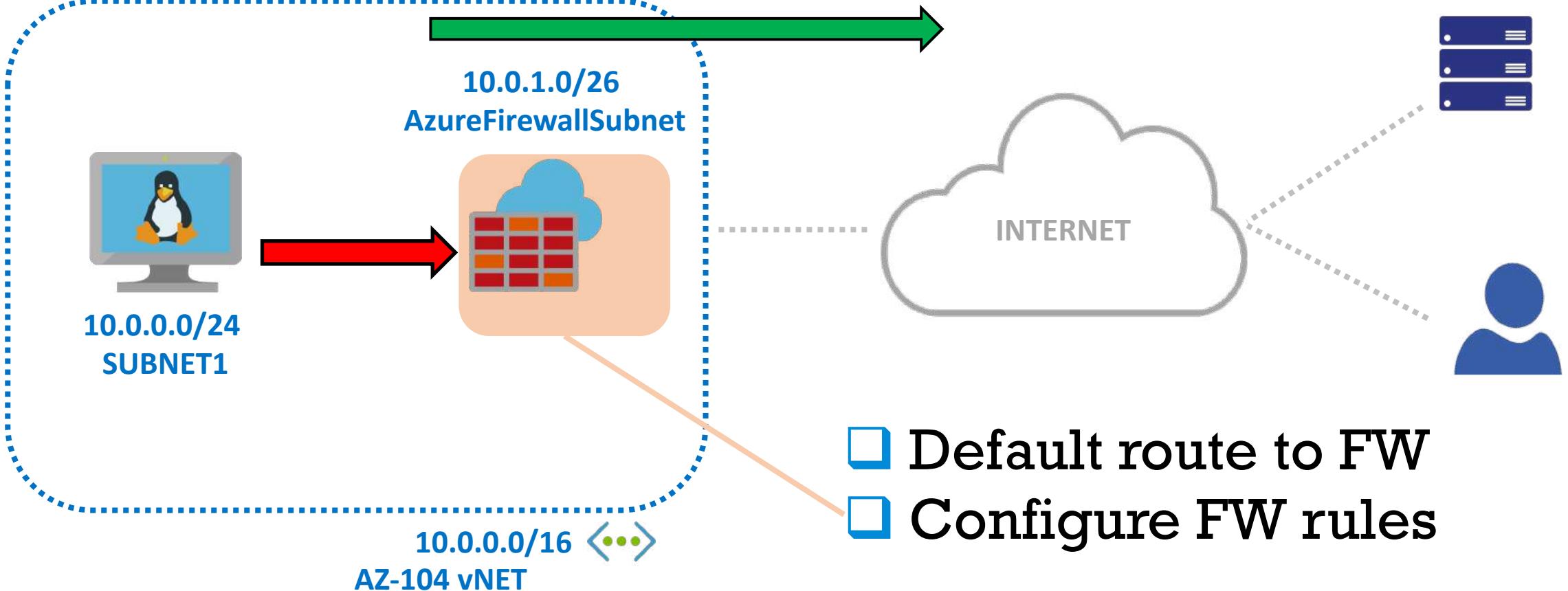




Module 10 – vNETs Security & Routing

Hands-on Lab - Deploy an Azure Firewall

Further steps to configure ...



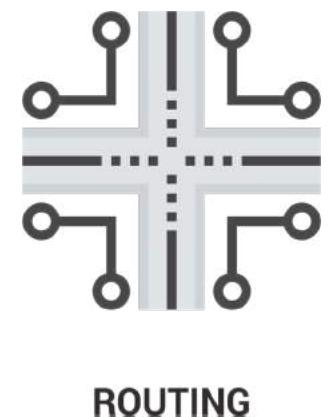


Module 10 – vNETs Security & Routing

Azure Routing Overview

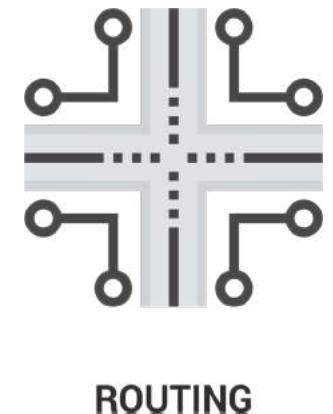
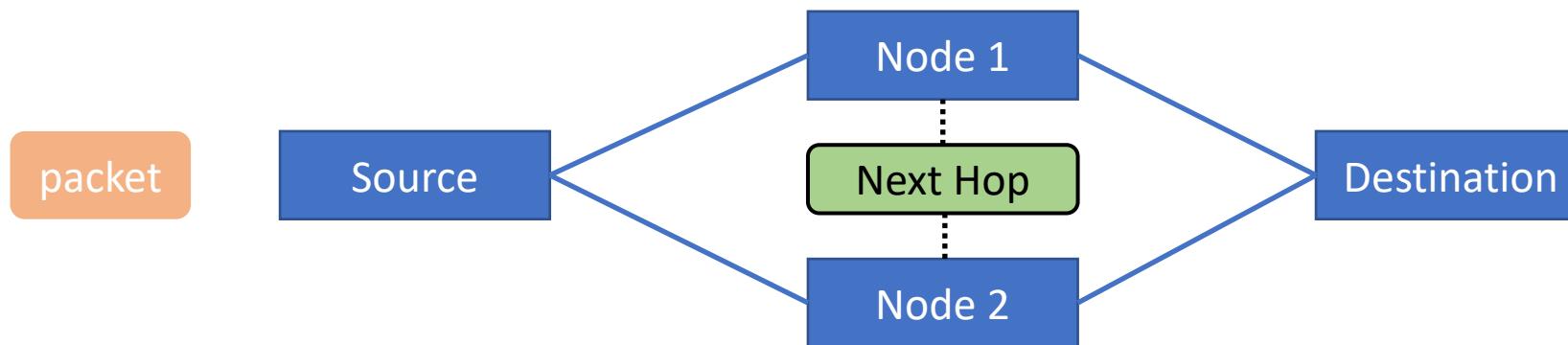
Azure System Routes Overview

- Traffic in Azure is automatically routed between Azure subnets, virtual networks, and on-prem - *system routes*
- VMs deployed in the same vNET communicate to each other based on system routes
- Change routing or override system routes with custom routes – user-defined routes
- System routes are “attached” at the subnet level



Routing: Routes and Route Tables

- Packet routing is the forwarding of packets from their source to final destination through intermediate nodes



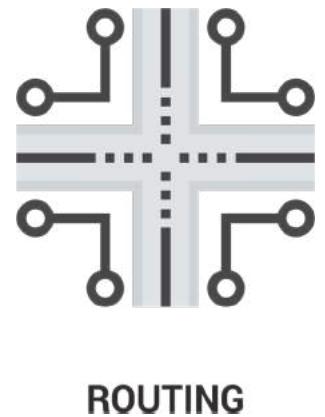
- Route: For Destination go to Next Hop – Node 1
- All routes are included in a Route Table



Default System Routes

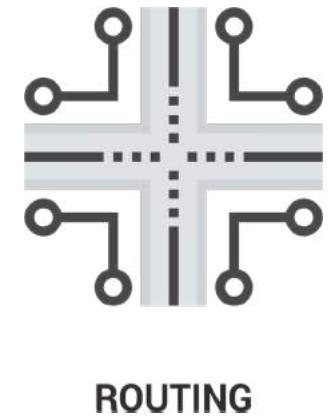
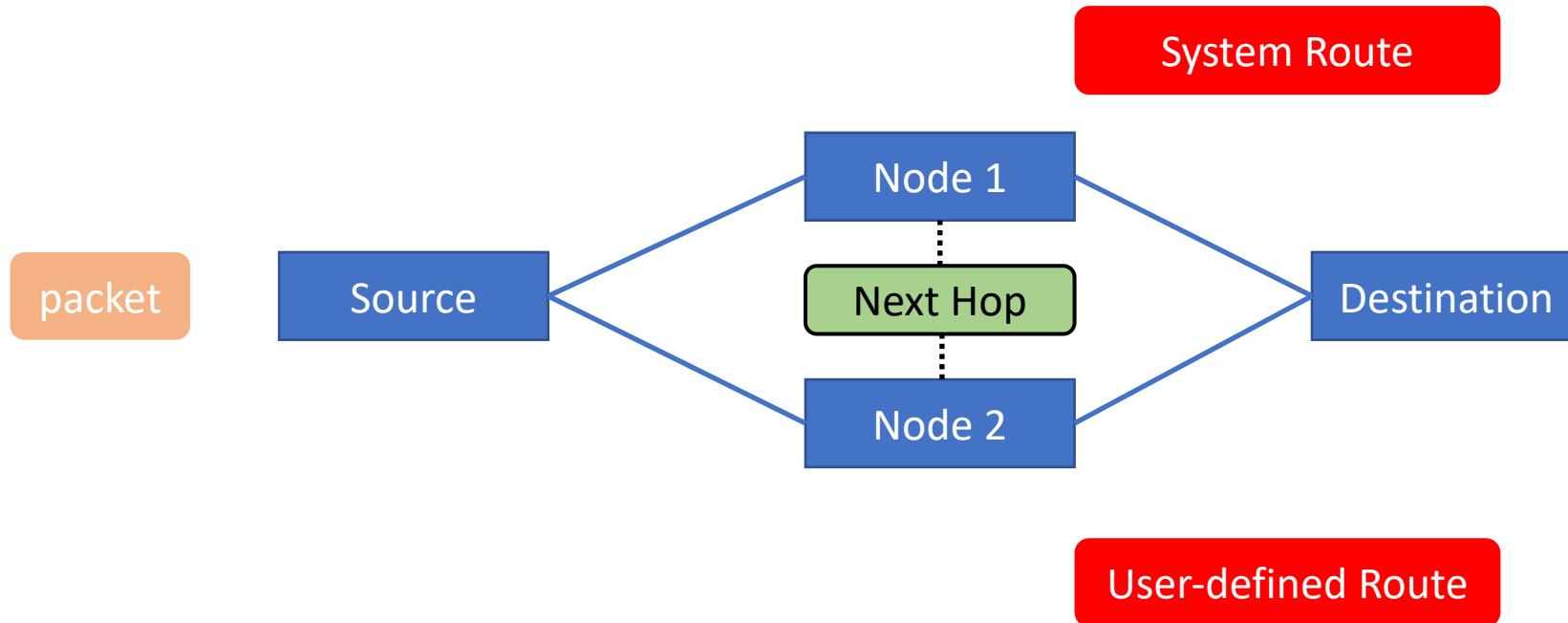
- Default system routes example:
 - AZ104-vNET – 10.0.0.0/16

Source	↑↓	State	↑↓	Address Prefixes	↑↓	Next Hop Type
Default		Active		10.0.0.0/16		Virtual network
Default		Active		0.0.0.0/0		Internet
Default		Active		10.0.0.0/8		None
Default		Active		100.64.0.0/10		None
Default		Active		192.168.0.0/16		None
Default		Active		25.33.80.0/20		None
Default		Active		25.41.3.0/25		None

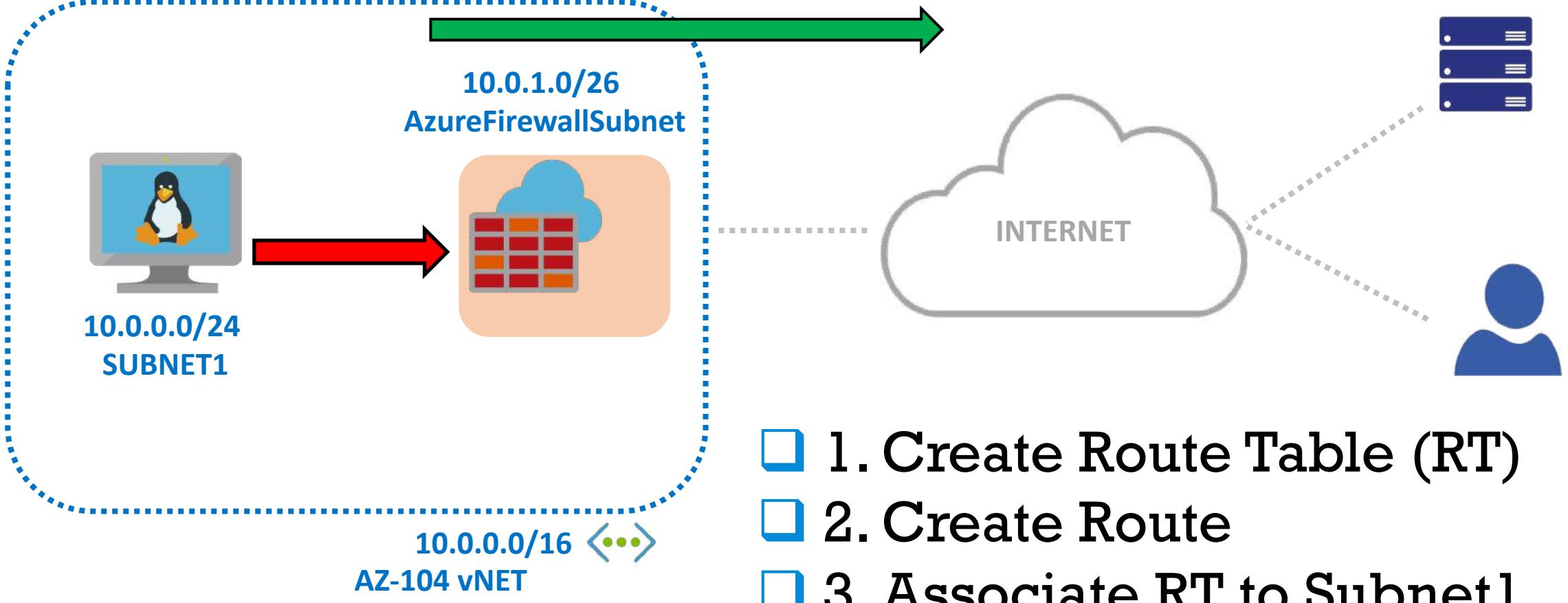


Custom Routes – User-defines Routes

- ❑ Override default routing
 - ❑ Custom routes – user-defined routes



Further steps to configure ...





Module 10 – vNETs Security & Routing

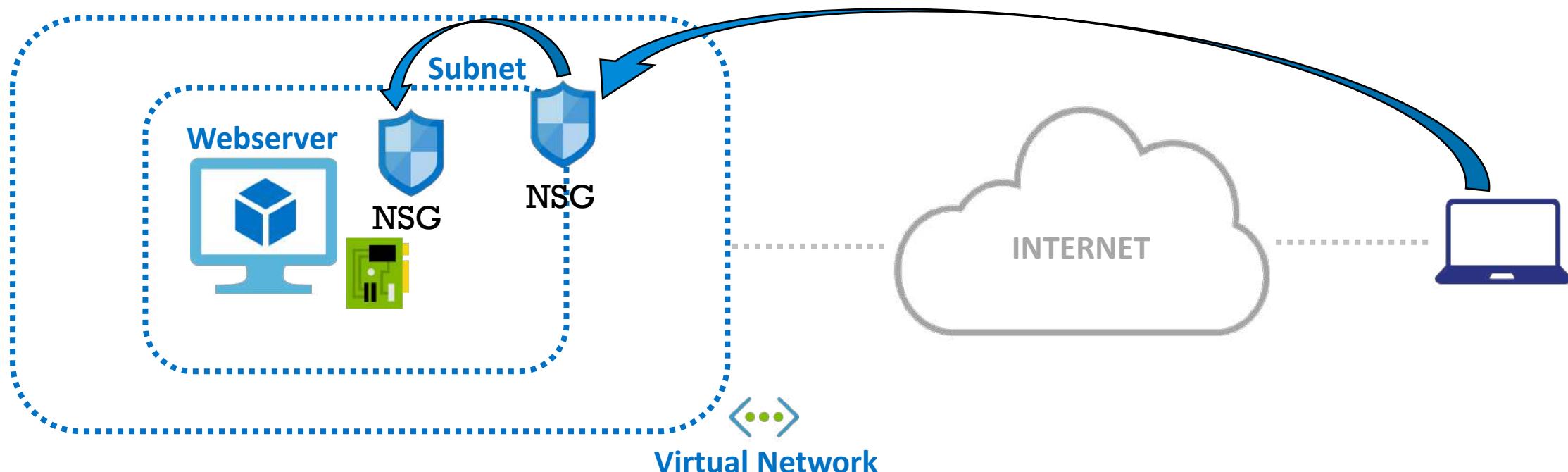
Module Completion & Exam Hints



Network Security Groups

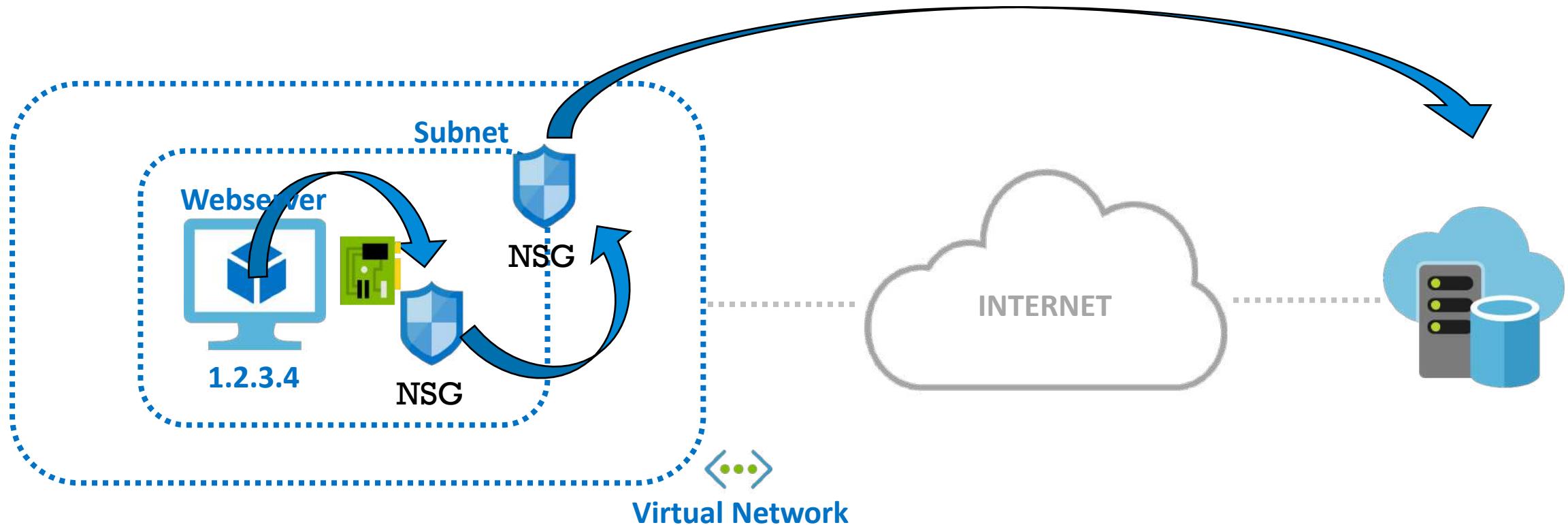
NSGs Order – Inbound Traffic Evaluation

- NSGs can be associated at two different levels:
 - Subnet level
 - NIC card level



NSGs Order – Outbound Traffic Evaluation

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 - NIC card level

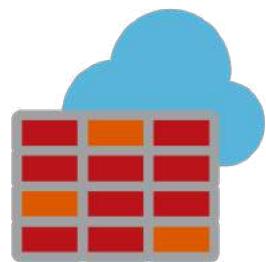




Azure Firewall

Azure Firewall Overview

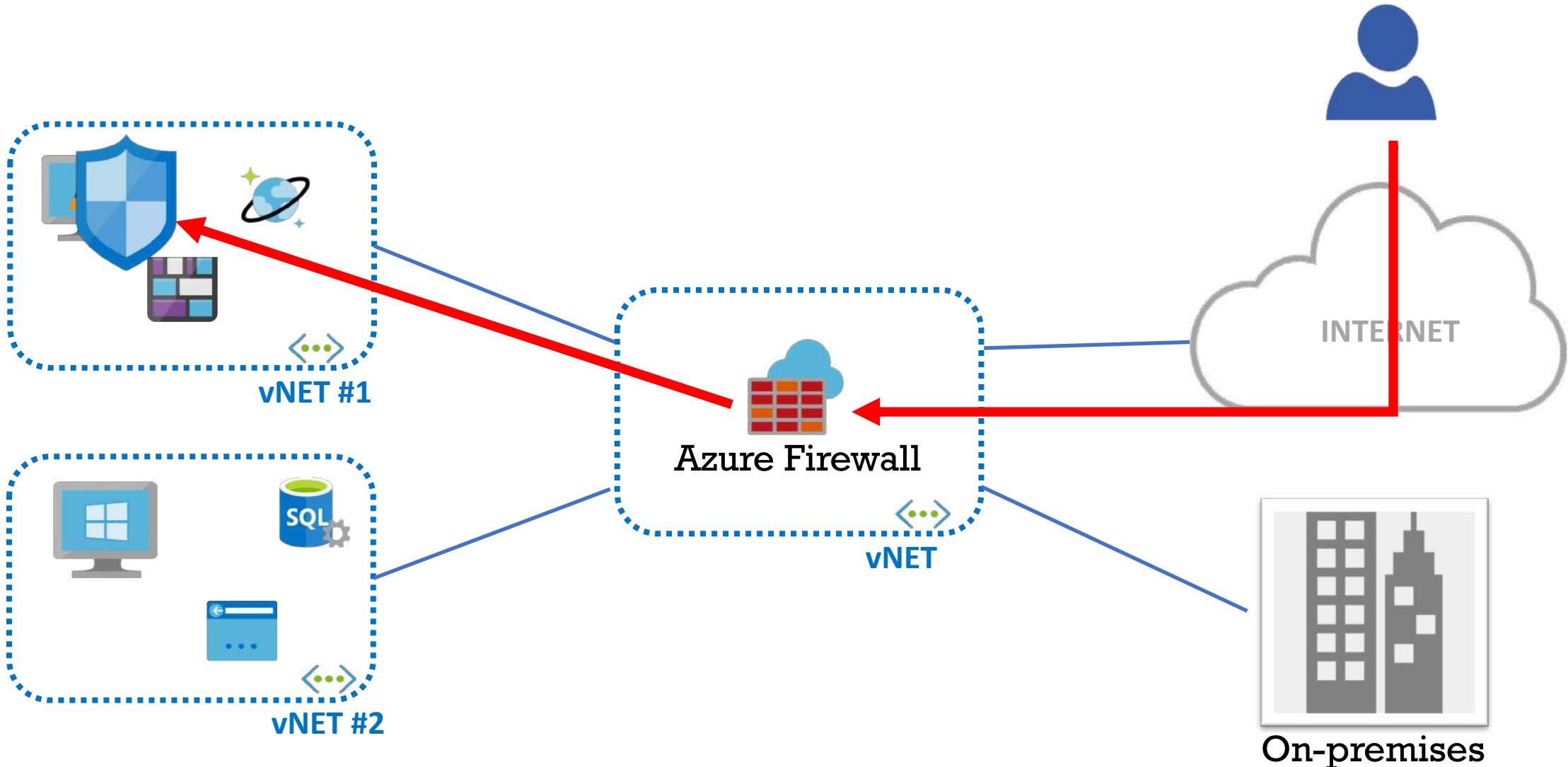
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- ❑ Azure Firewall - perimeter firewall (vNET)
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 - ❑ NSGs at subnet and/or VM level



Azure Firewall



Azure Firewall Architecture

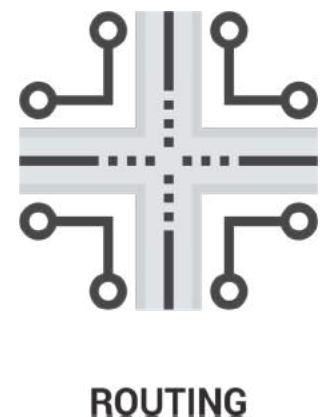




Azure Routing – System Routes & UDR

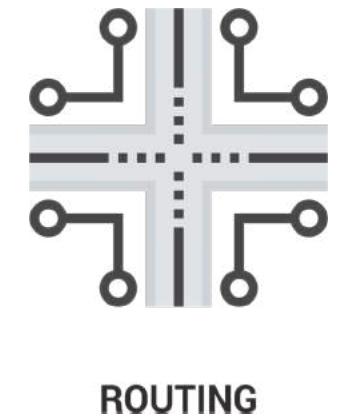
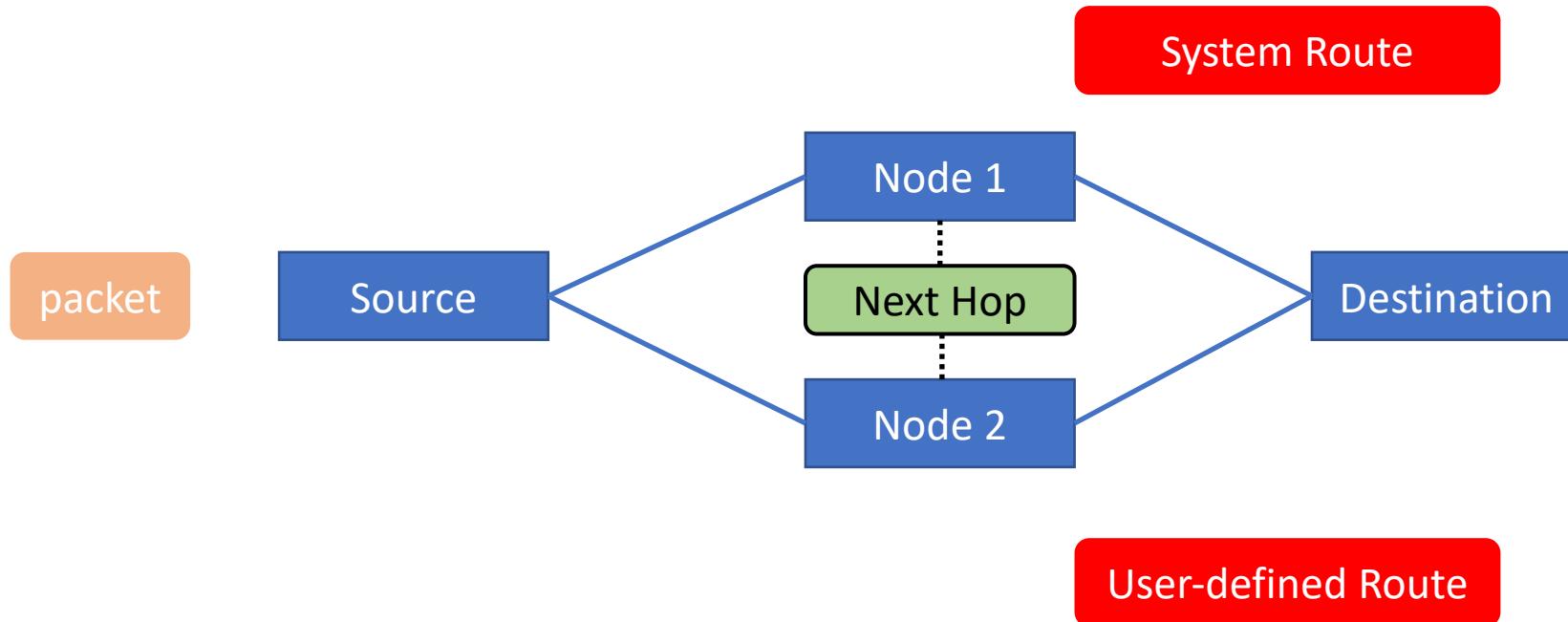
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- Change routing or override system routes with custom routes – user-defined routes
- System routes are “attached” at the subnet level



Add Custom Route - UDR

- ❑ Override default routing
- ❑ Custom routes – user-defined routes



Add Custom Route - UDR

- 1. Create Route Table (RT)
- 2. Create Route
- 3. Associate RT to Subnet1

1
`ciprian@Azure:~$ az network route-table create \
> --name RT-Subnet1 \
> --resource-group RG-10-Security-Routing
- Running ..`

2
Associate subnet
RT-Subnet1

Virtual network *ⓘ*
Az104-vNET

Subnet *ⓘ*
Subnet1

3
Add route
RT-Subnet1

Route name ***
DefaultRoute

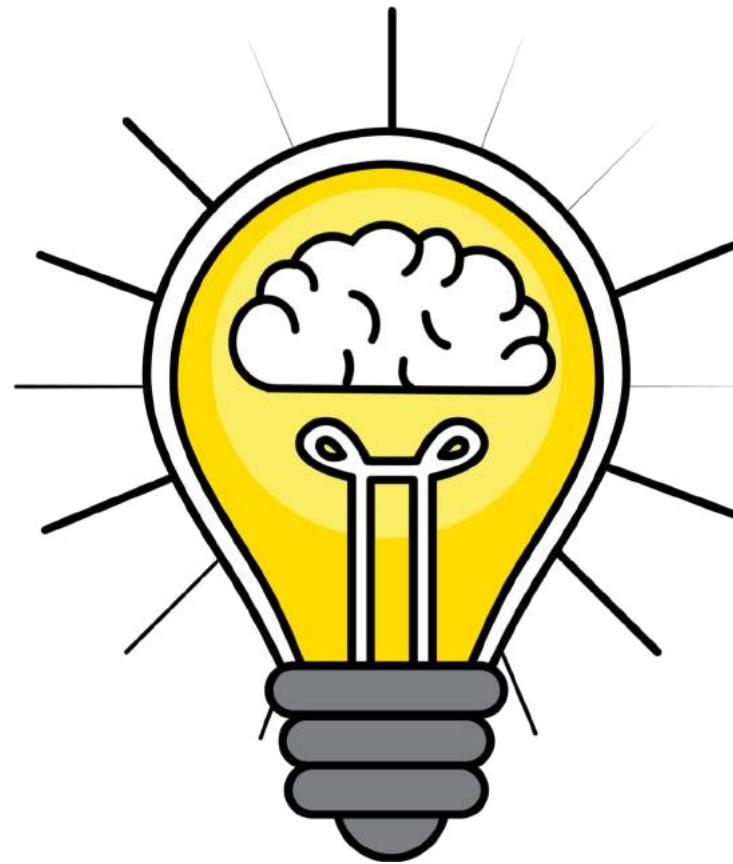
Address prefix *** *ⓘ*
0.0.0.0/0

Next hop type *ⓘ*
Virtual appliance

Next hop address *** *ⓘ*
10.0.1.4



Azure Security & Routing - Quiz



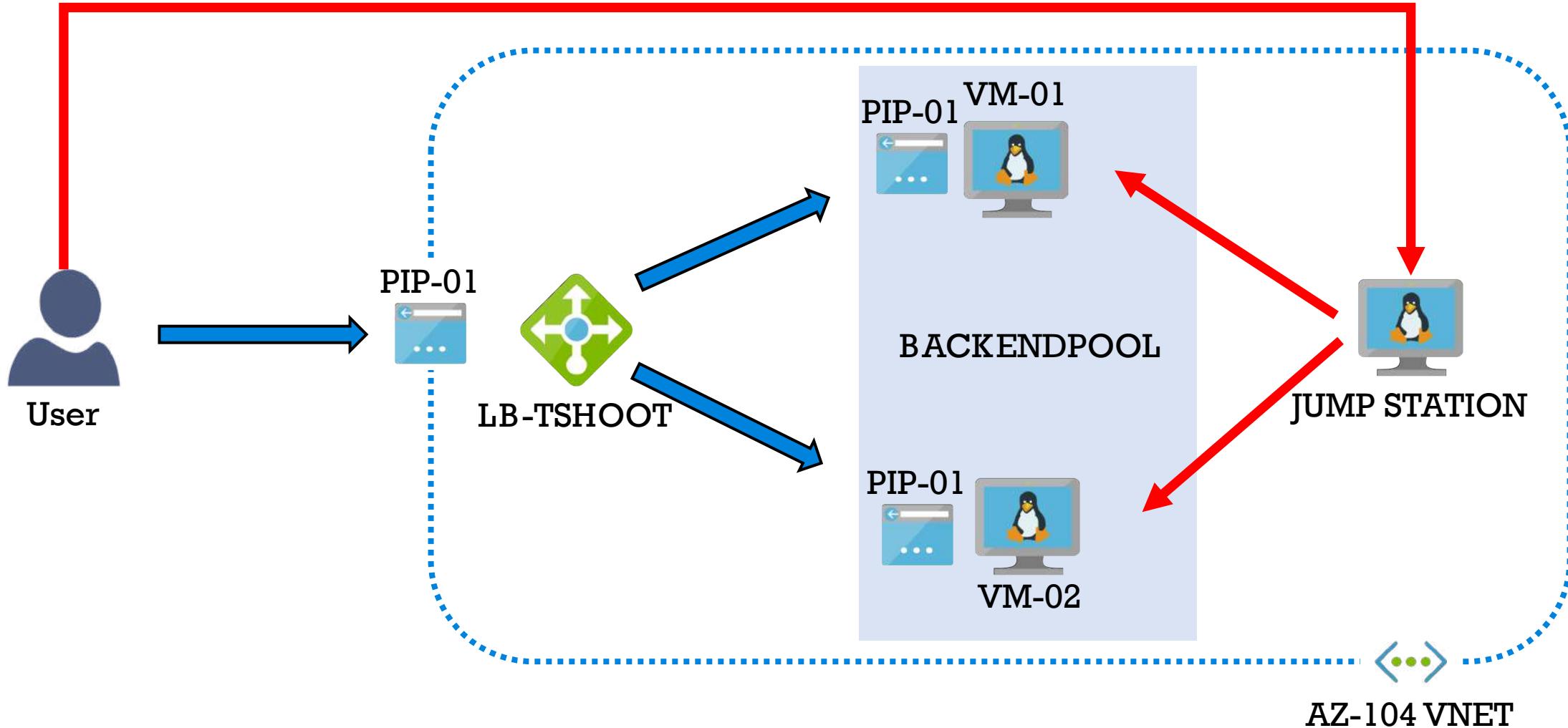
Microsoft Azure Administrator



Module 11 - Azure LB Deep Dive

Hands-on Lab - Deploy Troubleshooting Environment

Load Balancing Troubleshooting Environment





Module 11 - Azure LB Deep Dive

Load Balancing - Last Notes

Azure Load Balancing – Distribution Modes

- ❑ How is the traffic distributed to available servers?
- ❑ By default, a five-tuple hash is used:
 - ❑ Source IP
 - ❑ Source port
 - ❑ Destination IP
 - ❑ Destination port
 - ❑ Protocol type
- ❑ The algorithm provides *stickiness* only within a transport session – *send traffic to same VM*



Load Balancer

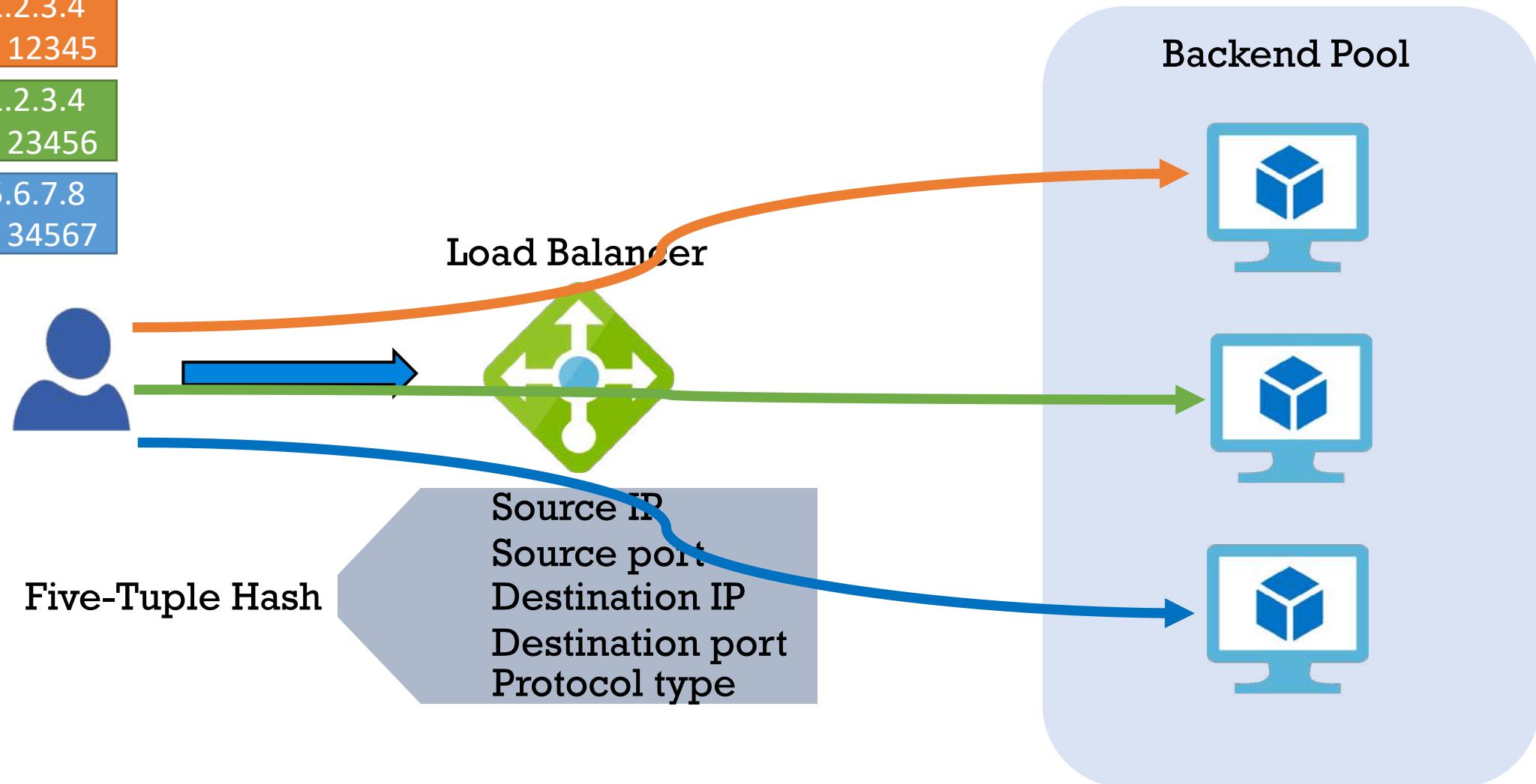


Azure Load Balancing – Five-Tuple Hash

SRC_IP: 1.2.3.4
SRC_Port: 12345

SRC_IP: 1.2.3.4
SRC_Port: 23456

SRC_IP: 5.6.7.8
SRC_Port: 34567



Azure Load Balancing – Source IP Affinity

- ❑ Also known as *session affinity* or *client IP affinity*
- ❑ This mode uses either:
 - ❑ Two-tuple (source IP and destination IP)
 - ❑ Three-tuple (source IP, destination IP, protocol type)
- ❑ Source IP affinity – connections from same client, are sent to the same endpoint (VM)
- ❑ Where to configure session affinity?



Load Balancer



Azure Load Balancing – Session Persistence

Load-Balancer 

Load balancer

Search (Cmd+ /)  Move  Delete  Refresh

Overview 

Resource group (change) : RG-LB

Location : West Europe

Subscription (change) : Pay-As-You-Go

Subscription ID : 73aeb018-2e2

SKU : Basic

Tags (change) : Click here to add tags

Settings

Frontend IP configuration

Backend pools

Health probes

Load balancing rules

Add load balancing rule

Load-Balancer

A load balancing rule distributes incoming traffic that is sent to a selected IP address and port combination across a group of backend pool instances. Only backend instances that the health probe considers healthy receive new traffic.

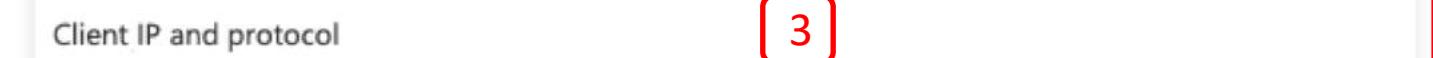
Name *

IP Version *

Session persistence

None  1

None  2

Client IP  3

Client IP and protocol

Backend pool  BE_Pool

Health probe  HP (TCP:80)

Session persistence

None  1

None  2

Client IP  3

Client IP and protocol



NVA – Network Virtual Appliance

- ❑ NVA – VM image that allows you to implement advanced networking and security capabilities



- ❑ NVAs - security, routing, etc.
- ❑ available in Azure Marketplace





Module 11 - Azure LB Deep Dive

Module Completion & Exam Hints



Internal Load Balancer

Internal Load Balancer

- ❑ Internal Load Balancer
- ❑ No public IP address, only private IP address
- ❑ Evenly distribute incoming traffic (hitting private IP) to Backend pool - VMs

Instance details

Name * Internal-Load-Balancer

Region * (Europe) West Europe

Type * Internal Public

SKU * Basic Standard



Load Balancer





Load Balancing Tshoot Sessions

Troubleshoot Load Balancing in Azure

❑ Things to remember:

- ❑ Azure Monitor
- ❑ Network Watcher
- ❑ Don't Guess -> Verify !

❑ Tshoot steps:

- ❑ 1. LB health state (Azure Monitor)
- ❑ 2. LB Rule + Health Probe
- ❑ 3. NSGs – subnet + VM level



Load Balancer





Load Balancing Hashing

Load Balancing Distribution Modes

- Default
 - 5 tuple: SRCIP, SRCPORT, DSTIP, DSTPORT, PROTOCOL
 - Can't predict what VM will process the traffic
- Client IP, Client IP and Protocol (*stickiness*)
 - connections from same client, are sent to the same VM



Azure LB Deep Dive - Quiz



Microsoft Azure Administrator



Module 12 - Azure Application Gateway

Azure Application Gateway Overview

Application Gateway Overview

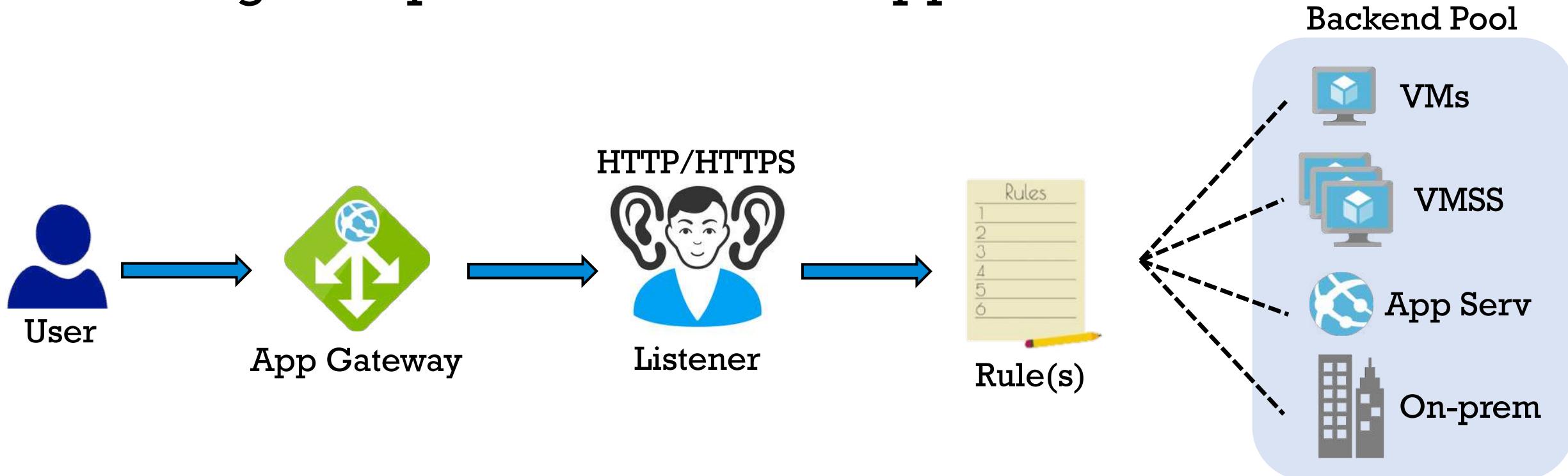
- ❑ Azure Application Gateway is a web traffic load balancer that enables you to manage traffic to your web apps
- ❑ Traditional LB vs Application Gateway ?!
- ❑ Application Gateway
 - ❑ Web traffic LB – HTTP, HTTPS
 - ❑ Understands HTTP/S traffic
 - ❑ Route traffic based on URL
- ❑ `/images/* -> send to Pool#1, ... /video/* -> Pool#2`



Application
Gateway

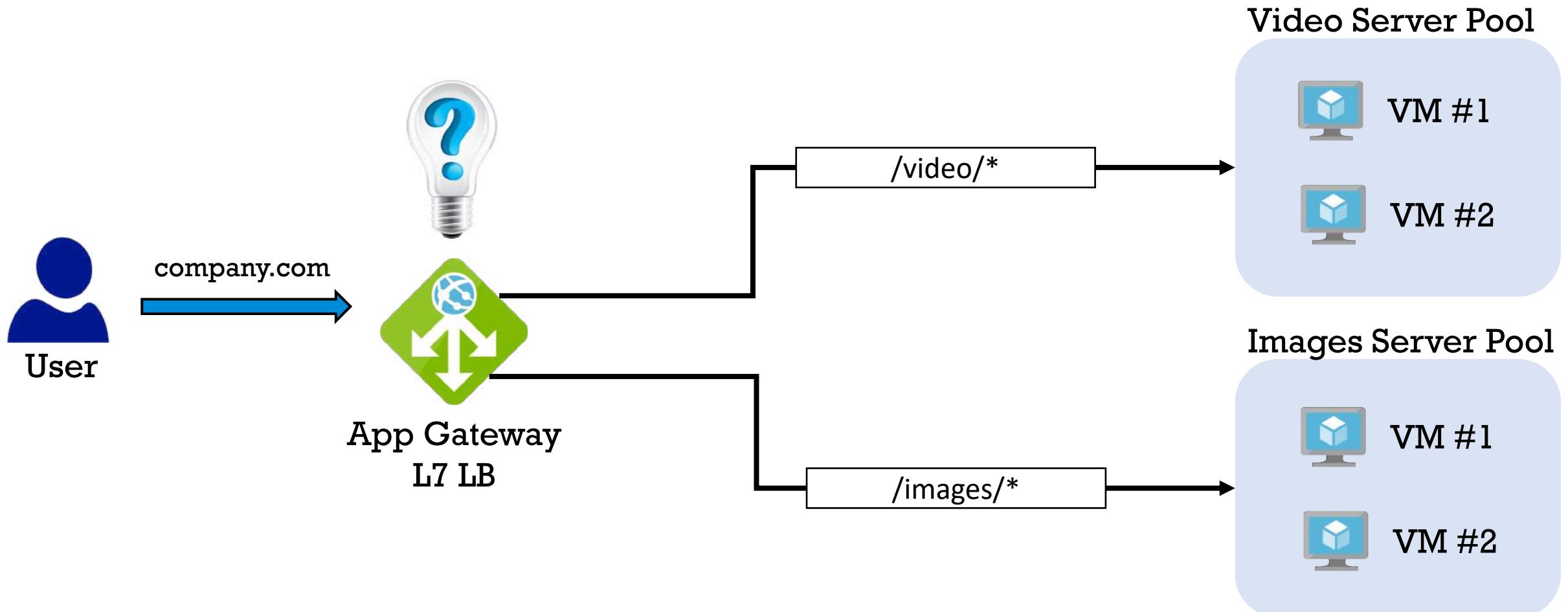
Application Gateway - Traffic Routing

- Application Gateway
 - manages requests sent to web apps



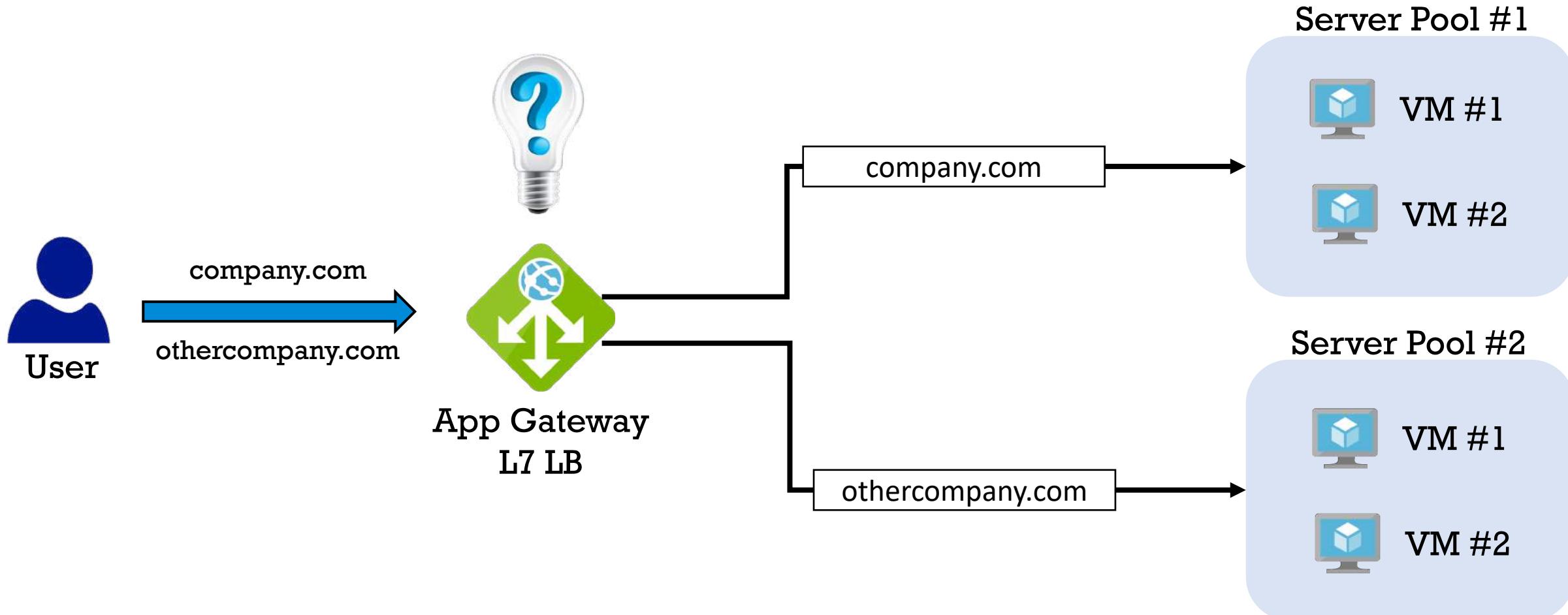
Application Gateway – Path-based Routing

- Send requests based on paths in received URL



Application Gateway – Multiple Site Routing

- Bind multiple web apps to one Application Gateway



Application Gateway – Load Balancing

- ❑ Requests are sent to servers in each back-end pool using a round-robin mechanism
- ❑ Session stickiness (persistence) available!
- ❑ Application Gateway deployment modes:
 - ❑ Standard Application Gateway
 - ❑ Application Gateway + WAF (web application firewall)
- ❑ Azure WAF – increased security for your web apps; protect from common known vulnerabilities and exploits



Application
Gateway

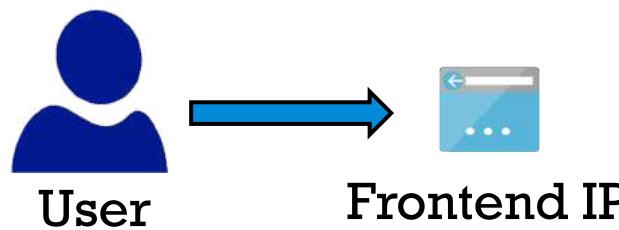


Module 12 - Azure Application Gateway

Application Gateway - How it Works

Application Gateway – Frontend IP address

- Frontend IP address - IP address associated with application gateway



✓ Basics **2 Frontends** 3 Backends 4 Configuration 5 Tags 6 Review + create

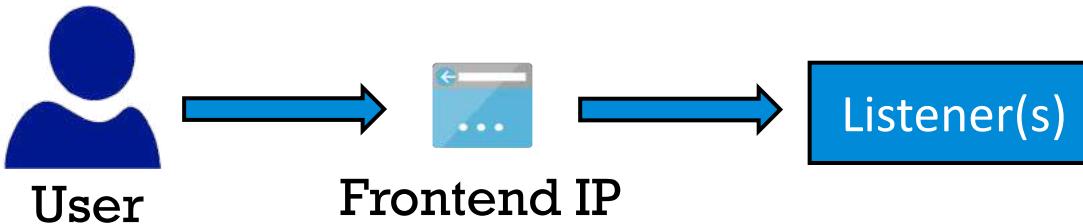
Traffic enters the application gateway via its frontend IP address(es). An application gateway can use a public IP address, private IP address, or one of each type.

Frontend IP address type ⓘ Public Private Both

Public IP address * ▾

Application Gateway – Listener(s)

- A listener is a logical entity that checks/accepts for incoming connection requests



Add a routing rule

Configure a routing rule to send traffic from a given frontend IP address to one or more backend targets. A routing rule must contain a listener and at least one backend target.

Rule name ***** RULE-01-HTTP-80

* Listener ***** Backend targets

A listener "listens" on a specified port and IP address for traffic that uses a specified protocol. If the listener criteria are met, the application gateway will apply this routing rule.

Listener name ***** LISTENER-HTTP-80

Frontend IP ***** Public

Protocol ***** HTTP HTTPS

Port ***** 80

Additional settings

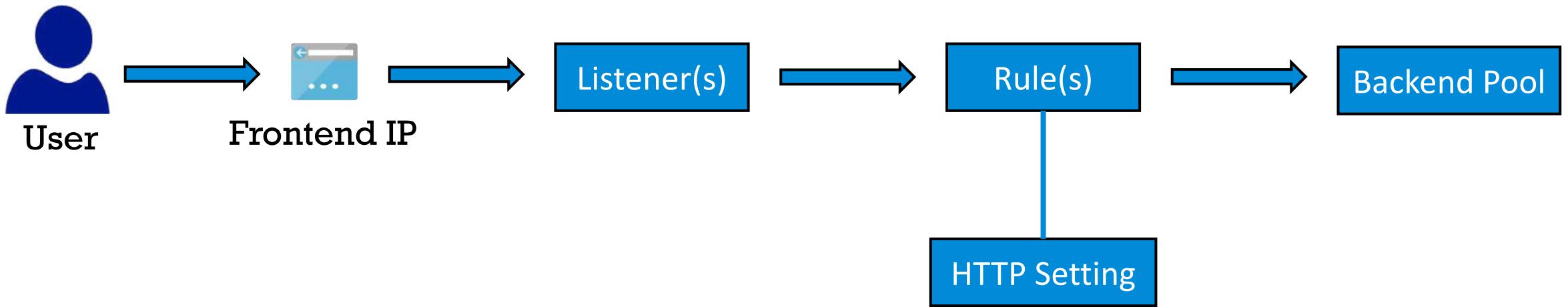
Listener type ***** Basic Multi site

The 'Protocol' and 'Listener type' sections are highlighted with a red border.



Application Gateway – Rule(s)

- ☐ Request routing rule - determines how to route traffic on the listener

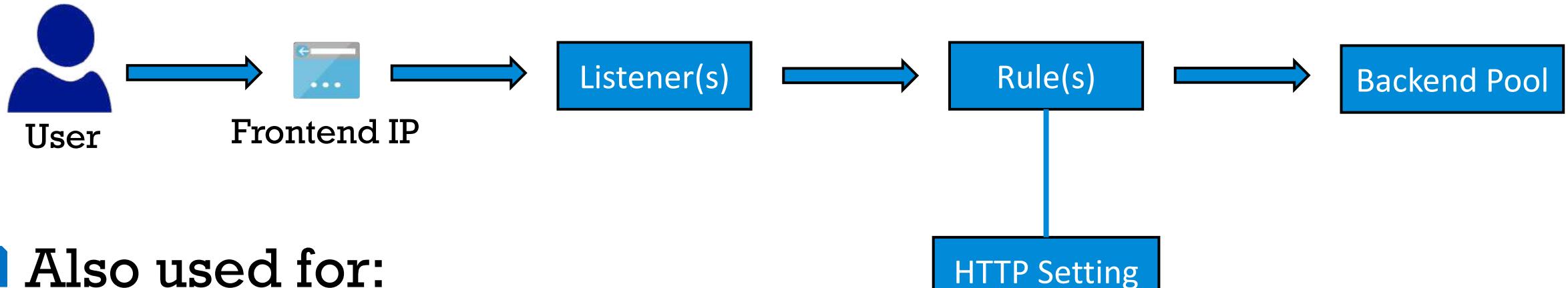


- ☐ Routing rule types:
 - ☐ Basic – based on HTTP settings
 - ☐ Path-based – based on URL



Application Gateway – HTTP Setting

- ❑ HTTP Settings – part of the request routing rule

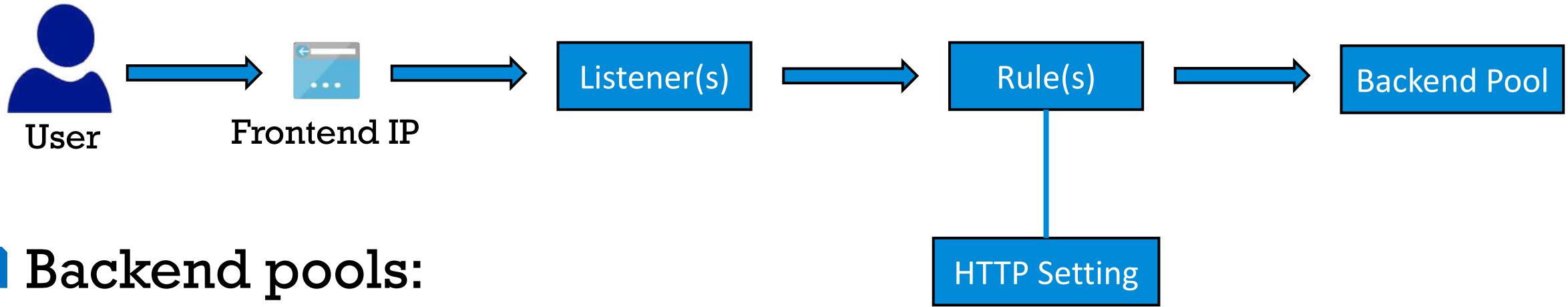


- ❑ Also used for:
 - ❑ Session affinity
 - ❑ Connection draining



Application Gateway – Backend Pool

- ❑ Container for different servers options that run the apps



- ❑ Backend pools:
 - ❑ VMs
 - ❑ VMSS
 - ❑ App Service
 - ❑ On-prem servers



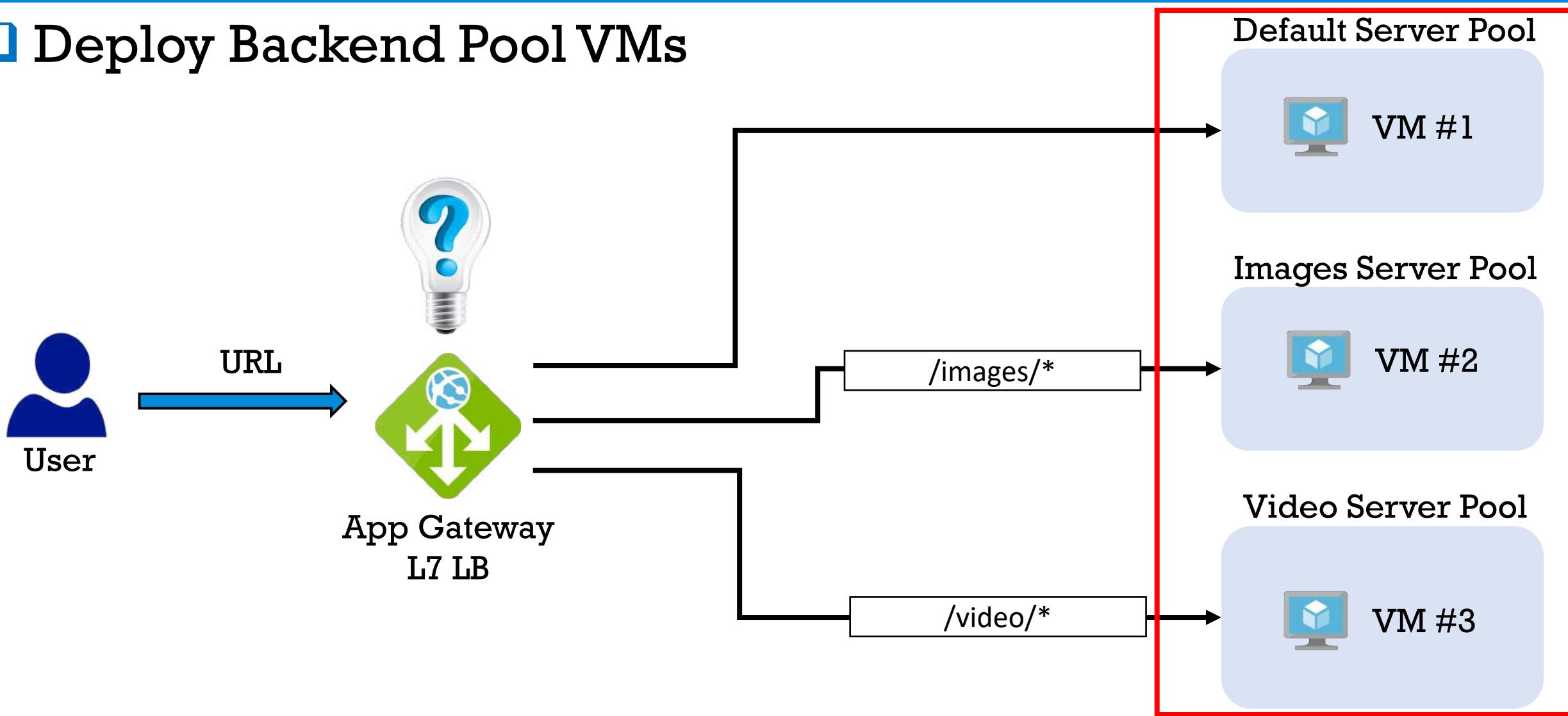


Module 12 - Azure Application Gateway

Hands-on Lab - Deploy Backend Pool Servers

Hands-on Lab Overview

□ Deploy Backend Pool VMs



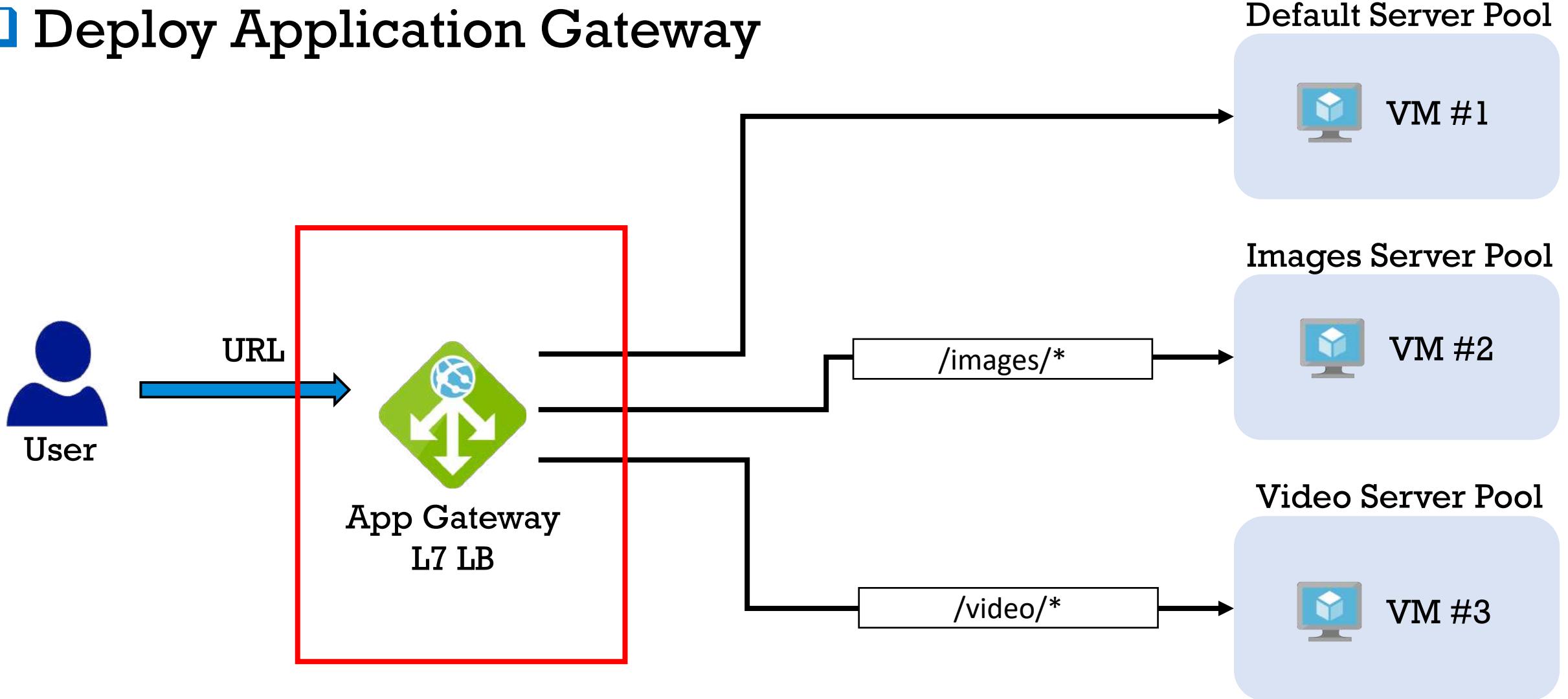


Module 12 - Azure Application Gateway

Hands-on Lab - Deploy Application Gateway

Hands-on Lab Overview

☐ Deploy Application Gateway





Module 12 - Azure Application Gateway

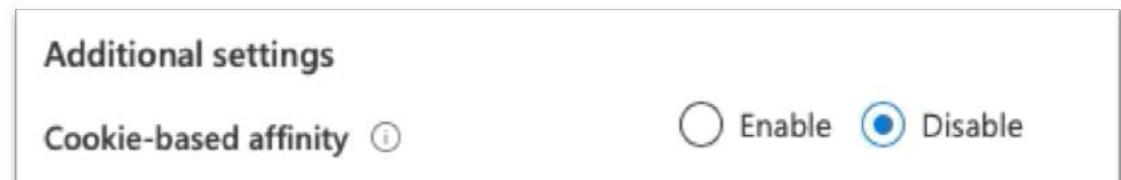
Module Completion & Exam Hints

Application Gateway Overview

- ❑ Azure Application Gateway is a web traffic load balancer that enables you to manage traffic to your web apps
- ❑ Web traffic LB -> HTTP/S traffic
- ❑ Requests are sent to servers in each back-end pool using a round-robin mechanism
- ❑ Session stickiness (persistence) available!

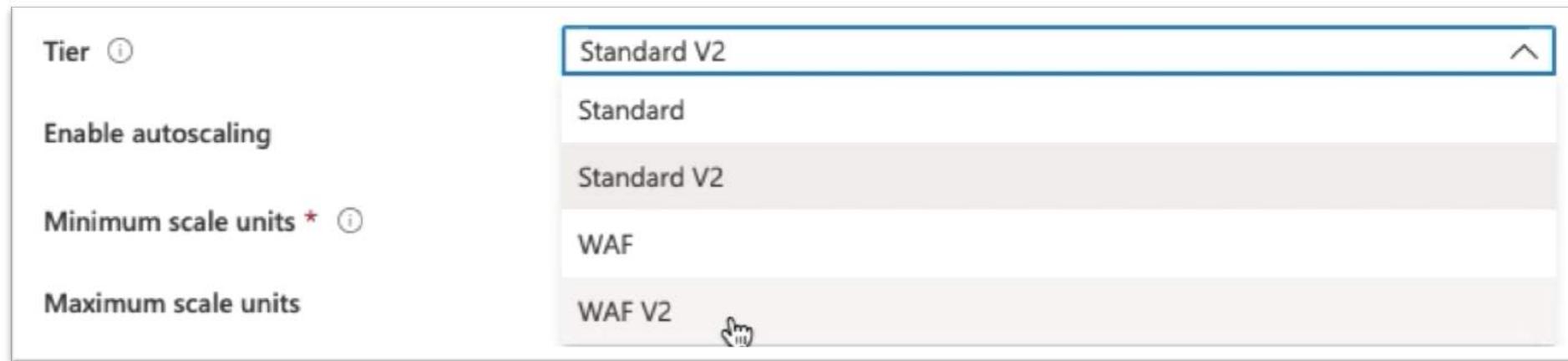


Application
Gateway



Application Gateway – SKU Options

- Application Gateway deployment modes:
 - Standard Application Gateway - Standard / Standard v2
 - Application Gateway + WAF – WAF / WAF v2
- Azure WAF – increased security for your web apps; protect from common known vulnerabilities and exploits



The screenshot shows the 'Tier' configuration section of an Azure Application Gateway. The 'Tier' dropdown is open, showing the following options: Standard V2 (selected), Standard, Standard V2, WAF, and WAF V2. The 'Standard V2' option is highlighted with a blue border. To the left of the dropdown, there are other configuration fields: 'Enable autoscaling', 'Minimum scale units *' (with a help icon), and 'Maximum scale units'.

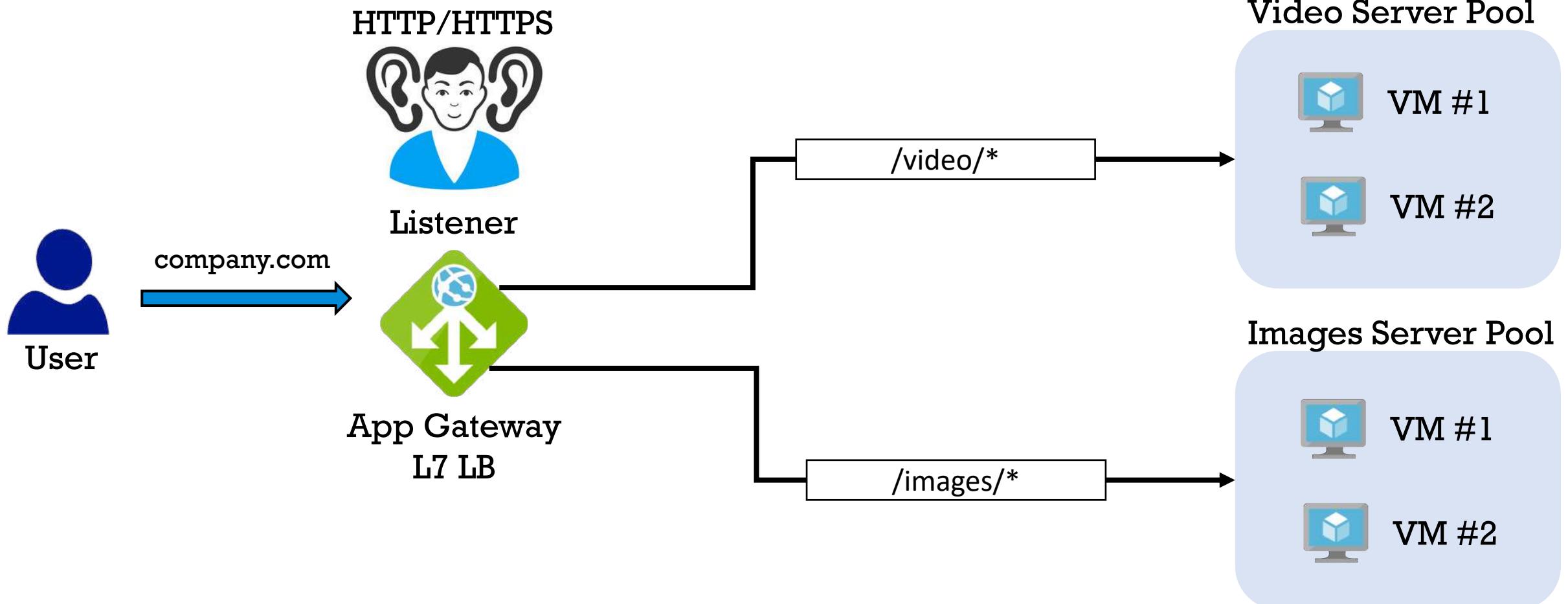


Application
Gateway



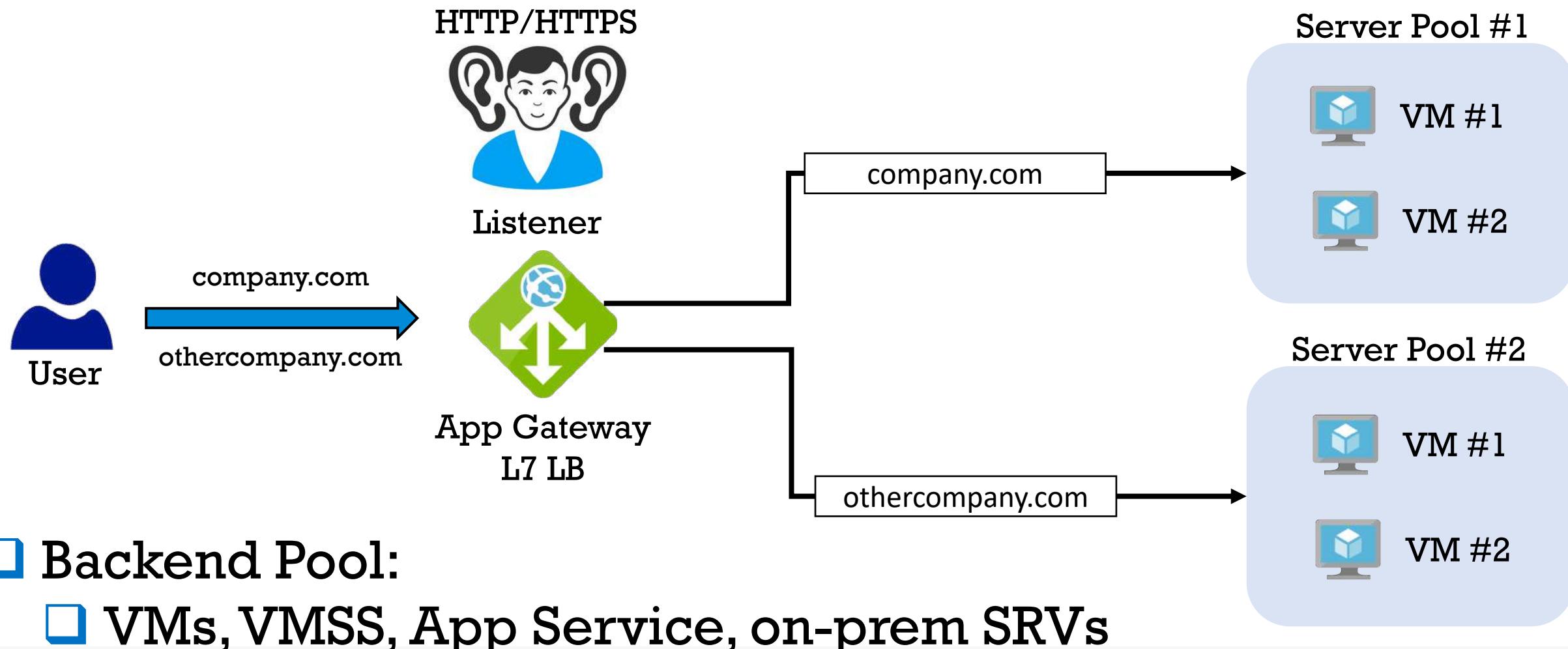
Application Gateway – Path-based Routing

- Send requests based on paths in received URL



Application Gateway – Multiple Site Routing

- Bind multiple web apps to one Application Gateway

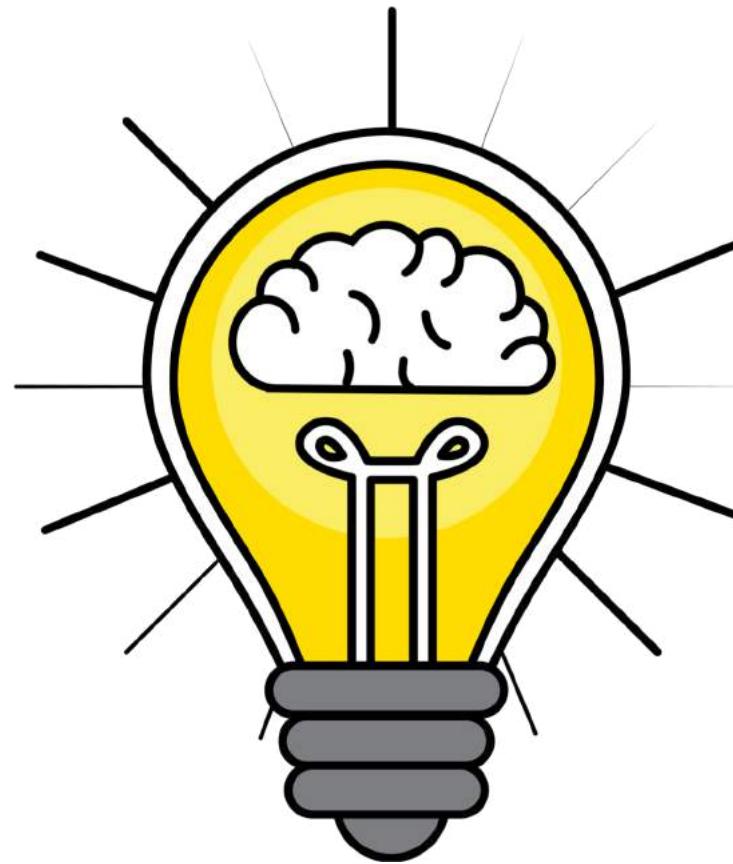


- Backend Pool:

- VMs, VMSS, App Service, on-prem SRVs



Application Gateway - Quiz



Microsoft Azure Administrator



Module 13 - Azure DNS

Azure DNS Overview

What is DNS?

- DNS stands for Domain Name System and acts as the phonebook of the Internet



- When you want to call someone and you don't know the phone number, you look it up in the phone book

Phonebook

- You find there an association between the person's name and the phone number

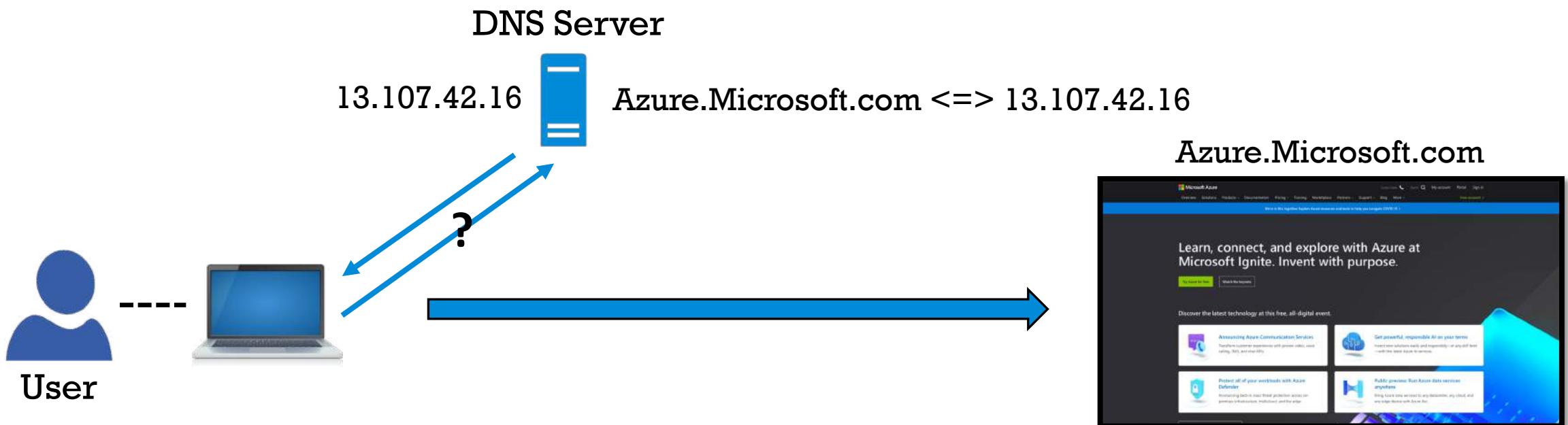
William Stones +1-123-456-7890



Microsoft Azure Administrator

What is DNS?

- You can then call Mr. William, because now you know this gentleman's phone number
- DNS solves a similar problem, but for the Internet



What is Azure DNS?

- Azure DNS - hosting service for DNS domains that provides name resolution
- DNS server = name server
 - Name to IP binding = DNS record
- DNS zone - administrative space which allows for more granular control of DNS components
- The configuration information for your DNS server is stored as a file, within a *zone*, on your DNS server



Azure DNS – Default Record Types

Name	Type	TTL	Value	Alias resource type	Alias target
@	NS	172800	ns1-05.azure-dns.com. ns2-05.azure-dns.net. ns3-05.azure-dns.org. ns4-05.azure-dns.info.		
@	SOA	3600	Email: azuredns-hostmaster.micr... Host: ns1-05.azure-dns.com. Refresh: 3600 Retry: 300 Expire: 2419200 Minimum TTL: 300 Serial number: 1		

- NS – Name Server record type
 - “company.com” <-> list of name servers
- SOA – Start of Authority
 - Administrative information



Azure DNS –Record Types

- A – assign IP address to domain
 - 1.2.3.4 <-> www.company.com
- CNAME (canonical name) – alias for an A record
 - company.com -> newcompany.com
- MX – mail exchange record
 - domain: company.com | mail srv: mail.company.com
 - Email to user@company.com -> mail.company.com
- TXT – text record – domain owner verification



Azure DNS –Record Sets

- ❑ Record Set - multiple resources to be defined in a single record

❑ <u>www.company.com</u>	3600	IN	A	1.2.3.4
❑ <u>www.company.com</u>	3600	IN	A	5.6.7.8

- ❑ Alias record set – direct traffic to an Azure resource
 - ❑ i.e. PIP, Azure Traffic Manager, Azure CDN endpoint





Module 13 - Azure DNS

Configure a Public DNS Zone in Azure

Public DNS Zone Overview

- The domain name system is a hierarchy of domains
 - .(dot) => com, net, org => `azurexaas.com` ...
- Microsoft Azure – domain name registrar
 - www.azurexaas.com
 - `mail.azurexaas.com`
 - etc
- Public DNS - maintains a record of publicly available domain names reachable from any device with Internet access



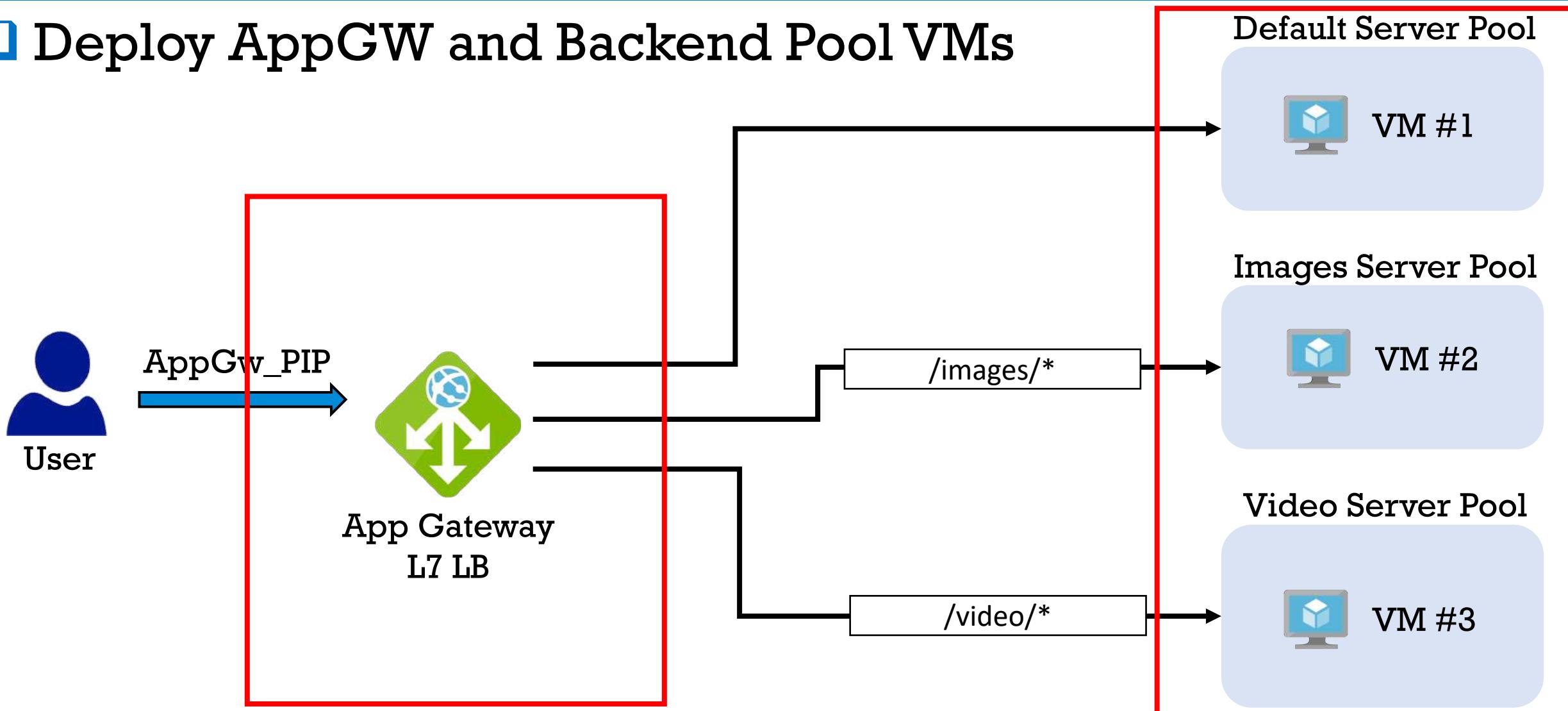


Module 13 - Azure DNS

Hands-on Lab - Configure Public DNS Zone Testing Environment

Hands-on Lab Overview

□ Deploy AppGW and Backend Pool VMs



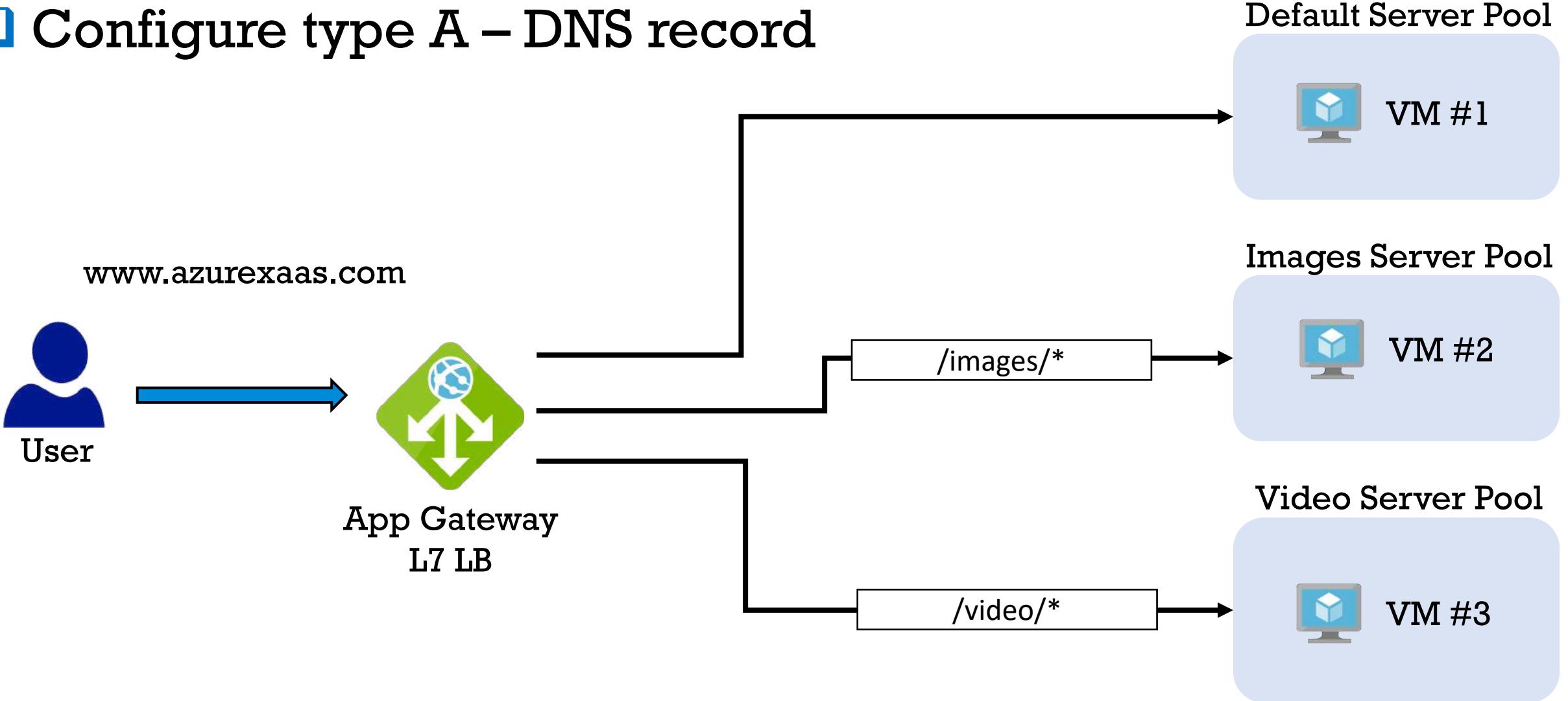


Module 13 - Azure DNS

Hands-on Lab - Configure a Public DNS Zone

Hands-on Lab Overview

☐ Configure type A – DNS record





Module 13 - Azure DNS

Module Completion & Exam Hints

What is Azure DNS?

- Azure DNS - hosting service for DNS domains that provides name resolution
- DNS server = name server
 - Name to name, name to IP address
- DNS zone - administrative space which allows for more granular control of DNS components
- The configuration information for your DNS server is stored as a text file, within a zone



Azure DNS – Record Types

- ❑ NS – Name Server record type
 - ❑ “company.com” <-> list of name servers
- ❑ SOA – Start of Authority
 - ❑ Administrative information
- ❑ A / AAAA – assign IPv4/IPv6 address to domain
 - ❑ 1.2.3.4 <-> www.company.com
- ❑ CNAME (canonical name) – alias for an A record
 - ❑ company.com -> newcompany.com



Azure DNS –Record Types

- ❑ MX – mail exchange record
 - ❑ specifies the mail server responsible for accepting email messages on behalf of a domain name
 - ❑ domain: company.com | mail srv: mail.company.com
- ❑ TXT – text record – domain owner verification
- ❑ SRV – service record - specifies a host and port for specific services such as VoIP, IM, and so on
 - ❑ Most DNS records only specify a server/IP address, SRV records include a port at that IP address as well.



Public DNS Zone Overview

- The domain name system is a hierarchy of domains
 - .(dot) => com, net, org => `azurexaas.com` ...
- Microsoft Azure – domain name registrar
 - [azurexaas.com](https://www.azurexaas.com); www - > type A DNS record
 - `private.azurexaas.com`; `VM-02.private.azurexaas.com`
 - etc
- Public DNS - maintains a record of publicly available domain names reachable from any device, with Internet access



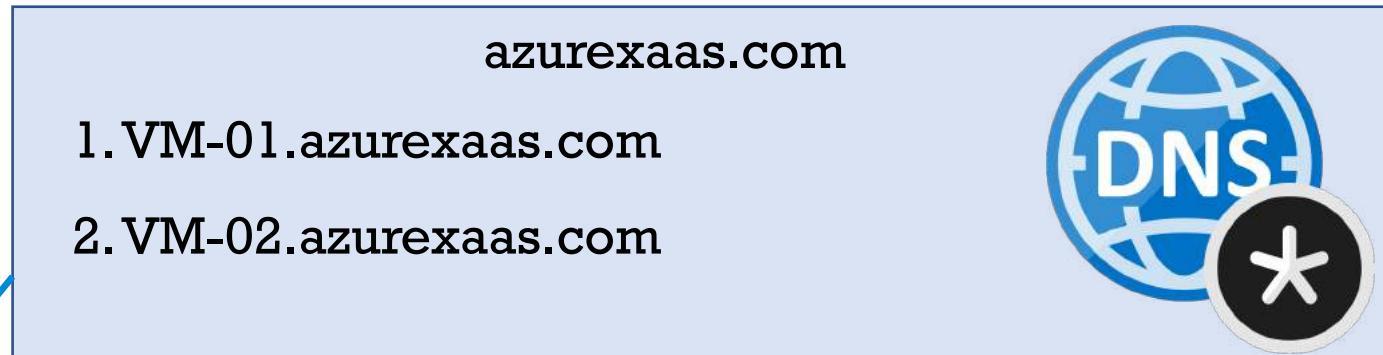
Private DNS Zone Overview

- ❑ Azure Private DNS – reliable DNS service to manage and resolve domain names in a vNET
- ❑ Hands-on Lab example:
 - ❑ provide name resolution for VMs within a vNET (and between vNETs peering)
- ❑ Step #1:
 - ❑ Create a private zone
- ❑ Step #2:
 - ❑ Link private zone to vNET
- ❑ Step #3:
 - ❑ Create DNS records

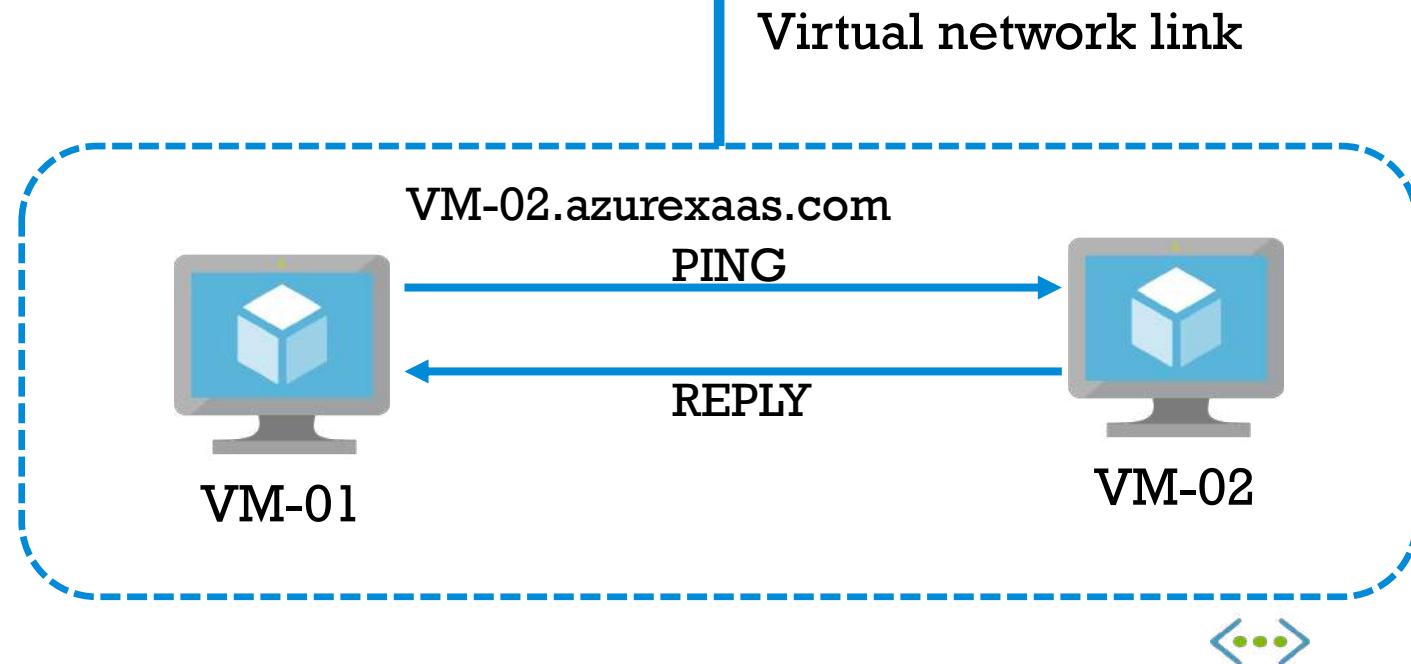


Understand Private DNS Zone for the Exam

Private DNS Zone

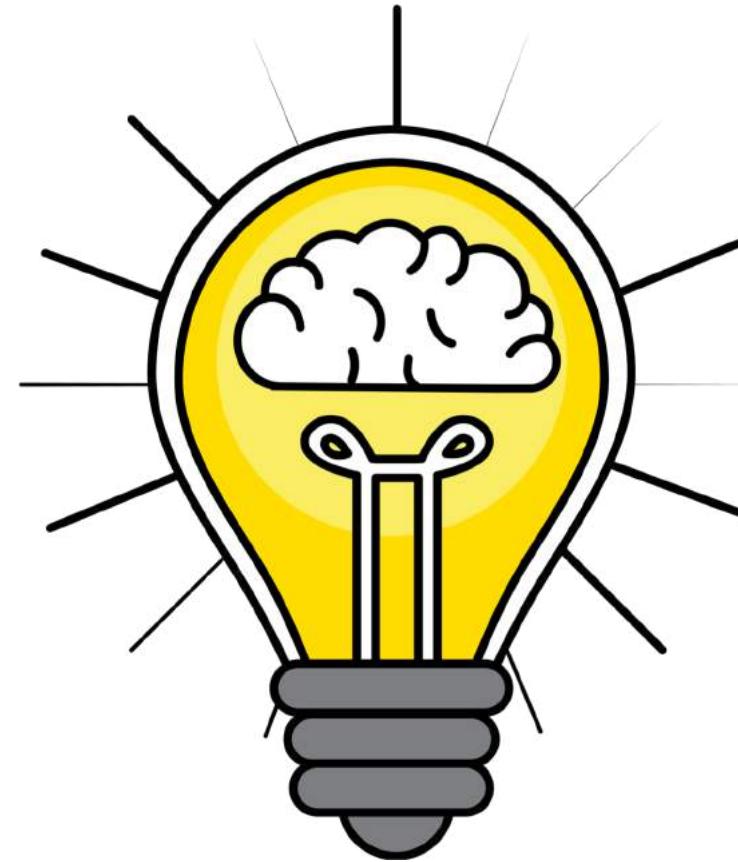


Auto registration



Microsoft Azure Administrator

Azure DNS - Quiz



Microsoft Azure Administrator

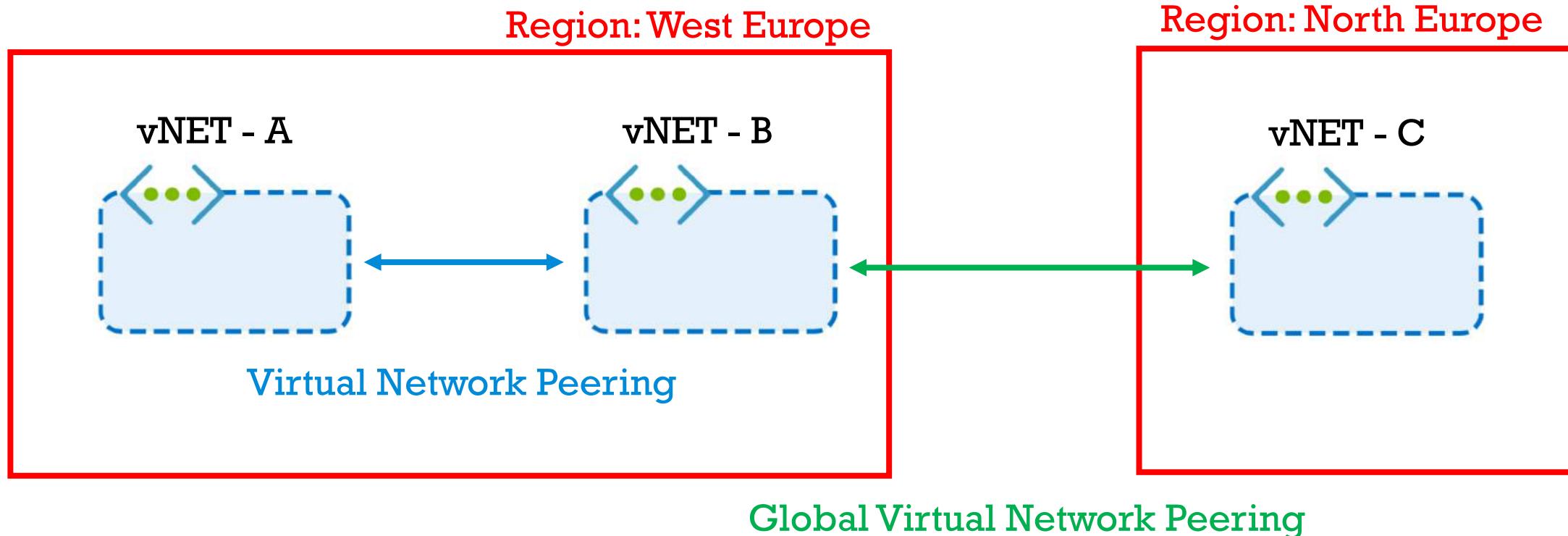


Module 14 - Connect Azure vNETs

Virtual Networks Peering Overview

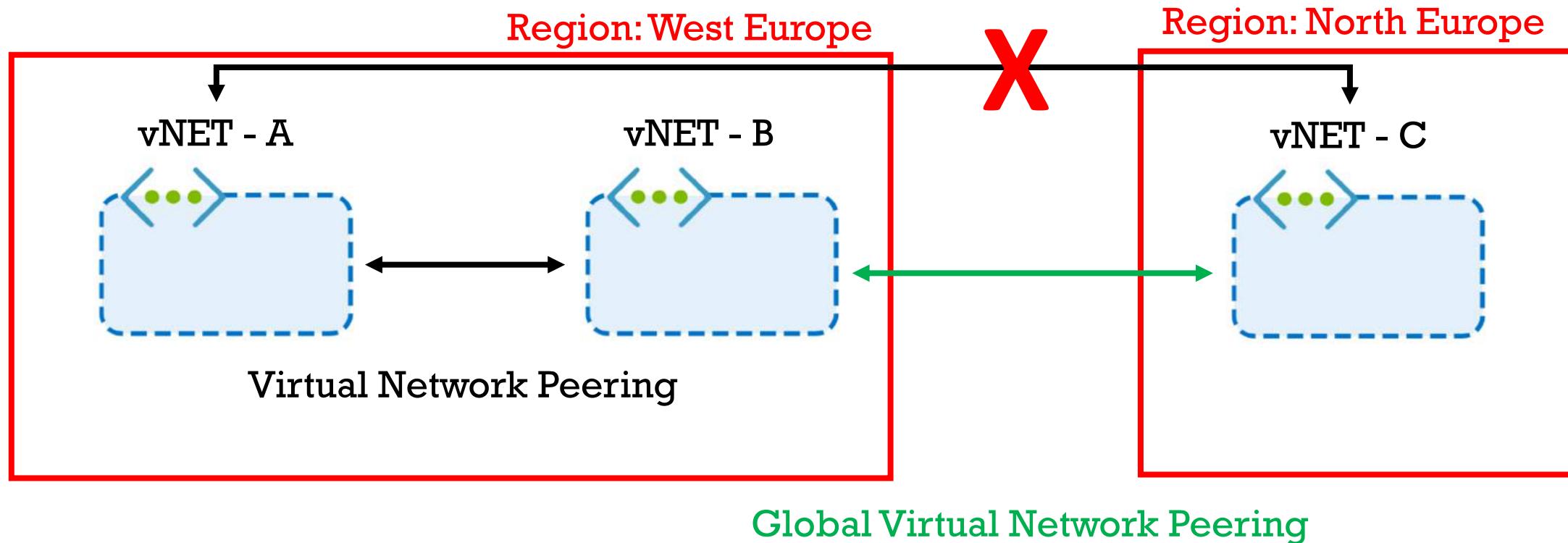
vNET Peering Overview

- Virtual network peering enables you to seamlessly connect two or more Virtual Networks in Azure



vNET Peering – Further notes

- ☐ Peering configuration needs to be applied on both vNETs

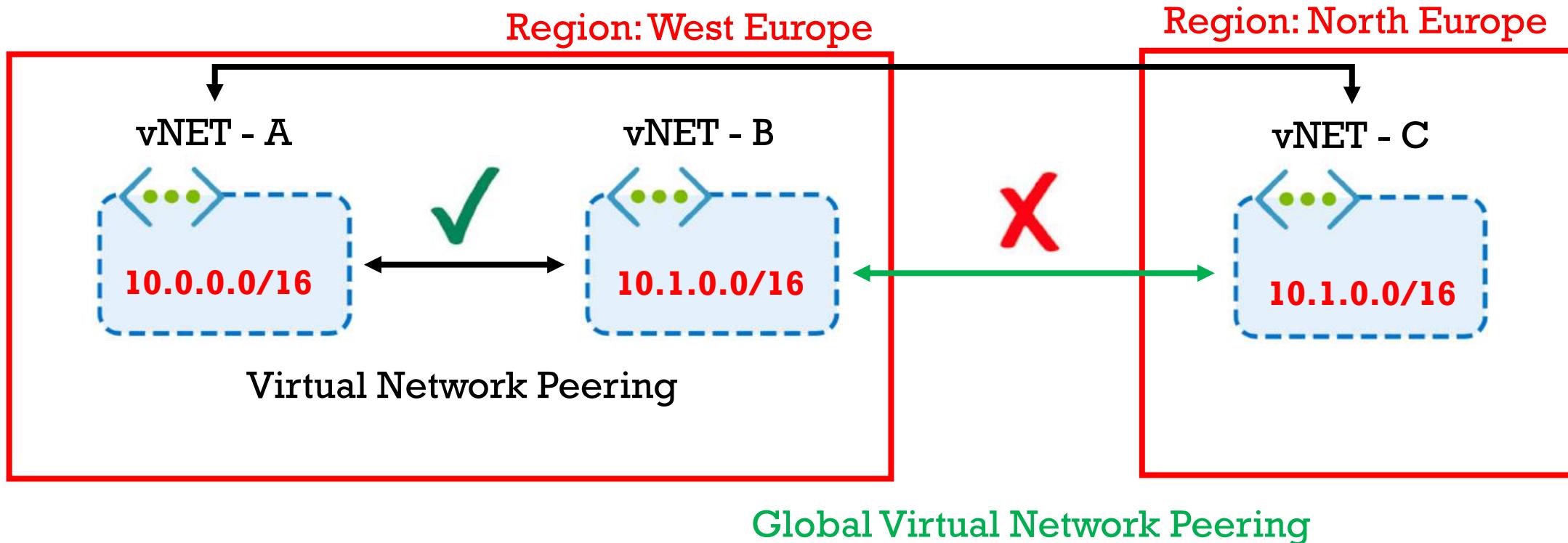


- ☐ Peering across different subscriptions is also available



vNET Peering – IP Address Overlapping

- ☐ vNETs must have different IP address spaces !!!



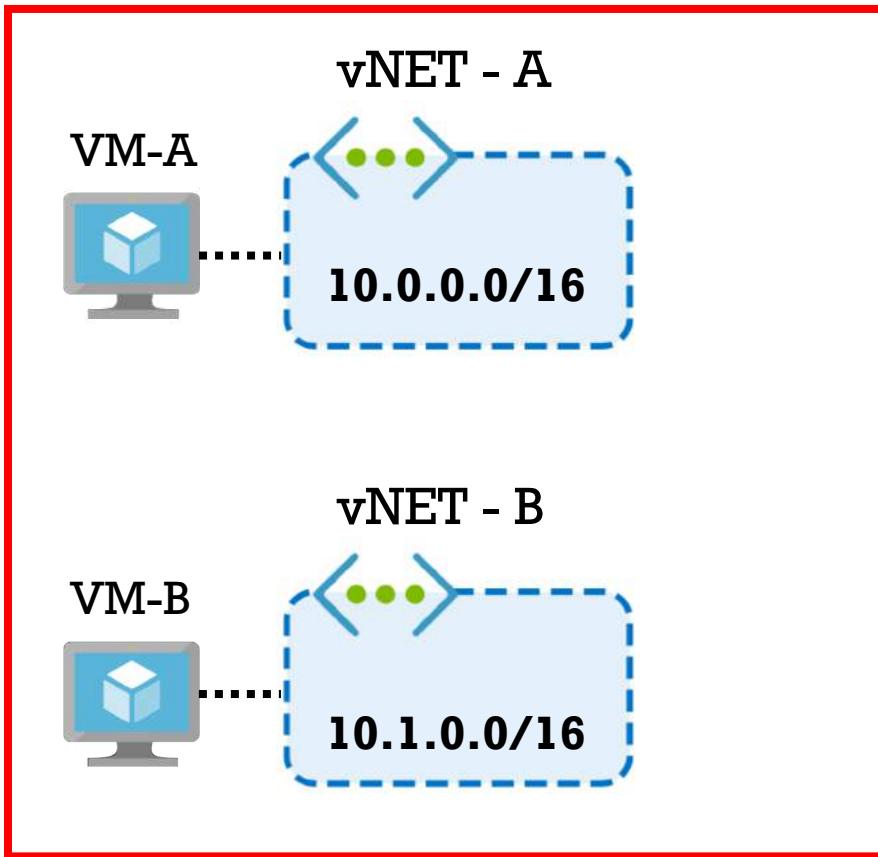


Module 14 - Connect Azure vNETs

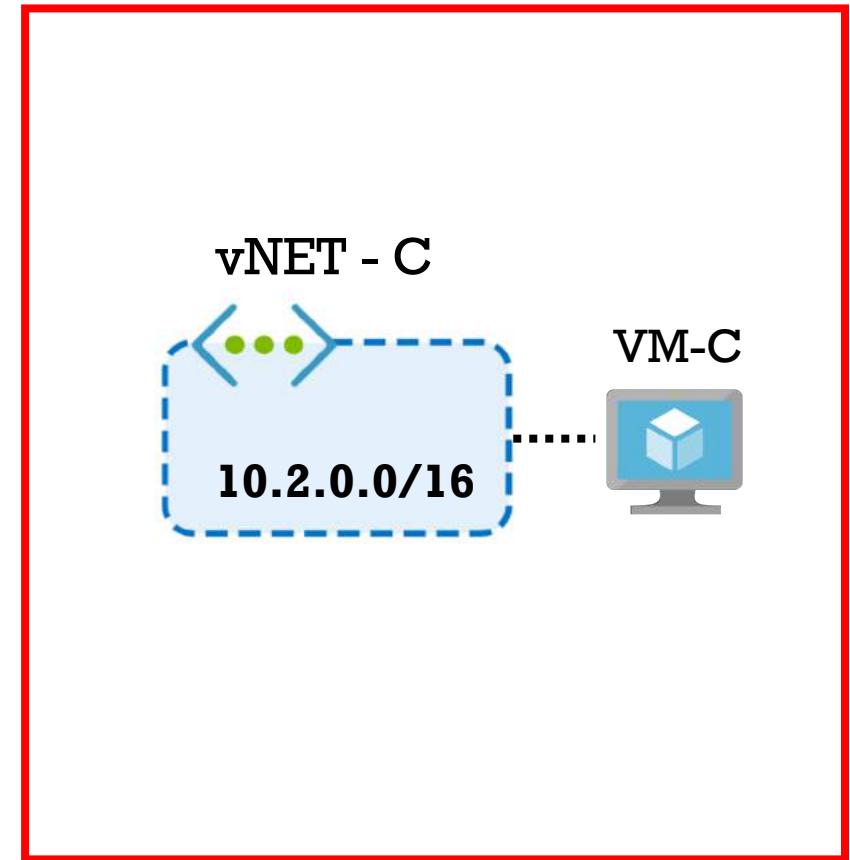
Hands-on Lab - Configure vNET Peering Testing Environment

Hands-on Lab Overview

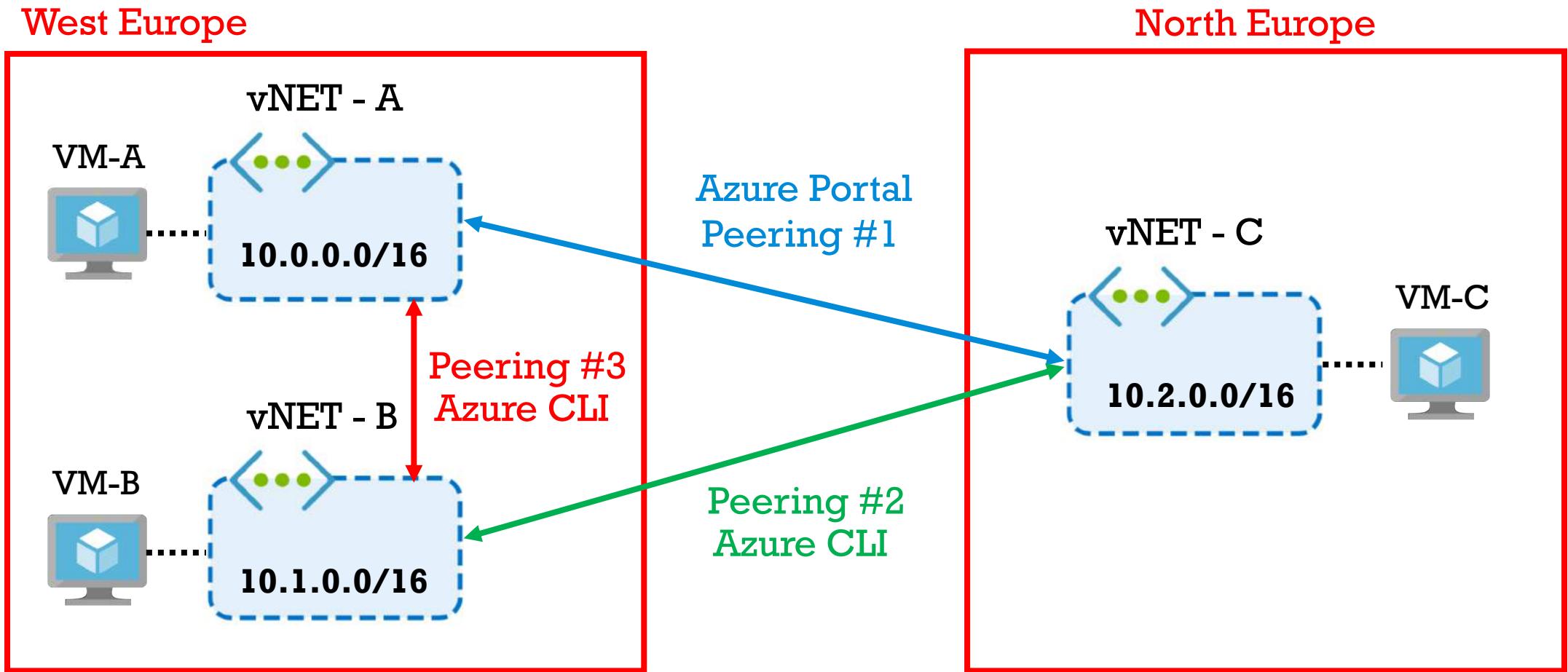
West Europe



North Europe



Hands-on Lab Overview

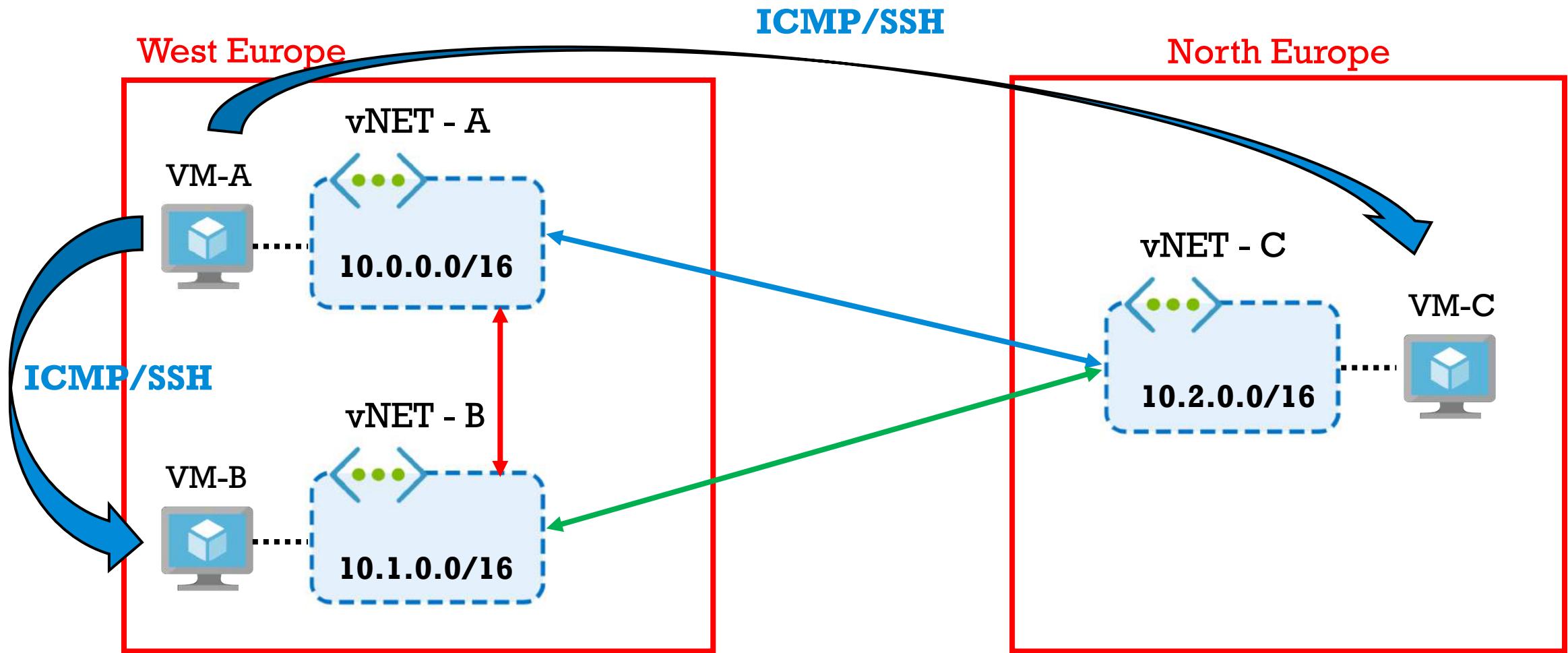




Module 14 - Connect Azure vNETs

Hands-on Lab - vNET Peering Testing

Hands-on Lab Overview





Module 14 - Connect Azure vNETs

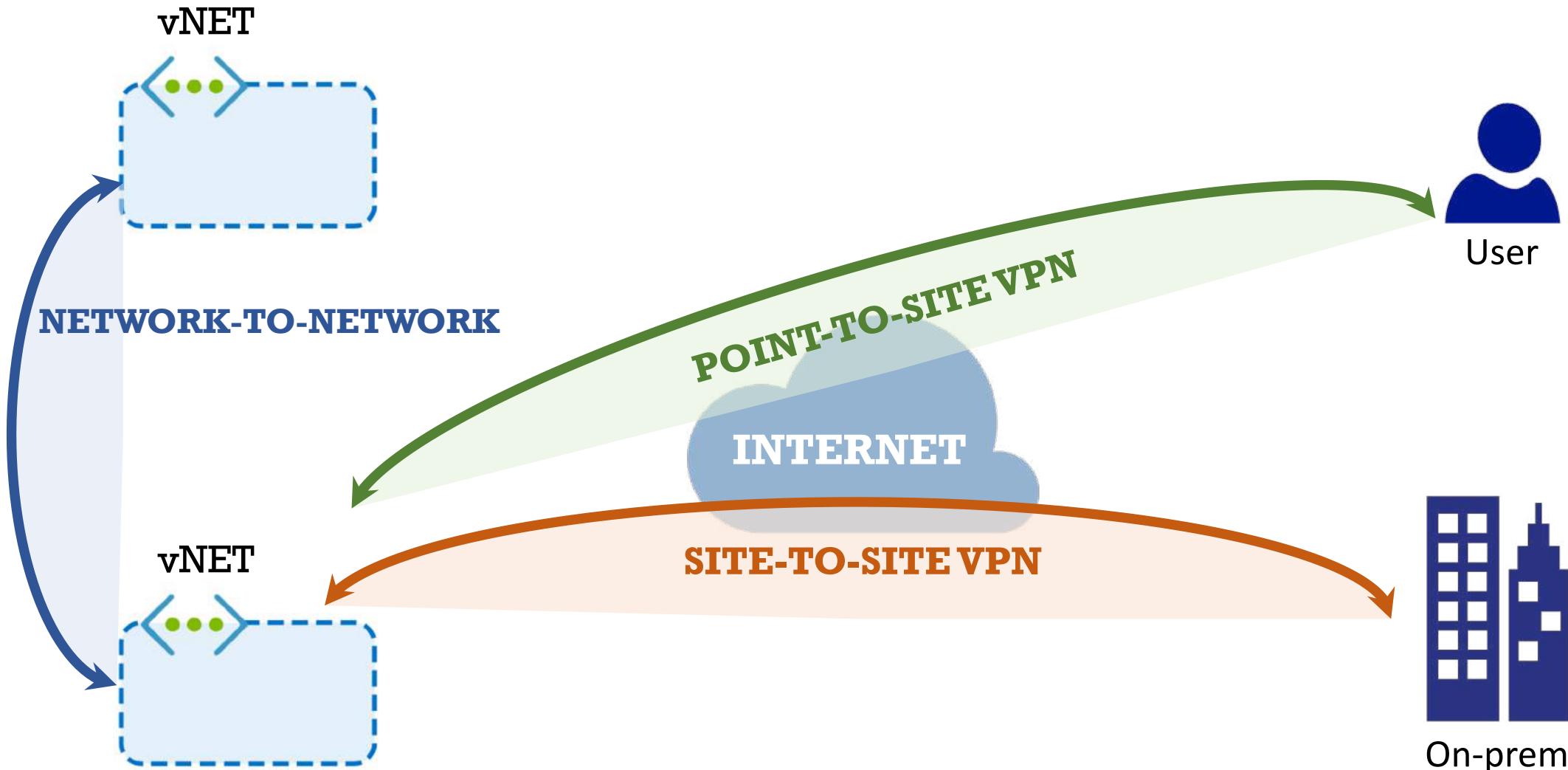
Azure VPNs Overview

Azure VPNs Overview

- ❑ VPN – Virtual Private Network
 - ❑ Secure tunnel (communication channel)
 - ❑ Typically built over the Internet
 - ❑ Traffic is encrypted between source and destination
- ❑ VPN Gateway
 - ❑ Azure resource is used to send encrypted traffic between an Azure vNET and peer
- ❑ Each virtual network can have only one VPN gateway !



Azure VPN Types



Azure VPN Gateway SKUs

Gateway SKUs by tunnel, connection, and throughput

VPN Gateway Generation	SKU	S2S/VNet-to-VNet Tunnels	P2S SSTP Connections	P2S IKEv2/OpenVPN Connections	Aggregate Throughput Benchmark	BGP	Zone-redundant
Generation1	Basic	Max. 10	Max. 128	Not Supported	100 Mbps	Not Supported	No
Generation1	VpnGw1	Max. 30*	Max. 128	Max. 250	650 Mbps	Supported	No
Generation1	VpnGw2	Max. 30*	Max. 128	Max. 500	1 Gbps	Supported	No
Generation1	VpnGw3	Max. 30*	Max. 128	Max. 1000	1.25 Gbps	Supported	No
Generation2	VpnGw4	Max. 30*	Max. 128	Max. 5000	5 Gbps	Supported	No
Generation2	VpnGw5	Max. 30*	Max. 128	Max. 10000	10 Gbps	Supported	No

- ❑ <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-vpngateways>



VPNs Types – Policy Based & Route Based

- ❑ Policy-based VPN
 - ❑ Considered “legacy”
 - ❑ Compatible with legacy VPN devices (firewalls)
 - ❑ Uses IKEv1 standard
 - ❑ Uses static routing

- ❑ Route-based VPN
 - ❑ IKEv2 support
 - ❑ Dynamic routing (BGP – Border Gateway Protocol)
 - ❑ Support all VPN types: S2S, P2S, network-to-network

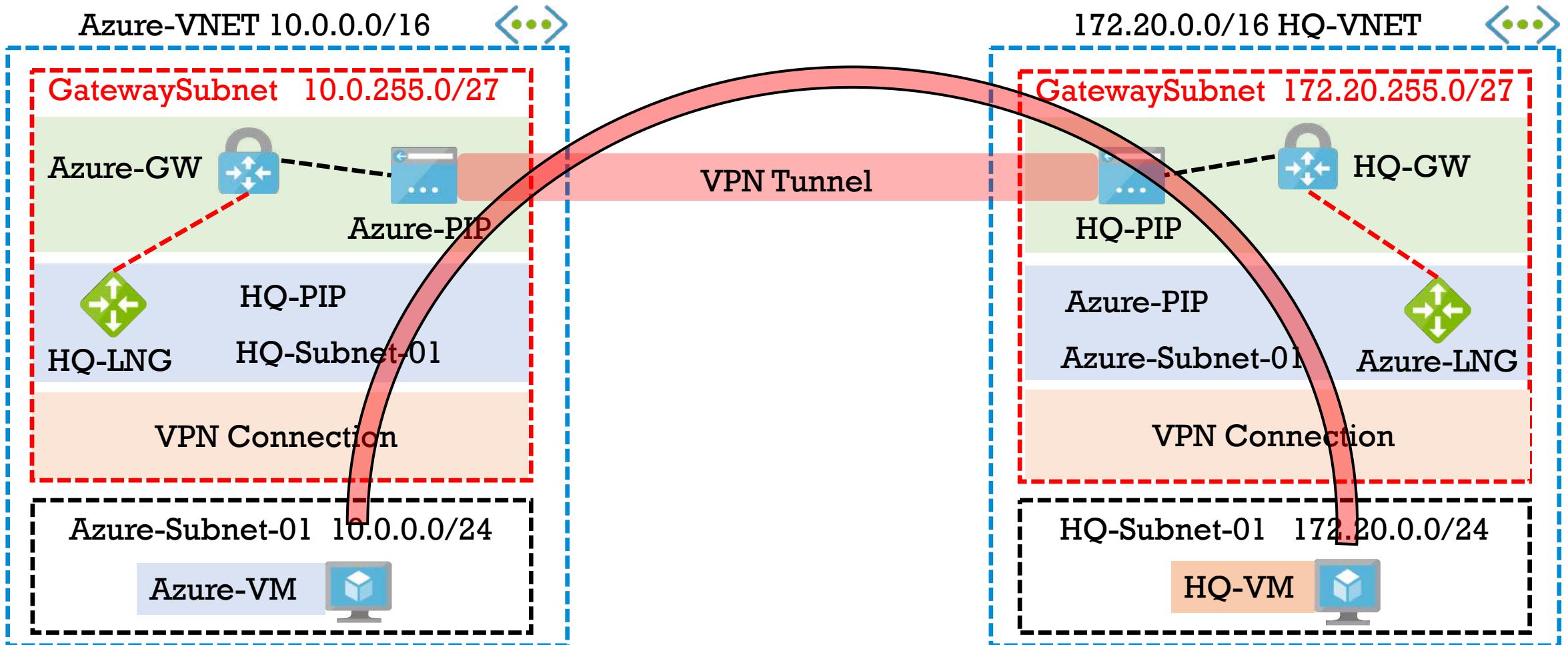




Module 14 - Connect Azure vNETs

Deploying Azure VPNs – Puzzle Pieces

Deploying VPNs in Azure

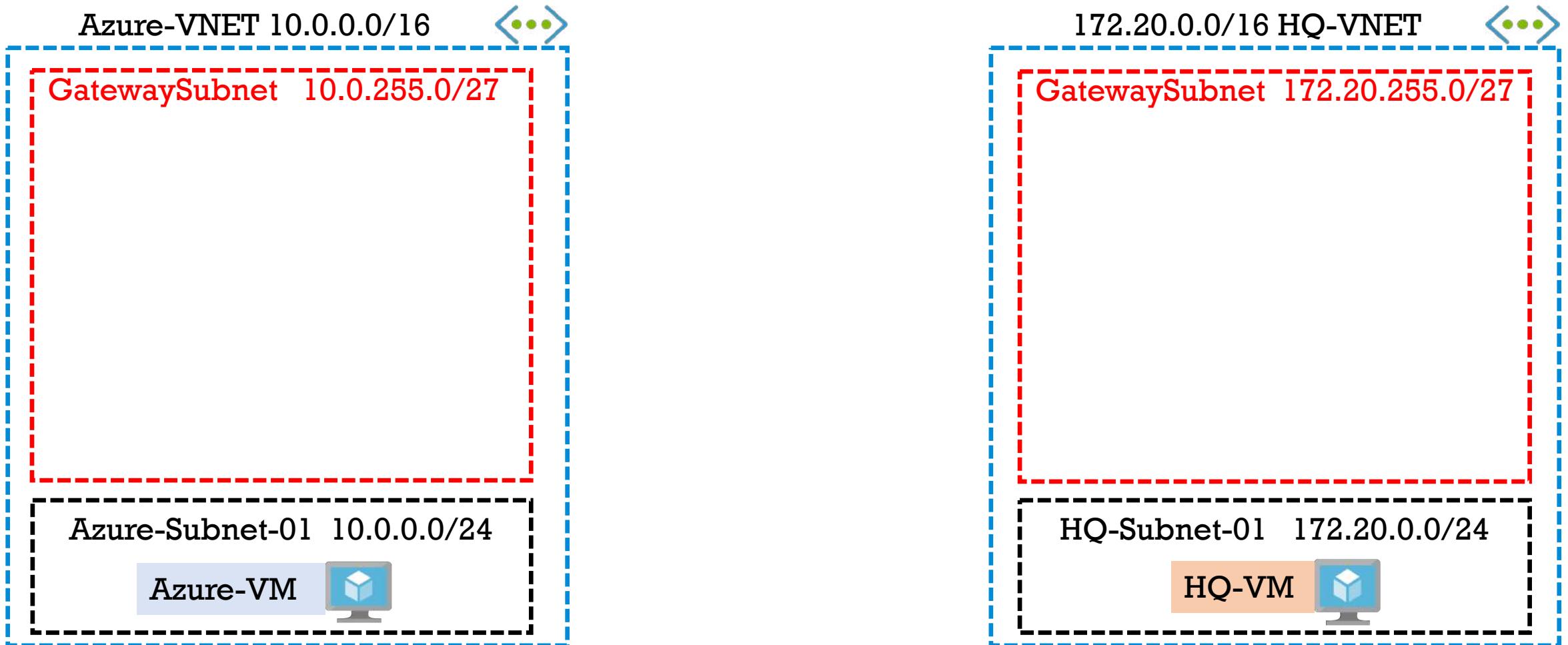




Module 14 - Connect Azure vNETs

Hands-on Lab - Configure Site-to-Site VPN Testing Environment

Hands-on Lab Overview – Deploy vNETs & VMs

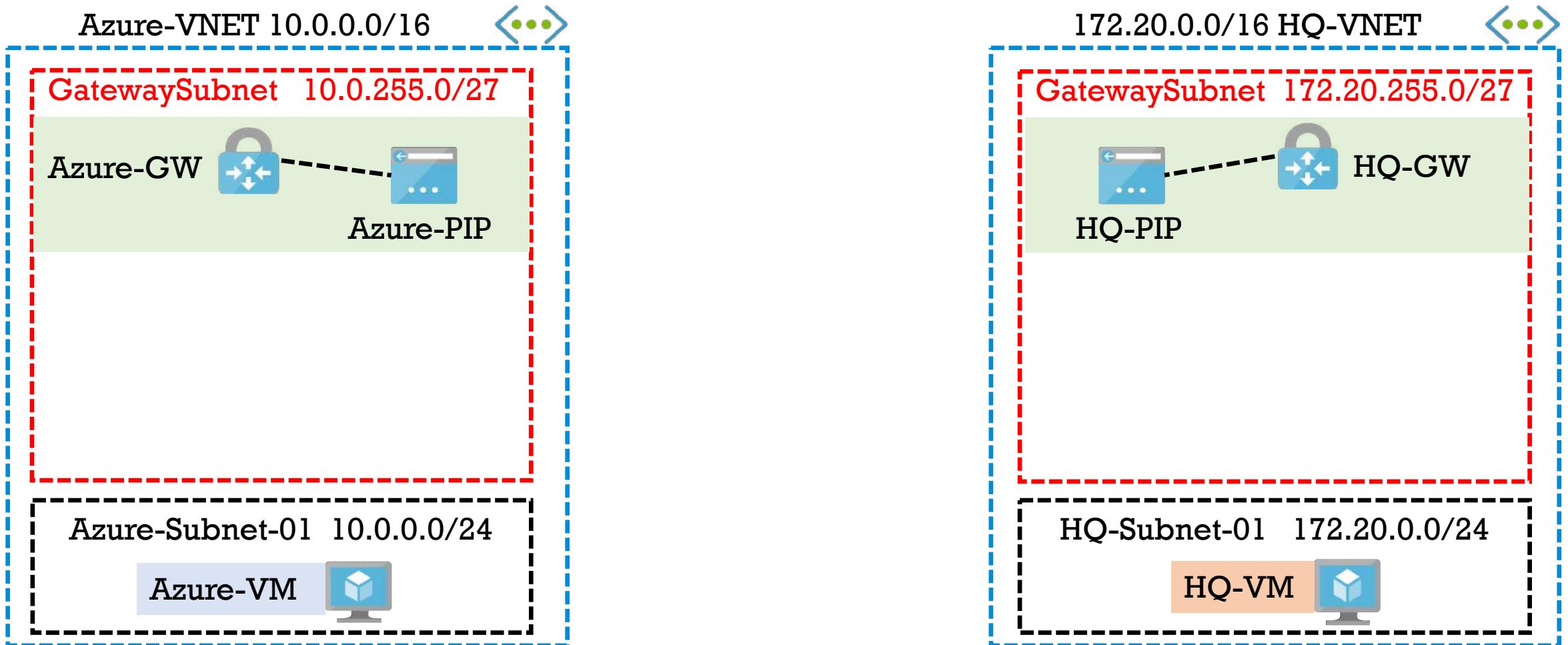




Module 14 - Connect Azure vNETs

Hands-on Lab - Configure Site-to-Site VPN Testing Environment

Hands-on Lab Overview – Deploy vNETs & VMs

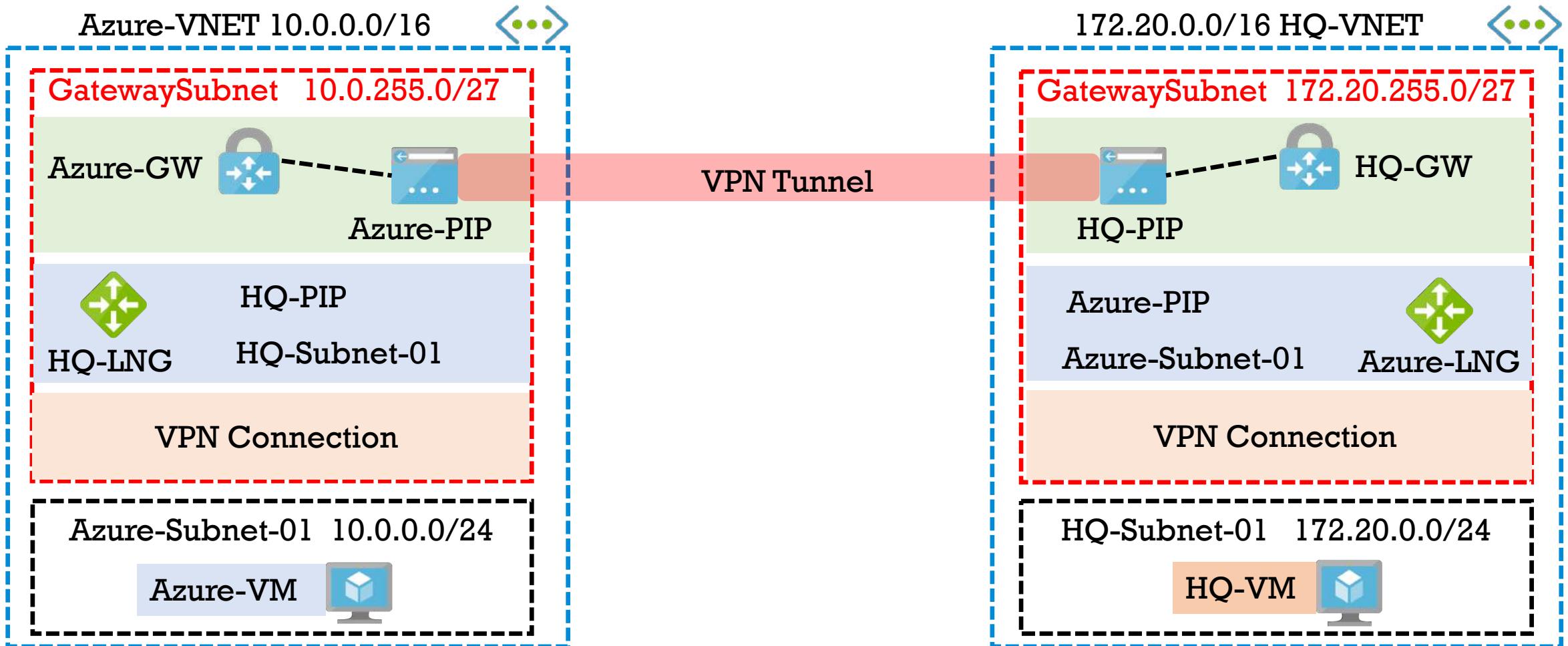




Module 14 - Connect Azure vNETs

Hands-on Lab - Deploy VPN GWs

Hands-on Lab Overview – Deploy vNETs & VMs

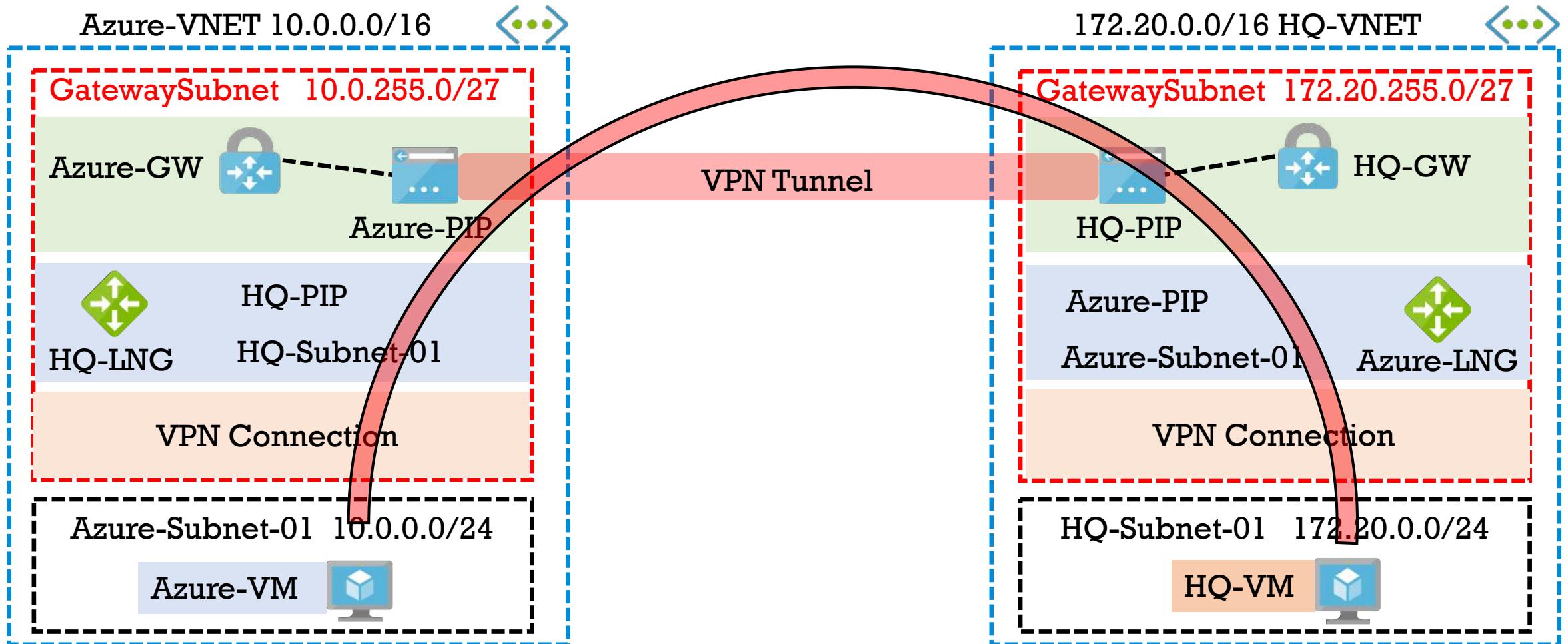




Module 14 - Connect Azure vNETs

Hands-on Lab - Site-to-Site VPN Testing

Hands-on Lab Overview – Deploy vNETs & VMs



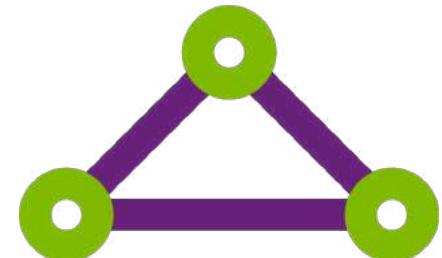


Module 14 - Connect Azure vNETs

Azure ExpressRoute Overview

What is Azure ExpressRoute?

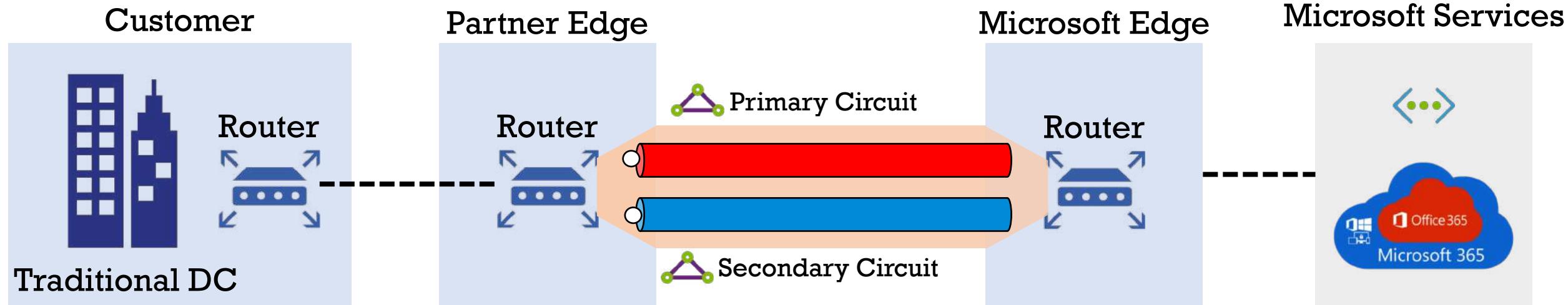
- ExpressRoute lets you extend your on-premises networks into the Microsoft cloud
- ExpressRoute vs VPN ?!
 - ExpressRoute connections don't go over the public Internet network
 - Faster speeds, consistent latencies and higher security



ExpressRoute

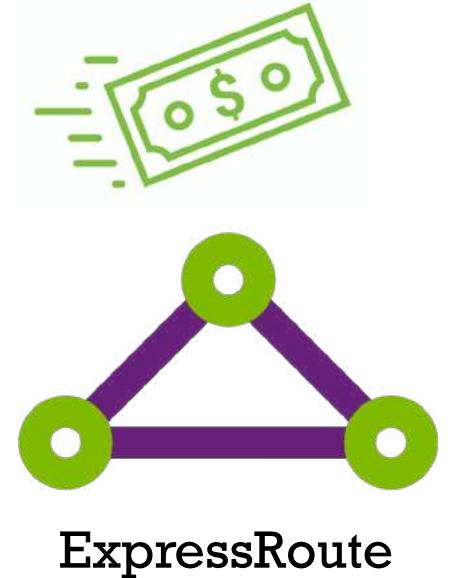


ExpressRoute Architecture – How it works



ExpressRoute Billing Options

- ❑ Three options are available:
 - ❑ Unlimited data
 - ❑ All in/out data is free of charge
- ❑ Metered data
 - ❑ In is free, out is charged
- ❑ Premium add-on
 - ❑ More capabilities included: more routes allowed, global connectivity services





Module 14 - Connect Azure vNETs

Azure Virtual WAN Overview

What is Azure Virtual WAN?

- ❑ Azure Virtual WAN – Azure networking service
 - ❑ Simplifies connectivity between all your company's endpoints
- ❑ Scenario – company.com:
 - ❑ One HQ location
 - ❑ 100 branch locations
 - ❑ 1000 remote users
 - ❑ Apps and services deployed in Azure and on-prem DC
- ❑ We need to implement mesh connectivity (any-to-any)



Not a solution !!!

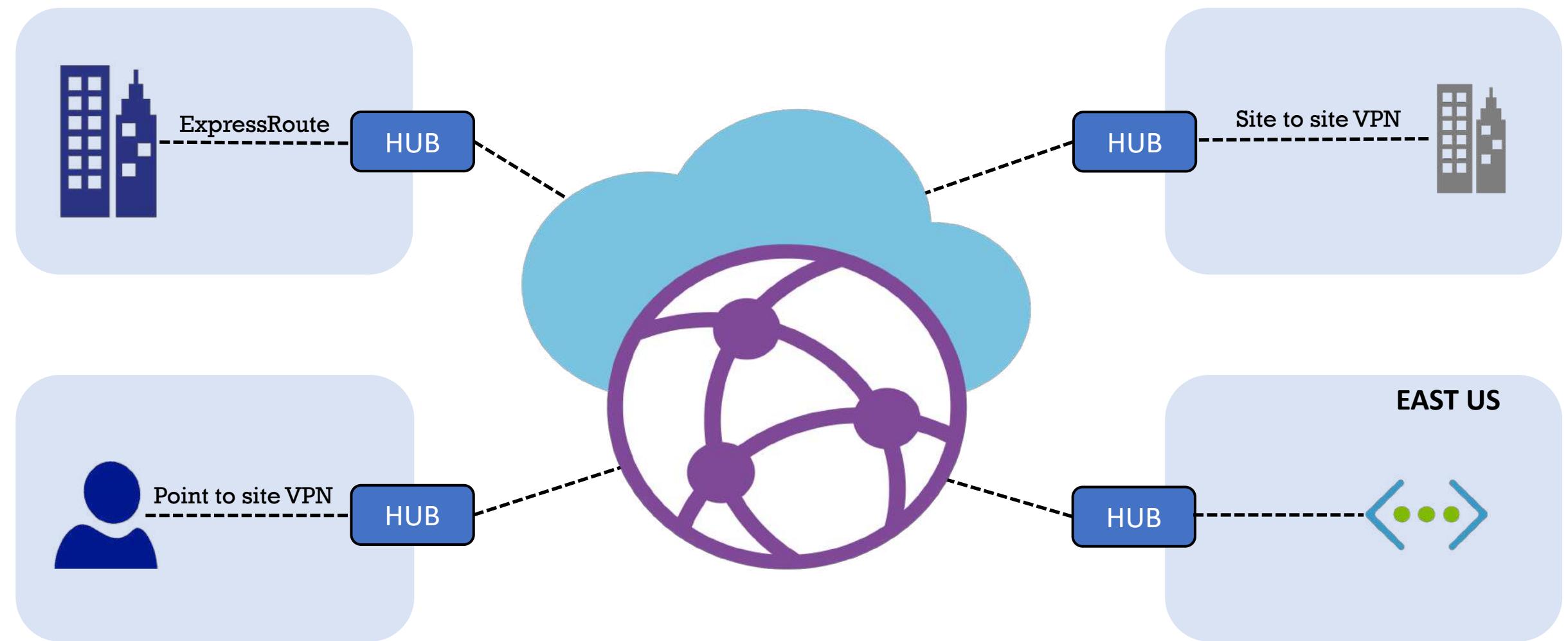
- Start with HQ:
 - Build 100 s2s VPNs with all branch locations
 - Build 1000 p2s VPNs with all remote users
- Branch location:
 - HQ VPN – done
 - Build 99 s2s VPNs with branch locations
 - Build 1000 p2s VPNs with remote users
- Scalable? Easy management ?! – not really !



Virtual WAN



Azure Virtual WAN – The solution ...





Module 14 - Connect Azure vNETs

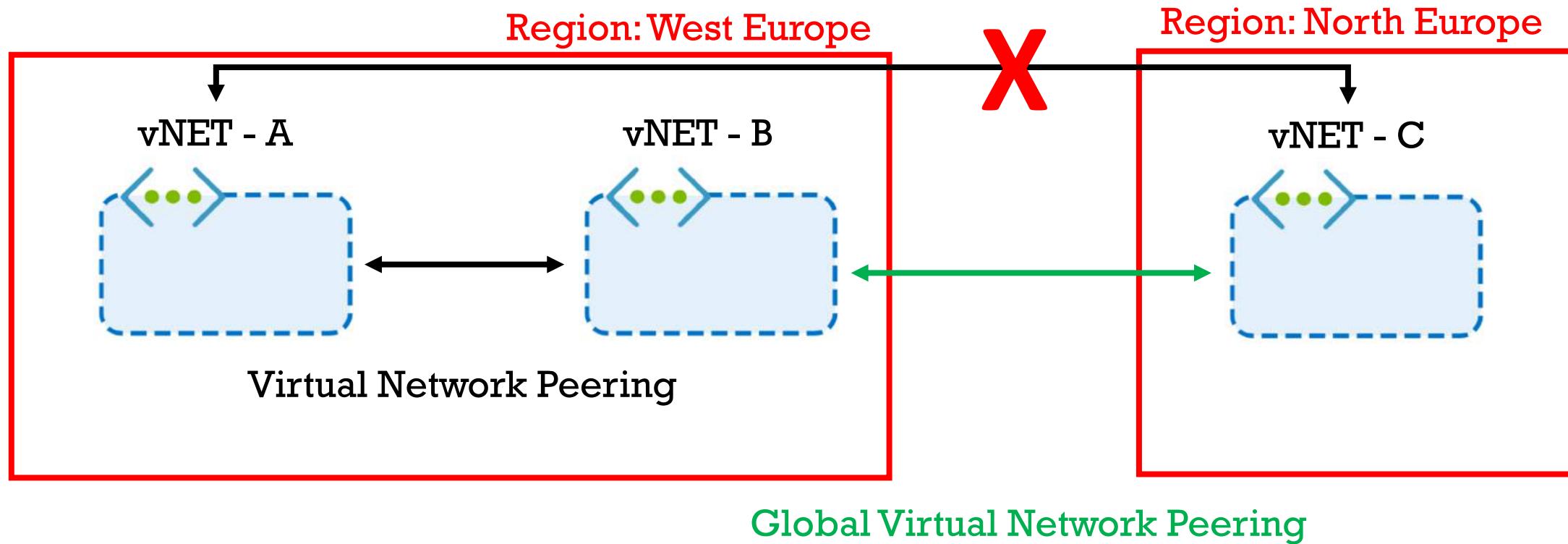
Module Completion & Exam Hints



vNET Peering

vNET Peering – Further notes

- ☐ Peering configuration needs to be applied on both vNETs

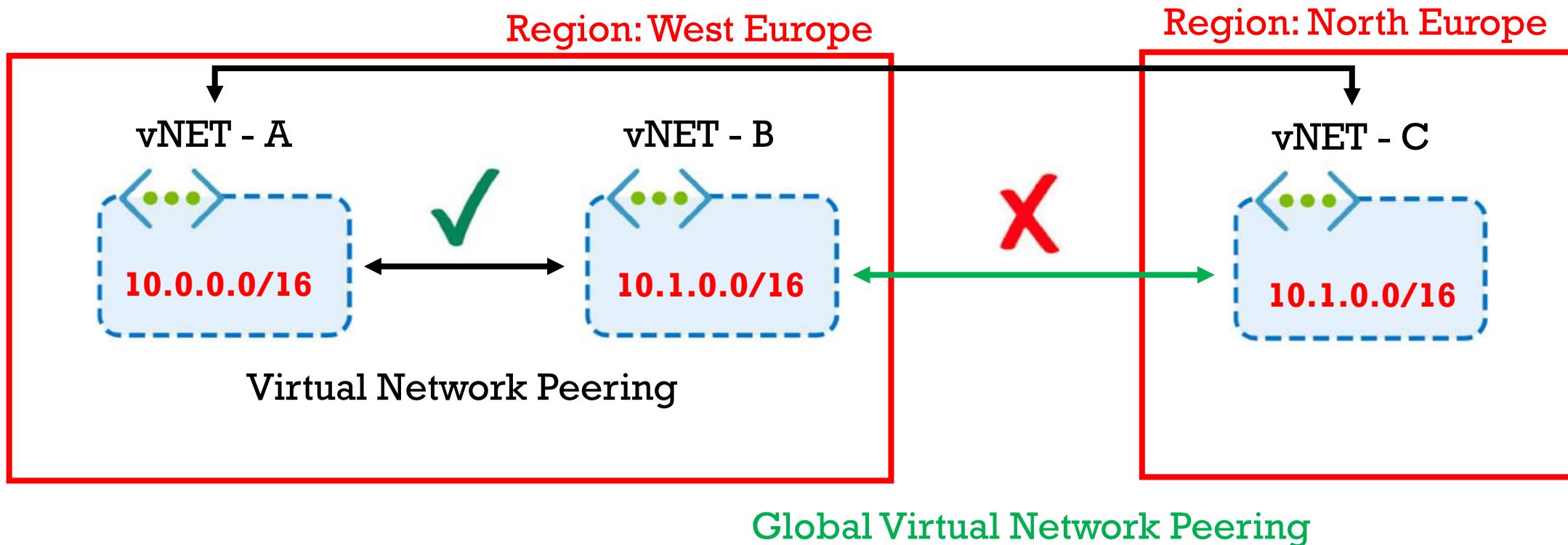


- ☐ vNET Peering is not transitive!



vNET Peering – IP Address Overlapping

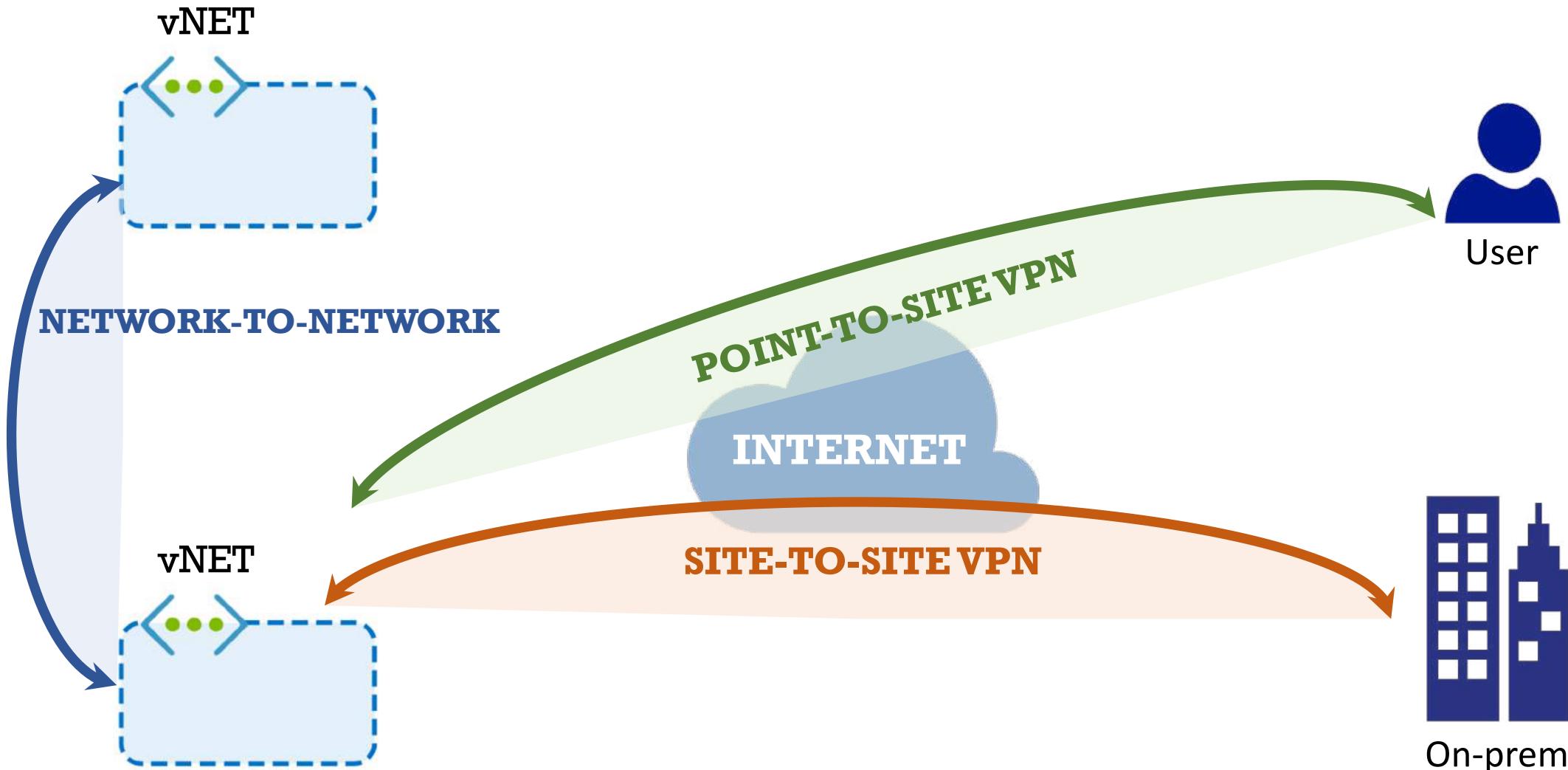
- ☐ vNETs must have different IP address spaces !!!



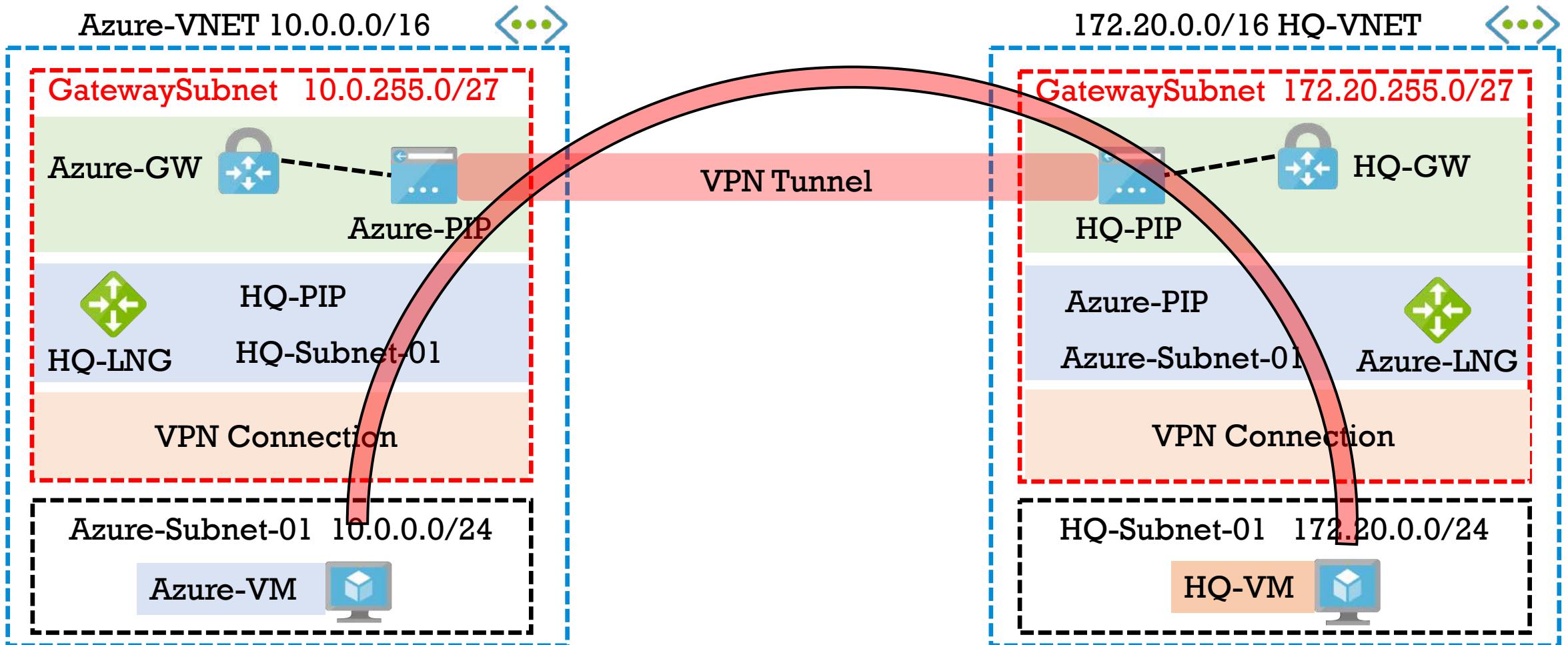


Azure VPNs

Azure VPN Types



Deploying VPNs in Azure

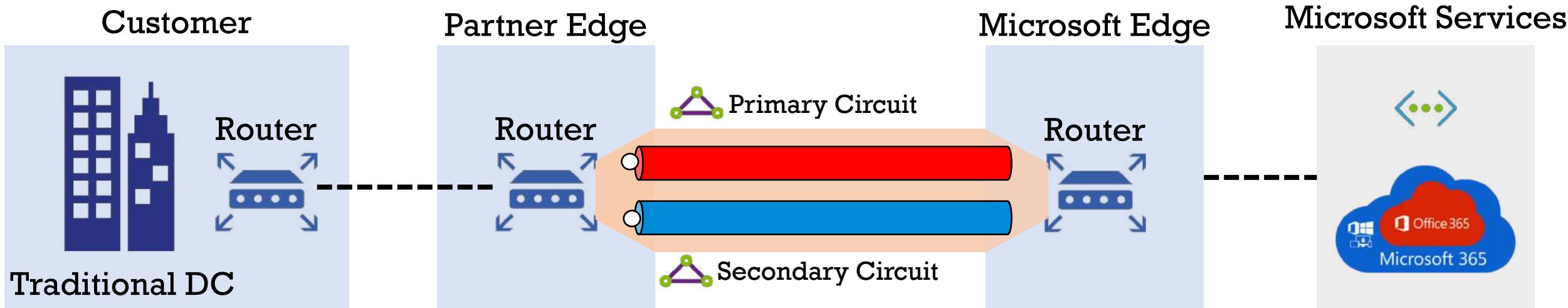




Azure ExpressRoute

Azure ExpressRoute Architecture

- ❑ ExpressRoute lets you extend your on-premises networks into the Microsoft cloud, through private links
- ❑ ExpressRoute vs VPN – Faster speed, low latency





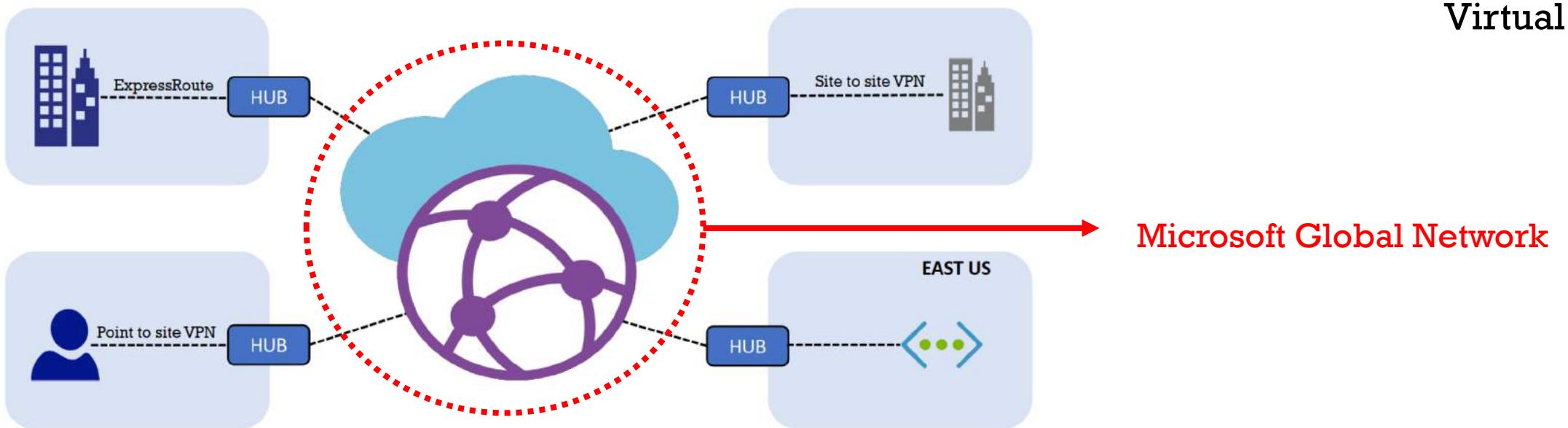
Azure Virtual WAN

What is Azure Virtual WAN?

- Azure Virtual WAN – Azure networking service
 - Simplifies connectivity between all your company's endpoints AND provides ultra-high speed links



Virtual WAN





Azure Network Watcher

Network Watcher – Monitor & Diagnostic Tool

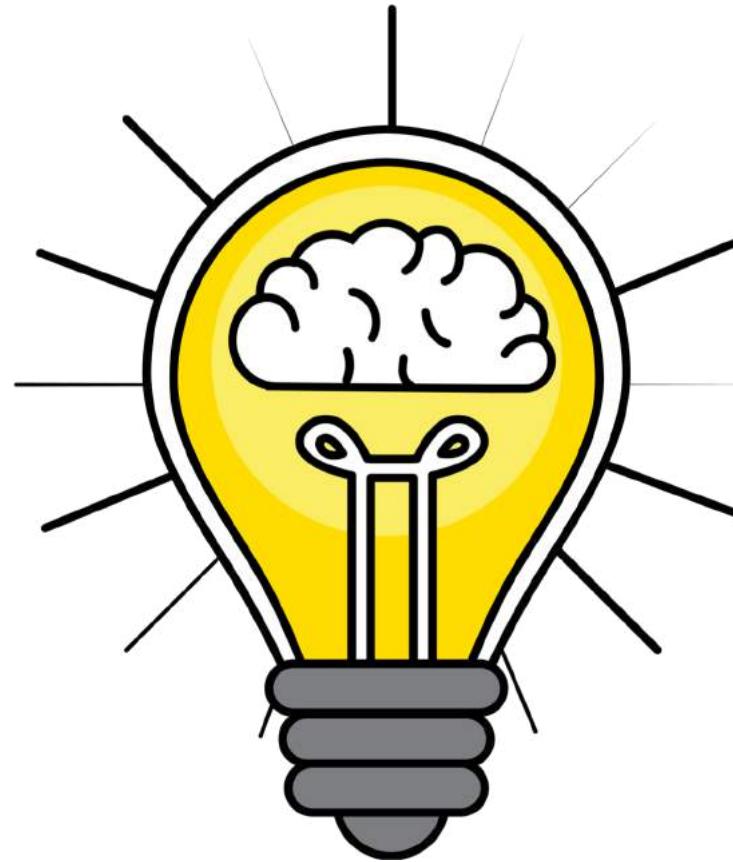
- ❑ Connection Monitor
 - ❑ Check latency (RTT) between two VMs
- ❑ IP Flow Verify
 - ❑ Check if a packet is allowed or denied to or from a virtual machine (NSGs)
- ❑ Monitor events on a VM
 - ❑ Enable Network Watcher in the region
 - ❑ LogAnalyticsWorkspace – create Storage Account



Network Watcher



Connect Azure vNETs - Quiz



Microsoft Azure Administrator



Module 15 - Azure Storage

Introduction to Azure Storage

Introduction to Azure Storage

- Azure Storage is Microsoft's cloud storage solution for modern data storage scenarios
- Azure storage services:
 - Durable and highly available
 - Secure
 - Scalable
 - Managed
 - Accessible

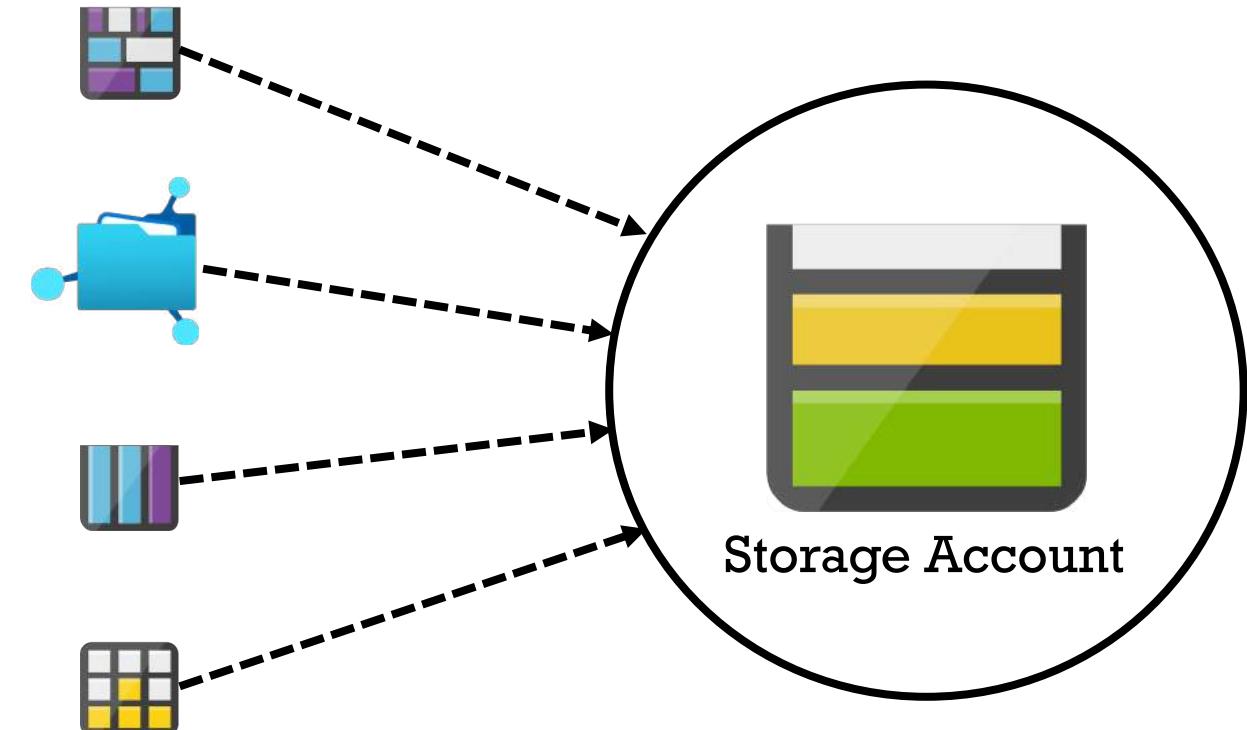


Storage Account



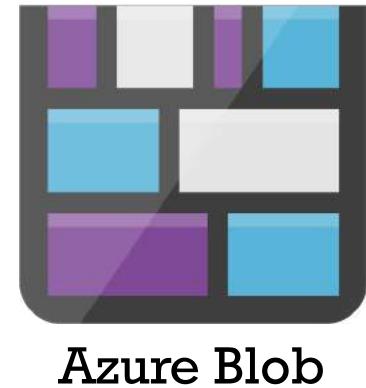
Azure Storage Services Overview

- Azure Storage includes the following data services:
 - Azure Blobs ✓
 - scalable object store
 - Azure Files ✓
 - managed file share
 - Azure Queues X
 - messaging store
 - Azure Tables X
 - NoSQL structured data



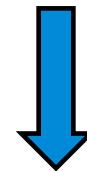
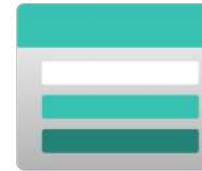
Azure Blobs Overview

- ❑ Azure Blob storage is Microsoft's object storage solution for the cloud, optimized to store massive amounts of unstructured data (text or binary data)
- ❑ BLOB – Binary Large Objects
- ❑ What is Blob Storage suitable for ?
 - ❑ Store images and files
 - ❑ Stream video and audio
 - ❑ Log files
 - ❑ Store data for BKP and restore, DR



Azure Blobs Hands-on Lab

Storage Account



Container



Blobs - Files

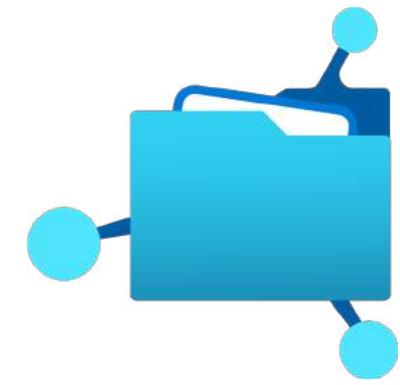


- unique namespace in Azure for your data
- similar to a directory in a file system; organizes blobs
- actual file



Azure Files Overview – SMB File Share

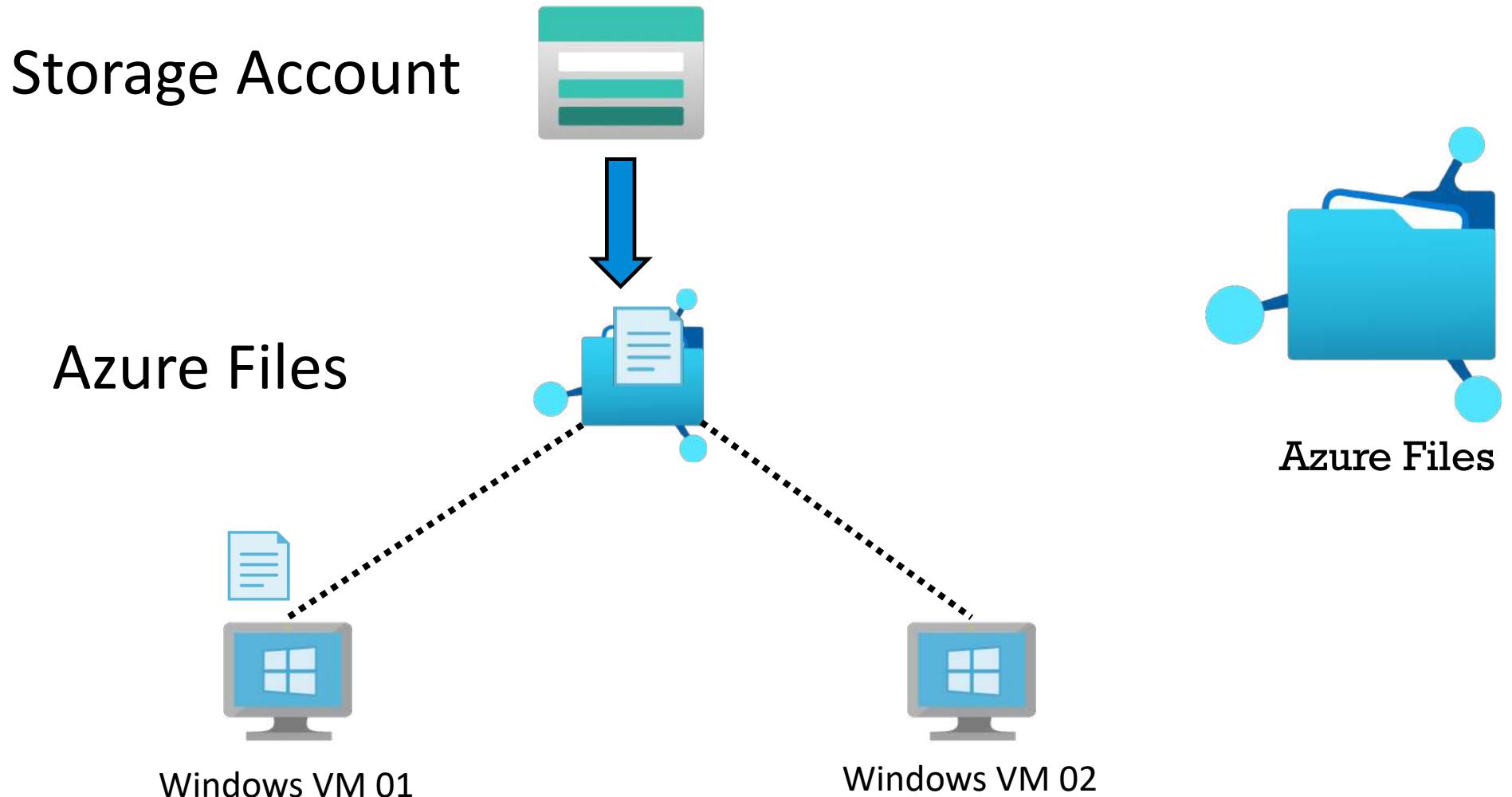
- Azure Files offers fully managed file shares in the cloud that are accessible via SMB protocol
- Azure File shares can be mounted (attached) by both on-premises and cloud machines
- Applications can mount a file share storage to access file data, just as a desktop application would mount a typical SMB share



Azure Files



Azure Files Hands-on Lab



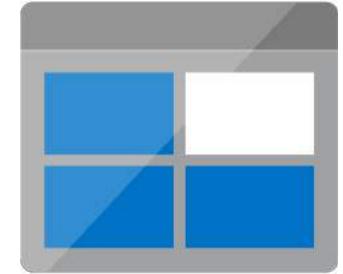


Module 15 - Azure Storage

Azure Blob Storage Fundamentals 101

Azure Blobs Overview – Unstructured Data

- Azure Blob storage is Microsoft's object storage solution for the cloud, optimized to store massive amounts of unstructured data (text or binary data)



- BLOB – Binary Large Objects

- Unstructured Data ?

- Any type of data can be stored, no restrictions

Blob Storage



Azure Blob Storage Lifecycle & Access Tiers

- ❑ Azure storage offers three access tiers:
 - ❑ Hot – frequently accessed data
 - ❑ Cool – infrequently accessed data (stored min. 30 days)
 - ❑ Archive – rarely accessed data (stored min. 180 days)
- ❑ Multiple access tiers available, we can build a storage lifecycle policy, which translates to cost-effective storage
- ❑ Policy : HOT -> COOL -> ARCHIVE

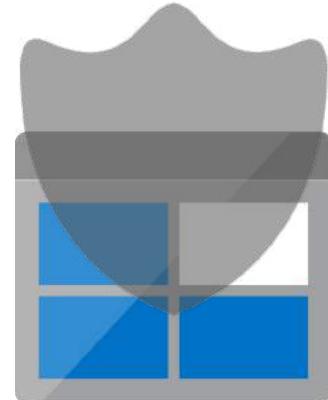


Blob Storage



Azure Storage Encryption

- Azure Storage automatically encrypts your data in Azure Cloud
- Encryption is done using:
 - Microsoft-managed encryption keys (Azure Storage Service Encryption-SSE)
 - Customer encryption keys (client-side encryption)

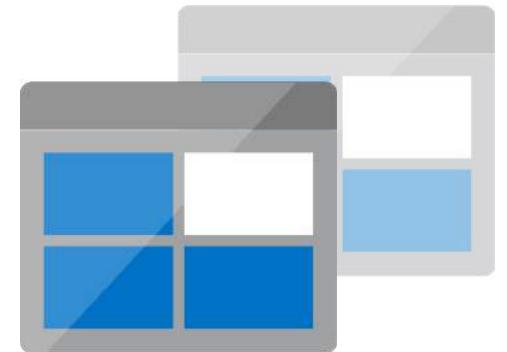


Storage Encryption



Azure Storage Replication

- ☐ Microsoft Azure always replicates data in your storage account to ensure durability and high availability
- ☐ Data can be replicated within the same DC, across zonal DCs within the same region or across geographically separated regions
- ☐ Multiple redundancy options exist, can be selected when storage account is created



Storage Replication



Azure Storage Replication

Replication

Access tier (default)

Read-access geo-redundant storage (RA-GRS) 

Locally-redundant storage (LRS)

Zone-redundant storage (ZRS)

Geo-redundant storage (GRS)

Read-access geo-redundant storage (RA-GRS)

Geo-zone-redundant storage (GZRS) (preview)

Read-access geo-zone-redundant storage (RA-GZRS) (preview)

- Locally Redundant Storage (LRS) replicates your data three times within a single data center
- Zone-Redundant Storage (ZRS) replicates your data across three storage clusters in a single region (3 AZs)



Azure Storage Replication

Replication ⓘ

Access tier (default) ⓘ

Read-access geo-redundant storage (RA-GRS)

Locally-redundant storage (LRS)

Zone-redundant storage (ZRS)

Geo-redundant storage (GRS)

Read-access geo-redundant storage (RA-GRS)

Geo-zone-redundant storage (GZRS) (preview)

Read-access geo-zone-redundant storage (RA-GZRS) (preview)

- Geo-Redundant Storage (GRS) replicates data to a secondary region (min. 300 miles away)
- RA-GRS provides read-only access to the data in the secondary location, in addition to geo-replication across two regions (GRS)



Microsoft Azure Administrator

Azure Storage Replication

Replication 

Access tier (default) 

Read-access geo-redundant storage (RA-GRS) 

Locally-redundant storage (LRS)

Zone-redundant storage (ZRS)

Geo-redundant storage (GRS)

Read-access geo-redundant storage (RA-GRS)

Geo-zone-redundant storage (GZRS) (preview)

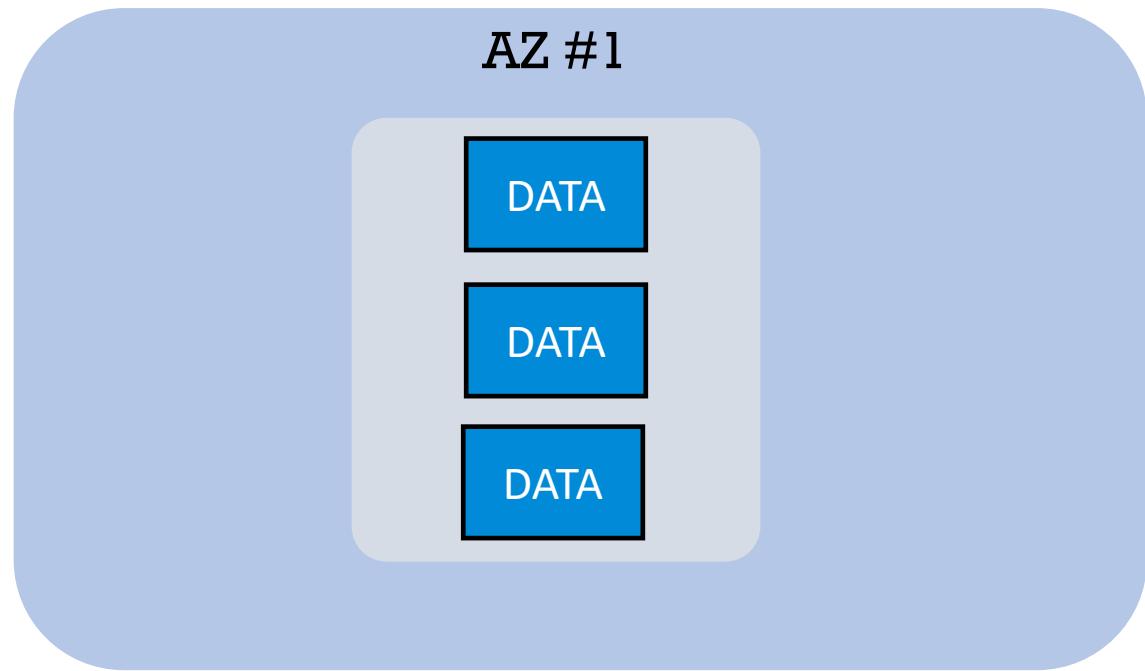
Read-access geo-zone-redundant storage (RA-GZRS) (preview)

- **Geo-Zone-Redundant Storage (GZRS) combines ZRS and LRS, data in 3 AZs (1st region) and in a 2nd region**
- **Read-Access GZRS enables read access to data in the secondary region**

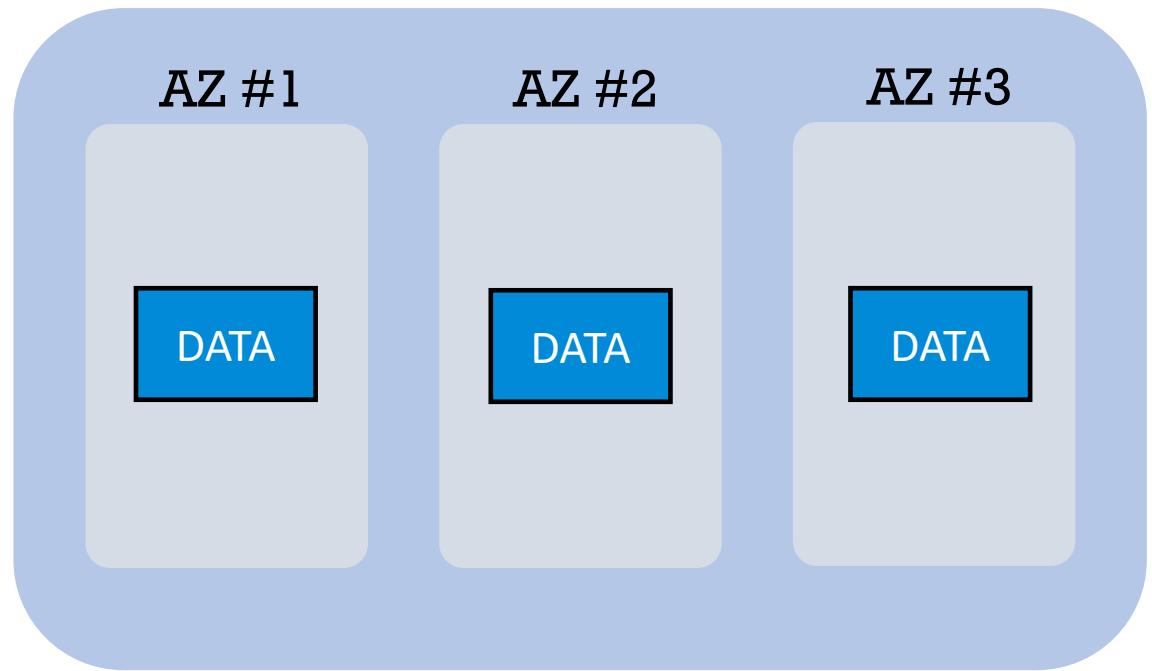


Azure Storage Replication – LRS and ZRS

Locally Redundant Storage (LRS)

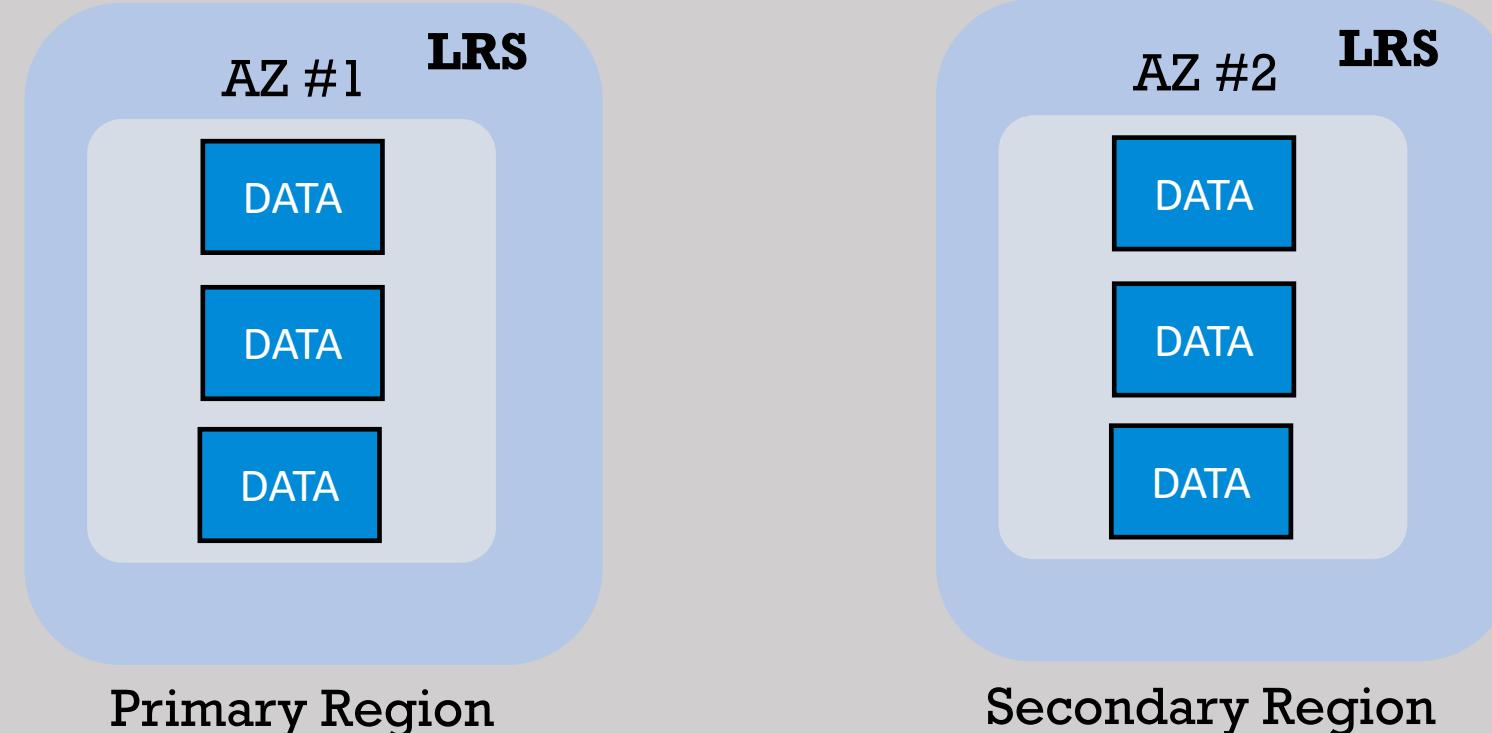


Zone Redundant Storage (ZRS)



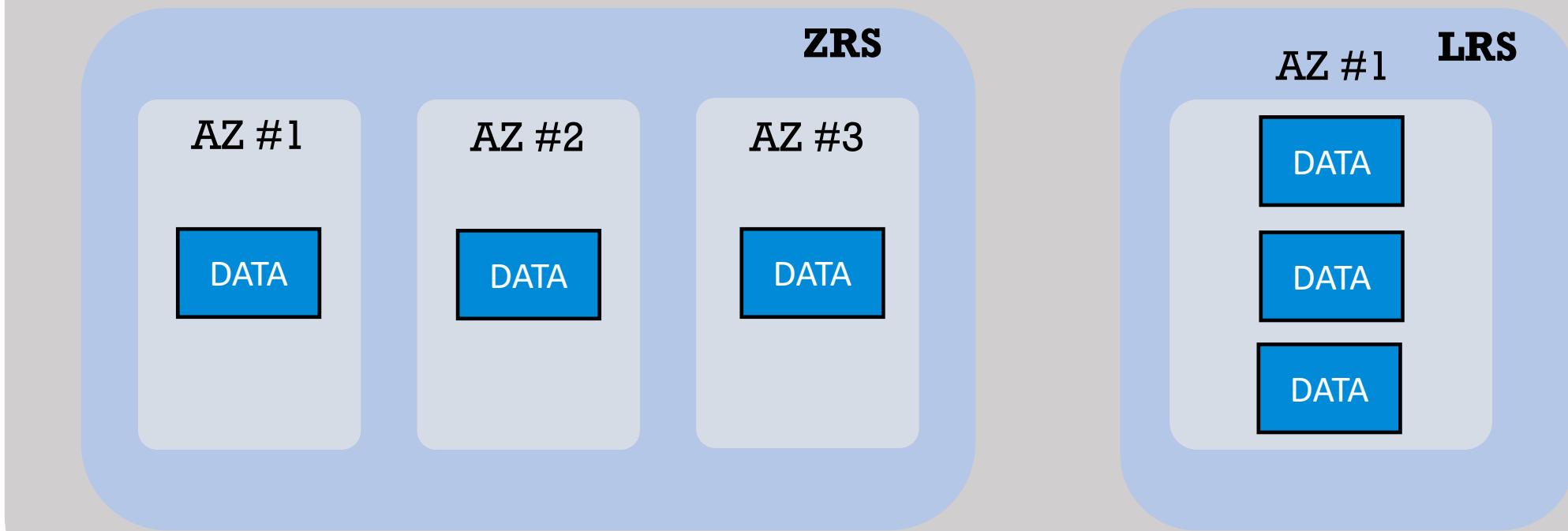
Azure Storage Replication - GRS

Geo-redundant storage (GRS) = 2 x LRS

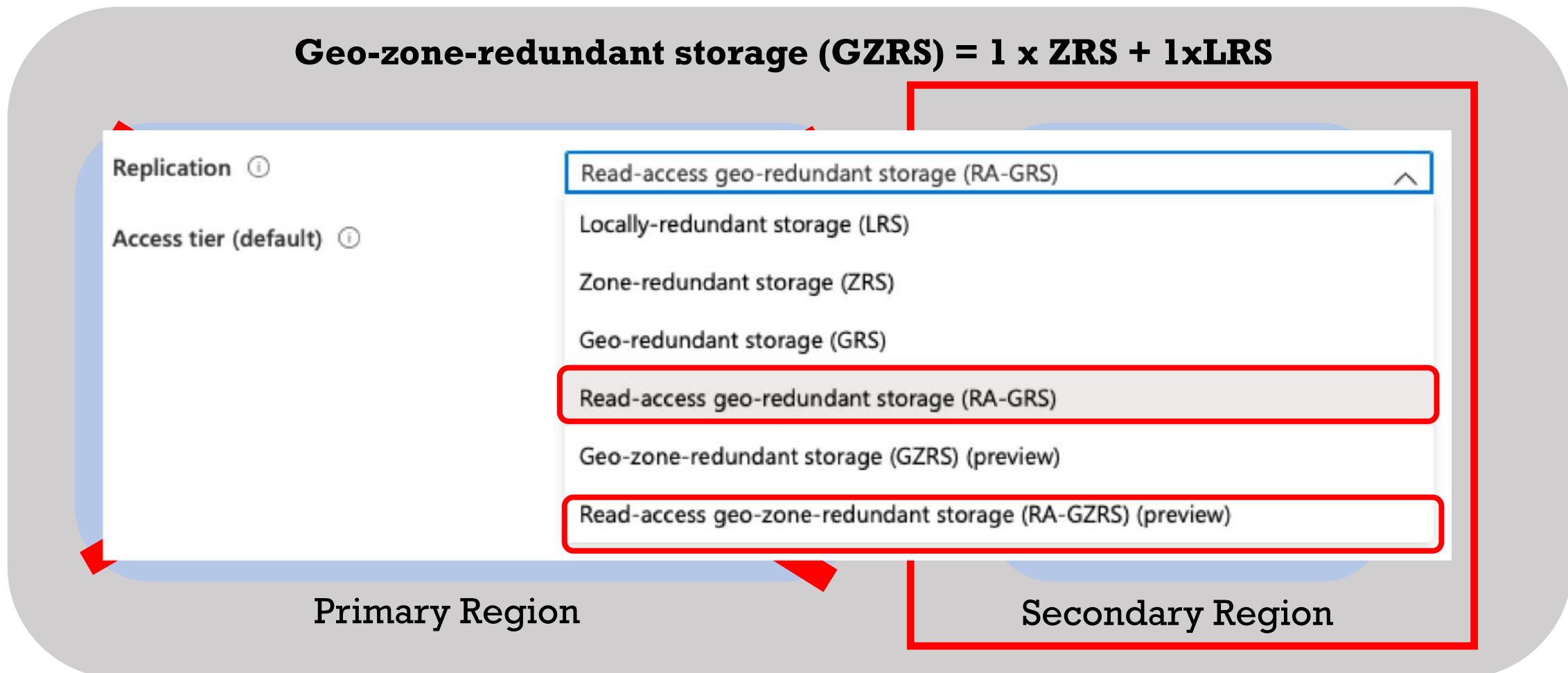


Azure Storage Replication - GZRS

Geo-zone-redundant storage (GZRS) = 1 x ZRS + 1xLRS



Azure Storage – Read Access in Secondary Region



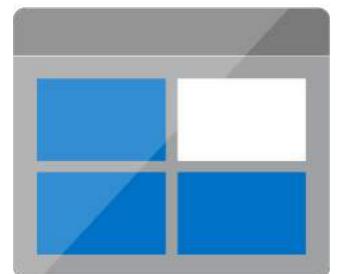


Module 15 - Azure Storage

Hands-on Lab - Create a Container and Upload Data to Azure

Blob Storage – Full URL Path

- ❑ Storage account:
 - ❑ <https://myaccount.blob.core.windows.net>
 - ❑ <https://az104trainingbootcamp.blob.core.windows.net>
- ❑ Storage container:
 - ❑ <https://myaccount.blob.core.windows.net/mycontainer>
 - ❑ <https://az104trainingbootcamp.blob.core.windows.net/container1>



Blob Storage





Module 15 - Azure Storage

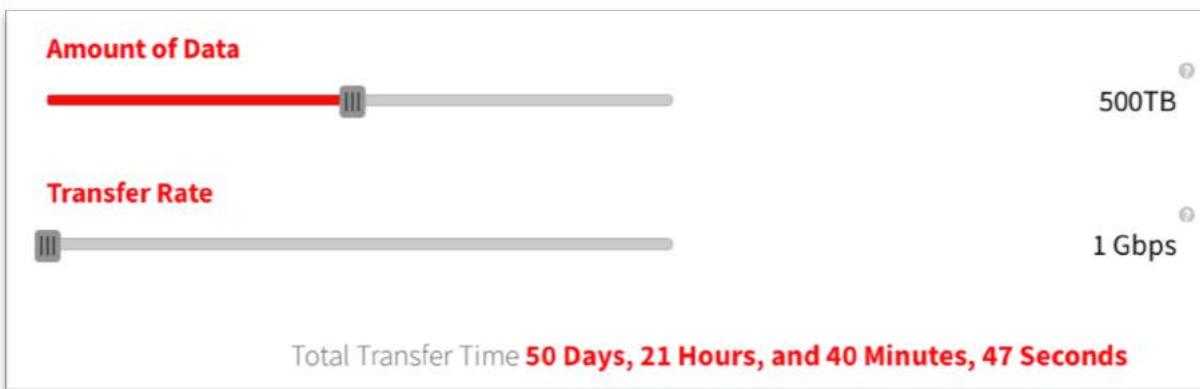
Manage Data with Azure Import/Export

Azure Storage – Available Tools

☐ Interact with Azure Storage:

- ☐ Azure Portal
- ☐ Azure CLI
- ☐ Azure PowerShell
- ☐ Azure Storage Explorer
- ☐ AzCopy

INTERNET



Azure Import/Export Overview

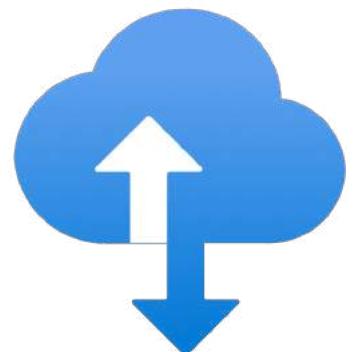
- Azure Import/Export service:
 - Import data to Azure Blob storage and Azure Files
 - Export data from Azure Blob
- How is this implemented ?
 - Disk drives are shipped between Azure <-> on-prem
 - These are customer's disk drives
- Import job – data into Azure
- Export job – data out of Azure (!not Files storage)
- Service helps to track import and export jobs



Import/Export

Supported Storage Accounts

- ❑ Azure Import/Export service supports all types of storage accounts:
 - ❑ Standard General Purpose v2 storage accounts
 - ❑ General Purpose v1 storage accounts
 - ❑ Blob Storage accounts
- ❑ Only Blob and Files storage supported
- ❑ Export not available for Files storage



Import/Export

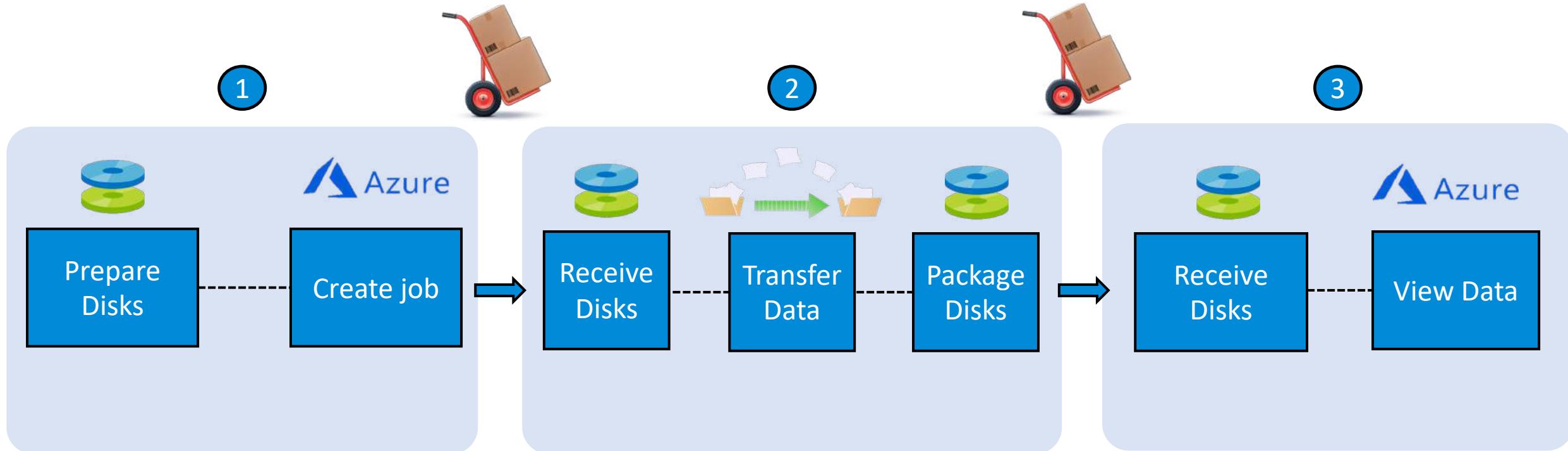


WAImportExport Tool

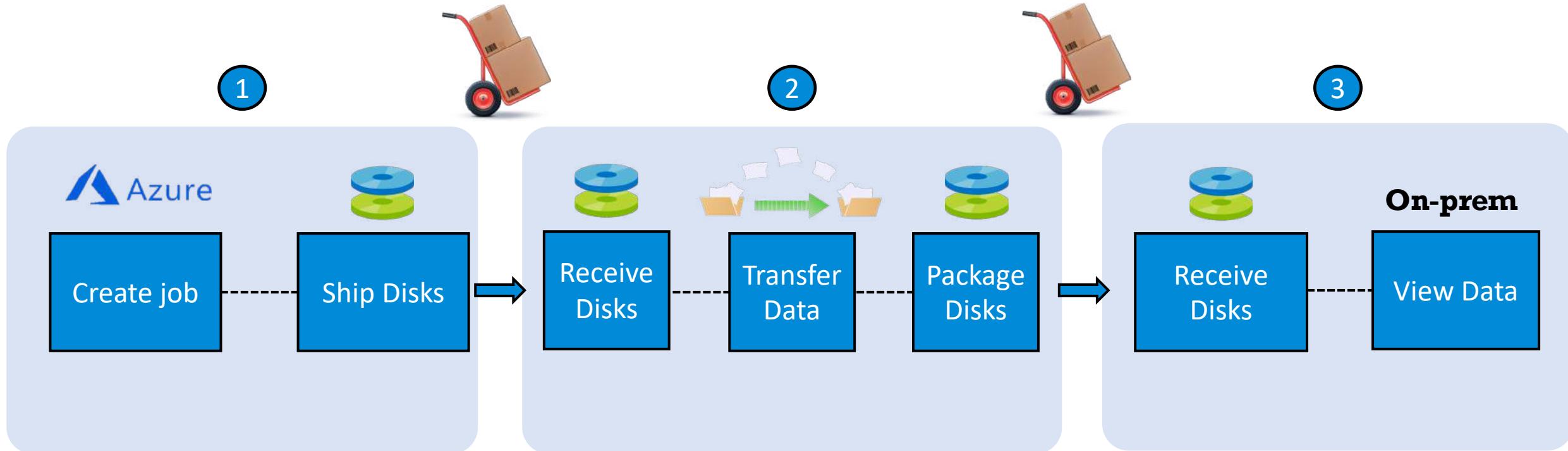
- ❑ WAImportExport command-line tool:
 - ❑ Prepares disk drives that are shipped for import
 - ❑ Encrypts the data with AES 128/256-bit BitLocker
 - ❑ Generates the journal files used for import/export jobs
 - ❑ Helps identify no. of drives needed for export jobs
- ❑ WAImportExport tool version:
 - ❑ Version 1 – import/export to/from Blob Storage
 - ❑ Version 2 – import to Azure Files



Import Data to Azure

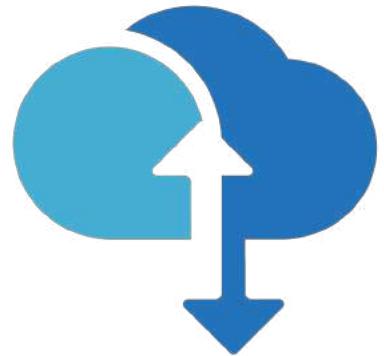


Export Data to Azure



Azure Data Box Family

- ❑ Azure Data Box allows you send TB of data into and out of Azure, using Microsoft's proprietary boxes
- ❑ Each storage device has a maximum usable storage capacity of 80 TB
- ❑ You can use Azure Data Box for import and export jobs
- ❑ Data Box is a good fit when transferring data sizes larger than 40 TBs



Azure Data Box



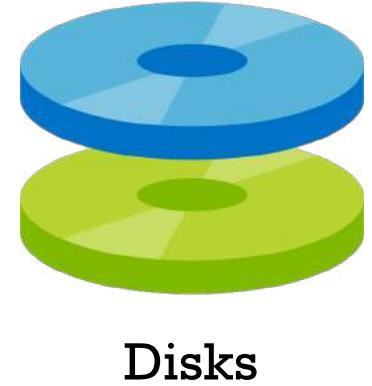


Module 15 - Azure Storage

Azure Managed Disks Fundamentals 101

Storage for VMs - Overview

- The hard drive is where a computing device stores data for short or long term
- Available disks types in Azure:
 - Unmanaged disks
 - Managed disks
- Data stored in a VHD is stored in a storage account
- Who manages the storage account ?
 - Azure
 - Customer

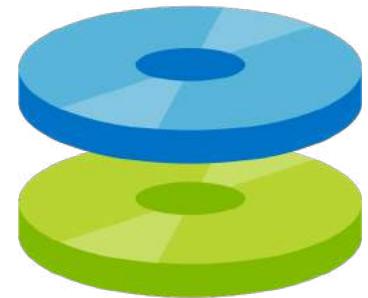


Disks



Azure Managed Disks Introduction

- Azure managed disks are block-level storage volumes that are managed by Azure and used with Azure VMs
- Azure Managed Disks - Recommended
 - Azure will manage the storage account for you that will store the *.VHD file
- You only need to specify the disk size, the disk type and provision the disk
- Options: Standard HDD/SSD, Premium SSD, Ultra Disks



Disks

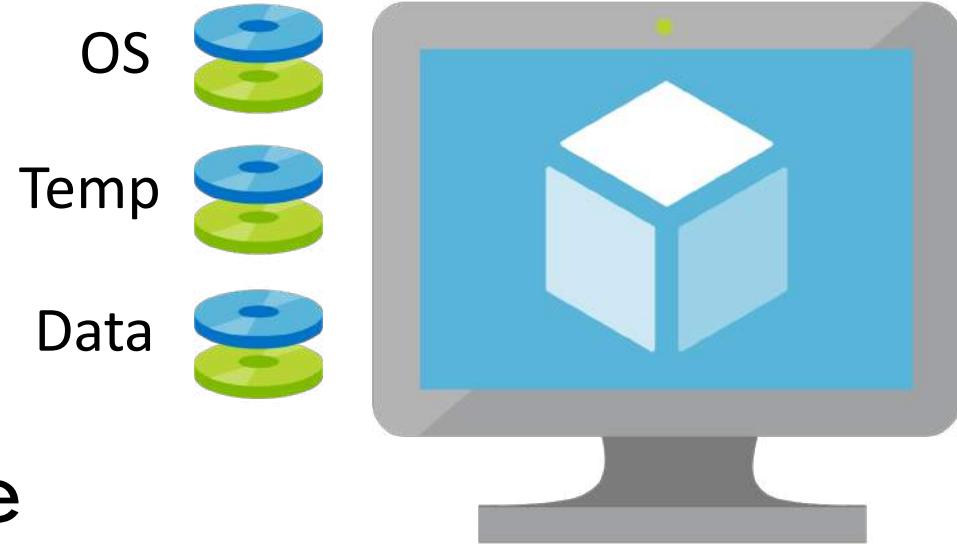
Azure Disk Types

- Standard HDD
 - Non-critical workloads, max. 500 MB/s & 2000 IOPS
- Standard SSD
 - Web servers, light apps, max 750 MB/s & 6000 IOPS
- Premium SSD
 - Production workloads, max 900 MB/s & 20.000 IOPS
- Ultra Disks
 - IO Intensive apps, 2 TB/s & 160.000 IOPS



Azure Disk Roles

- In Azure, there are currently three main disk roles:
 - OS disk
 - Temporary disk
 - Data disk
- OS disk – pre-installed OS
- Temporary disk – short-term storage
 - Data persists a VM reboot
 - Power off – data is lost
- Data disk – Persistent data



Azure Managed Disks - Benefits

- ❑ Highly durable and Highly available
 - ❑ 99,999% availability
 - ❑ 99.999999999% (11 9's) -> Locally Redundant Storage
 - ❑ 99.9999999999999% (16 9's) -> Geo-ZRS
- ❑ Deploy VMs simple and highly scalable
 - ❑ 50,000 VM disks of a type in a subscription per region
- ❑ Fully integrated with availability sets
 - ❑ Disks are isolated from each other to avoid a single point of failure (SPOF)



Azure Managed Disks - Benefits

- ❑ Fully integrated with availability zones
 - ❑ Disks are isolated from each other, protects you from datacenter failures
- ❑ Granular access control
 - ❑ Assign specific permissions for a managed disk to one or more users

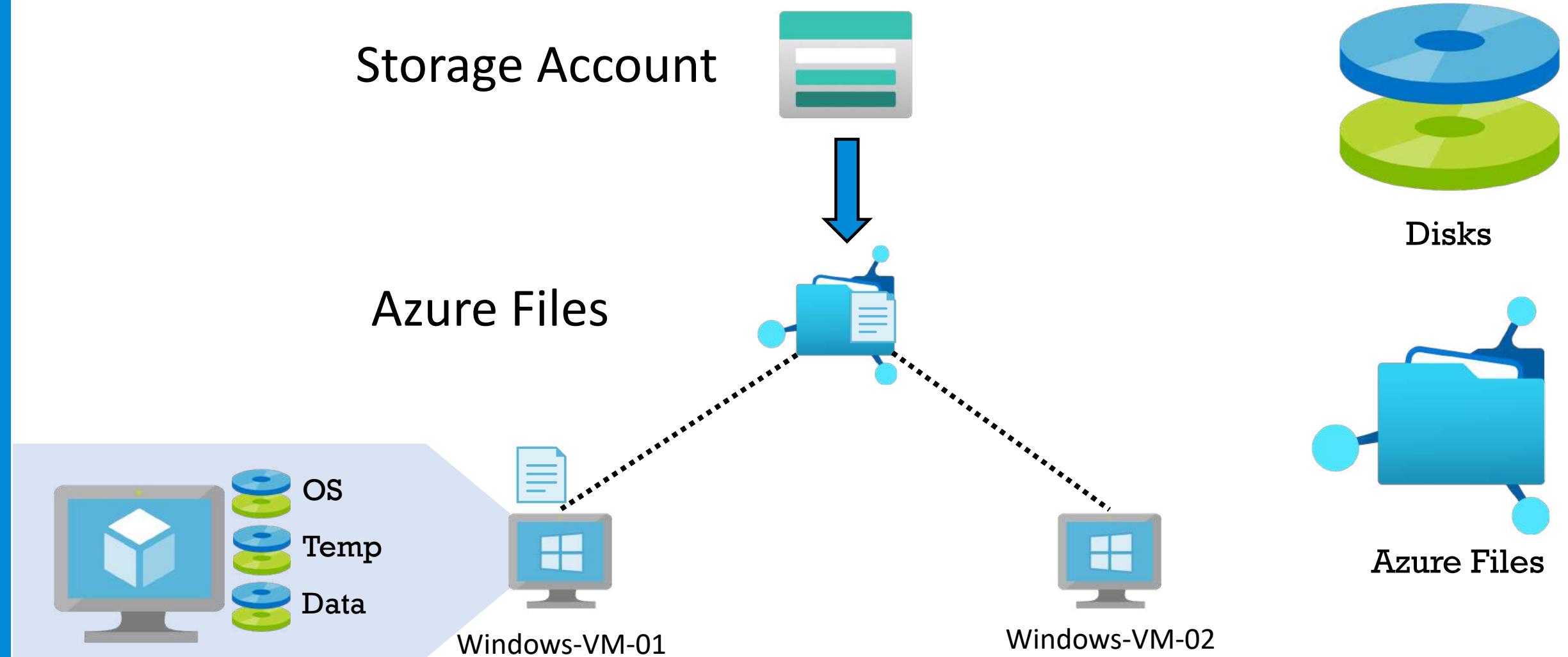




Module 15 - Azure Storage

Hands-on Lab - Launch Windows VMs in Azure Portal

In the next hands-on labs ...



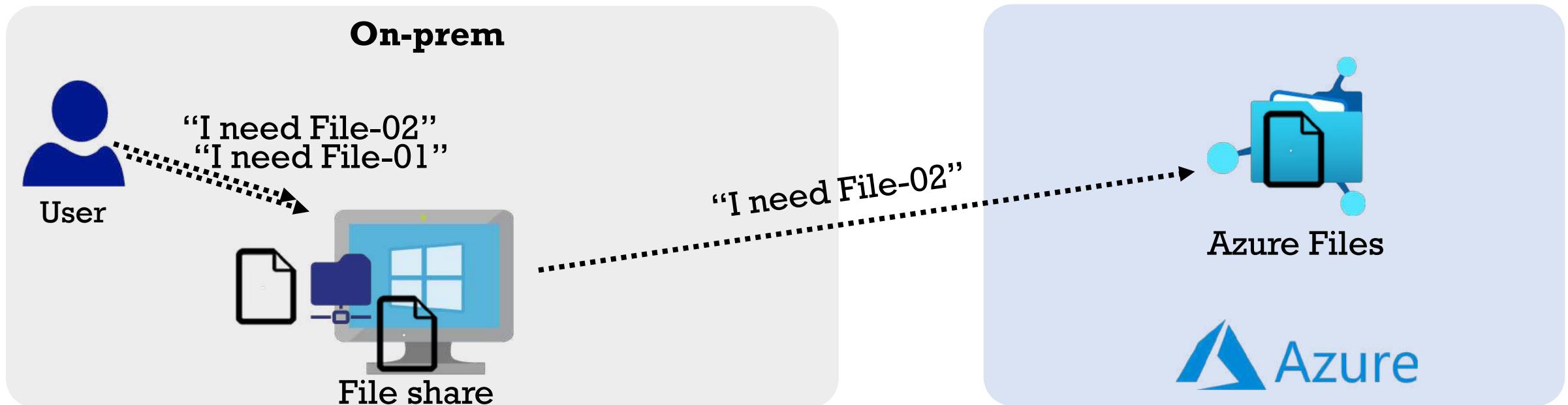


Module 15 - Azure Storage

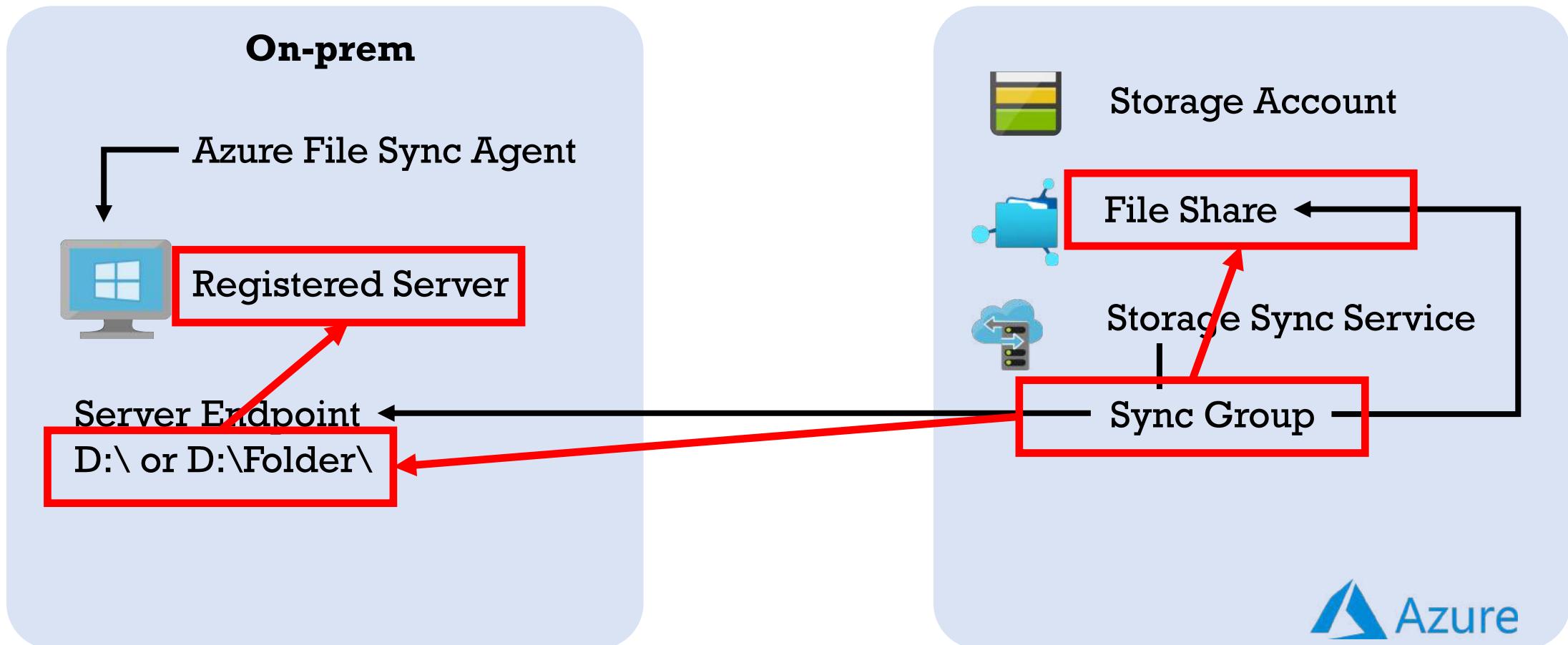
Introduction to Azure File Sync

Azure File Sync Overview

- Azure File Sync allows you to cache file shares on an on-premises Windows Server



Azure File Sync – Components and Terminology



In the next hands-on labs ...

- 1. Evaluate Windows Server
- 2. Create File Sync resources in Azure
- 3. Install Azure File Sync agent
- 4. Register Windows Server with Storage Sync Service
- 5. Create the server endpoint





Module 15 - Azure Storage

Hands-on Lab - Deploy File Sync on Windows Server

Install Azure File Sync Agent

- Download the Agent:

- <https://go.microsoft.com/fwlink/?linkid=858257>



Microsoft Azure Administrator



Module 15 - Azure Storage

Azure Storage Security

Azure Storage Security Overview

- Azure Storage security features:
 - Data encryption, at-rest and in-transit
 - Storage account keys
 - Shared access signatures
 - Network access control to storage account
- Role-based access control (RBAC) is also available
 - Create RBAC roles and assign to users
 - Admin role, read-only role, contributor role, etc.



Storage Account



Azure Storage Security Features

❑ Encryption

- ❑ At-rest - Storage Service Encryption (SSE) with a 256-bit Advanced Encryption Standard (AES) cipher

Encryption Encryption scopes (preview)

Save Discard

Storage service encryption protects your data at rest. Azure Storage encrypts your data as it's written to the storage account. By default, data in the storage account is encrypted using Microsoft-managed keys. Encryption for support is not enabled for tables and queues in this account.

Please note that after enabling Storage Service Encryption, only new data will be encrypted, and existing data will be processed. [Learn more about Azure Storage encryption](#)

Infrastructure encryption Disabled Enabled

Encryption type Microsoft-managed keys Customer-managed keys

- ❑ In-transit – data is encrypted between Azure and client, using HTTPS

Secure transfer required Enabled Disabled



Storage Account Keys

- ❑ Account access keys - authorize access to data in your storage account
- ❑ Don't share! Manage & protect - Azure Key Vault



- ❑ VM → Storage account access keys → Blob Storage



Shared Access Signatures (SAS)

- ❑ Shared access signature – string that contains a security token that can be attached to a URI
- ❑ Provide and control access to third-party using SAS

Allowed services ⓘ
 Blob File Queue Table

Allowed resource types ⓘ
 Service Container Object

Allowed permissions ⓘ
 Read Write Delete List Add Create Update Process

Blob versioning permissions ⓘ
 Enables deletion of versions

Start and expiry date/time ⓘ
Start
End
(UTC+00:00) Dublin, Edinburgh, Lisbon, London

Allowed IP addresses ⓘ
for example, 168.1.5.65 or 168.1.5.65-168.1.5.70

Allowed protocols ⓘ
 HTTPS only HTTPS and HTTP



Firewall and Network Access

- By default, all clients including the Internet, can access the storage account

The screenshot shows the 'Firewalls and virtual networks' section of the Azure Storage account settings. The 'Selected networks' radio button is selected under 'Allow access from'. The 'Virtual networks' section shows a table with columns for 'Virtual Network', 'Subnet', and 'Address range', and a note that 'No network selected.' The 'Firewall' section allows adding IP ranges, with a note to 'Add IP ranges to allow access from the internet or your on-premises networks.' and a checkbox for 'Add your client IP address'. The 'Address range' input field is empty. The left sidebar lists other settings: Events, Storage Explorer (preview), Access keys, Geo-replication, CORS, Configuration, Encryption, Shared access signature, Firewalls and virtual networks (selected), and Private endpoint connections.

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
No network selected.		

Firewall

Add IP ranges to allow access from the internet or your on-premises networks. [Learn more](#).

Add your client IP address

Address range

IP address or CIDR

Events

Storage Explorer (preview)

Settings

Access keys

Geo-replication

CORS

Configuration

Encryption

Shared access signature

Firewalls and virtual networks

Private endpoint connections





Module 15 - Azure Storage

Azure Storage Security

Provide access with SAS token

- ❑ Complete URL:
- ❑ `https://<Blob_URL><SAS_Token>`





Module 15 - Azure Storage

Hands-on Lab - Copy Data using AzCopy Tool

AzCopy Utility - Overview

- ❑ AzCopy is a command-line utility that you can use to copy blobs or files to or from a storage account
- ❑ AzCopy software – executable file
 - ❑ <https://aka.ms/downloadazcopy-v10-windows>
 - ❑ <https://aka.ms/downloadazcopy-v10-windows-32bit>
 - ❑ <https://aka.ms/downloadazcopy-v10-linux>
 - ❑ <https://aka.ms/downloadazcopy-v10-mac>
- ❑ Windows OS – PowerShell, Mac OS/Linux - Terminal



AzCopy Utility – Authorization Credentials

- ❑ Authentication – prove your identity
- ❑ Authorization = permissions, allowed actions
- ❑ You can provide authorization credentials by using Azure Active Directory (AD), or by using a Shared Access Signature (SAS) token
 - ❑ Azure AD – in the next module
 - ❑ Shared Access Signature (SAS) token





Module 15 - Azure Storage

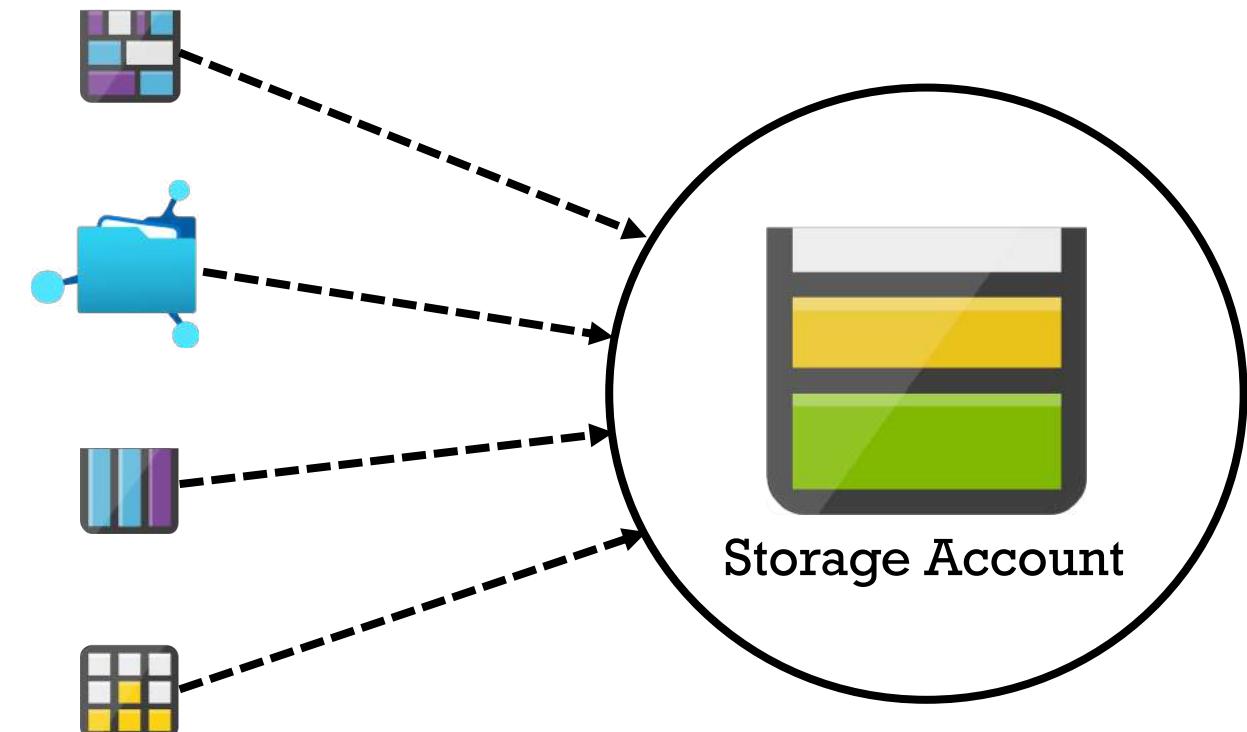
Module Completion & Exam Hints



Intro to Azure Storage

Azure Storage Services Overview

- Azure Storage includes the following data services:
 - Azure Blobs ✓
 - scalable object store
 - Azure Files ✓
 - managed file share
 - Azure Queues X
 - messaging store
 - Azure Tables X
 - NoSQL structured data





Tools to Work in Azure Storage

Tools to interact with Azure Storage

- ❑ Azure Portal, CLI, PowerShell – default options
- ❑ Azure Storage Explorer
 - ❑ Two options: in Azure portal or separate application
- ❑ AzCopy – executable, runs on any OS
 - ❑ `azcopy copy <source> <destination>`
 - ❑ `azcopy copy D:/Folder https://<storageaccounname>.blob.core.windows.net/<container>`
- ❑ AzCopy – copy data to only Blob and Files Storage !
- ❑ Auth and Authorization: Blob: Azure AD & SAS, File: SAS



Storage Tiers



Storage Tiers - Overview

- ❑ Azure storage tiers:
 - ❑ Hot - frequently accessed data
 - ❑ Cool - infrequently accessed data (min. 30 days)
 - ❑ Archive - rarely accessed (min. 180 days)
- ❑ Azure Blob storage lifecycle
 - ❑ Transition blobs to a cooler storage tier (hot to cool, hot to archive, or cool to archive) to optimize cost
 - ❑ Delete blobs at the end of their lifecycles

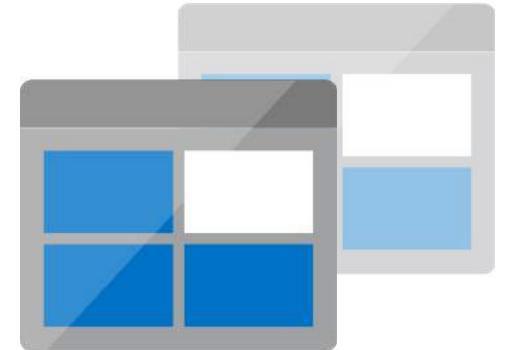




Azure Storage Replication

Azure Storage Replication

- ☐ Microsoft Azure always replicates data in your storage account to ensure durability and high availability
- ☐ Data can be replicated within the same DC, across zonal DCs within the same region or across geographically separated regions
- ☐ Multiple redundancy options exist, can be selected when storage account is created

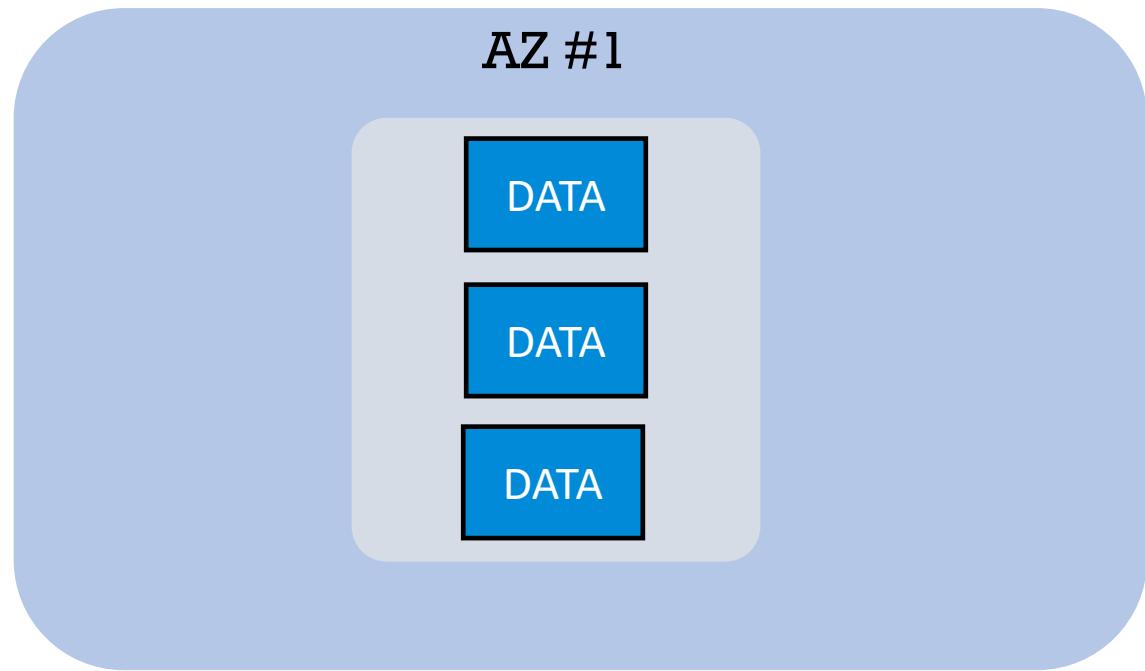


Storage Replication

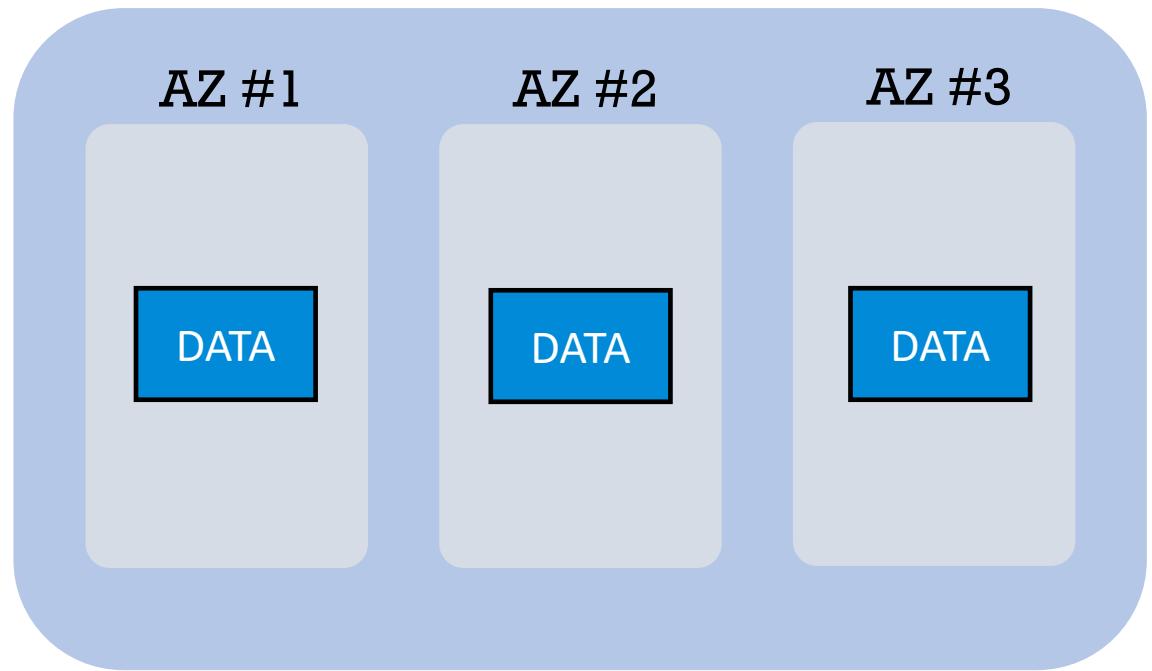


Azure Storage Replication – LRS and ZRS

Locally Redundant Storage (LRS)

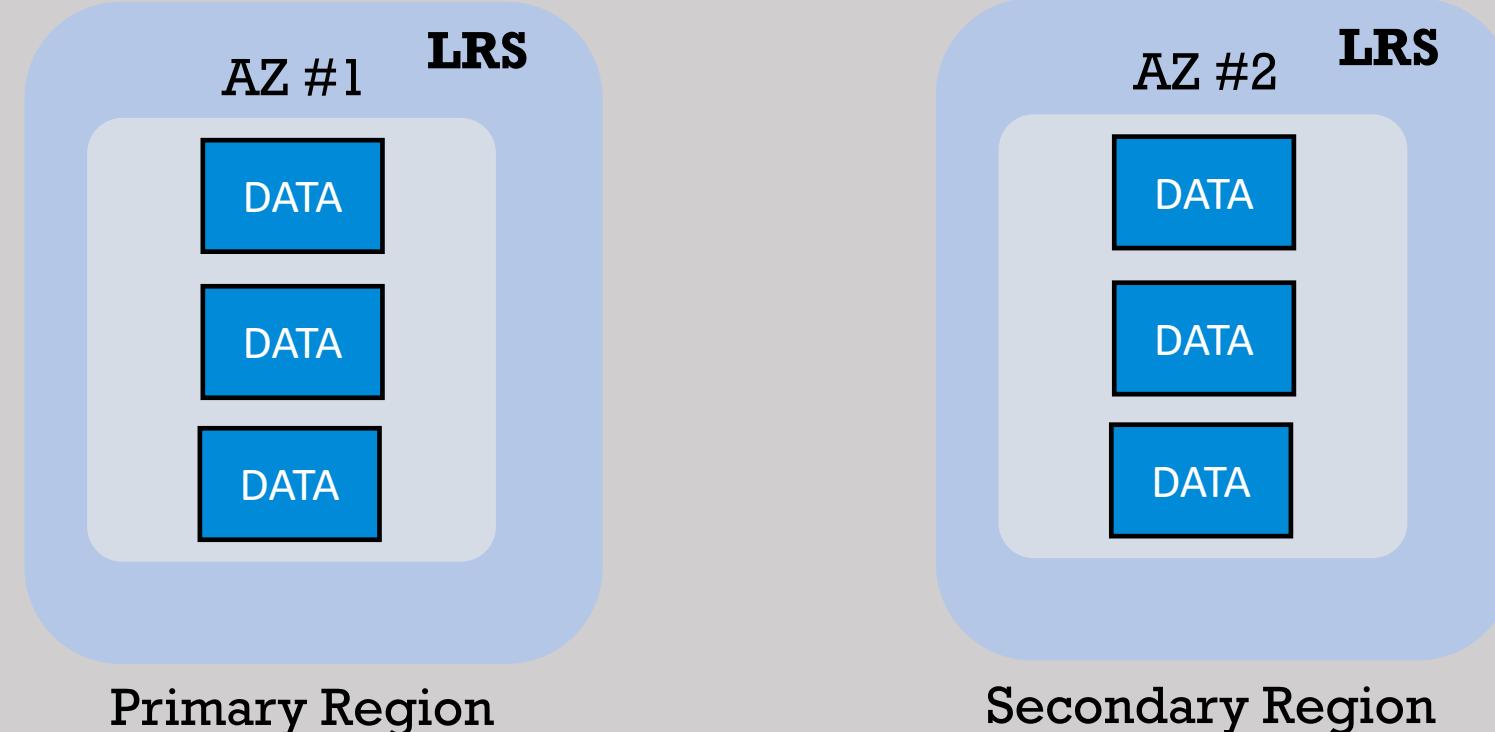


Zone Redundant Storage (ZRS)



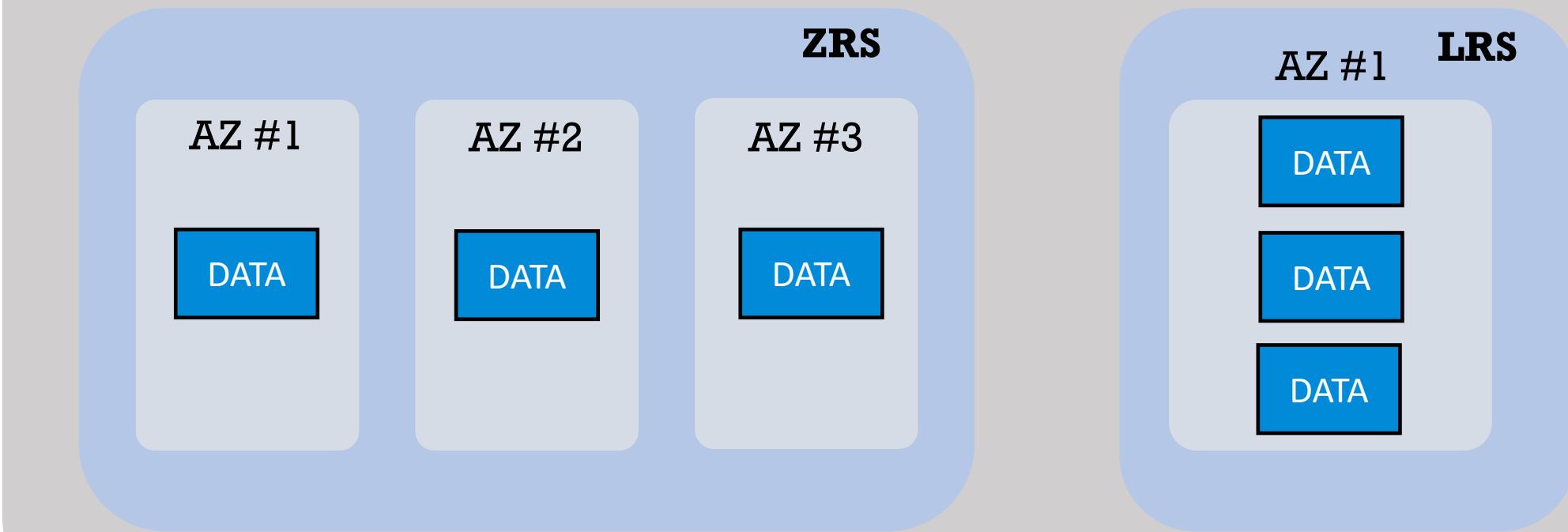
Azure Storage Replication - GRS

Geo-redundant storage (GRS) = 2 x LRS

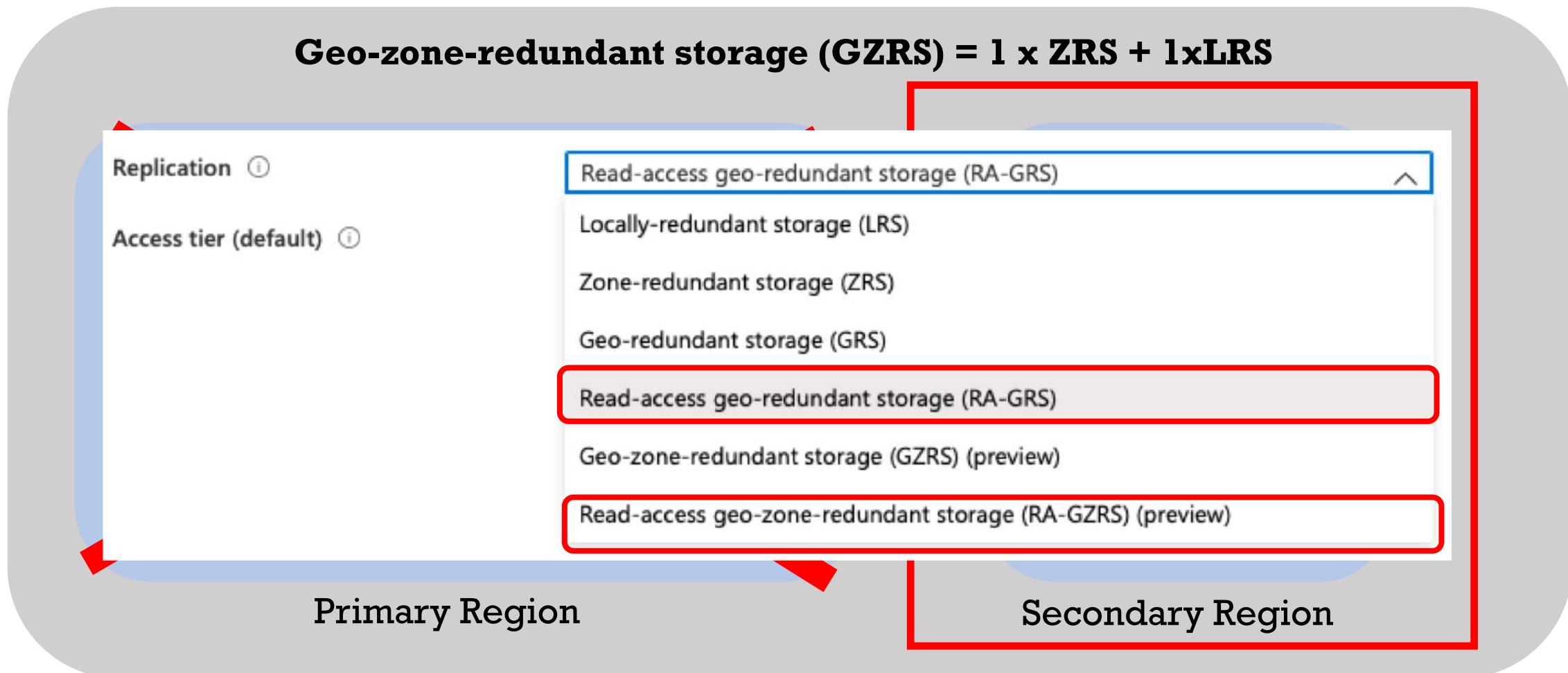


Azure Storage Replication - GZRS

Geo-zone-redundant storage (GZRS) = 1 x ZRS + 1xLRS



Azure Storage – Read Access in Secondary Region





Azure Import/Export

Azure Import/Export Overview

- Azure Import/Export service:
 - Import data to Azure Blob storage and Azure File Share
 - Export data from Azure Blob
- Disk drives are shipped between Azure <-> on-prem
- Import job:
 - Run WAImportExport Tool
 - Create import job in Azure portal
 - Detach disks and send them to Azure
 - Update import job



Import/Export

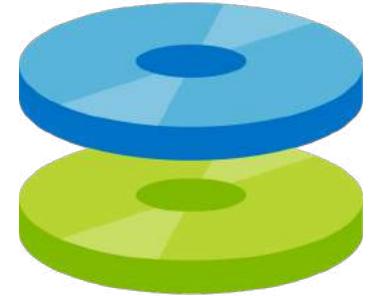




Storage for VMs

Storage for VMs - Overview

- Available disks types in Azure:
 - Unmanaged disks
 - Managed disks
- Data stored in a VHD is stored in a storage account
- Options: Standard HDD/SSD, Premium SSD, Ultra Disks
- In Azure, there are currently three main disk roles:
 - OS disk, Temporary disk, Data disk



Disks

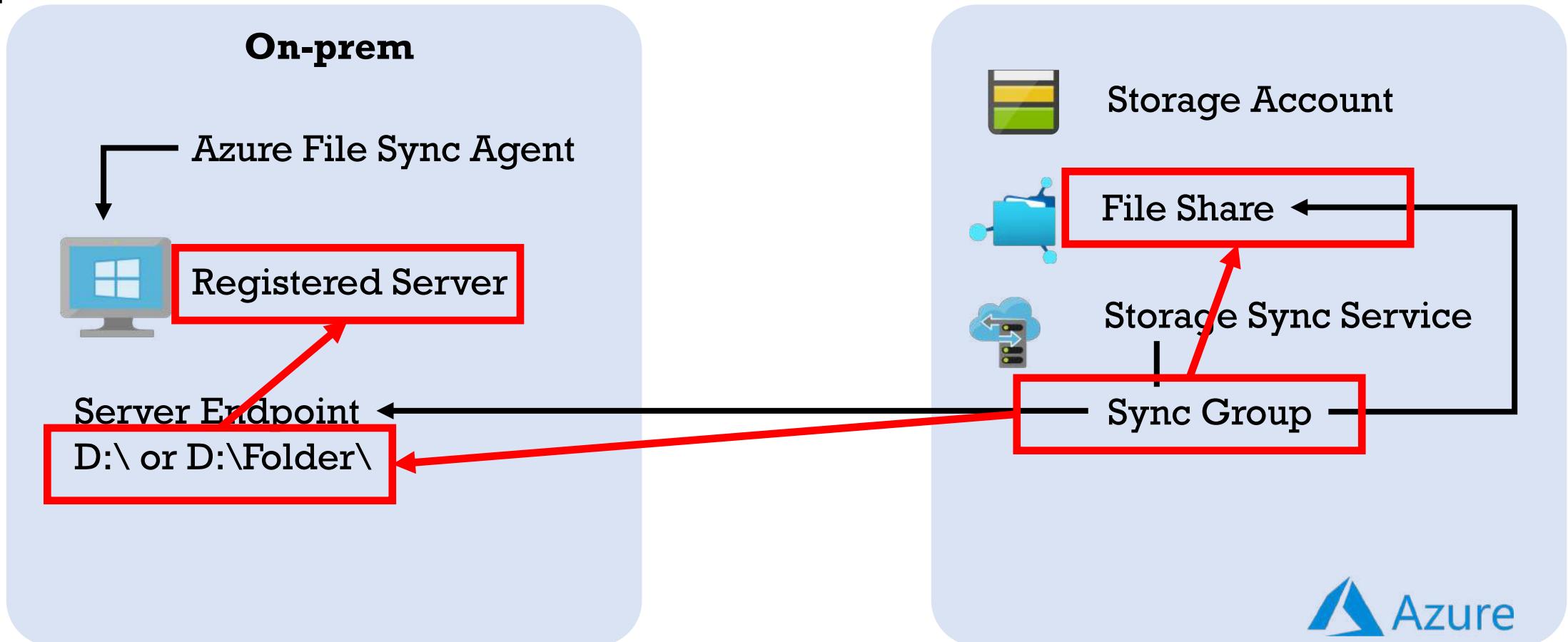




Azure File Sync – Sync Service

Azure File Sync Overview

- Azure File Sync allows you to cache file shares on an on-premises Windows Server



Azure File Sync – Rule

- A sync group must contain only one cloud endpoint (which represents an Azure file share) and one or more server endpoints (folders on registered servers)





Azure Storage Security

Storage Account Keys

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- ❑ Don't share! Manage & protect - Azure Key Vault



- ❑ VM → Storage account access keys → Blob Storage



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Allowed services ⓘ
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End
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Allow access from

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Add your client IP address

Address range

IP address or CIDR

Events

Storage Explorer (preview)

Settings

Access keys

Geo-replication

CORS

Configuration

Encryption

Shared access signature

Firewalls and virtual networks

Private endpoint connections



Azure Storage - Quiz



Microsoft Azure Administrator



Module 16 - Azure Active Directory

Azure Active Directory (AD) Overview

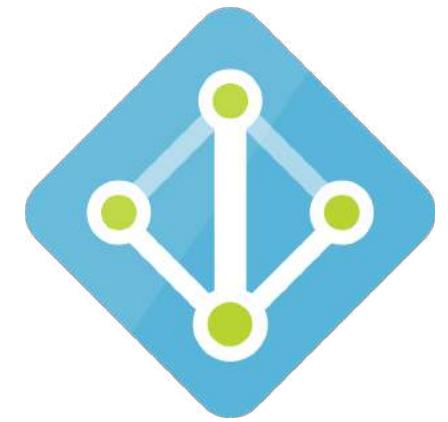
What is Active Directory?

- Active Directory (AD) is a Microsoft technology used to create and manage domains, users and objects
 - domain – group of computers
- IT Admins can create groups of users and assign necessary access permissions to directories
- Active Directory provides several different services, which fall under the umbrella of "Active Directory Domain Services" or AD DS



What is Azure Active Directory?

- Azure AD is a cloud-based identity management solution
 - Cloud-based apps: Azure, Microsoft 365 (email, etc.)
 - Corporate network apps
- Azure AD stores users deployed in a tenant
- Each tenant can have multiple groups, that hold multiple users, and different access levels are applied at the group level



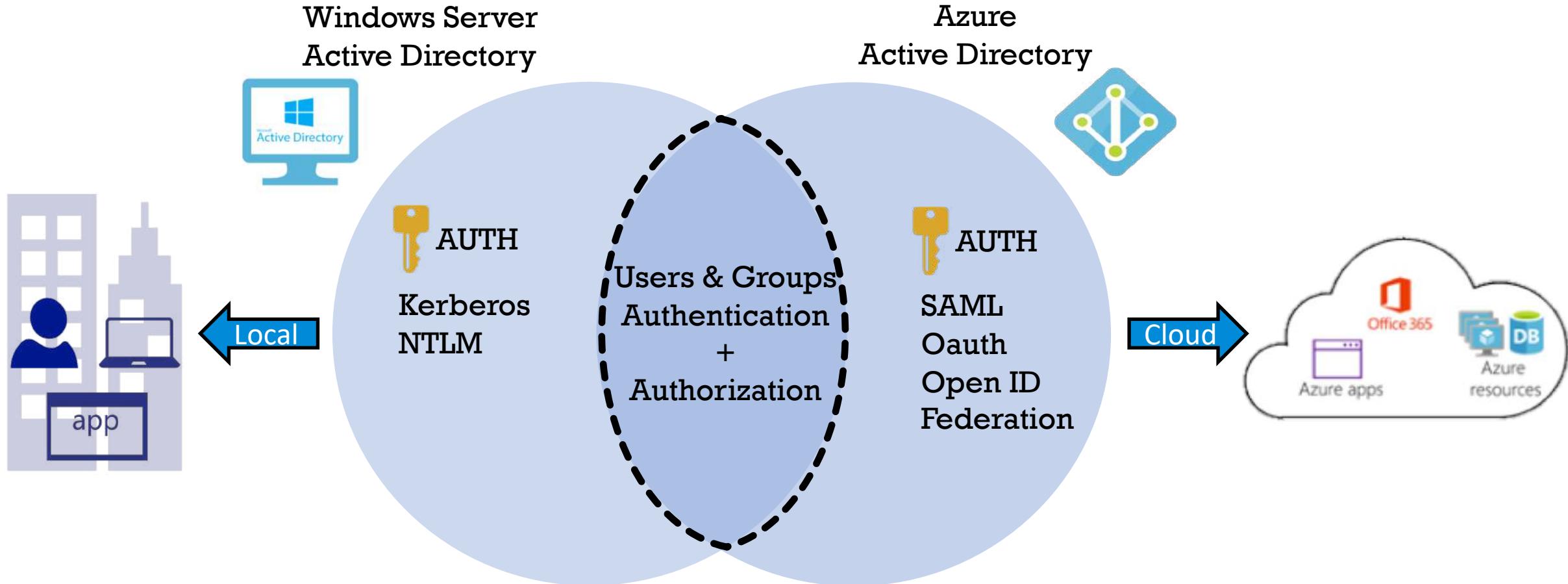
Azure AD



Active Directory vs Azure AD

On-prem Apps

Cloud Apps



Azure Active Directory – Terminology

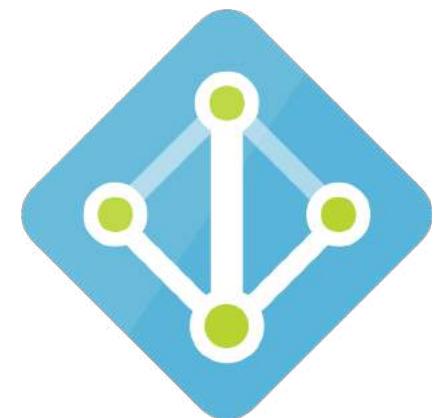
- Azure AD Tenant – an instance of an Azure AD
- Azure AD Directory – includes users, groups, apps
- Global Administrator – full administrator of Azure AD
- Owner role - manage all resources in Azure
- Identity – user, app, service
- Account – identity with data associated to it



Azure AD

Azure AD Licensing Options

- Azure Active Directory Free**
 - Manage users & groups, SSPR, SSO, AD sync, etc.
- Azure Active Directory Premium P1**
 - Dynamic groups, SSPR for on-prem, etc.
- Azure Active Directory Premium P2**
 - AD Identity Protection
- Pay-as-you-go**
 - Pay per feature; AD B2B, AD B2C, etc.



Azure AD



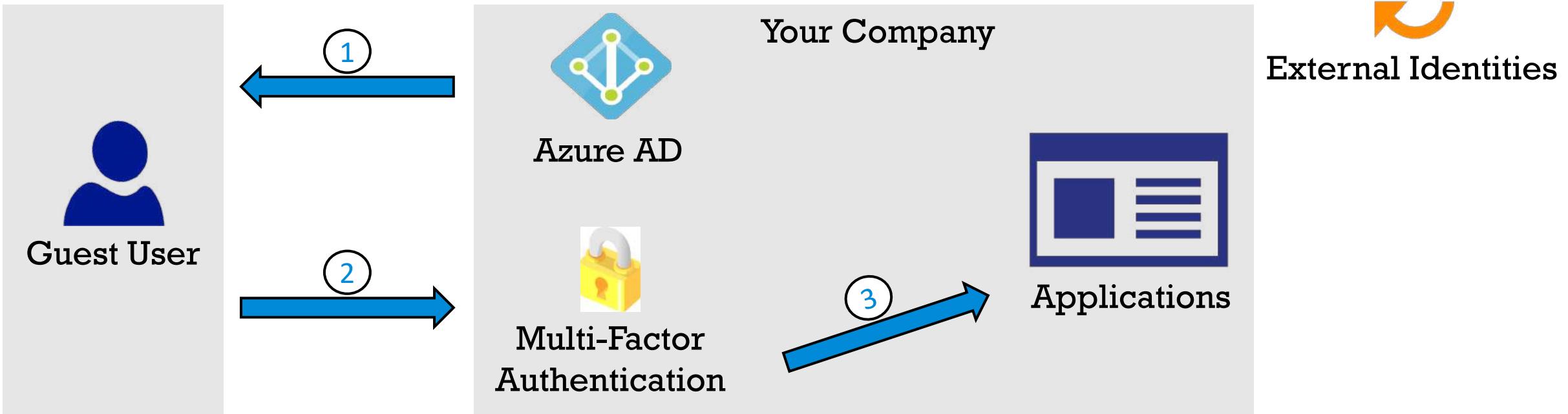


Module 16 - Azure Active Directory

Azure Active Directory - Main Features

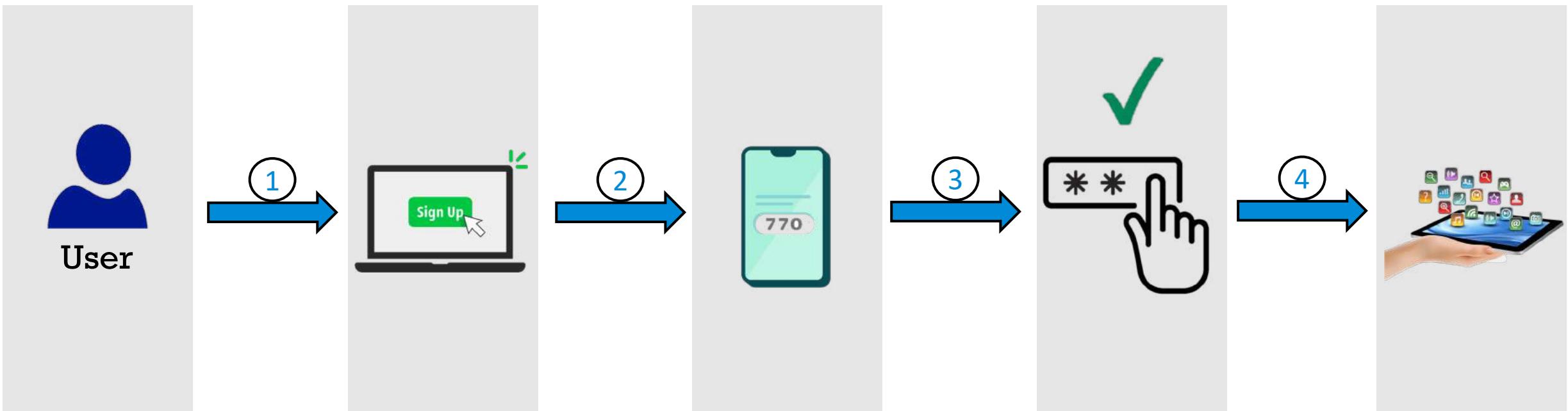
Azure AD B2B

- ❑ Azure AD B2B - invite guest users to collaborate with your organization
- ❑ External partners don't need Azure AD!



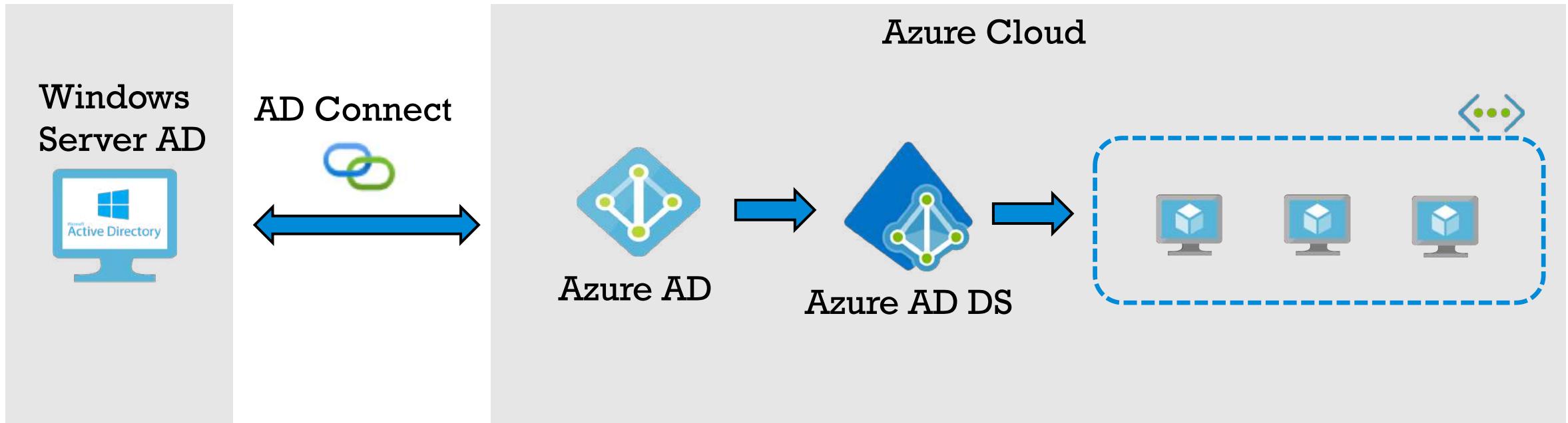
Azure AD B2C

- ❑ Azure AD B2C - manage your customers' identities and access
- ❑ Independent of Azure AD, provides auth. to users !



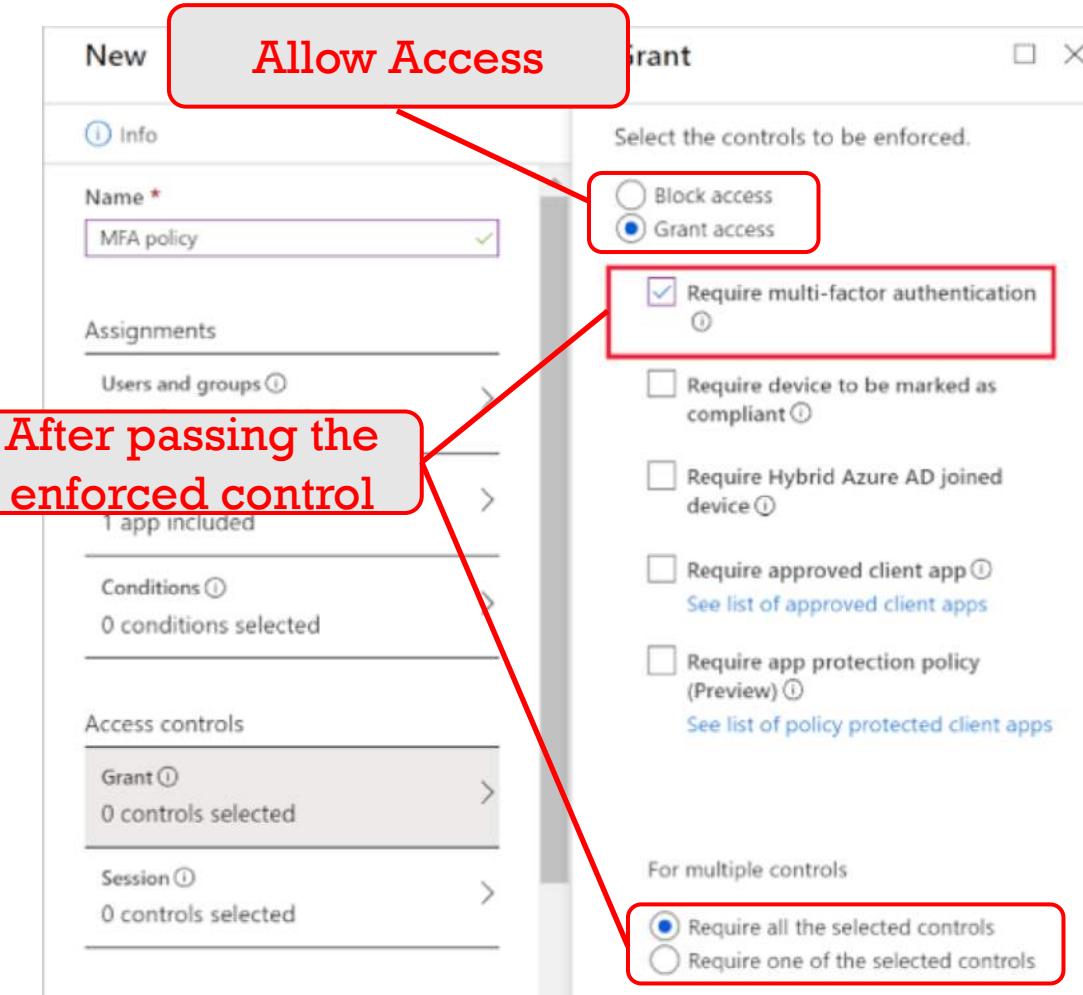
Azure AD DS – Domain Services

- Azure AD DS - add virtual machines to a domain without needing domain controllers



Conditional-Access Policies

- ❑ Conditional-access policies require users to pass additional auth. challenges, before access is allowed
- ❑ Conditional Access policies are “if-then” statements
- ❑ Available with P1 and P2 licensing tiers



Azure AD Identity Protection

- Azure AD Identity Protection allows you to accomplish:
 - Automate detection & remediation of risks
 - Investigate risks
 - Export risk detection data for further analysis
- User Risk and Sign-in Risk
- Examples:
 - Unusual travel, Anonymous IP address
- High | Medium | Low | No Risk → Define Policies !



AD Identity
Protection





Module 16 - Azure Active Directory

Device Identity and Azure AD Join

What is Device Identity ?

- ❑ IT professionals are faced with two opposing goals:
 - ❑ Allow users to be productive
 - ❑ Protect the organization's assets
- ❑ Device identities need to be managed !
- ❑ Device identities can be managed with Mobile Device Management (MDM) platforms, i.e. Microsoft Intune
- ❑ Device identity management is the foundation for device-based Conditional Access



Getting devices in Azure AD

- To get a device in Azure AD, you have multiple options:
 - Azure AD registered
 - BYOD – personal devices; Ws, Mac, iOS, Android
 - Azure AD joined
 - Devices owned by organization; Ws 10, WS2019
 - Hybrid Azure AD joined
 - Devices owned by organization
 - Devices deployed in cloud and on-premises
 - Ws7, 8.1, 10, WS 2008 or newer



Azure AD Join Overview

- Azure AD joined devices are signed in with an organizational Azure AD account
- Azure AD join - join devices to Azure AD without needing to sync with an on-premises Active Directory instance
- Provisioning options:
 - Self-service
 - Windows Autopilot
 - Bulk enrollment



Device Settings in Azure Portal

Devices | Device settings

XaaS - Azure Active Directory

Save Discard Got feedback?

All devices

Device settings

BitLocker keys (Preview)

Diagnose and solve problems

Activity

Audit logs

Bulk operation results (Preview)

Troubleshooting + Support

New support request

Users may join devices to Azure AD ⓘ

All Selected None

Selected
No member selected

Users may register their devices with Azure AD ⓘ

All None

Require Multi-Factor Auth to join devices ⓘ

Yes No

Maximum number of devices per user ⓘ

50





Module 16 - Azure Active Directory

Module Completion & Exam Hints



Azure Active Directory

Azure Active Directory Introduction

- ❑ Azure AD is a cloud-based identity management solution
 - ❑ Cloud-based apps: Azure, Microsoft 365 (email, etc.)
 - ❑ Corporate network apps
- ❑ Azure AD stores users and devices deployed in a tenant
- ❑ Each tenant can have multiple groups, that hold multiple users, and different access levels are applied at the group level



Azure AD



Azure Active Directory – Terminology

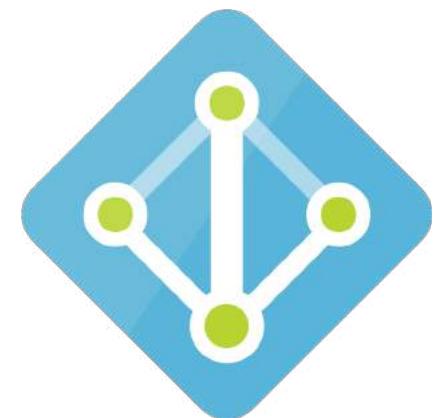
- Azure AD Tenant – an instance of an Azure AD
- Azure AD Directory – includes users, groups, apps
- Global Administrator – full administrator of Azure AD
- Owner role - manage all resources in Azure
- Identity – user, app, service
- Account – identity with data associated to it



Azure AD

Azure AD Licensing Options

- Azure Active Directory Free**
 - Manage users & groups, SSPR, SSO, AD sync, etc.
- Azure Active Directory Premium P1**
 - Dynamic groups, SSPR for on-prem, etc.
- Azure Active Directory Premium P2**
 - AD Identity Protection
- Pay-as-you-go**
 - Pay per feature; AD B2B, AD B2C, etc.



Azure AD

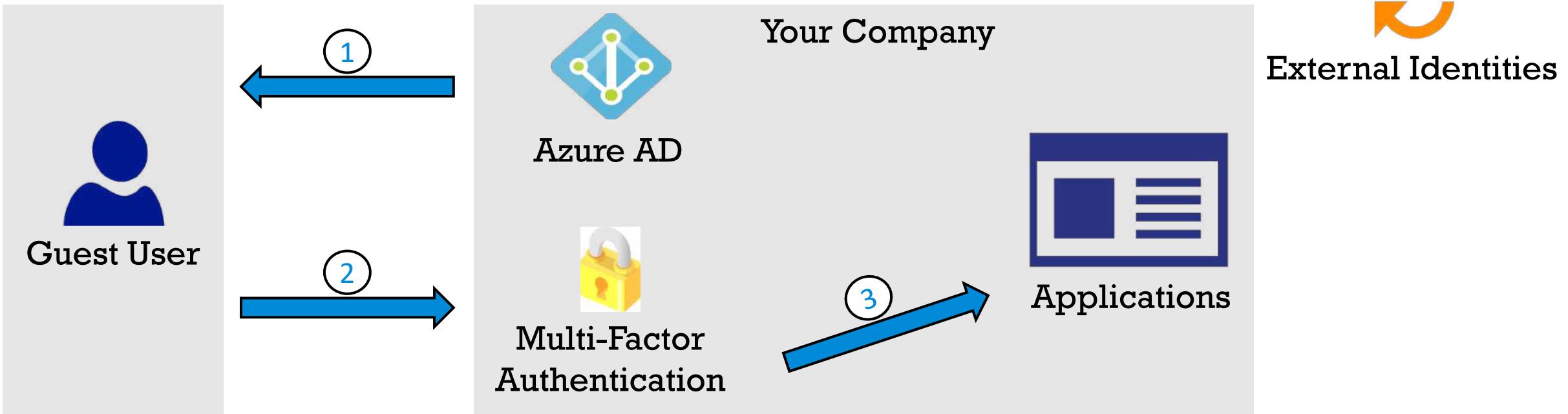




Azure AD Main Features

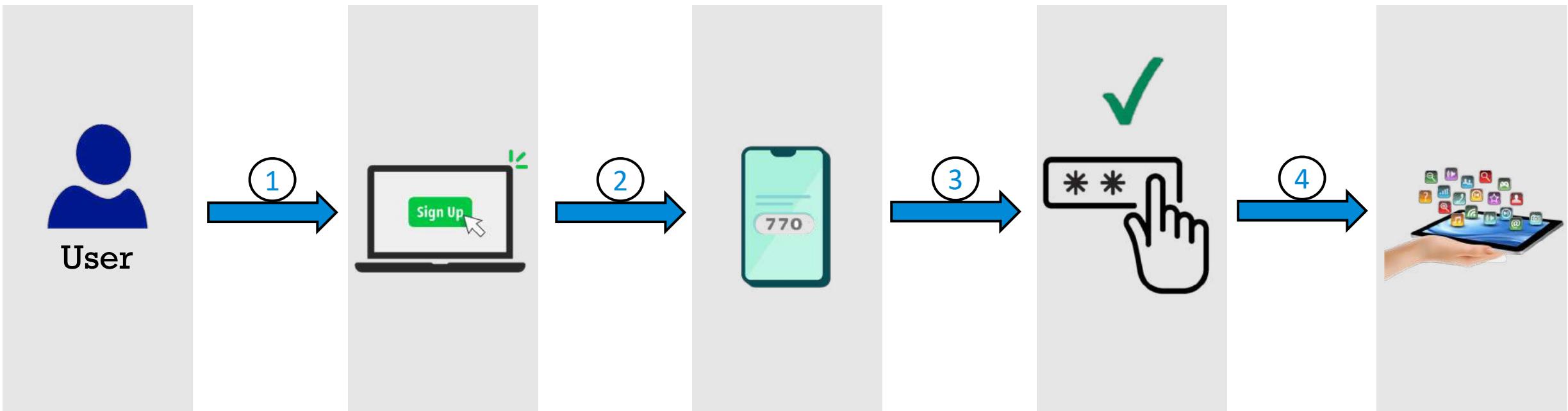
Azure AD B2B

- ❑ Azure AD B2B - invite guest users to collaborate with your organization
- ❑ External partners don't need Azure AD!



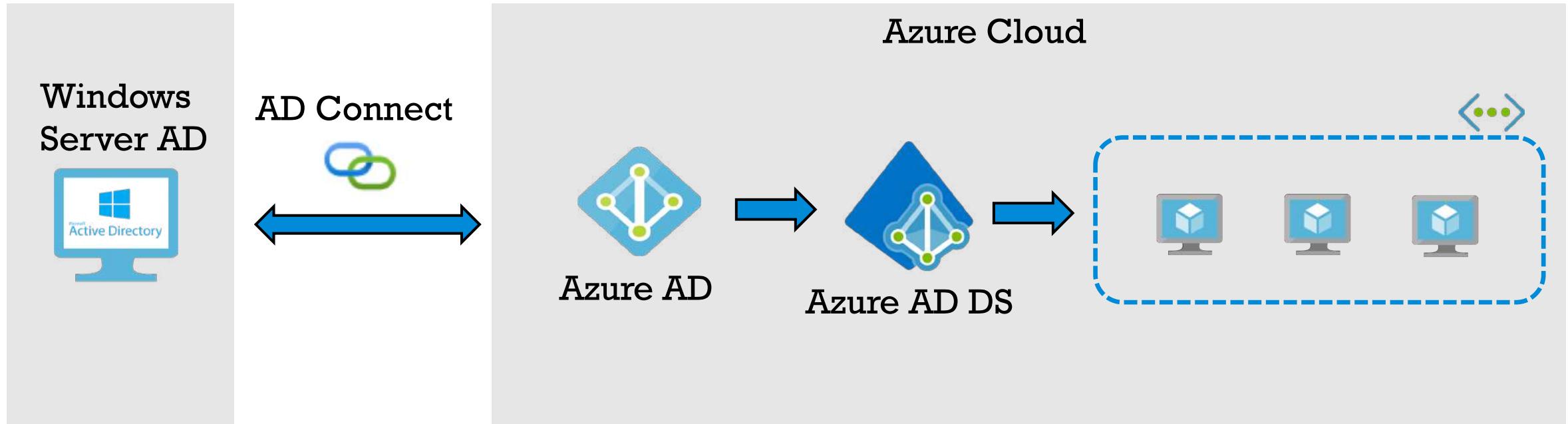
Azure AD B2C

- ❑ Azure AD B2C - manage your customers' identities and access
- ❑ Independent of Azure AD, provides auth. to users !



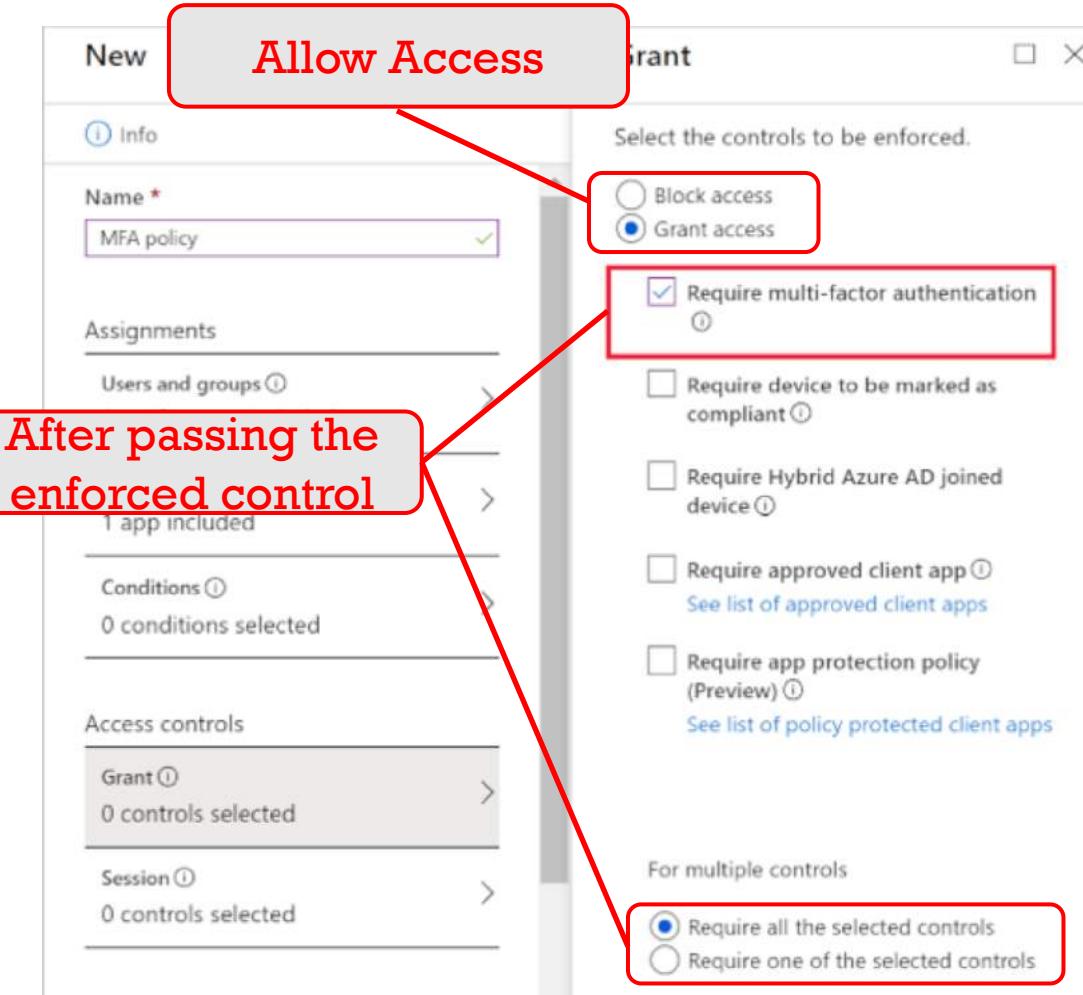
Azure AD DS – Domain Services

- Azure AD DS - add virtual machines to a domain without needing domain controllers



Conditional-Access Policies

- ❑ Conditional-access policies require users to pass additional auth. challenges, before access is allowed
- ❑ Conditional Access policies are “if-then” statements
- ❑ Available with P1 and P2 licensing tiers



Azure AD Identity Protection

- Azure AD Identity Protection allows you to accomplish:
 - Automate detection & remediation of risks
 - Investigate risks
 - Export risk detection data for further analysis
- Examples of risky event:
 - Unusual travel
- High | Medium | Low | No Risk → Define Policies !



AD Identity
Protection





Device Identity & AAD Join

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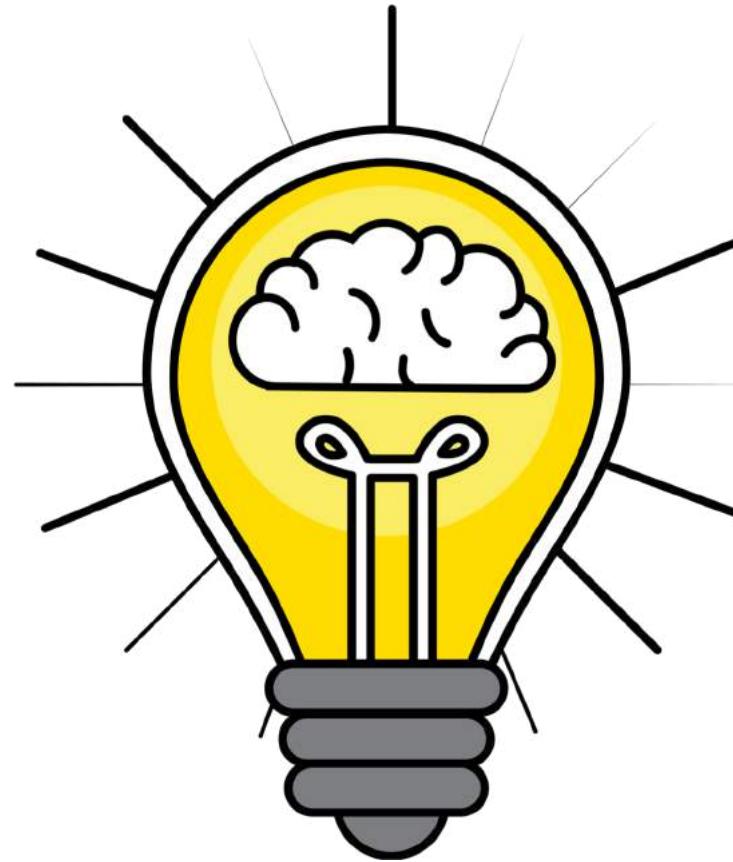


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Azure Active Directory - Quiz



Microsoft Azure Administrator

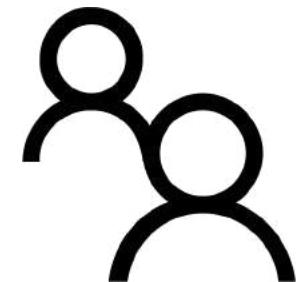


Module 17 – Role-based Access Control

Role-Based Access Control Overview

What is Role-based Access Control (RBAC)?

- RBAC - an authorization system that provides fine-grained access management to resources in Azure
- Role - collection of permissions
- RBAC Built-in Roles:
 - Owner – full access + assign permissions
 - Contributor – create and manages resources
 - Reader – can view resources
 - User Access Administrator – manage access to resources

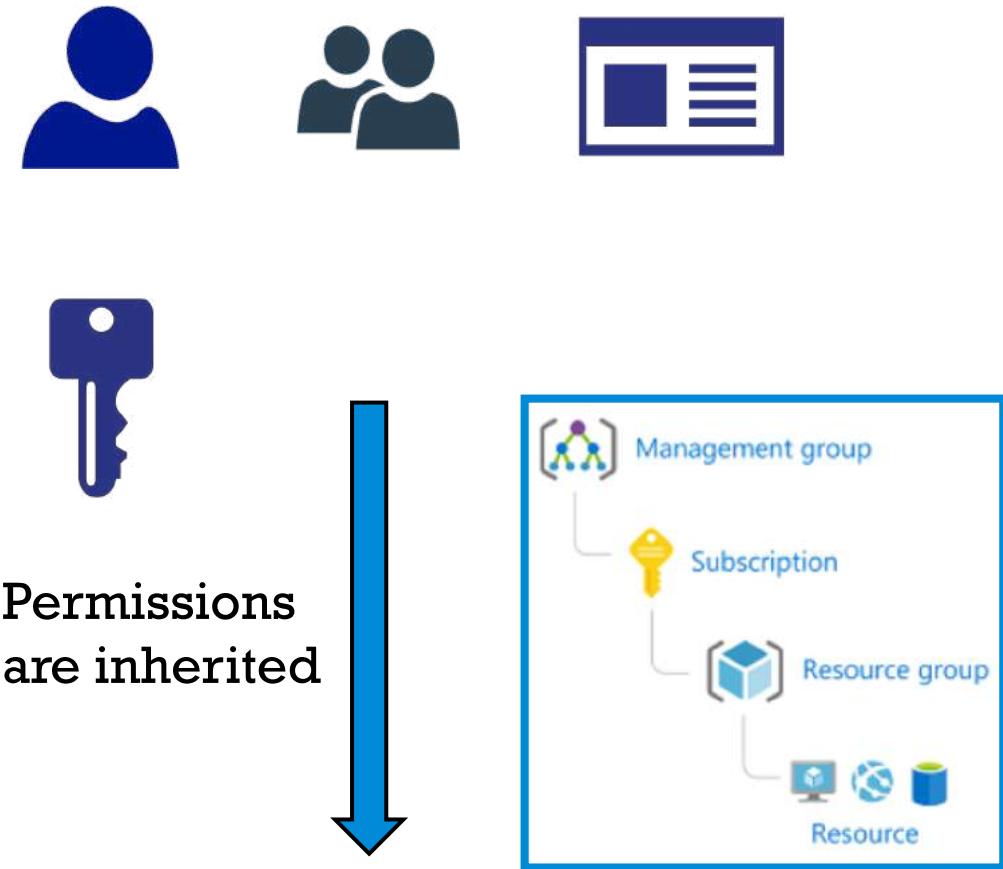


Access Control
(IAM)



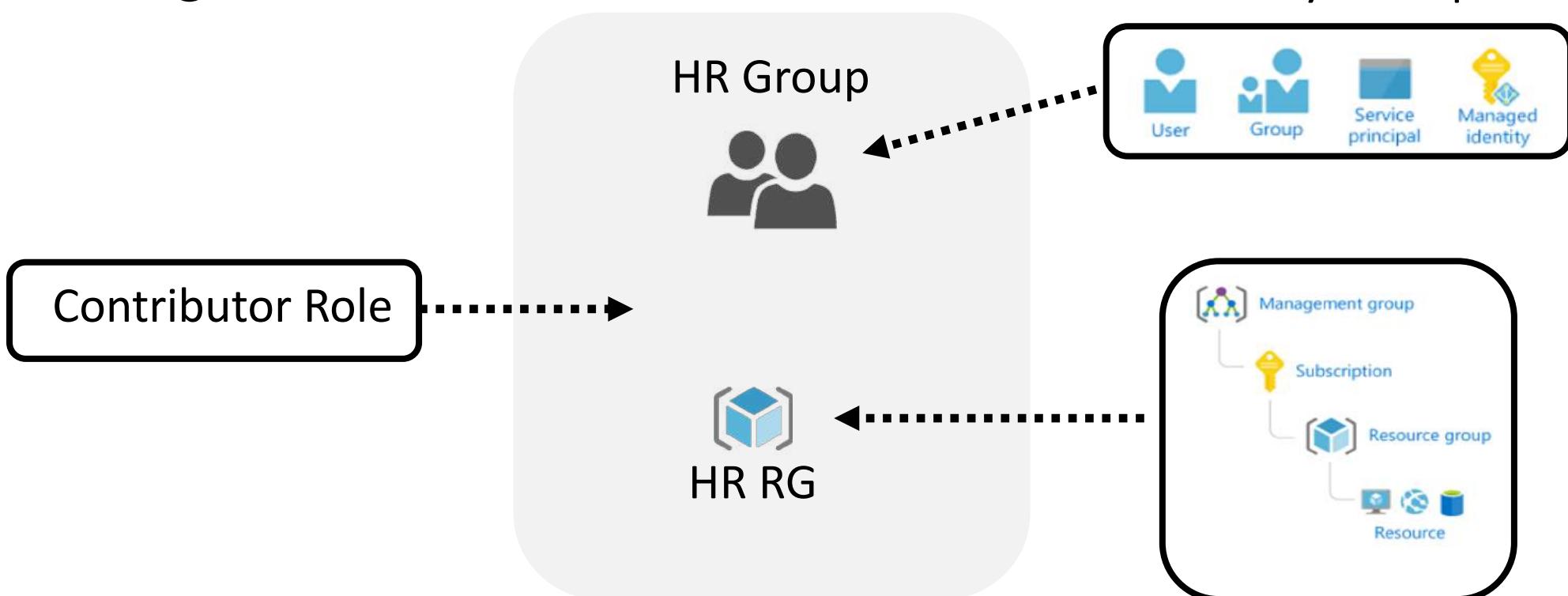
How RBAC Works – Who, What, Where ?

- ❑ Role assignment – security principal + role + scope
- ❑ Security principal – WHO
 - ❑ User, group or application
- ❑ Role definition – WHAT
 - ❑ Collection of permissions
- ❑ Scope – WHERE
 - ❑ Where access applies to



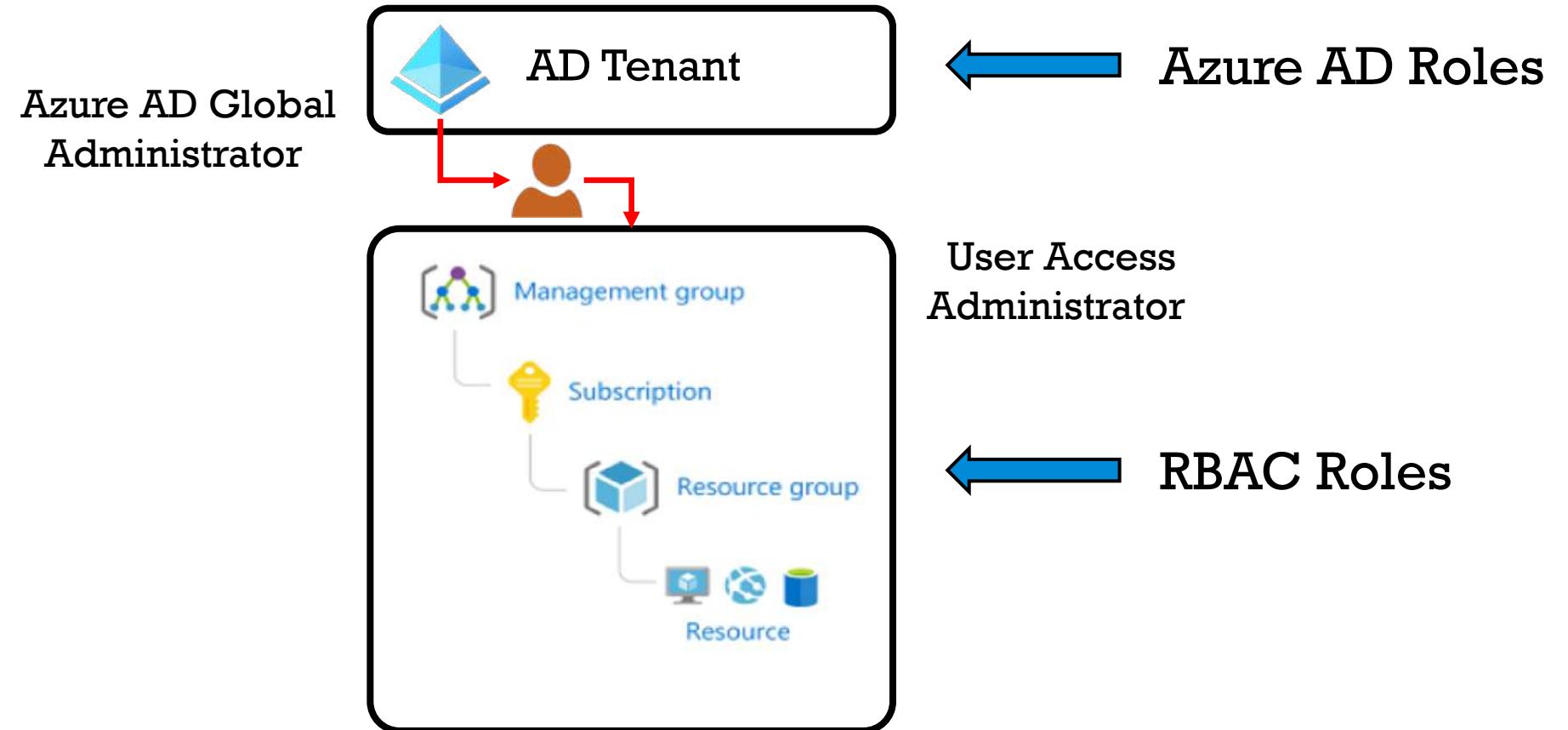
Role Assignment Example

- A role assignment is the process of binding a role to a security principal, at a particular scope, for the purpose of granting access



Roles – Azure AAD vs Azure RBAC

- ☐ Azure RBAC roles apply to Azure resources, Azure AD roles apply to Azure AD resources: users, groups, domains



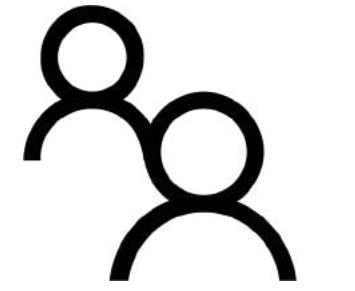


Module 17 – Role-based Access Control

Module Completion & Exam Hints

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 - Reader – can view resources, no changes allowed
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Access Control
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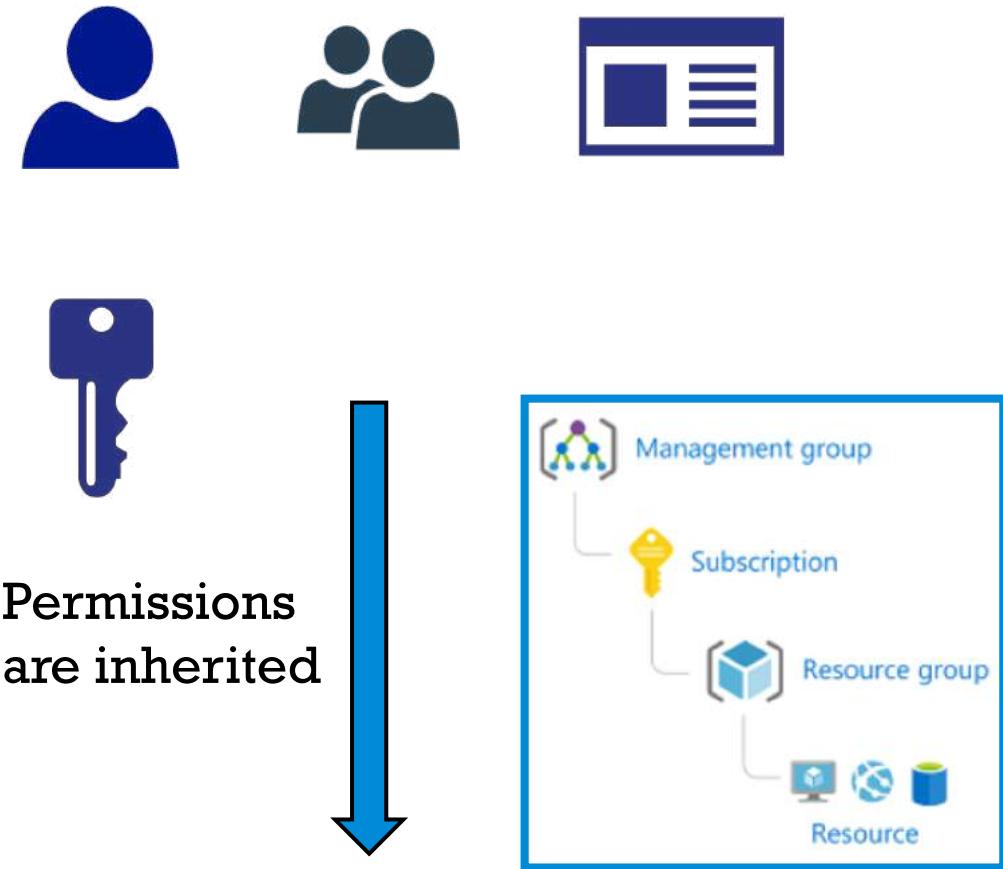
More RBAC Built-in Roles ...

- Network Contributor - manage networks, but not access to them
- Virtual Machine Contributor - manage VMs, but not access to them, or the vNET | storage account they're connected to
- Security Admin - View and update permissions for Security Center; can update security policies
- Storage Blob Data Reader, Logic App Reader, Security Reader - view resources, doesn't allow changes



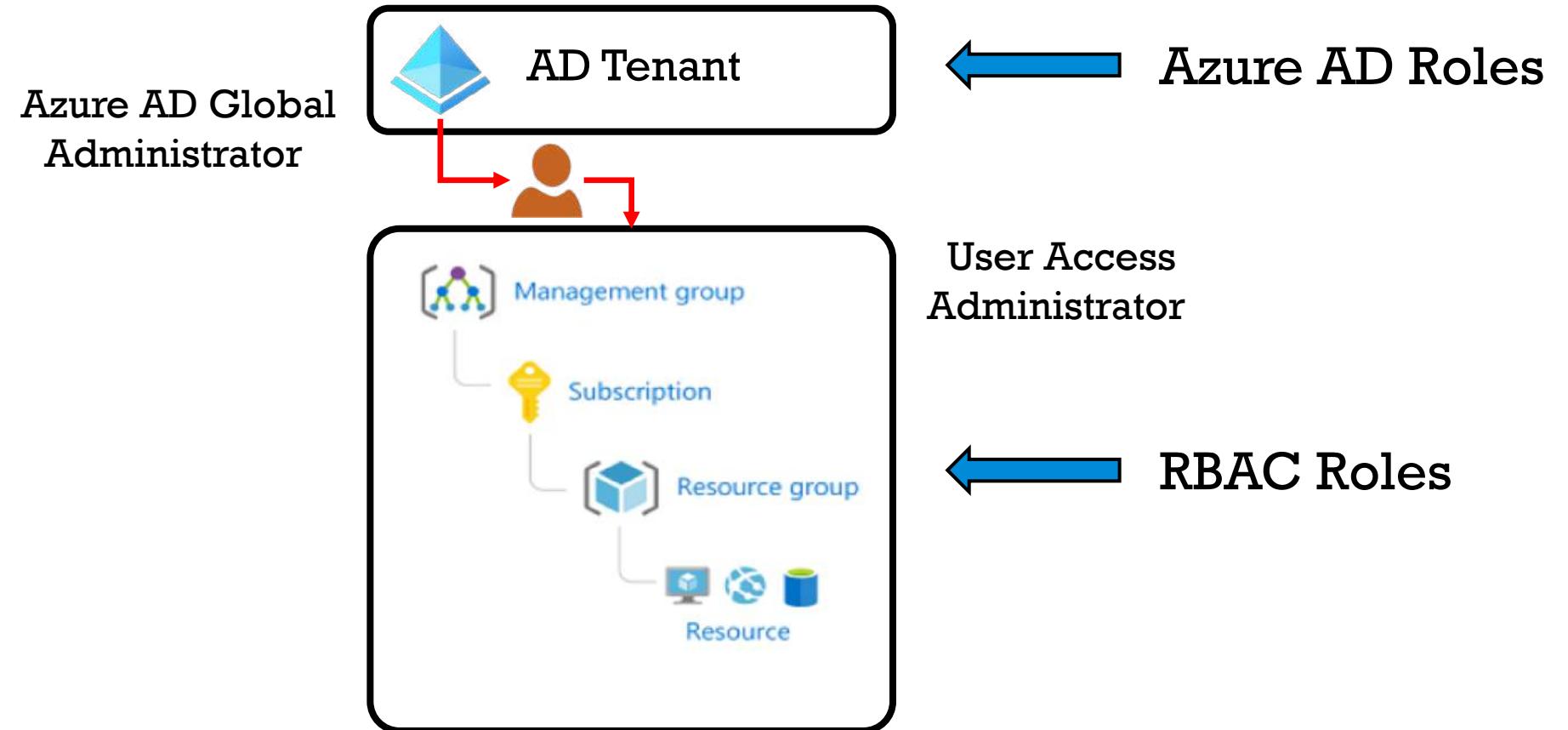
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Azure RBAC - Quiz



Microsoft Azure Administrator

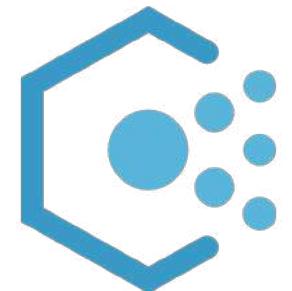


Module 18 – Policies, Locks & M. Groups

Azure Policies Overview

Azure Policy Overview

- Azure Policy helps to enforce organizational standards and to assess compliance at-scale – Microsoft.com
- Azure Policy - establishes conventions or rules that resources must comply with
- Examples:
 - Create only B1S VMs (Free Tier)
 - Create resources only in “westeurope”

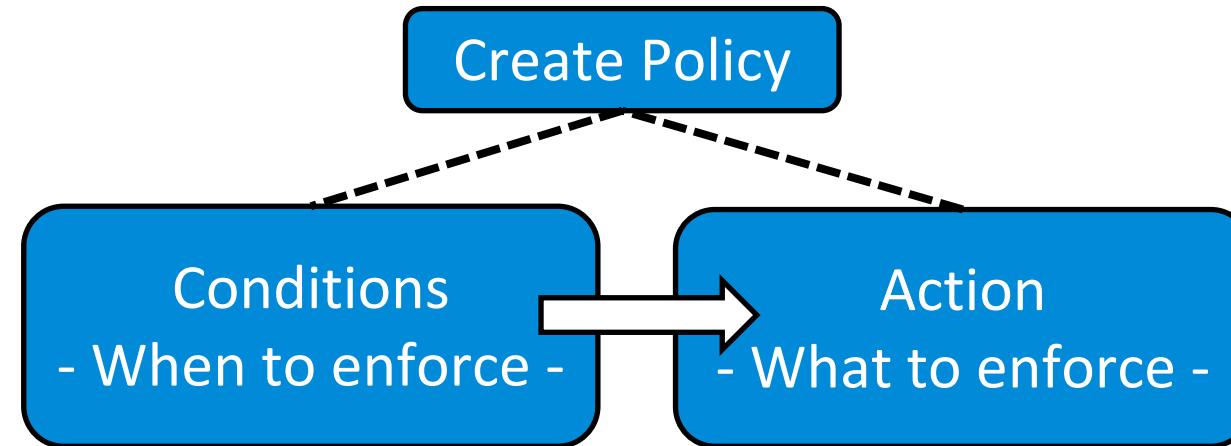


Azure Policy



Azure Policy – Definition & Assignment

- ❑ First, the Azure Policy needs to be created
 - ❑ Policy Definition – conditions and effect

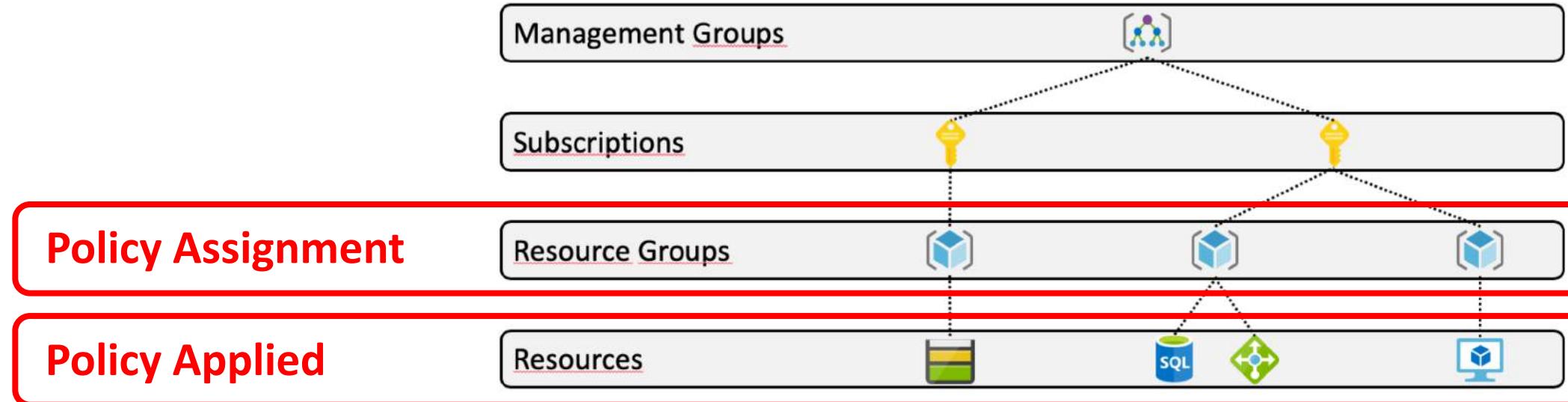


- ❑ Policy Assignment - assign the policy definition to a specific scope - simply said, where is the policy enforced ? Level ?



Azure Policy – Policy Assignment Scope

- ☐ Azure Policy is assigned to a scope, from management group down to a resource

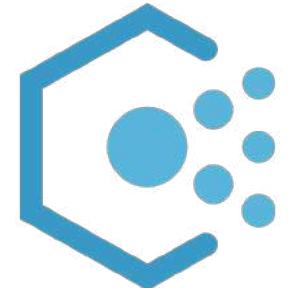


- ☐ Policy assignments are inherited by all child resources
 - ☐ Example: apply policy at RG level, then policy is applied to all resources in that specific RG



Built-in Azure Policies

- Built-in Azure Policies are available by default, covering common scenarios – similar to RBAC built-in roles
 - Allowed Locations
 - New resources to be deployed in specific locations
 - Allowed Virtual Machines SKUs
 - Only specific VM SKUs to be used (Bls)
 - Require a tag on resources
 - Enforces a required tag and its value to a resource

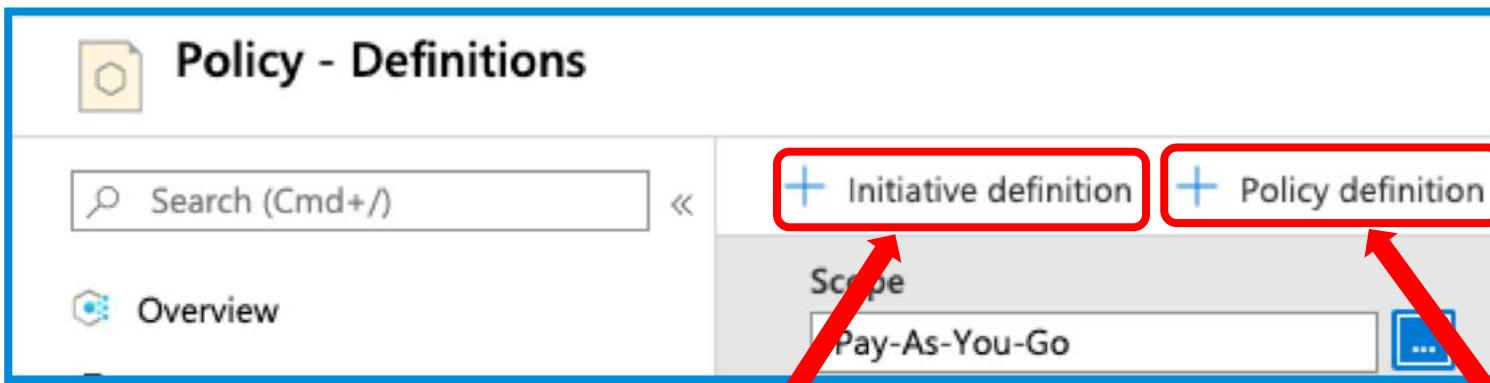


Azure Policy



Policy and Initiative Definitions

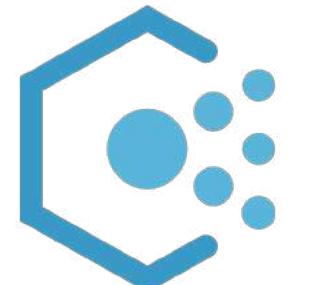
- ❑ What if you need to apply multiple policies at once ?
- ❑ Initiative definitions simplify managing and assigning policy definitions, by grouping a set of policies as one single item - initiative



The screenshot shows the 'Policy - Definitions' blade in the Azure portal. At the top, there is a search bar labeled 'Search (Cmd+ /)' and a 'Scope' dropdown set to 'Pay-As-You-Go'. Below the search bar are two buttons: '+ Initiative definition' and '+ Policy definition', both highlighted with red boxes. Red arrows point from these buttons to two red boxes at the bottom of the image: 'Collection of Policies' pointing to the Initiative definition button, and 'Single Policy' pointing to the Policy definition button.

Collection of Policies

Single Policy



Azure Policy



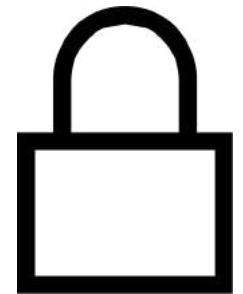


Module 18 – Policies, Locks & M. Groups

Azure Locks Overview

Azure Locks Overview

- Azure Locks – prevent users in your organization from accidentally deleting or modifying critical resources
- Two options are available:
 - Delete
 - Read and Modify a resource, can't Delete
- Read-only
 - Read a resource, can't Modify or Delete

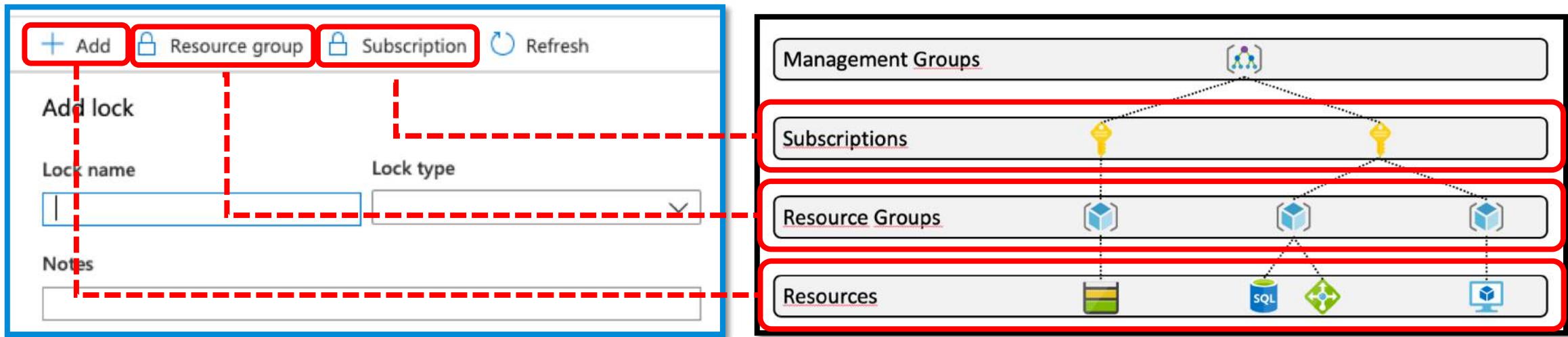


Azure Locks



Applying Azure Locks

- Similar to Azure Policies, when you apply Locks at a parent scope, all resources within that scope will inherit the lock



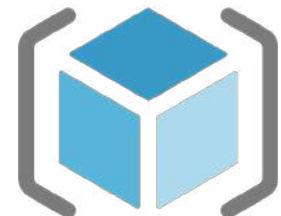


Module 18 – Policies, Locks & M. Groups

Resource Groups and Azure Tags Fundamentals

Resource Groups Overview

- Resource Groups - logical containers for resources deployed on Azure
- All deployed resources (Azure services) are part of a single resource group and can be moved between RGs later on
- BTW, resources in a RG can be deployed in different Azure regions, no restriction here
- In simple terms, we use RGs to better manage and organize our resources in Azure

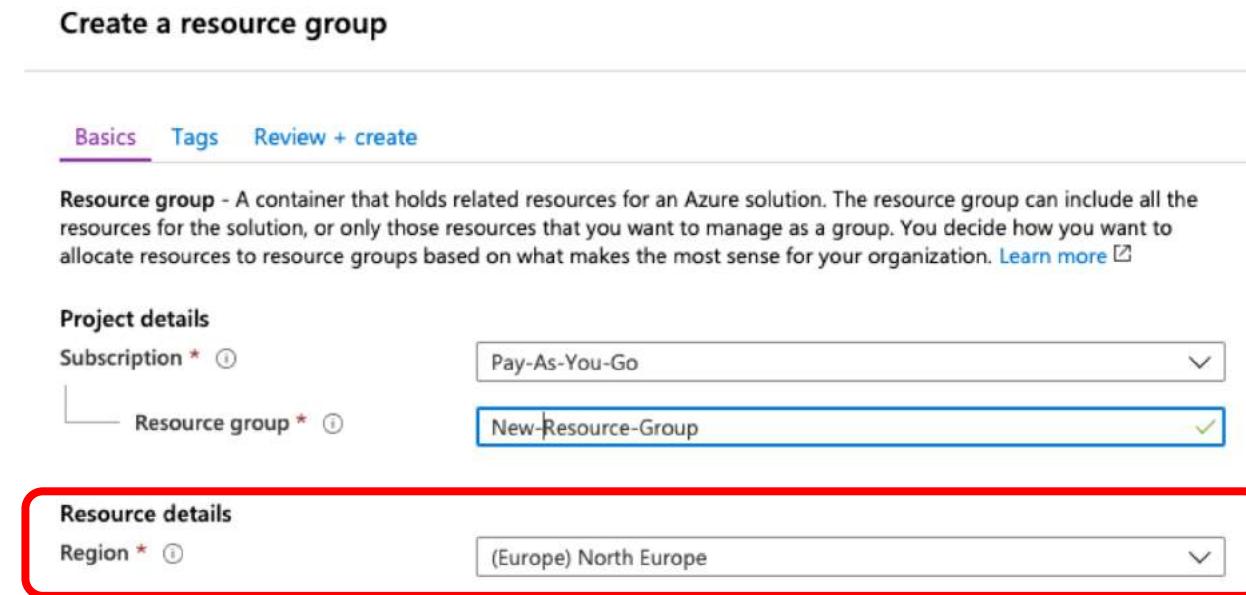


Resource Group



Resource Groups Location – Why ?

- Why do we need to specify a location when we create a resource group ?
- Resources in a RG can be part of any region, but RGs are tied to a specific region
- It's about metadata of the resources, which has to be stored in a location



Resource Groups Naming Convention

- ❑ Consistent Naming Convention for RGs
 - ❑ What it is used for ?
 - ❑ Types of resources in container ?
 - ❑ Type of the resource itself
- ❑ Example: ProjectAlpha-WebVMs-RG
- ❑ Another option is <Resource><Subscription Type><Region>
 - ❑ VNET-Shared-01Sub-WestUS



Resource Groups – Organizing Principles

- We can organize resources in many ways:
 - By environment: RG-Prod, RG-Dev/Ops, RG-Testing
 - By resource type: RG-VMs, RG-Storage, RG-VNETs
 - By department: RG-IT, RG-Marketing, RG-HR
 - By admin type: RG-Owner, RG-Contributor, RG-Reader
 - By lifecycle: RG-Project1, RG-Project2
 - Billing reports purposes
- Takeaway – invest time before starting your work in Azure, in order to define a clear, straightforward structure; lots of options exist, leverage Azure flexibility in your advantage



Azure Tags Overview

- Azure Tags - Tags are name/value pairs of text data that you can apply to resources and resource groups
 - Example: Name – “Environment”, Value – “Production”
- You can attach/bind up to 50 tags to a resource
- Common use cases:
 - Cost center – who's paying ?
 - Department – HR, Finance, DevOps, etc.
 - Environment – Prod, Dev, Test, etc.
 - Automation start or shutdown – 9AM – 6PM



Azure Tags



Azure Tags Overview

- ❑ How can you maintain order in your organizations ?
 - ❑ You define a procedure stating that all resources must have tags attached
 - ❑ Colleagues and peers are not adhering to it !
- ❑ You can enforce tagging rules and naming conventions throughout your organization with Azure Policies !
- ❑ Examples:
 - ❑ Add tag to RGs
 - ❑ Add tag to resources (Department - Finance)



Azure Tags





Module 18 – Policies, Locks & M. Groups

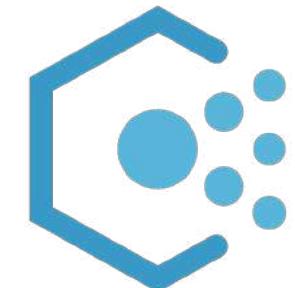
Module Completion & Exam Hints



Azure Policies

Azure Policy Overview

- Azure Policy establishes conventions for resources
 - Policy definition
 - Policy assignment
- Policy definitions describe resource compliance conditions and the effect to take if a condition is met
- Policy assignment
 - assign policy definition at a scope



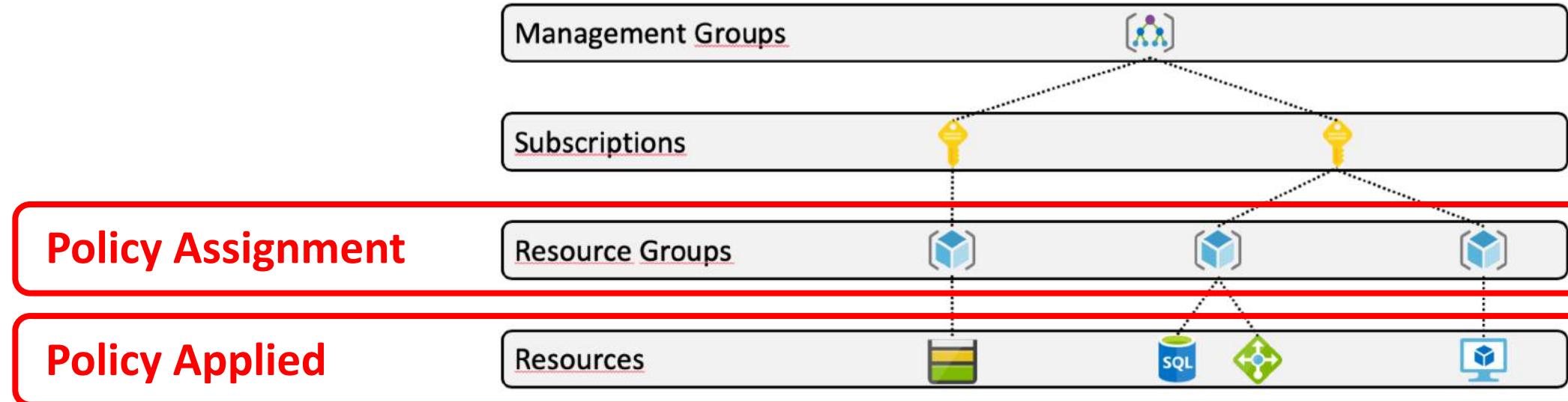
Azure Policy



Microsoft Azure Administrator

Azure Policy – Policy Assignment Scope

- ☐ Azure Policy is assigned to a scope; conditions inherited from management group down to a resource

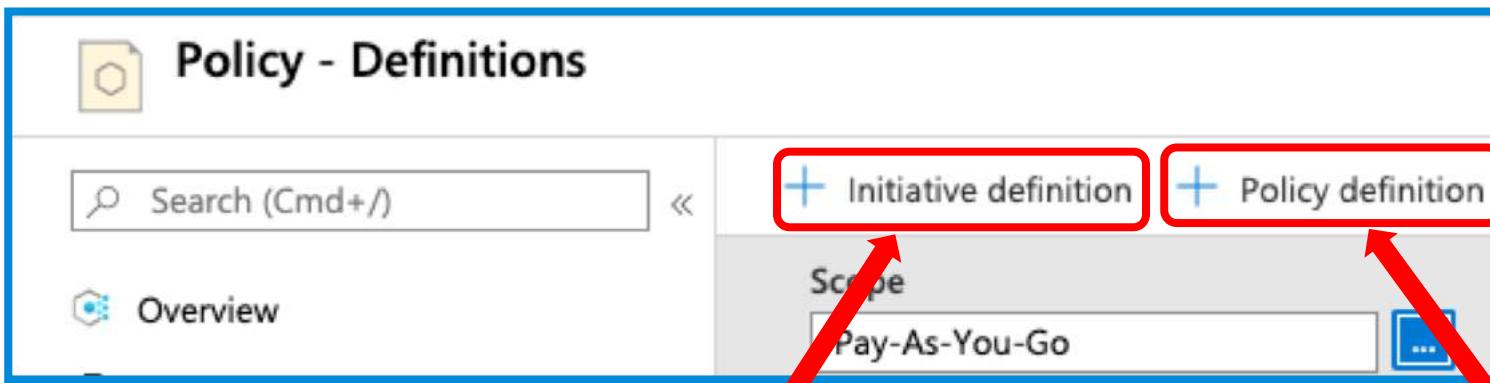


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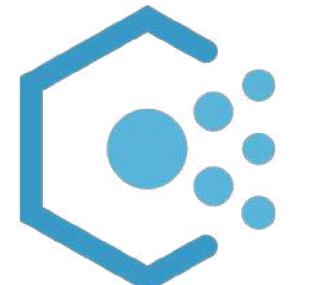
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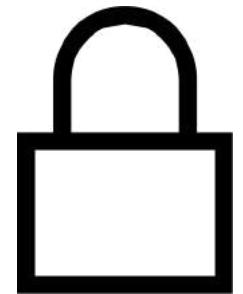




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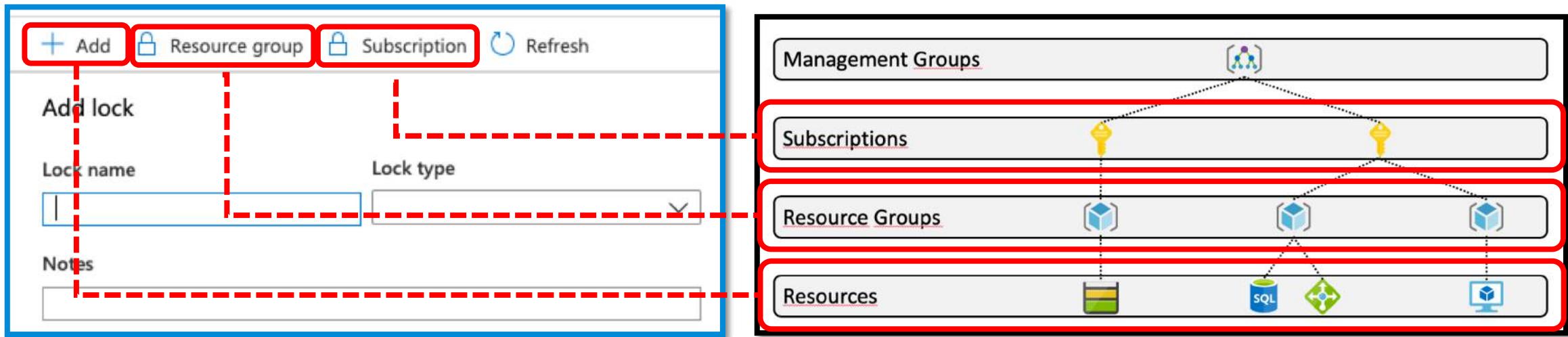


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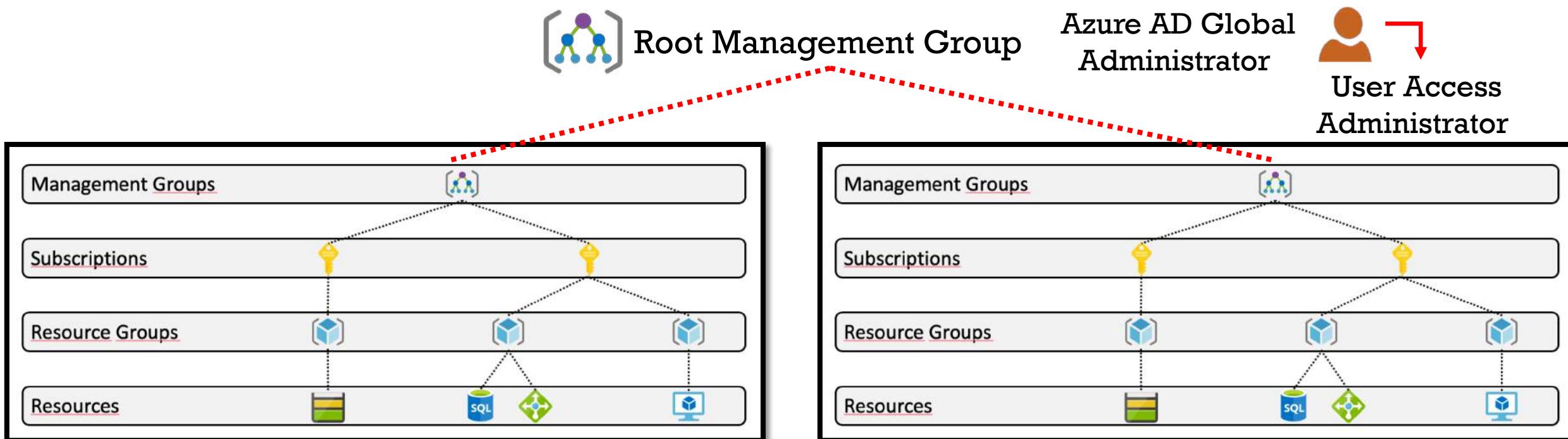




Management Groups

Management Groups Overview

- Management group - logical container that allows Azure Administrators to manage access, policy, and compliance across multiple Azure Subscriptions



Policies, Locks and M. Groups - Quiz



Microsoft Azure Administrator



Module 19 – Backup and Recovery

Disaster Recovery and Backup Overview

DR & Backup - Basic Terminology

- ❑ **High Availability** - ability of a system to be continuously operational and available for a long period of time
 - ❑ service or app HA = components are HA
- ❑ **Replication** – duplicate stored data to replicas
 - ❑ creates live copies of your data
- ❑ **Backup** - creates long-lived, read-only snapshots of data
 - ❑ powerful line of defense against permanent data loss
- ❑ **Disaster recovery** | **BCDR** (Business Continuity and Disaster Recovery) plan



Recovery Objectives – RPO and RTO

- ❑ Recovery Point Objective (RPO) – measured in “time”
 - ❑ maximum duration of acceptable data loss
- ❑ Recovery Time Objective (RTO)
 - ❑ maximum duration of acceptable downtime



Azure Replication and Backup Services

- ❑ Process recovery
 - ❑ failover to a separate, working deployment/environment
- ❑ Azure Site Recovery
 - ❑ manage process recovery for VMs – Azure or on-prem
 - ❑ replicate data to secondary location and failover
- ❑ Azure Backup
 - ❑ backup data to Azure Recovery Services vaults for storage and recovery
- ❑ Recovery Services vault - storage entity that stores data



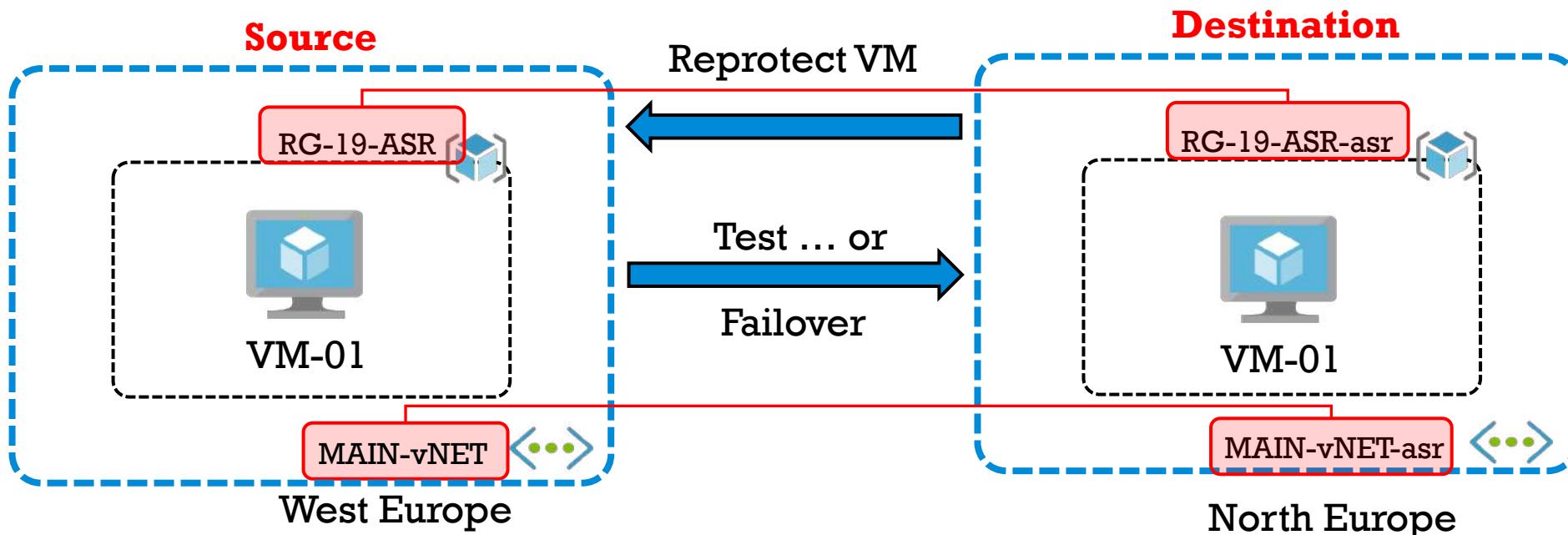


Module 19 – Backup and Recovery

Azure Site Recovery Overview

Azure Site Recovery - Overview

- Azure Site Recovery main use cases:
 - replicates workloads running on physical and VMs from a primary site to a secondary location
 - migrate VMs from on-premises infrastructure to Azure



VM Disaster Recover to Azure

1. Enable replication

- Replicate VM to North Europe region

2. Run a disaster recovery drill

- Test disaster recovery replication

3. Run fail over and reprotect

- Fail over to North Europe VM and reprotect VM

4. Run failback

- Fail back to West Europe region





Module 19 – Backup and Recovery

Azure Backup Overview

Azure Backup Overview

- ❑ Azure Backup - provides a simple and secure solution to back up your data and recover it from the Microsoft Azure
- ❑ What data can I back up?
 - ❑ Azure VMs
 - ❑ On-premises VMs, back up files, folders, etc.
 - ❑ Azure File shares
 - ❑ SQL Server on Azure VM
- ❑ Azure Backup vs Azure Site Recovery
 - ❑ Copies of data vs real-time replication of data

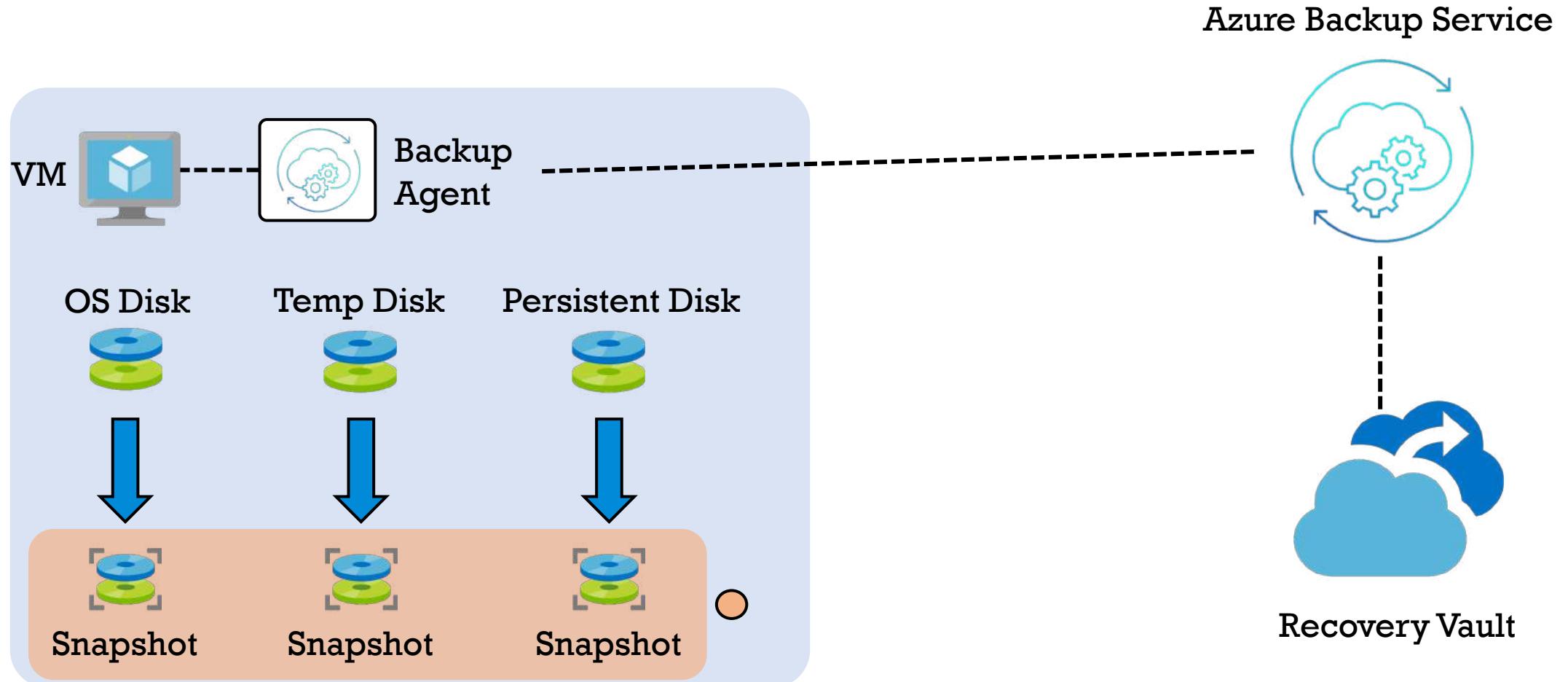


Azure Backup – How it works

- ❑ Azure VMs are backed up by taking disk snapshots at user-defined intervals and transferring those snapshots to a Recovery Services Vault, as per configured policy
- ❑ Snapshot - point-in-time backup of all disks on the VM
- ❑ Recovery Services Vault
 - ❑ storage entity in Azure that holds data
- ❑ Backup policy – frequency and retention duration
 - ❑ Snapshot tier or vault tier



Azure Backup – How it works





Module 19 – Backup and Recovery

Module Completion & Exam Hints



DR – Basic Concepts

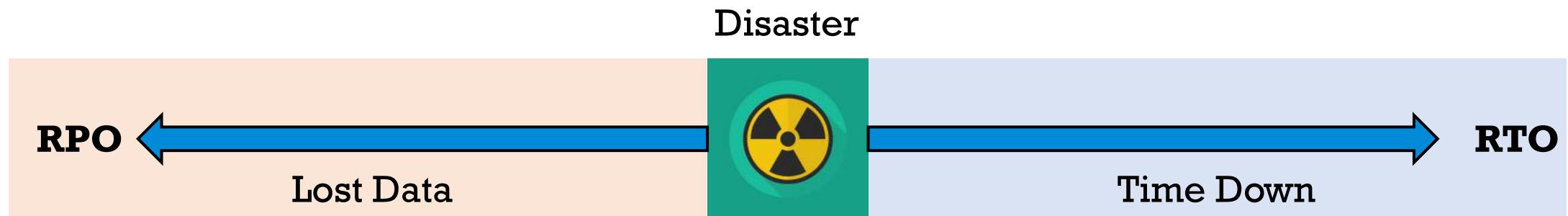
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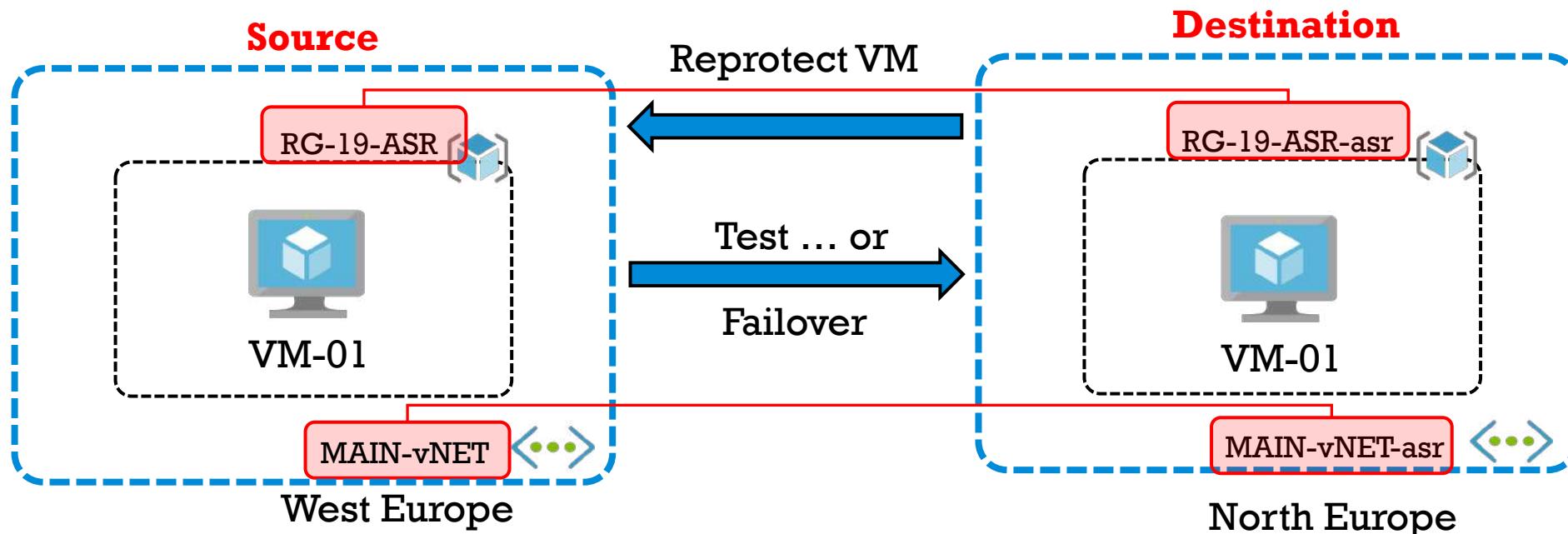




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Backup and Recovery - Quiz



Microsoft Azure Administrator



Module 20 – Monitoring in Azure

Azure Monitoring Overview

Monitoring in Azure Overview

- ❑ Monitor - collect, analyze and use information to track the progress or quality of (something) over a period of time
- ❑ What to monitor?
 - ❑ Performance of infrastructure and Apps
 - ❑ Security risks – suspicious activity
- ❑ Why to monitor ? – track and improve
- ❑ When to monitor? – implement continuous monitoring



Azure Monitor



Azure Monitoring Tools – Azure Monitor

- ❑ Azure Monitor - provides performance and availability monitoring for applications and services in Azure, other cloud environments, or on-premises
- ❑ Data collected by Azure Monitor into:
 - ❑ Logs
 - ❑ Metrics
- ❑ Data types collected by Azure Monitor:
 - ❑ App monitoring data, guest OS monitoring data, Azure resource/subscription/tenant monitoring data



Azure Monitor



Azure Monitoring Tools – Application Insights

- ❑ Azure Application Insights – feature of Azure Monitor, can be used to monitor live applications:
 - ❑ Azure VM or VMSS
 - ❑ Azure App Service
 - ❑ Azure cloud service applications
 - ❑ Azure Functions
- ❑ Hands-on Lab overview:
 - ❑ Configure Application Insights on a web app



Azure Monitoring Tools – Security Center

- ❑ Azure Security Center - manage the security of your infrastructure from a centralized location
 - ❑ advanced threat protection across hybrid workloads
- ❑ Security Center can help to:
 - ❑ Strengthen security posture
 - ❑ Protect against threats
 - ❑ Get secure faster



Security
Center





Module 20 – Monitoring in Azure

Module Completion & Exam Hints

Monitoring in Azure - Exam Hints

- ❑ Azure Monitor – includes Log Analytics workspaces
 - ❑ We can query and analyze data !
- ❑ Example: view the error from a table named Event
 - ❑ Event | search "error"
- ❑ Azure Diagnostics extension – VM specific and more granular metrics + additional monitoring / diagnostic data
- ❑ Action group - collection of notification preferences (and potentially actions)





Thank you !