



Module 1 – Course Introduction

Create Your Free Azure Account

Microsoft Azure Free Account

- ❑ Microsoft Azure Fundamentals AZ-900 – theoretical exam, no labs or practical activities included
- ❑ Goal of this course:
 - ❑ Prepare you for the AZ-900 exam
 - ❑ Help you get started and gain hands-on experience
- ❑ The best way to learn Azure Cloud is to practice ! Period !
- ❑ AZ-900 Fundamentals -> AZ-104 Administrator Associate



Microsoft Azure Free Account

- FAQ: I have an account already, do I need a new one ?
- What's included in the free tier 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-900 Exam Format & Official Exam Blueprint

Microsoft AZ-900 Exam Overview

- ❑ Exam Format
 - ❑ ~ 40 questions, single or multiple-choice answers
- ❑ Exam Time
 - ❑ 60 minutes
- ❑ Exam Cost
 - ❑ \$99 USD* (based on the country where exam is taken)
- ❑ Pearson VUE or Certiport Exam Test Centers



Microsoft AZ-900 Exam – Pearson VUE Options

In-person or Remote:

Select exam options

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 Fundamentals

Microsoft AZ-900 Exam Overview

- ❑ Skills measured:
 - ❑ Describe cloud concepts (20-25%)
 - ❑ Describe core Azure services (15-20%)
 - ❑ Describe core solutions and management tools on Azure (10-15%)
 - ❑ Describe general security and network security features (10-15%)
 - ❑ Describe identity, governance, privacy, and compliance features (20- 25%)
 - ❑ Describe Azure cost management and Service Level Agreements (10- 15%)
- ❑ Official Exam landing page:
 - ❑ <https://docs.microsoft.com/learn/certifications/exams/az-900>





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



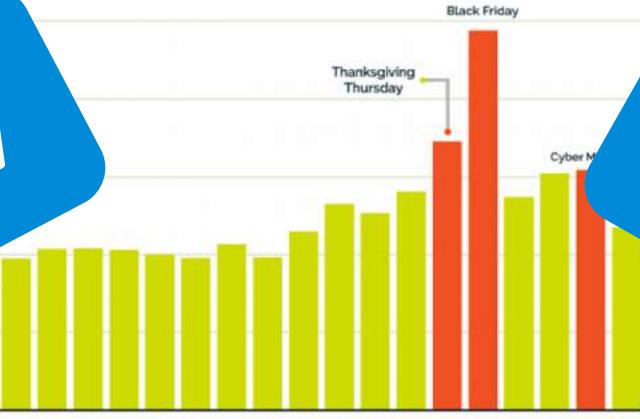
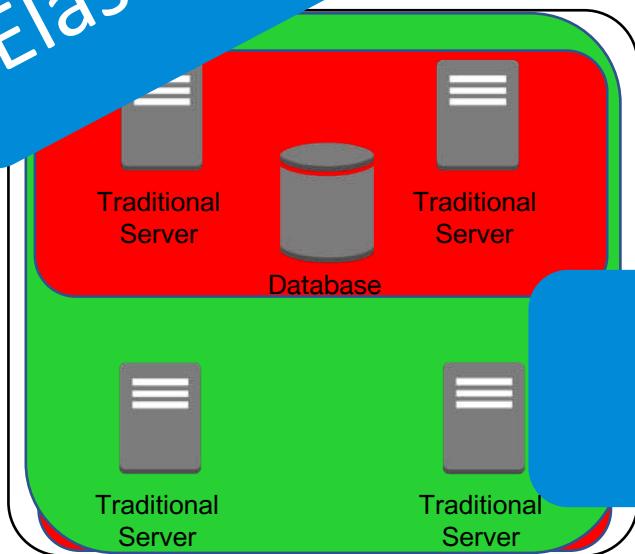
Running Your Apps in Azure Cloud

- 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 Fundamentals



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

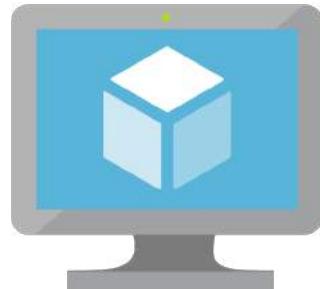
Cloud Computing Models

- ❑ 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 Service



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

Seven Advantages of Microsoft Azure Cloud Computing

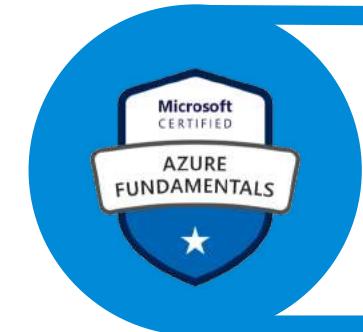


Azure Cloud is Cost-Effective

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

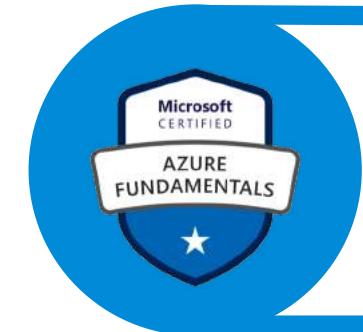


Vertical Scaling



Horizontal Scaling

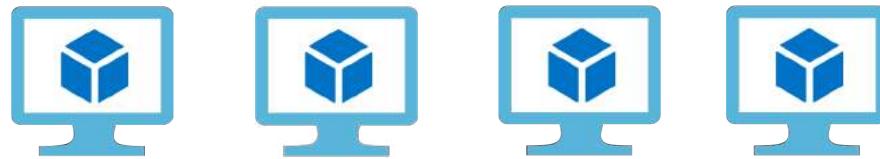




Azure Cloud is Elastic

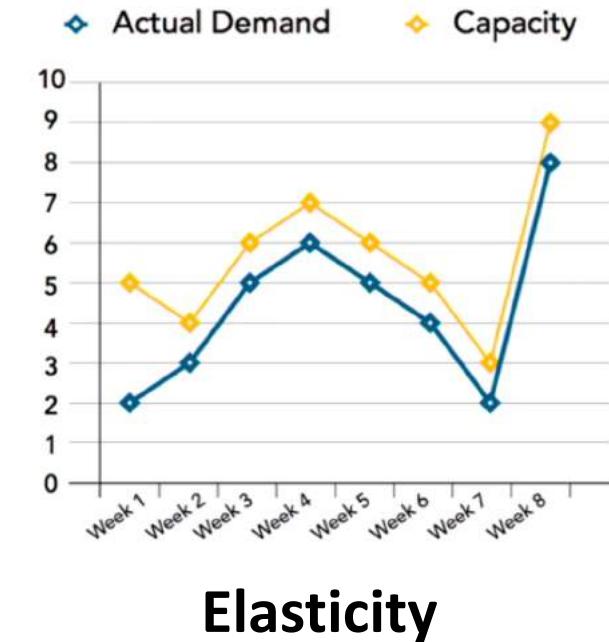
Azure Cloud is Elastic

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



Usual Traffic

Unexpected Heavy Traffic





Azure Cloud is Current

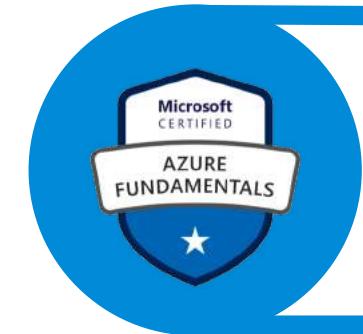
Azure Cloud is Current

- 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



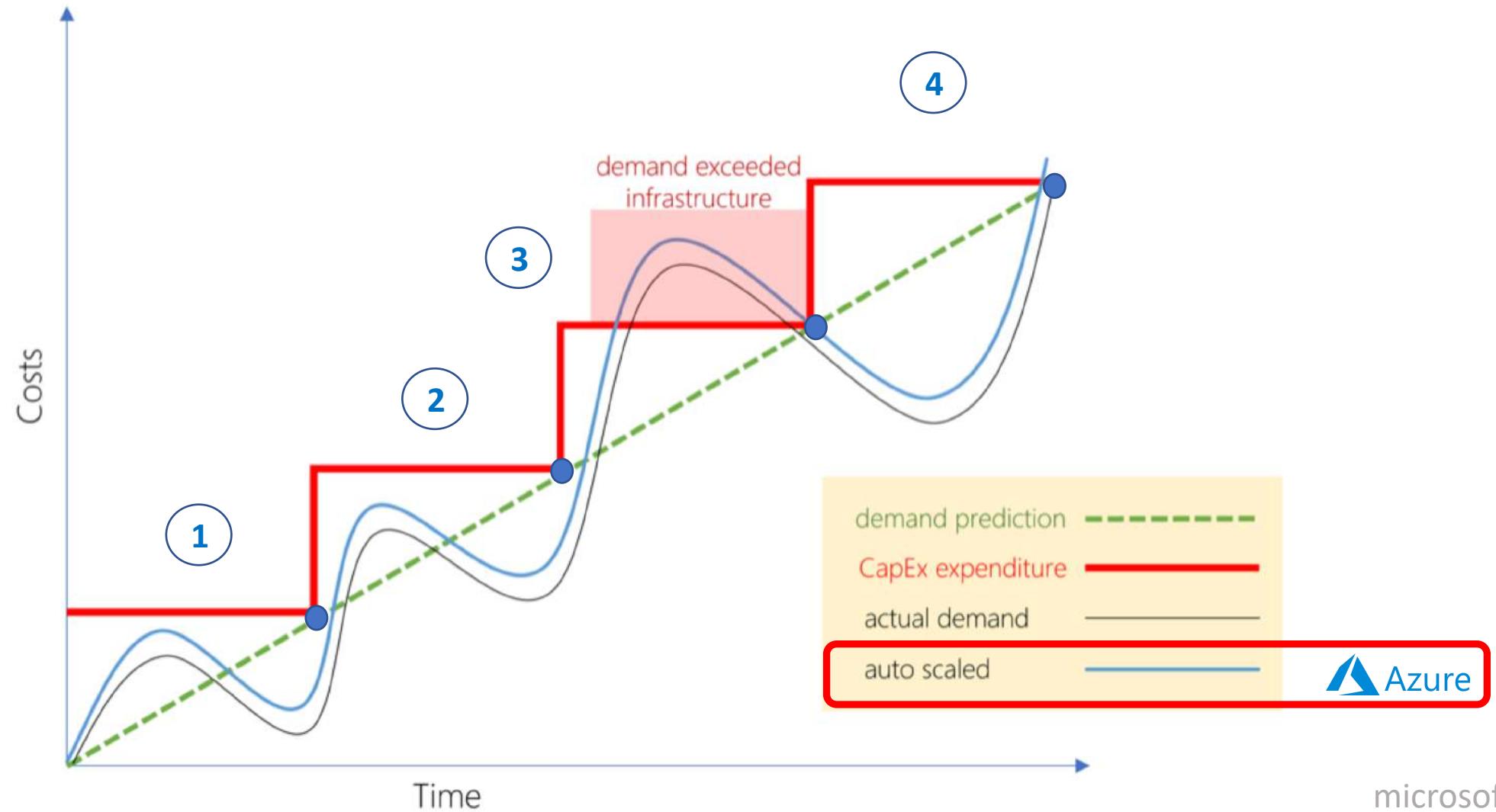
CapEx versus OpEx

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 - Regions and Availability Zones

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

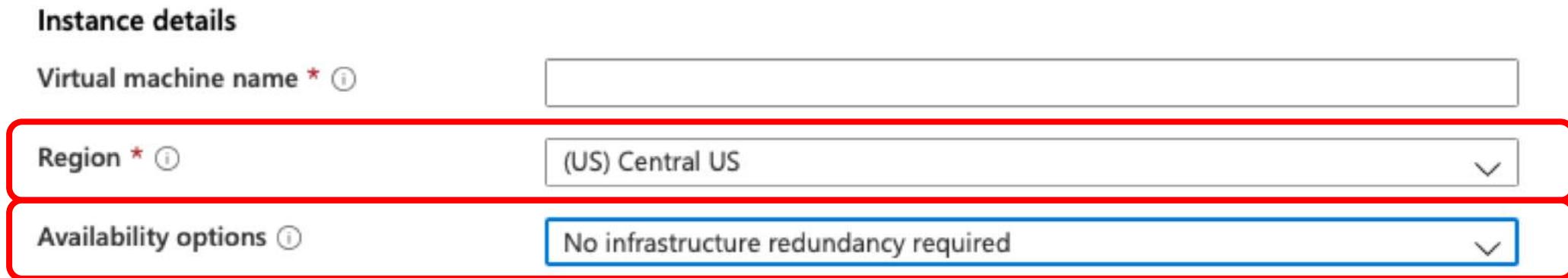
- ❑ A region is a set of datacenters deployed within a latency-defined perimeter and connected through a dedicated regional low-latency network
- ❑ When deploying resources in Azure we need to select:
 - ❑ Region
 - ❑ High Availability options

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” ?

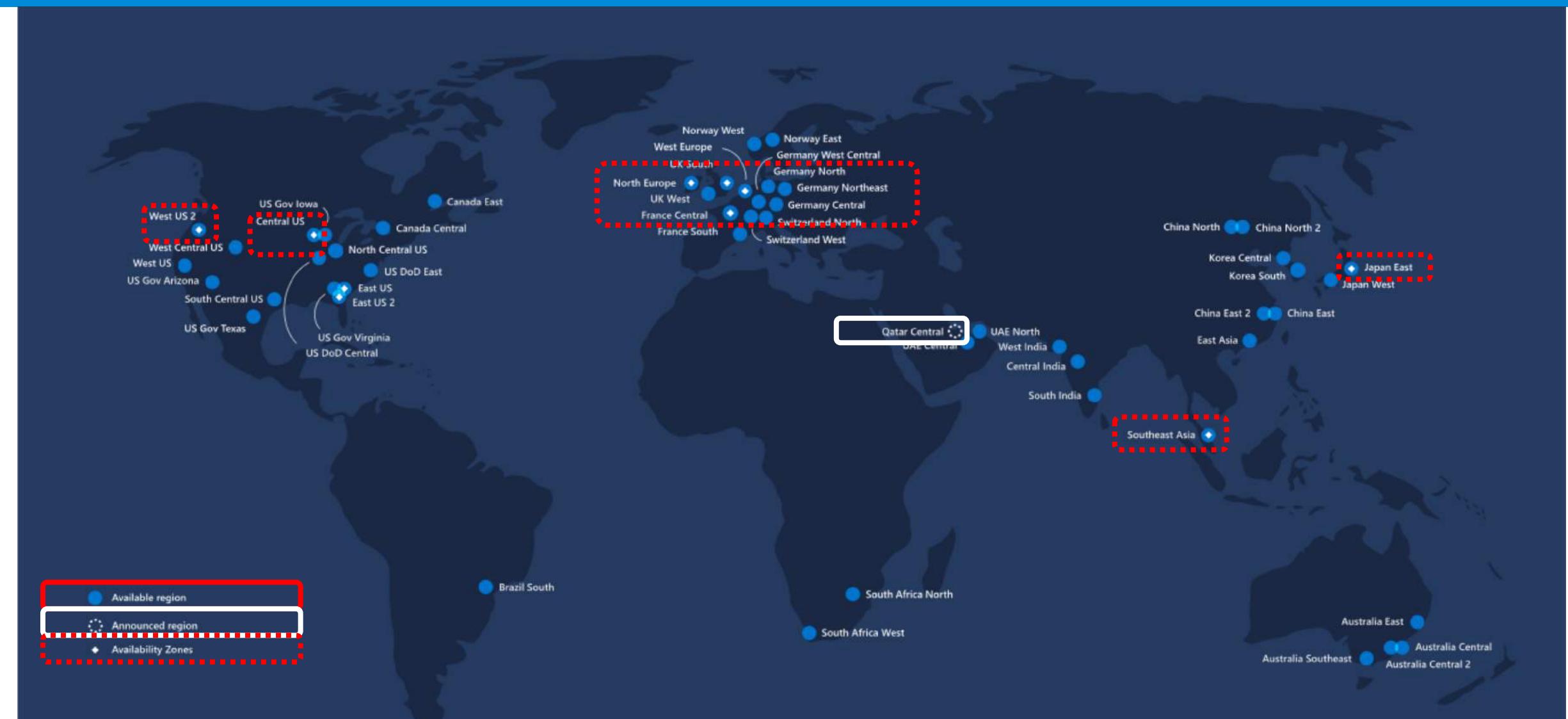
- Servers
- Networking
- Storage
- Security
- Balancers
- Etc.



- <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/data-residency/>
- ❑ 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/>

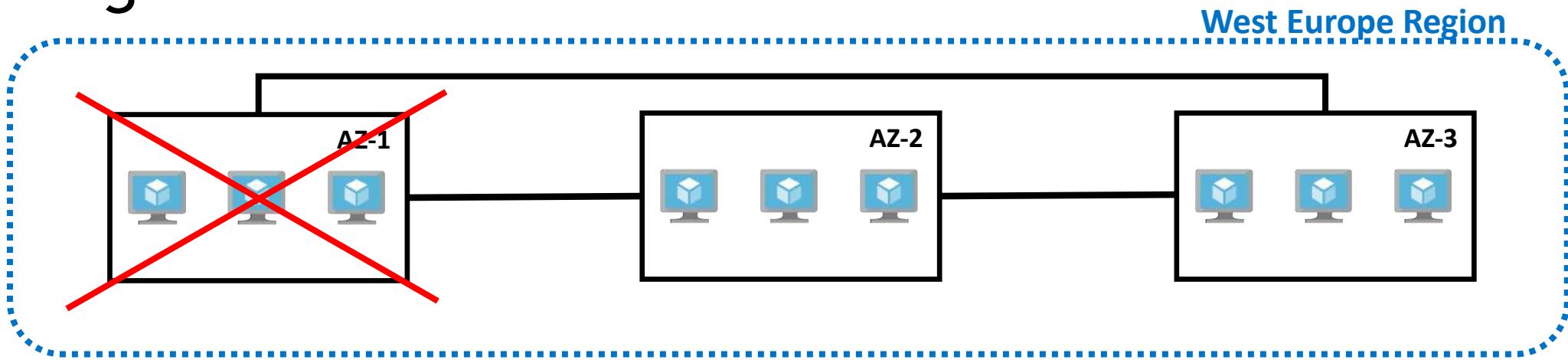




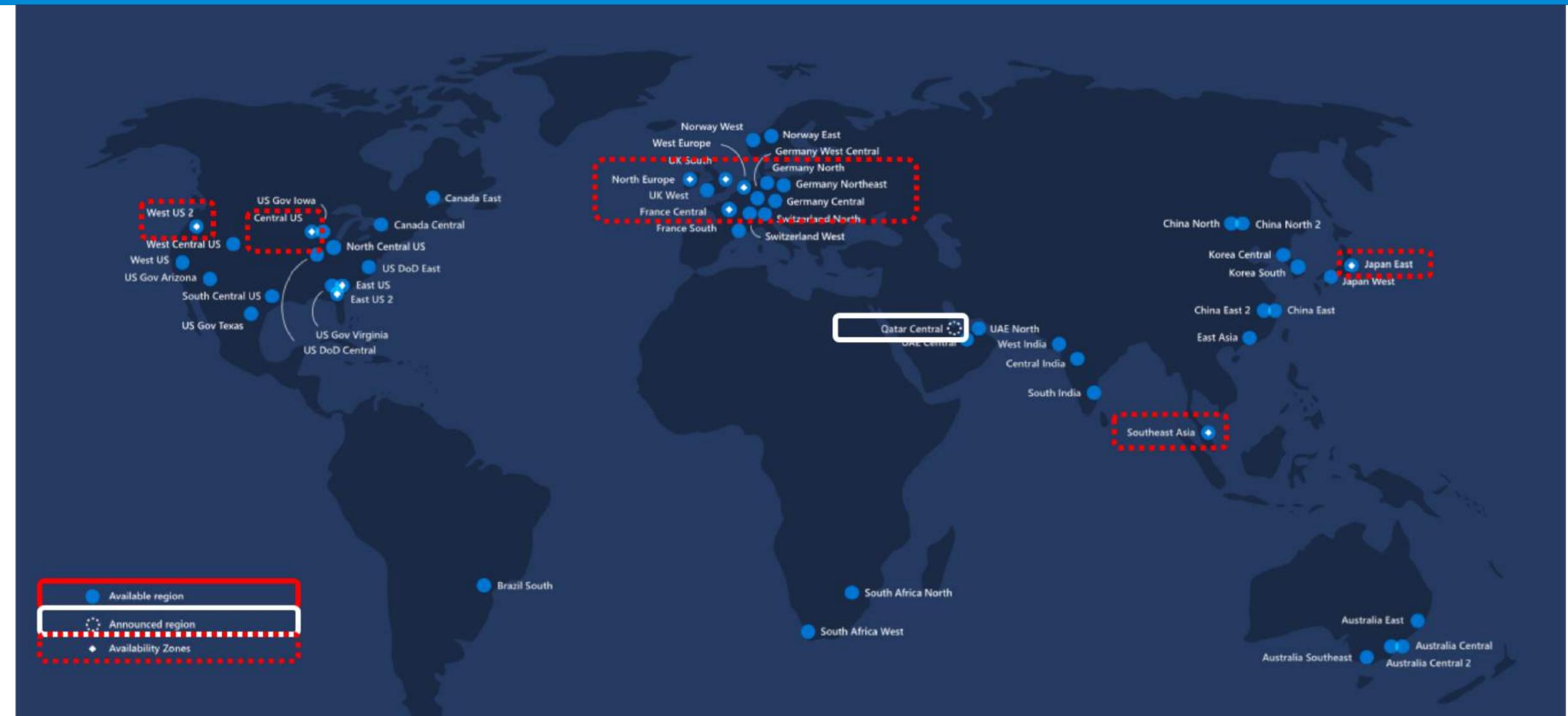
Azure Availability Zones

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

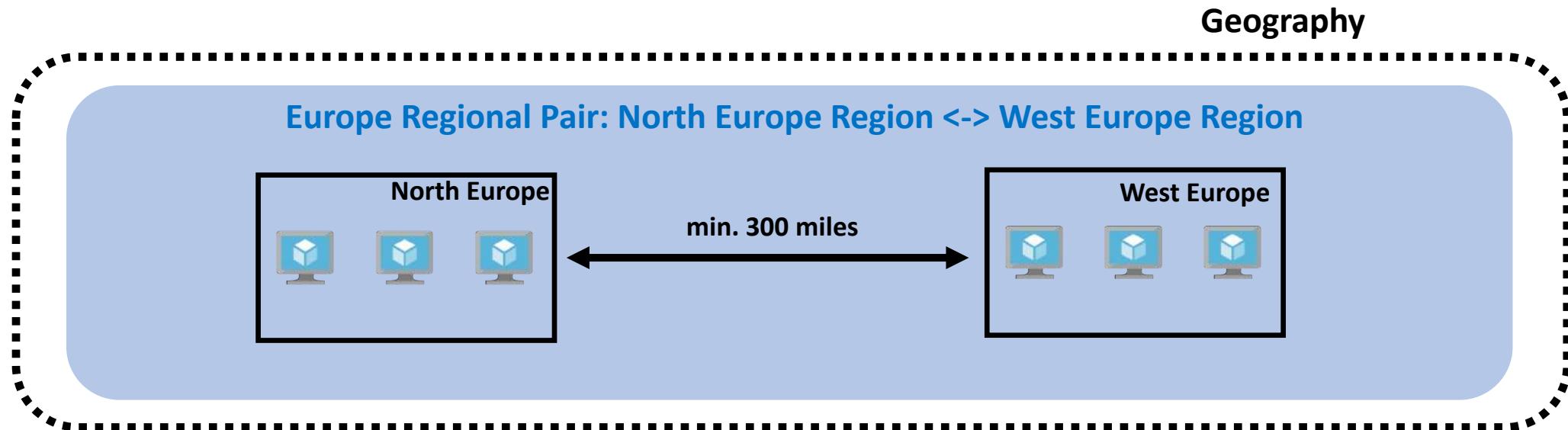




Azure Region Pairs

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 Government and Azure China



Azure Government

Azure Government Overview

- ❑ Azure Government delivers a dedicated (separate) cloud, enabling government agencies and their partners to run mission-critical apps in the cloud
- ❑ Azure Government uses physically isolated data centers and networks (located in U.S. only)
- ❑ Microsoft Azure Government provides world-class security, protection, and compliance services
- ❑ <https://azure.microsoft.com/en-us/global-infrastructure/government/>





Azure China

Azure China Overview

- ❑ Microsoft Azure operated by 21Vianet (Azure China) is a physically separated instance of cloud services located in China
- ❑ 21Vianet Group - largest carrier-neutral
 - ❑ Internet and data center service provider in China
- ❑ Azure China – dedicated DCs in E and N of China
 - ❑ Certifications dedicated for China
- ❑ <https://docs.microsoft.com/en-us/azure/china/overview-operations>





Module 2 – Azure Cloud Introduction

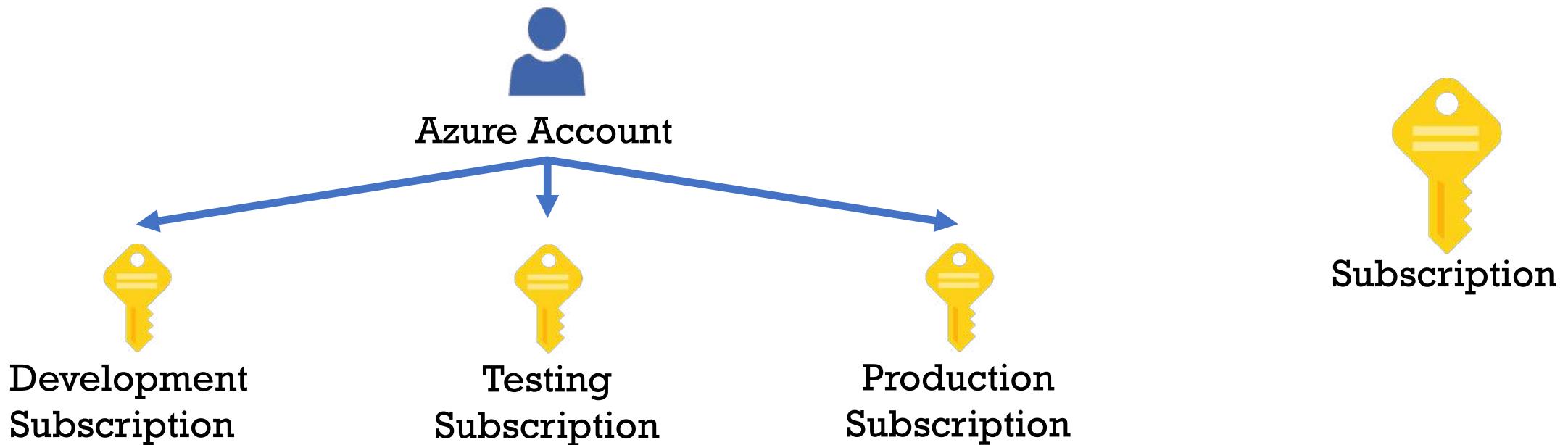
Subscriptions and Management Groups in Azure



Azure Subscriptions

Azure Subscription Overview

- An Azure subscription is a logical unit of Azure services that links to an Azure account



Azure Subscription Boundary

- ❑ One Azure account -> one or more subscriptions !
- ❑ Azure subscriptions use cases:
 - ❑ billing boundaries
 - ❑ access control boundaries
- ❑ Billing boundary – generate separate billing reports, invoices per subscription; organize & manage costs
- ❑ Access control – apply access policies at the subscription level; manage & control access to resources



Subscription



Working with multiple Azure Subscriptions

- 1. Environment separation
 - Dev, Test, Prod
- 2. Create distinct organizational structures
 - HR, Marketing, Management, IT, etc
- 3. Billing purposes
 - Costs are aggregated at the subscription level
- 4. Subscription limits
 - Default, 10 vCPU / subscription; increase hard limits



Subscription



Azure Subscriptions Offers

- ❑ Multiple options exist to purchase and use Azure, starting from free, up to Enterprise agreements
- ❑ Azure free account
 - ❑ 12 months of popular free services
 - ❑ \$200 credit to spend in the first 30 days
- ❑ Pay-As-You-Go
 - ❑ Pay for what you use, credit card attached
- ❑ Member offers – i.e. Microsoft Visual Studio – \$50/month



Subscription

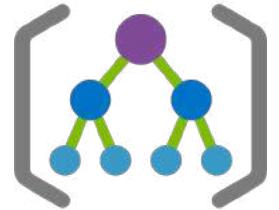




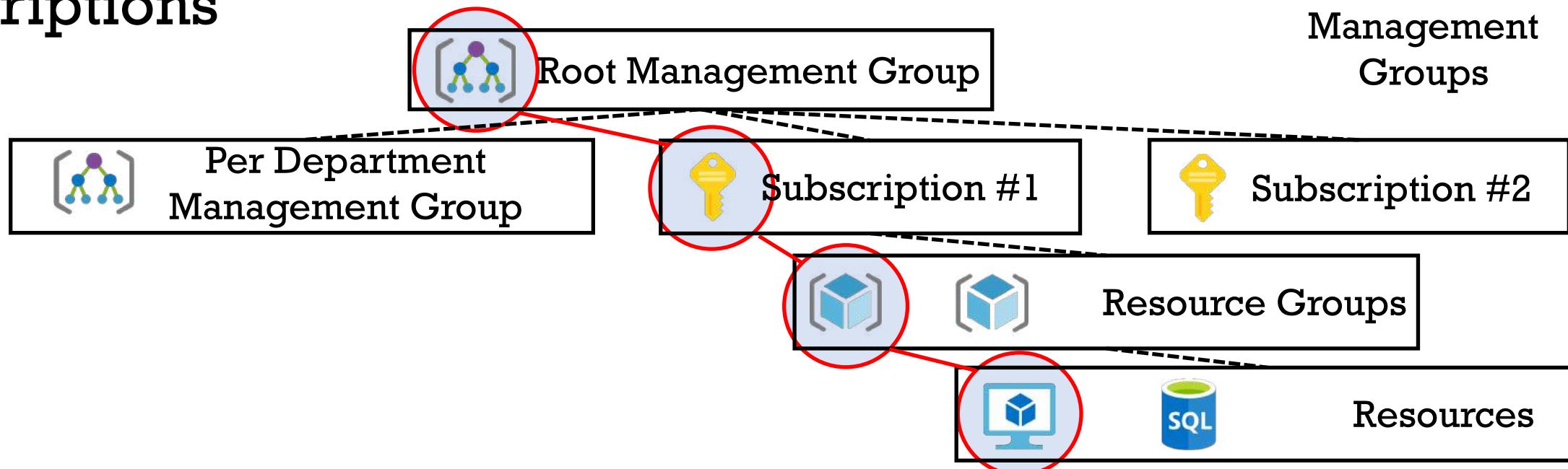
Management Groups

Management Groups Overview

- Azure resources hierarchy on levels: management groups, subscriptions, resource groups and resources



- Management groups – containers for multiple subscriptions





Module 2 – Azure Cloud Introduction

Azure Management Interfaces

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](#)

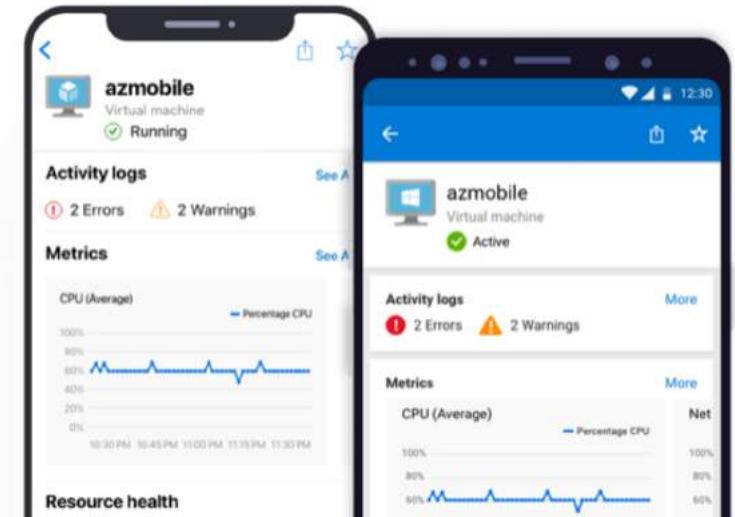




Azure Mobile App

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
 - PaaS – Platform as a Service
 - 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

CapEx and OpEx

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Economies of Scale

Economies of Scale

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Azure Global Infrastructure

Azure Global Infrastructure

- A **region** is a set of datacenters deployed within a latency-defined perimeter and connected through a dedicated regional low-latency network
- A **geography** is a discrete market, typically containing two or more regions, that preserves data residency and compliance boundaries
- Availability Zones are physically separate datacenters within an Azure region, with independent power, network and cooling





Azure Government & Azure China

Azure Government & Azure China

- ❑ Azure Government delivers a dedicated (separate) cloud, enabling government agencies and their partners to run mission-critical apps in the cloud
- ❑ Only entities in US can use Azure Government!
- ❑ Microsoft Azure operated by 21Vianet (Azure China) is a physically separated instance of cloud services located in China
- ❑ Meet specific laws and local regulations!





Subscriptions and Management Groups

Azure Subscriptions Overview

- An Azure subscription is a logical unit of Azure services that links to an Azure account
- One Azure account -> one or more Azure subscriptions, part of the same Azure account!
- Azure subscriptions use cases:
 - billing boundaries
 - access control boundaries

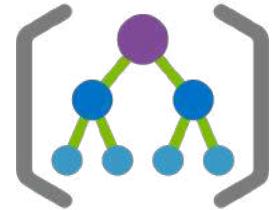


Subscription

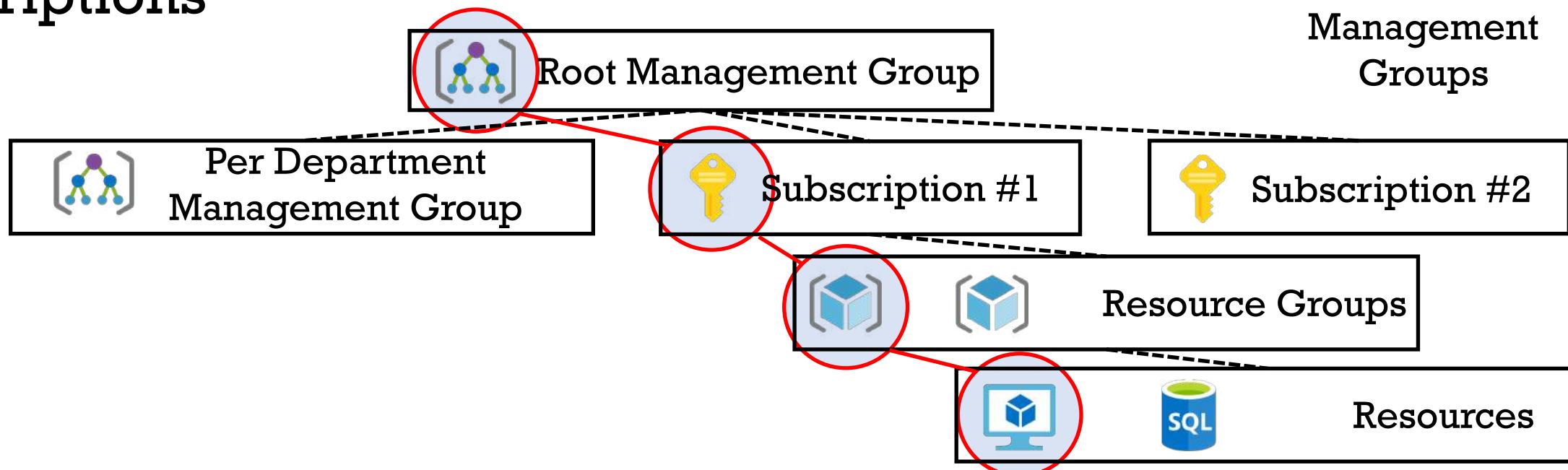


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Management Groups





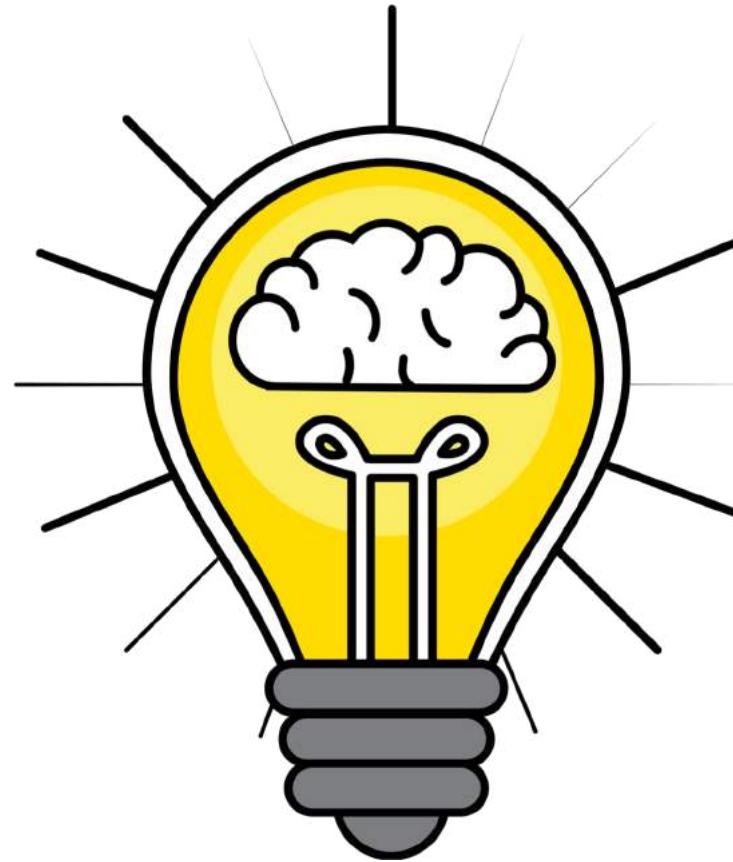
Azure Management Interfaces

Azure Management Interfaces

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Azure Cloud Introduction - Quiz



Microsoft Azure Fundamentals

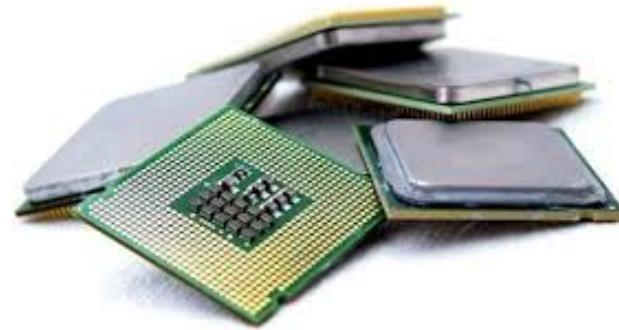


Module 3: Azure Core Services - VMs

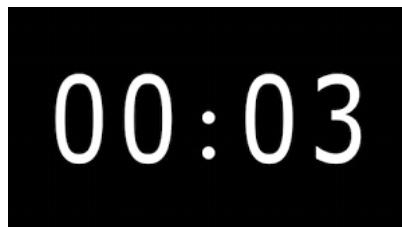
Microsoft Azure Compute Options Overview

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



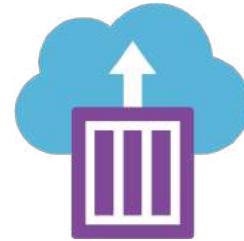
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



Containers



Azure App Service



Serverless Computing

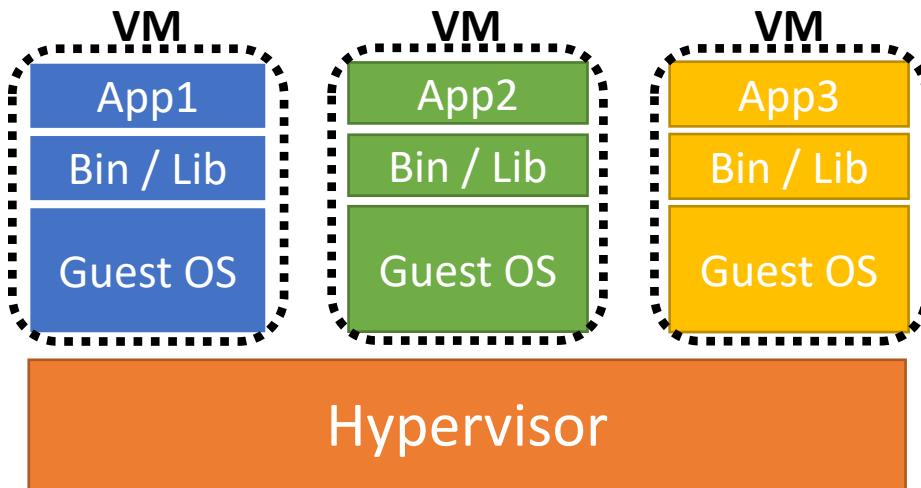


Azure Virtual Machines Introduction

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



Containers, VMs vs Containers



i.e. VMware Workstation, ESXi

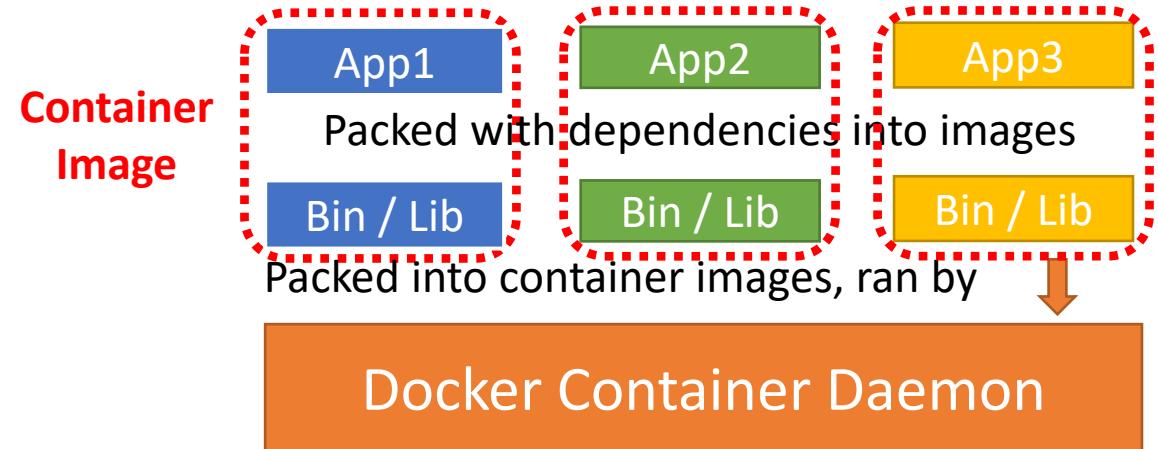
Host Operating System

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



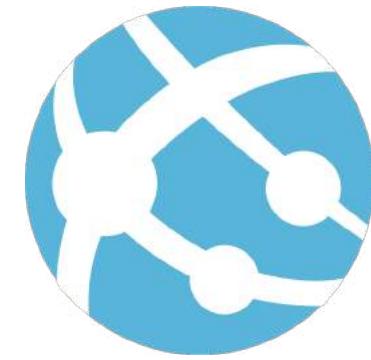
Microsoft Azure Fundamentals

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

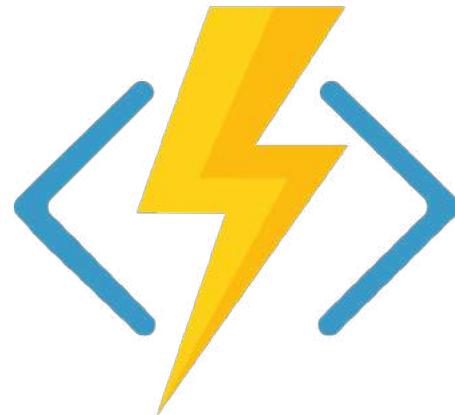
- Azure App Service – Azure PaaS offering
- Pricing – based on App Service Plan



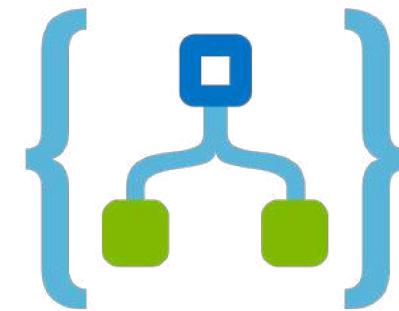
Microsoft Azure Fundamentals

Azure Serverless Computing Services

- ❑ Most popular Azure serverless computing services:



Azure Functions



Azure Logic App





Module 3: Azure Core Services - VMs

Azure Virtual Machines Fundamentals 101

What's a Virtual Machine (VM) ?

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

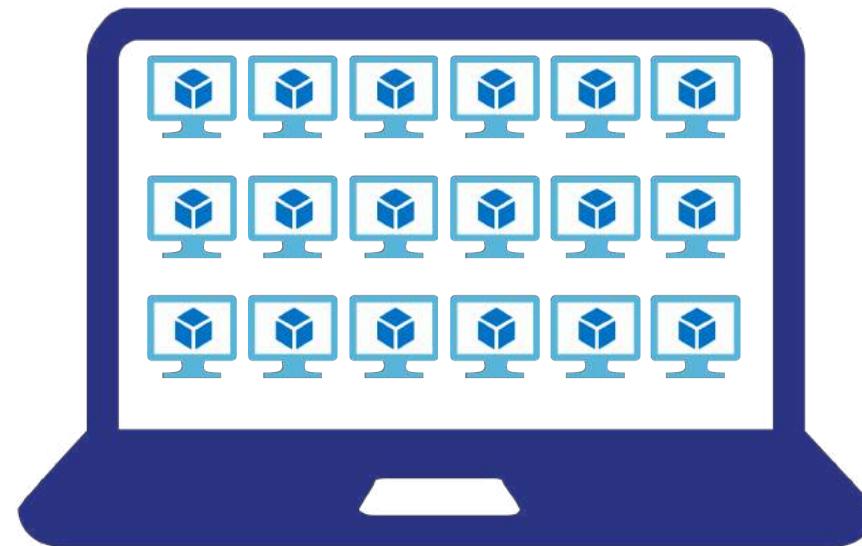


Virtual Machine



What's a Virtual Machine (VM) ?

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



USER STATION or SERVER



VMs Use Cases

□ Azure VMs - Infrastructure as a Service (IaaS)

□ VMs are great choice when:

① Total control over the OS



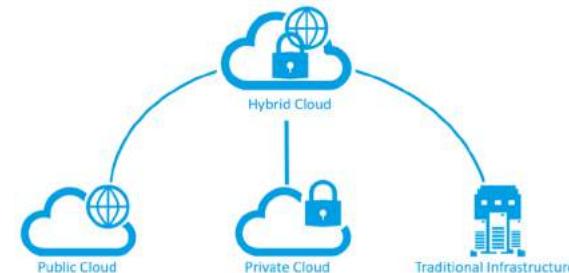
② Run custom software



③ Development and testing



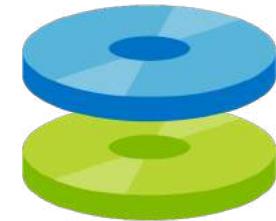
④ Extend your datacenter



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>





Module 3: Azure Core Services - VMs

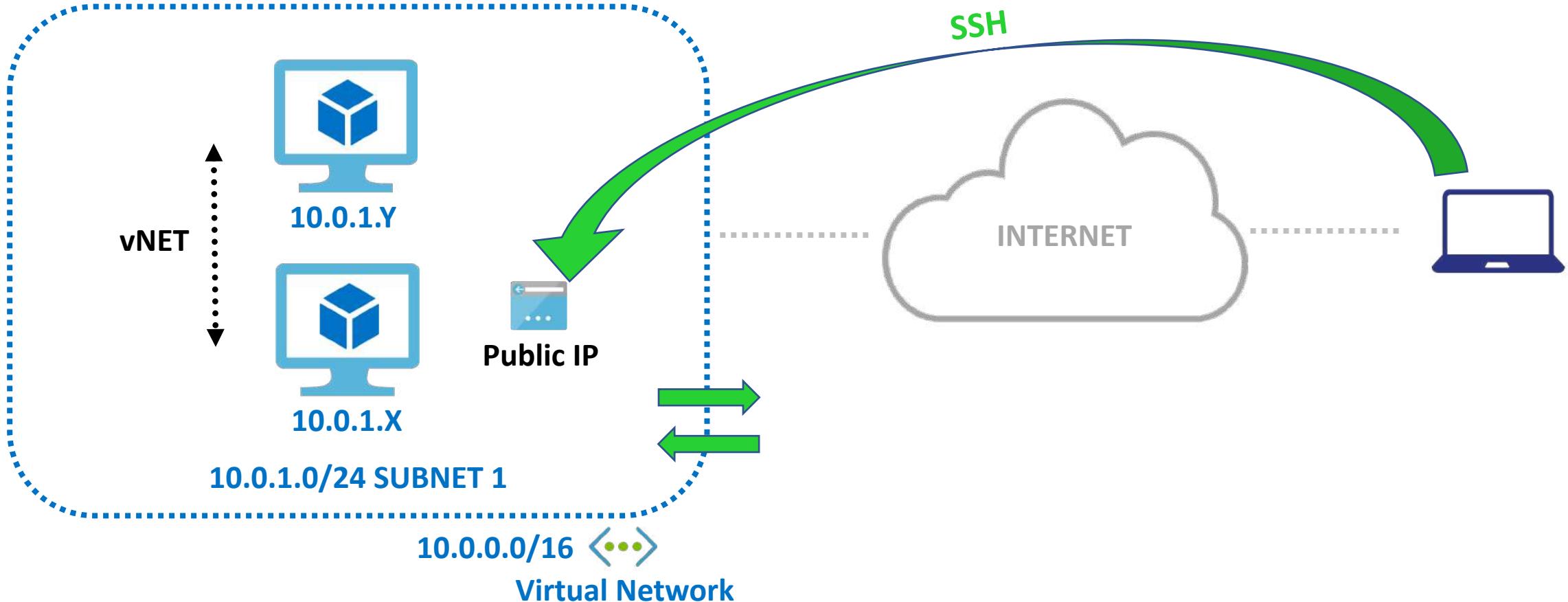
Azure VMs Networking and HA Fundamentals 101

VMs Networking Basics – Azure vNETs

- ❑ Azure Virtual Networks (vNETs) are the fundamental building block for your private network in Azure (build own private DC in Azure cloud)
- ❑ vNETs enable VMs to communicate between them, over the internet and with your on-prem DC
- ❑ Think of your traditional IP network that you need to setup in your organization or your DC; vNETs are your dedicated network, running in Azure



VMs Networking Basics – Azure vNETs



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)

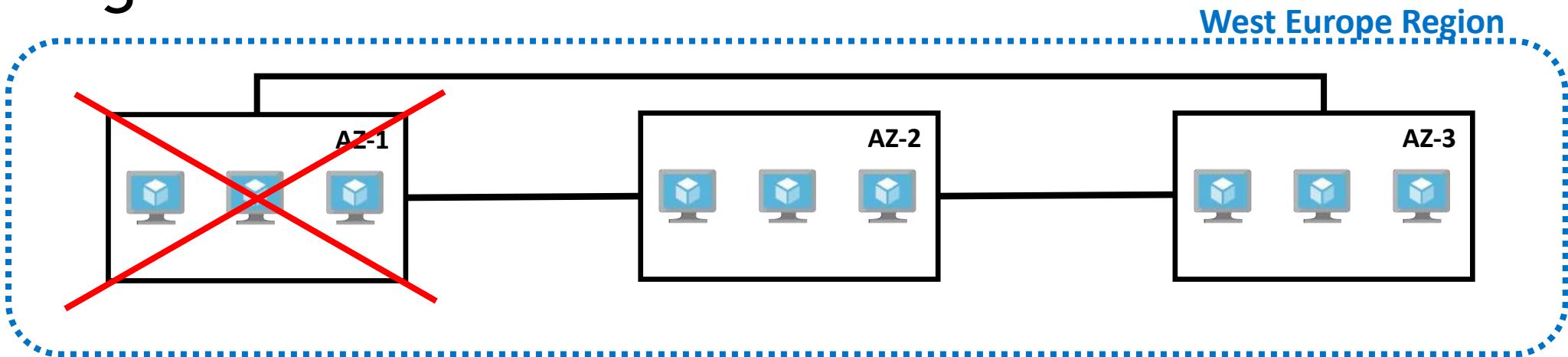


High Availability



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

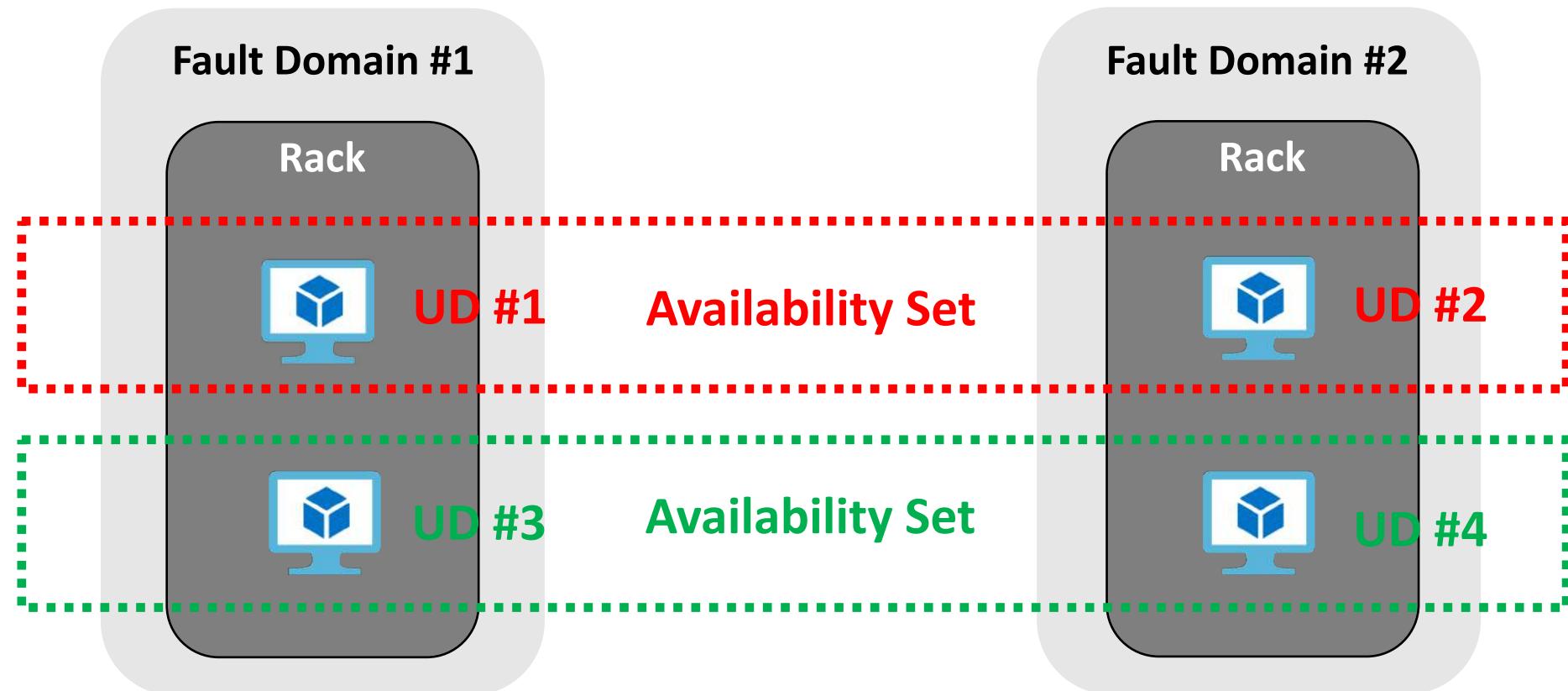


VMs High Availability – Availability Sets, FD, UD

- ❑ 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



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





Module 3: Azure Core Services - VMs

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>



Microsoft Azure Fundamentals



Module 3: Azure Core Services - VMs

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

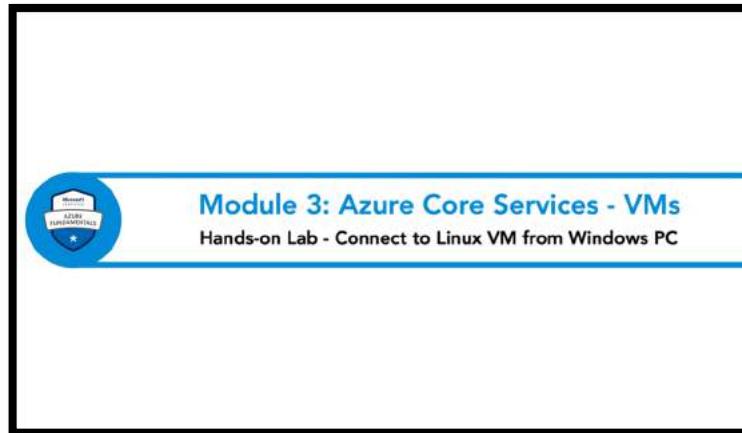
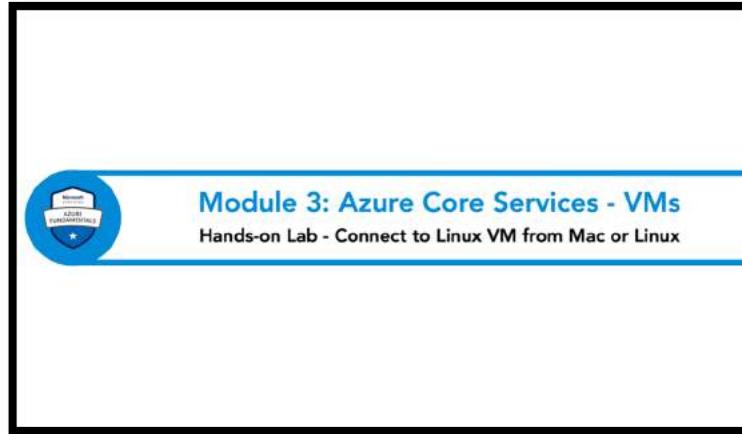
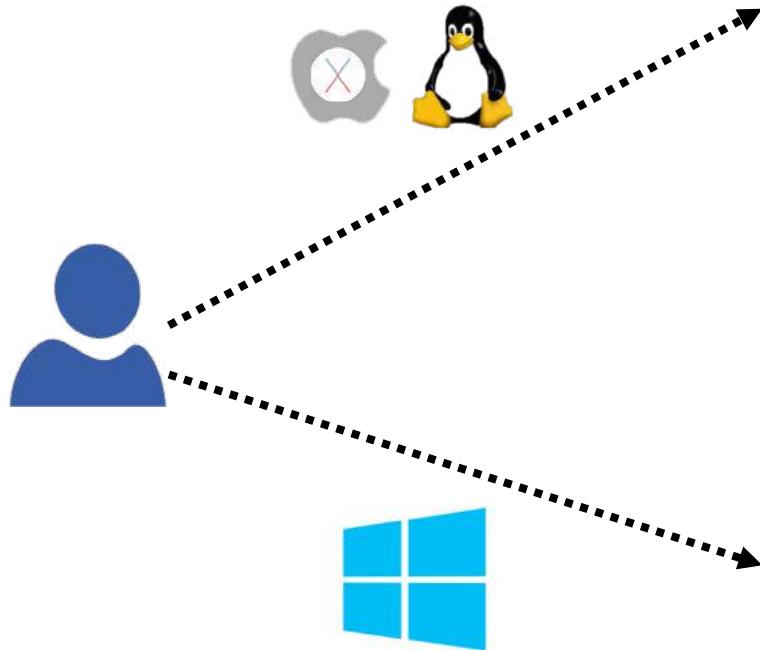


SSH Connect Options

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



Where to Go Next ?



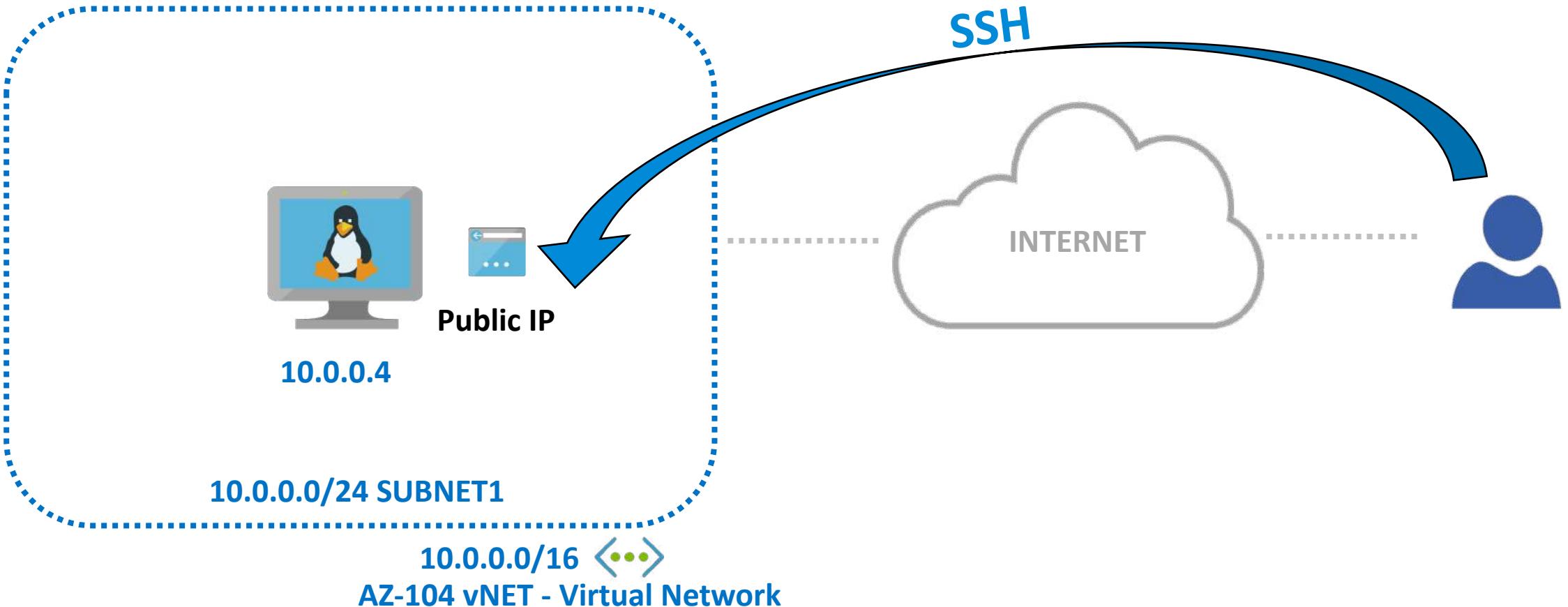


Module 3: Azure Core Services - VMs

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

Hands-on Lab Overview

☐ Connect to Linux VM from Mac or Linux



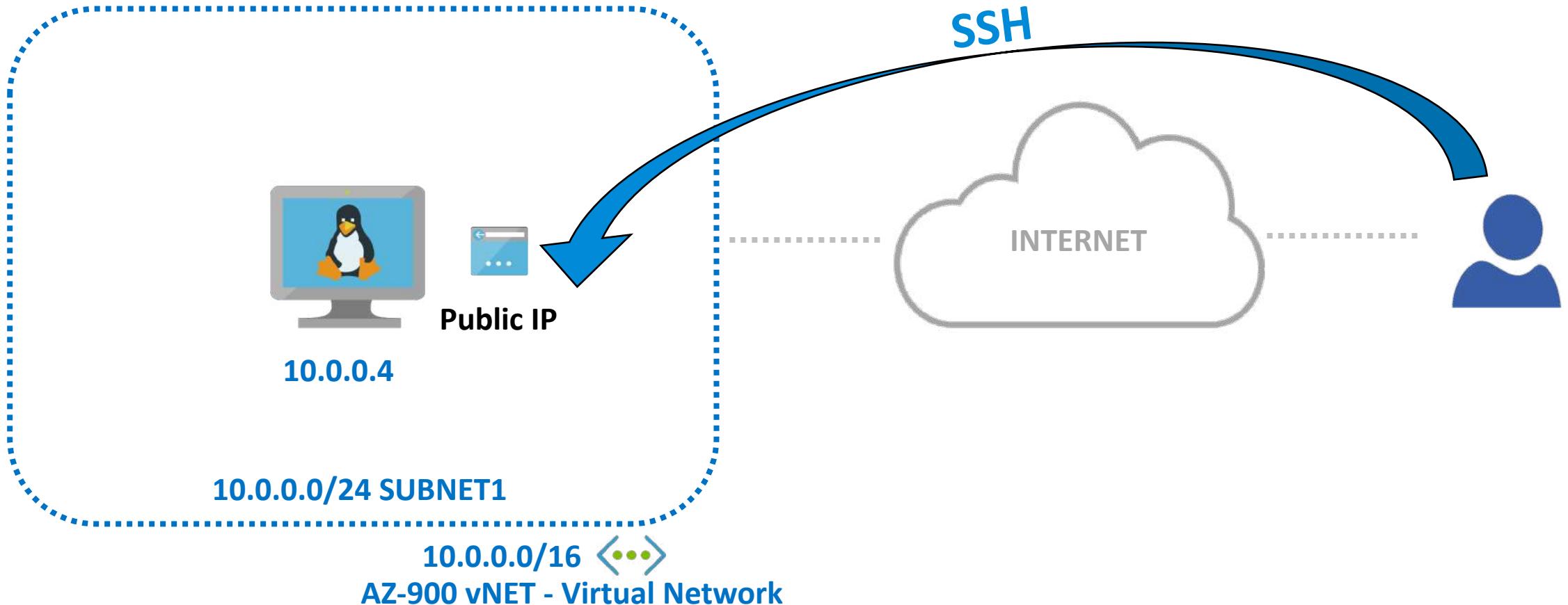


Module 3: Azure Core Services - VMs

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

Hands-on Lab Overview

☐ Connect to Linux VM from Windows PC



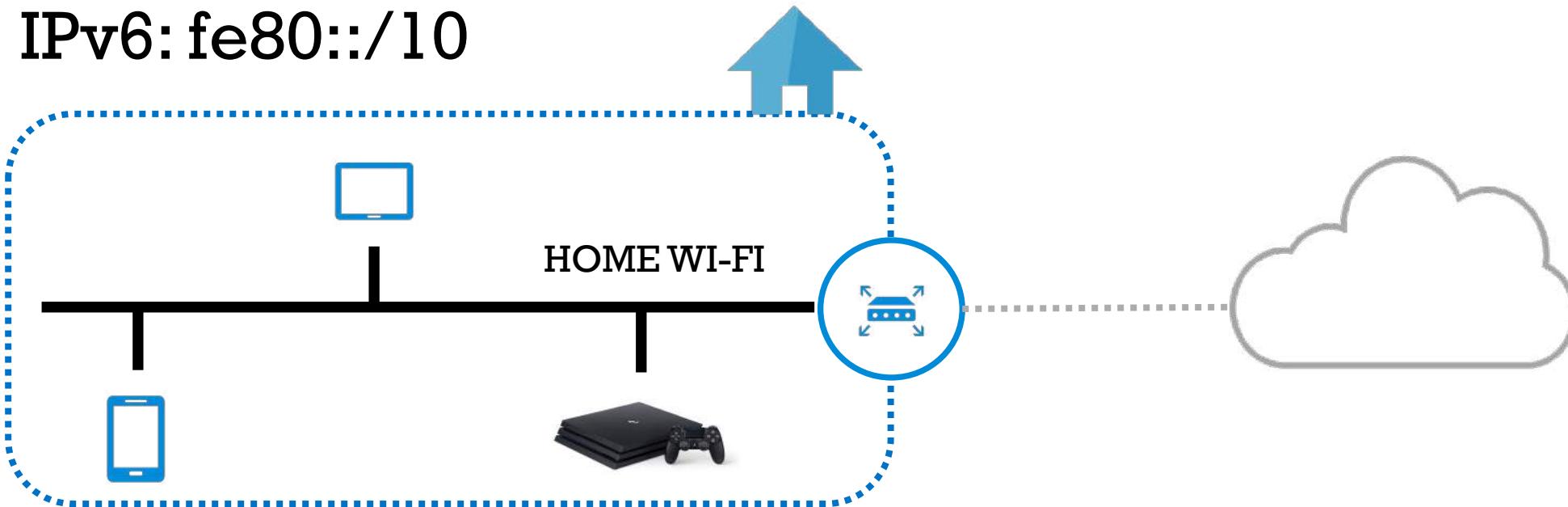


Module 3: Azure Core Services - VMs

IP Addressing Fundamentals - Private IP vs Public IP

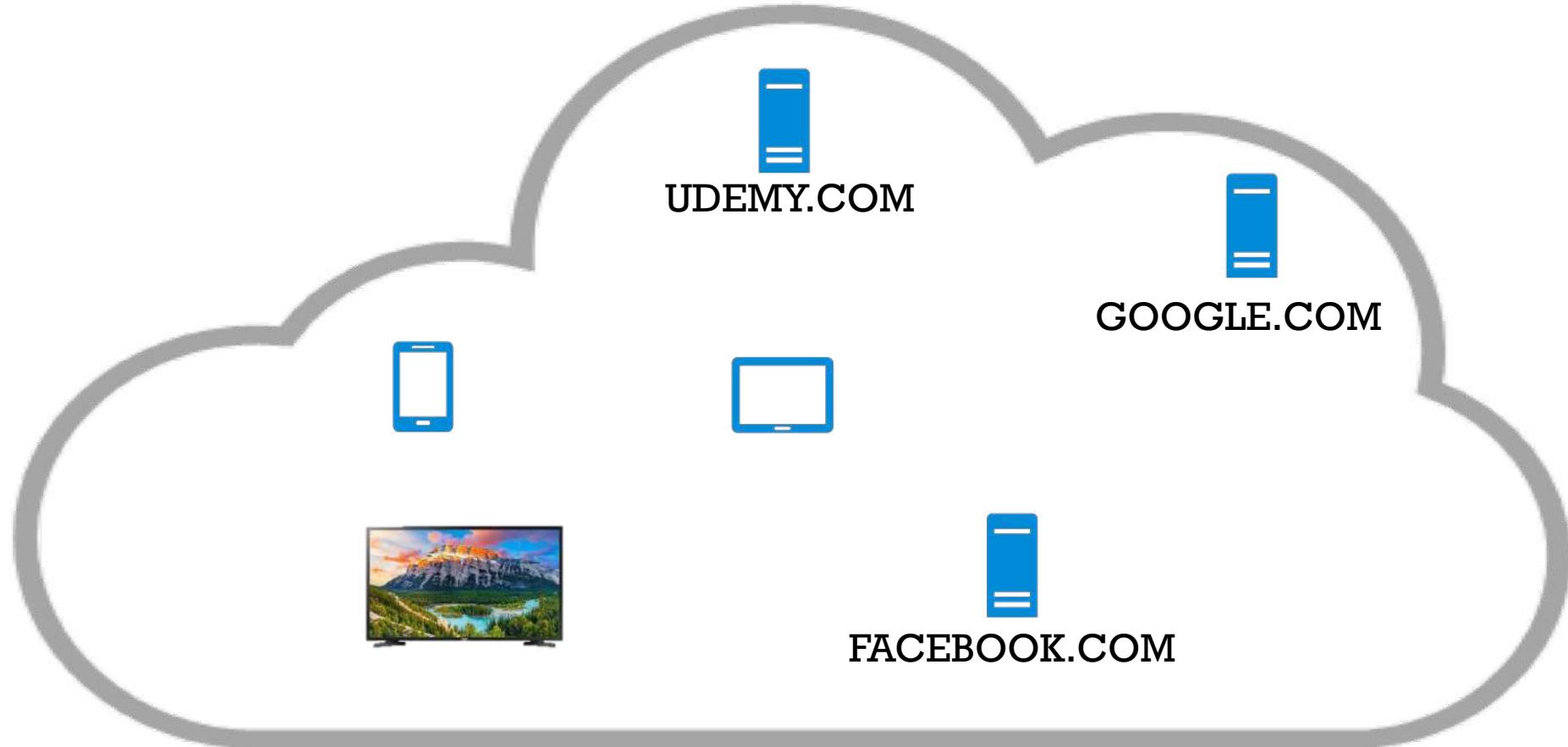
Private IP Addresses Overview

- ❑ 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



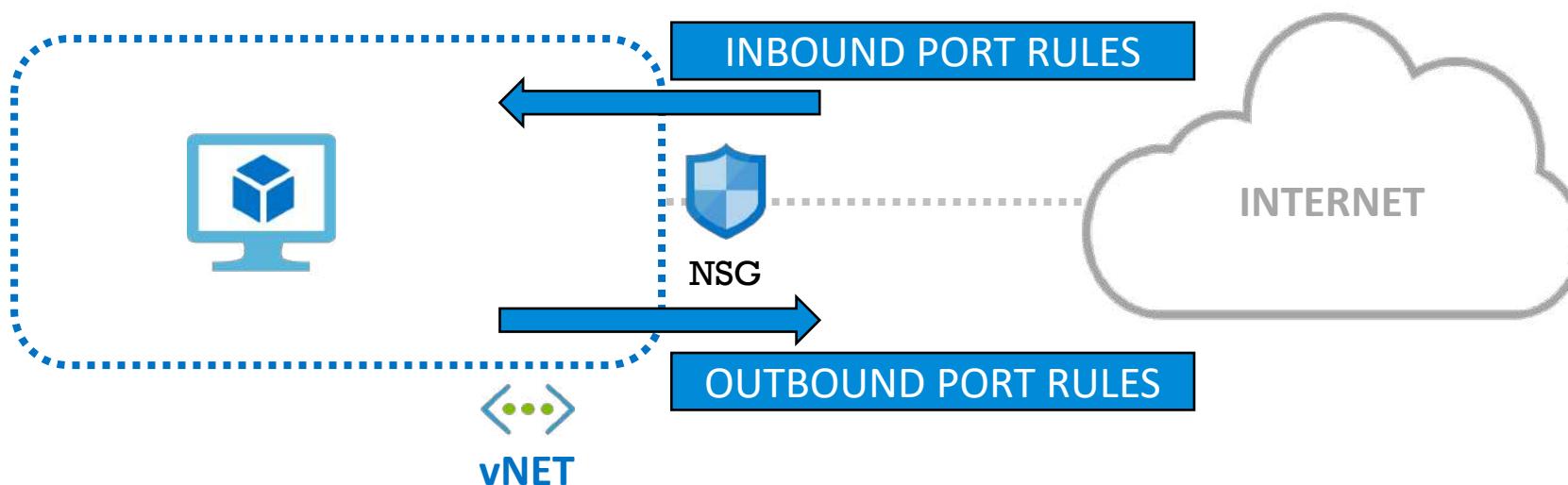


Module 3: Azure Core Services - VMs

Hands-on Lab - Azure Network Security Groups Fundamentals

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



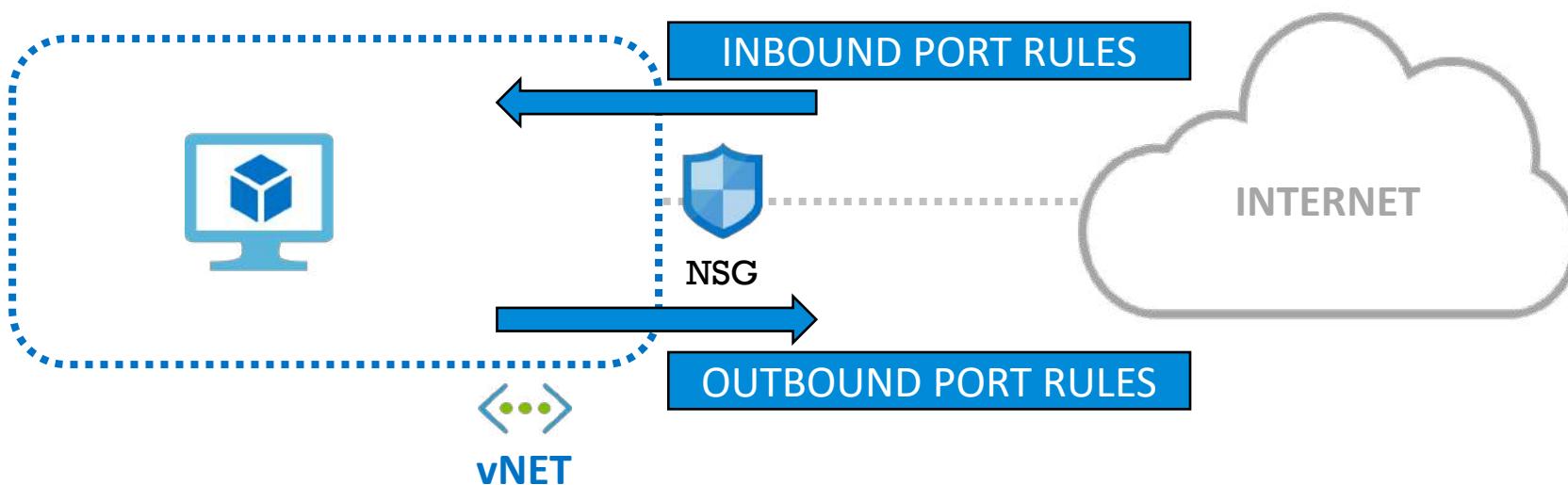


Module 3: Azure Core Services - VMs

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

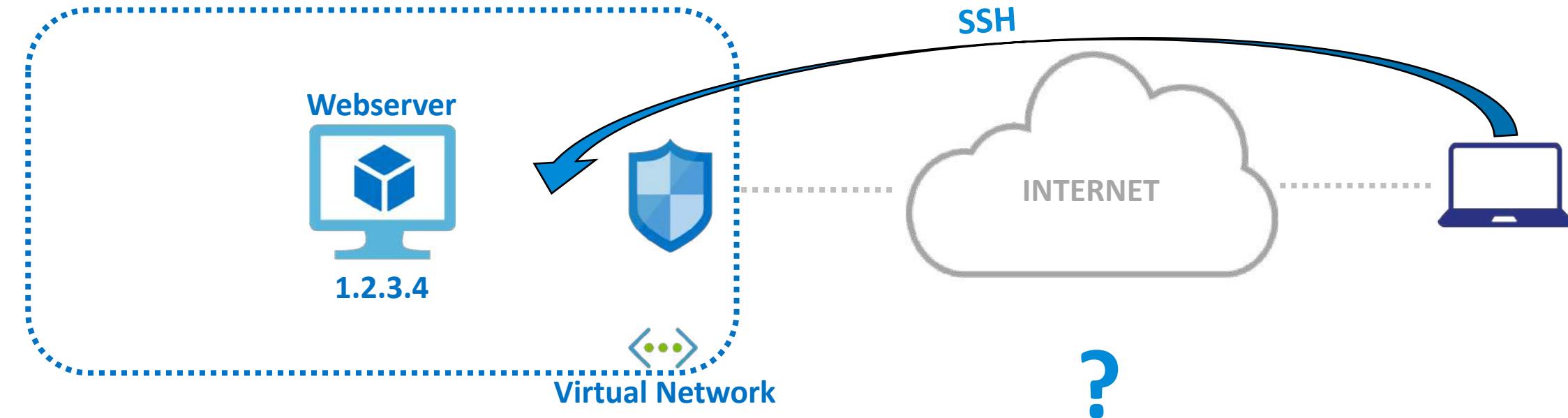
Network security group **Webserver01-nsg** (attached to network interface: [webserver01228](#))
Impacts 0 subnets, 1 network interfaces

[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	...



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	
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NSGs – Default Outbound Security Rules

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

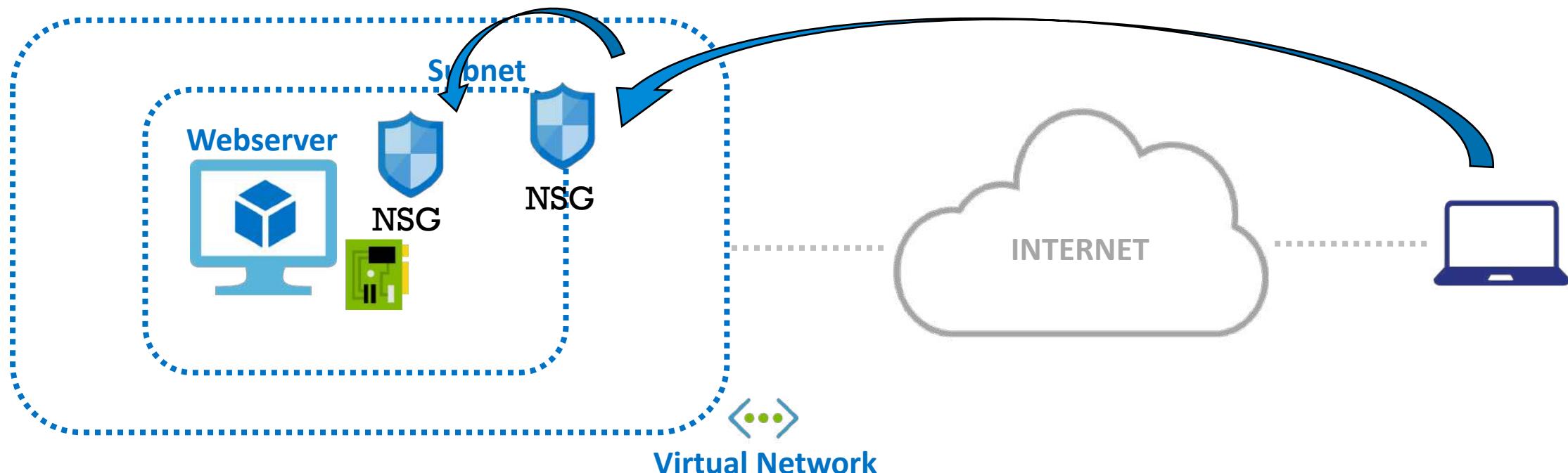
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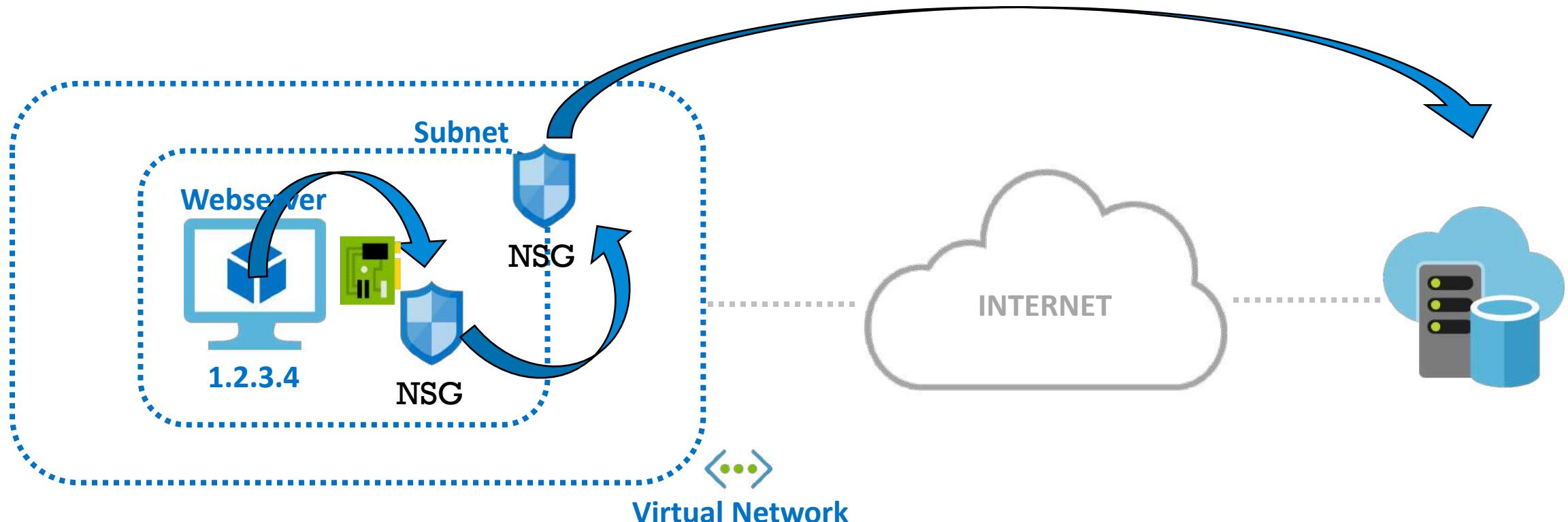
NSGs Order – Inbound Traffic Evaluation

- 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



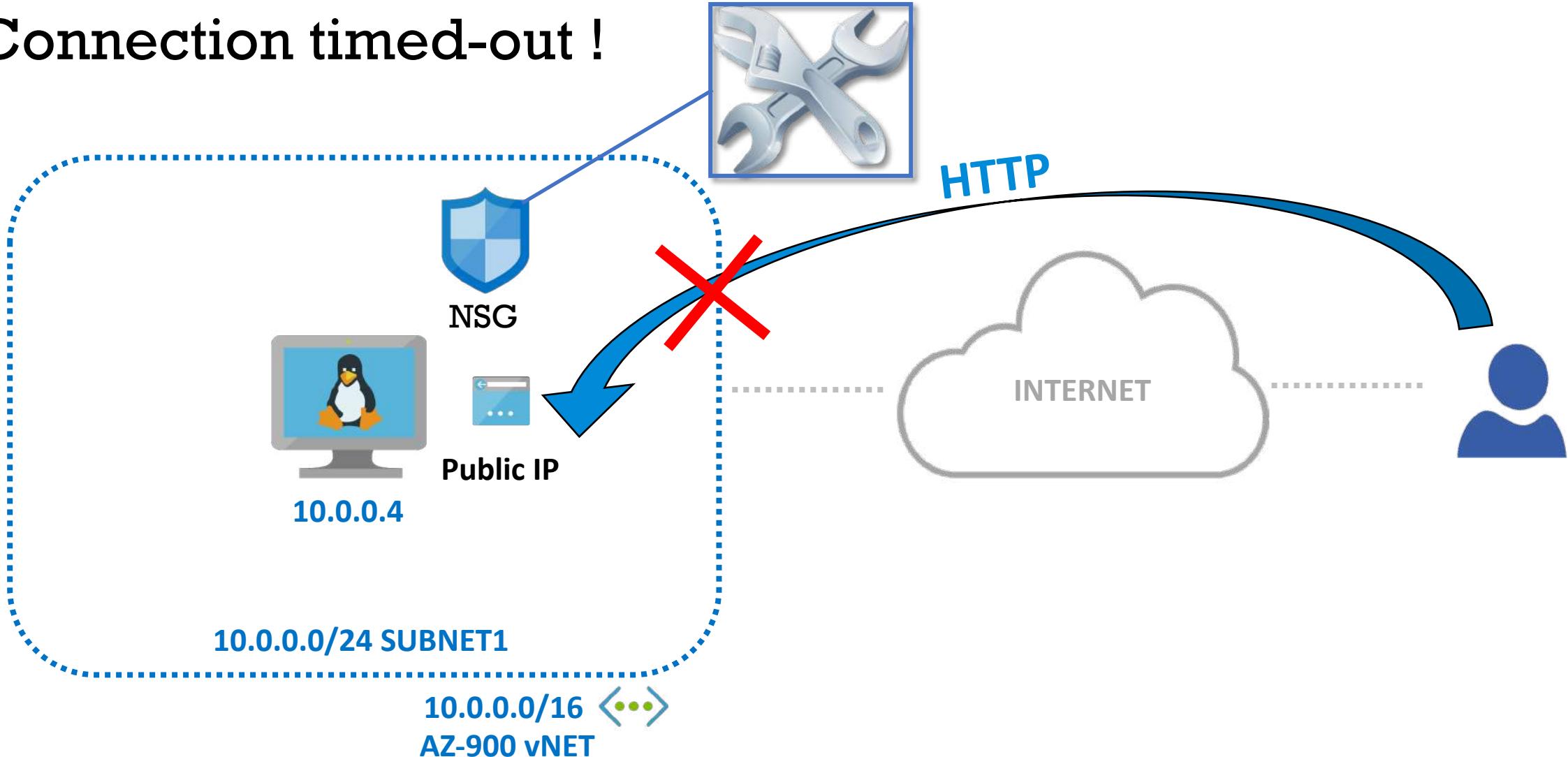


Module 3: Azure Core Services - VMs

Hands-on Lab - Modify NSG to Allow HTTP to Web Server

Hands-on Lab Overview

□ Connection timed-out !





Module 3: Azure Core Services - VMs

Azure Load Balancer Fundamentals 101

Load Balancing Introduction

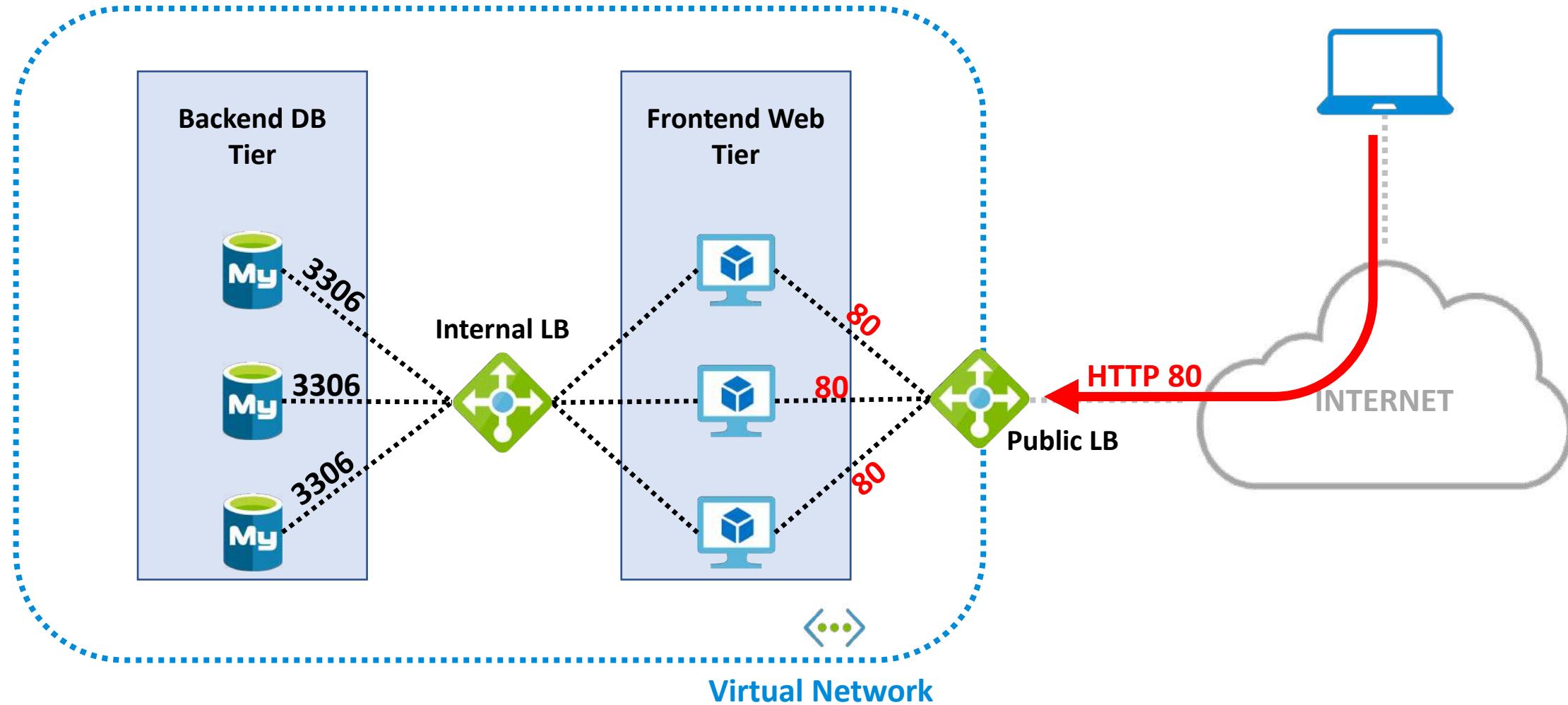
- Load balancing means equally distributing load (incoming traffic) to a group of servers (backend pool)
- The LB is the single point of contact for its clients; it distributes incoming traffic to the backend pool (VMs)
- Two types of LBs are available:
 - Internal LB
 - Public LB



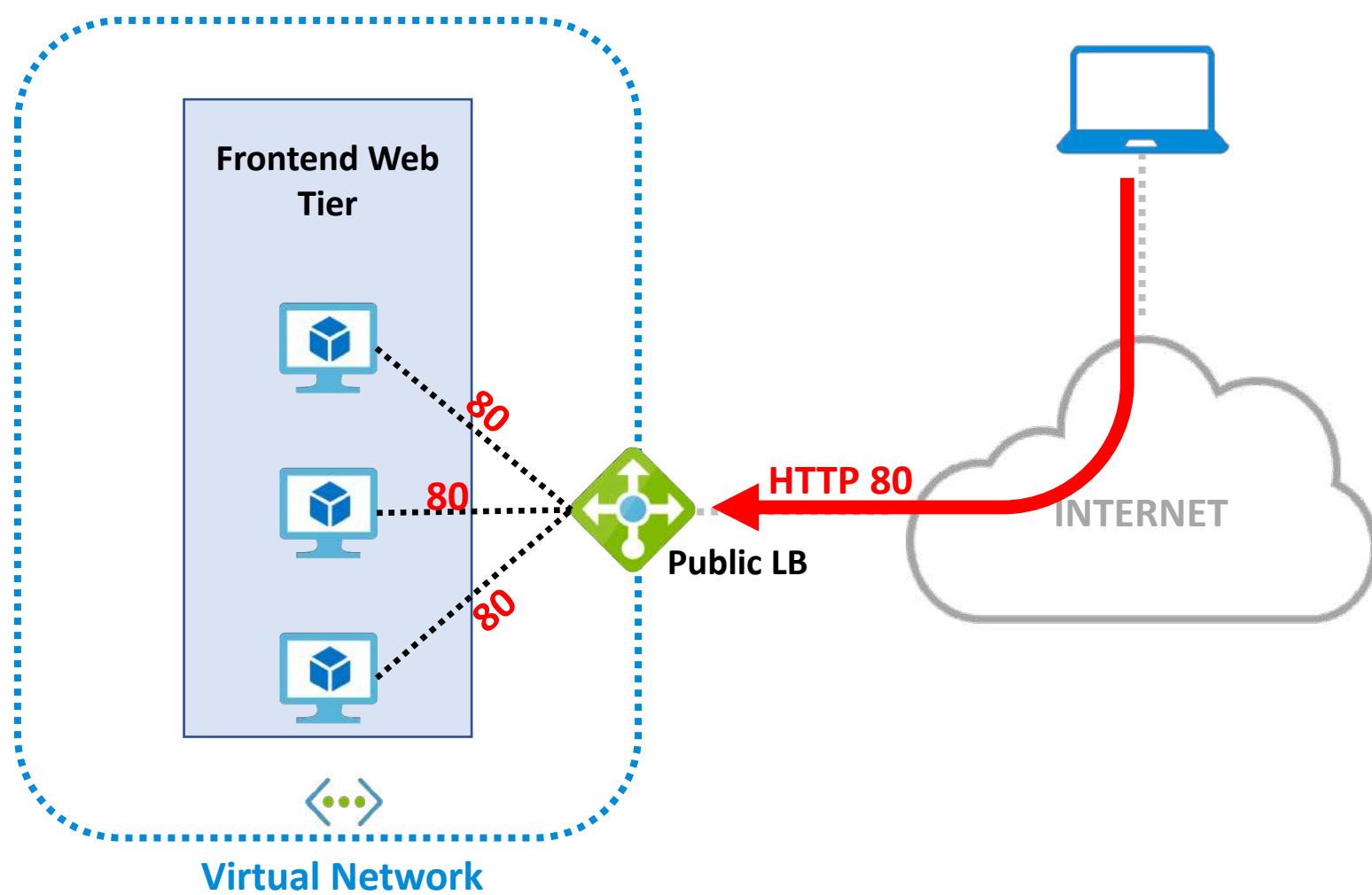
Load Balancer



Load Balancing Introduction



Azure Load Balancer – Configuration steps



Configuration steps:

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



Load Balancer



Microsoft Azure Fundamentals

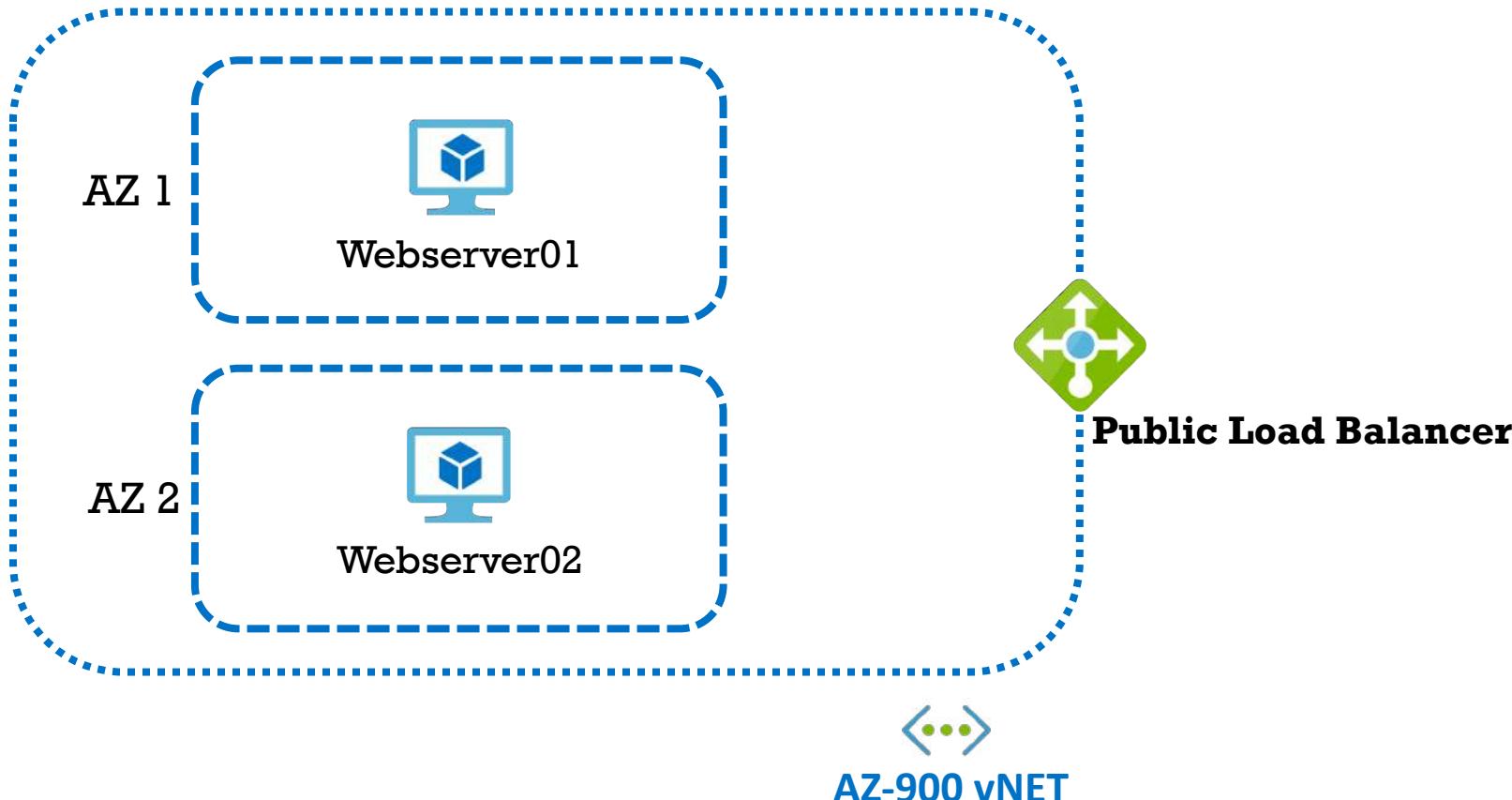


Module 3: Azure Core Services - VMs

Hands-on Lab - Create Azure Load Balancer

Hands-on Lab Overview

Configure a Standard Azure Load Balancer



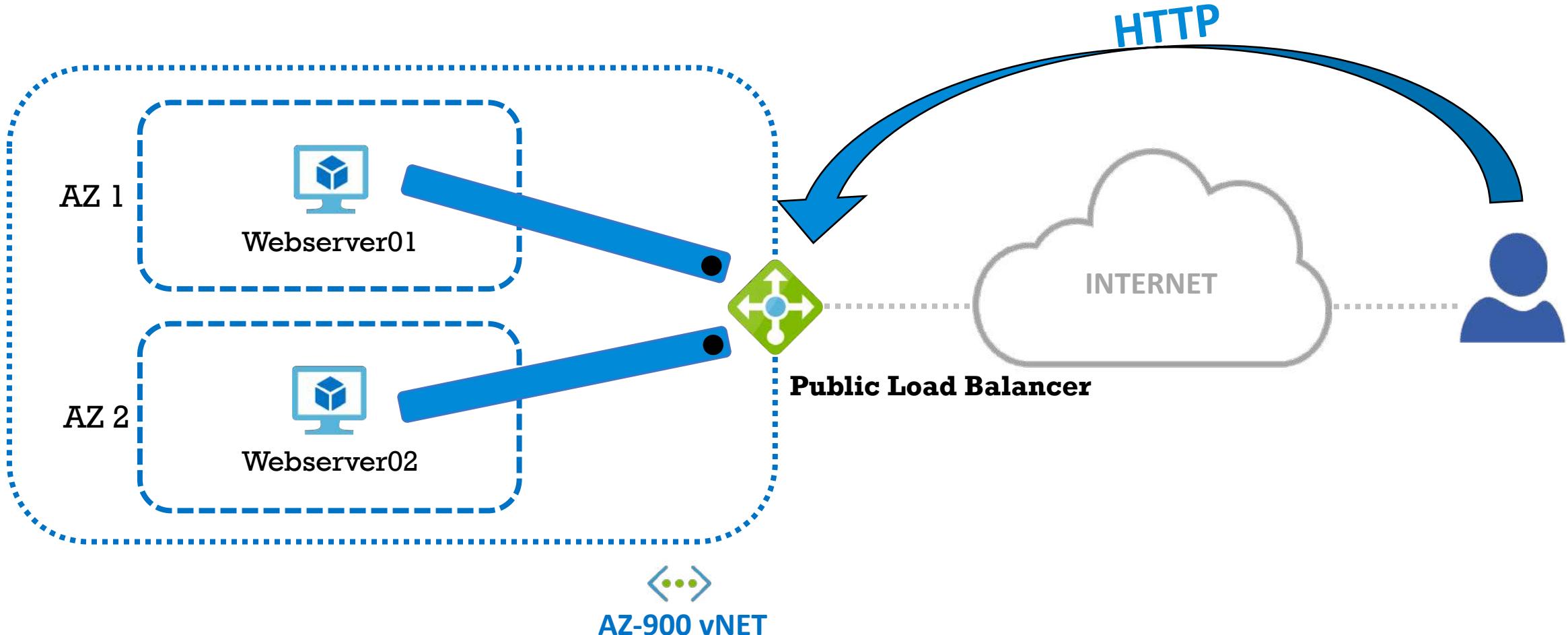


Module 3: Azure Core Services - VMs

Hands-on Lab - Deploy Two Web Servers

Hands-on Lab Overview

Configure the new Web servers



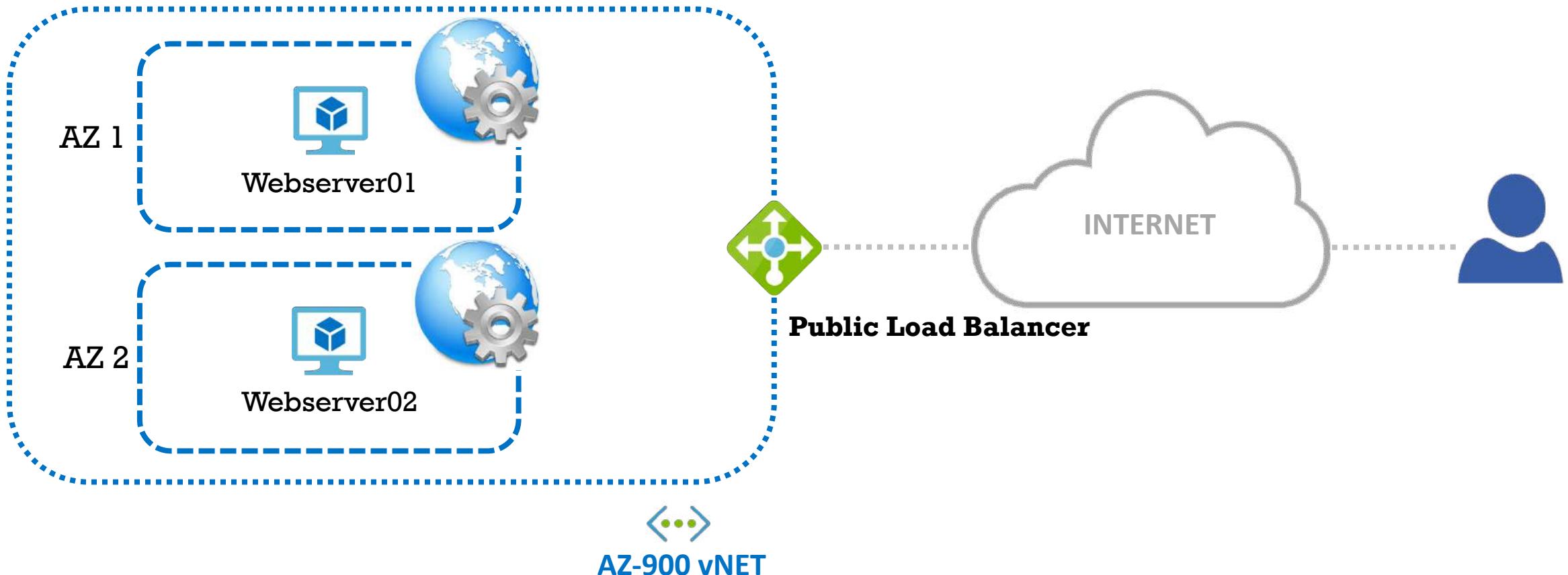


Module 3: Azure Core Services - VMs

Hands-on Lab - Install and Configure Apache2 on VMs

Hands-on Lab Overview

☐ Install and Configure Apache2 web service



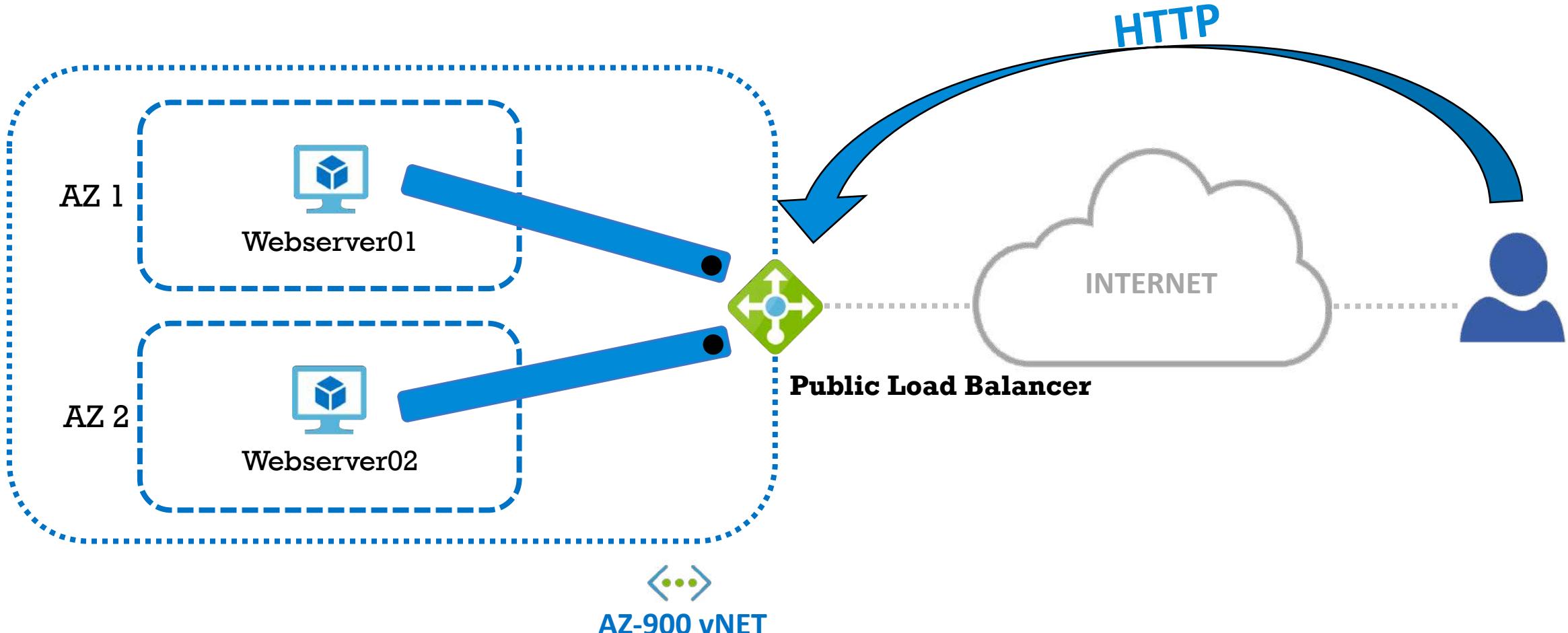


Module 3: Azure Core Services - VMs

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

Hands-on Lab Overview

☐ Test load balancing





Module 3: Azure Core Services - VMs

Module Completion & Exam Hints



Azure Compute Options

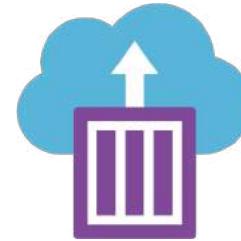
Azure Compute Options

□ Azure compute is delivered through:

□ Virtual Machines



□ Containers



□ Azure App Service



□ Serverless Computing

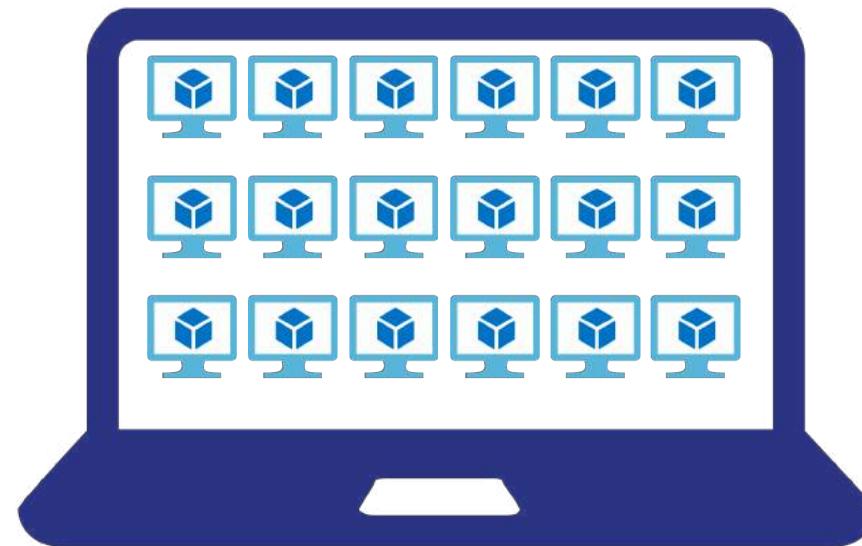




Azure VMs Fundamentals

What's a Virtual Machine (VM) ?

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



Hardware Equipment



VMs Use Cases

□ Azure VMs - Infrastructure as a Service (IaaS)

□ VMs are great choice when:

① Total control over the OS



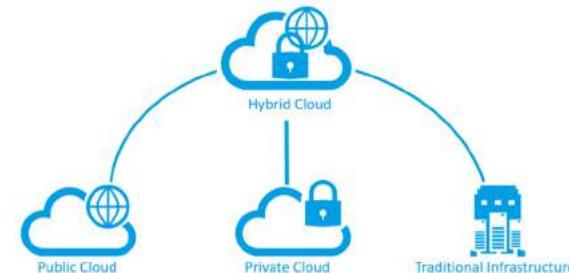
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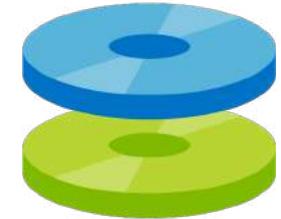
④ Extend your datacenter



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>



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

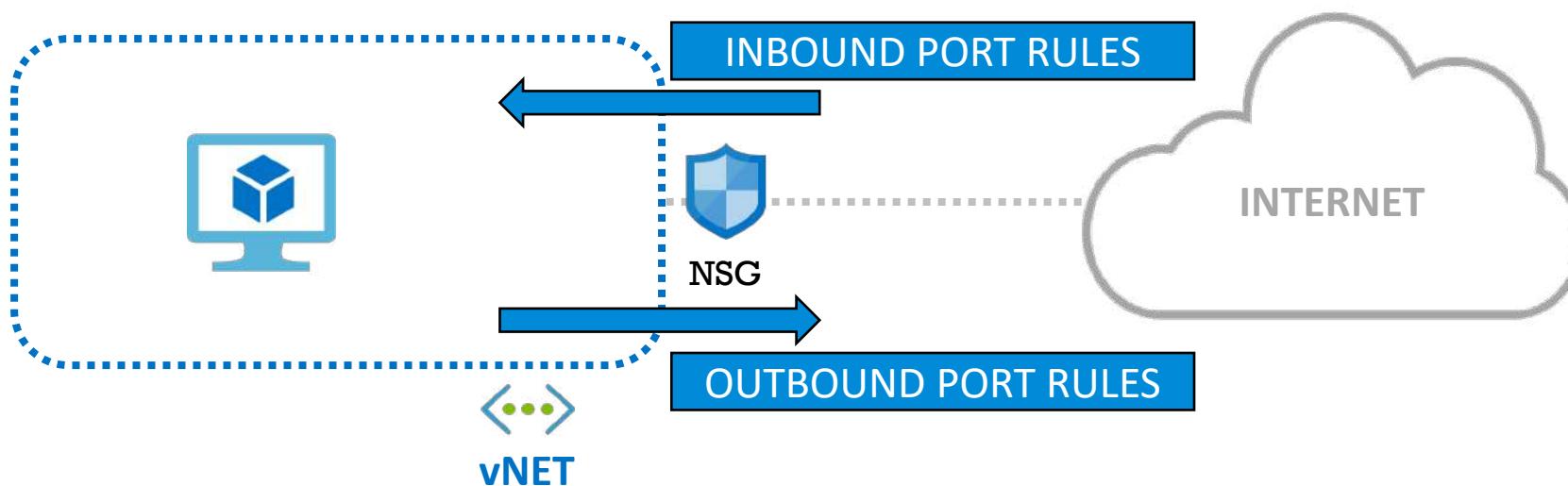




Network Security Groups

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
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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	
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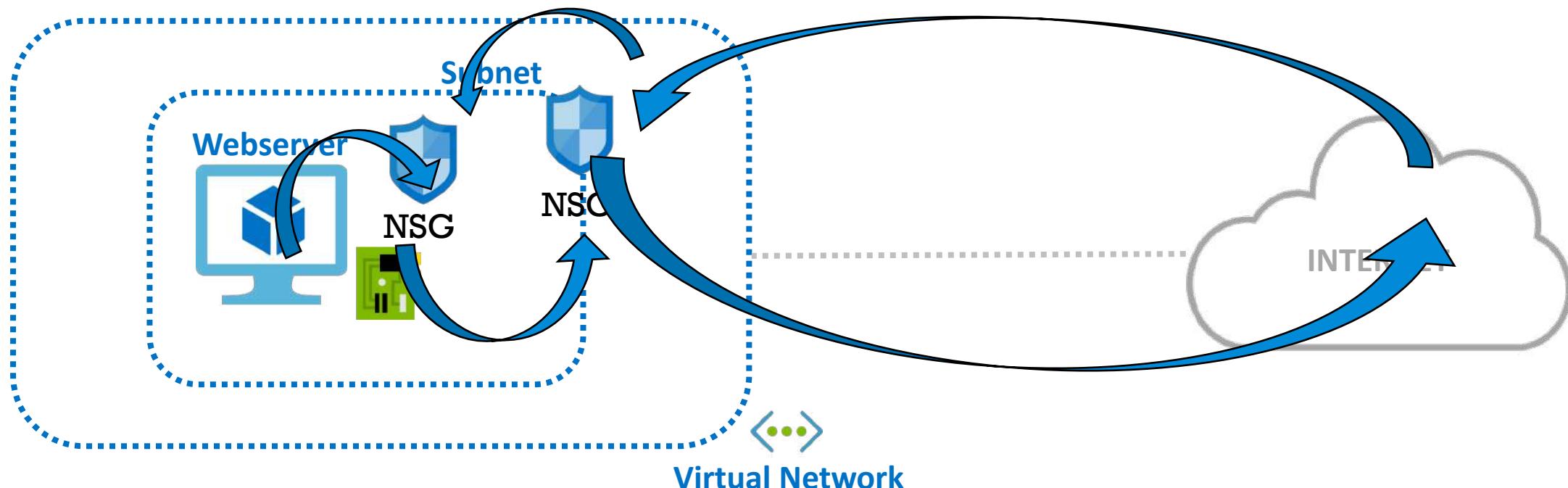
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65500	DenyAllOutBound	Any	Any	Any	Any	Deny	...



NSGs Order –Traffic Evaluation

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





Azure Load Balancer

Load Balancing Introduction

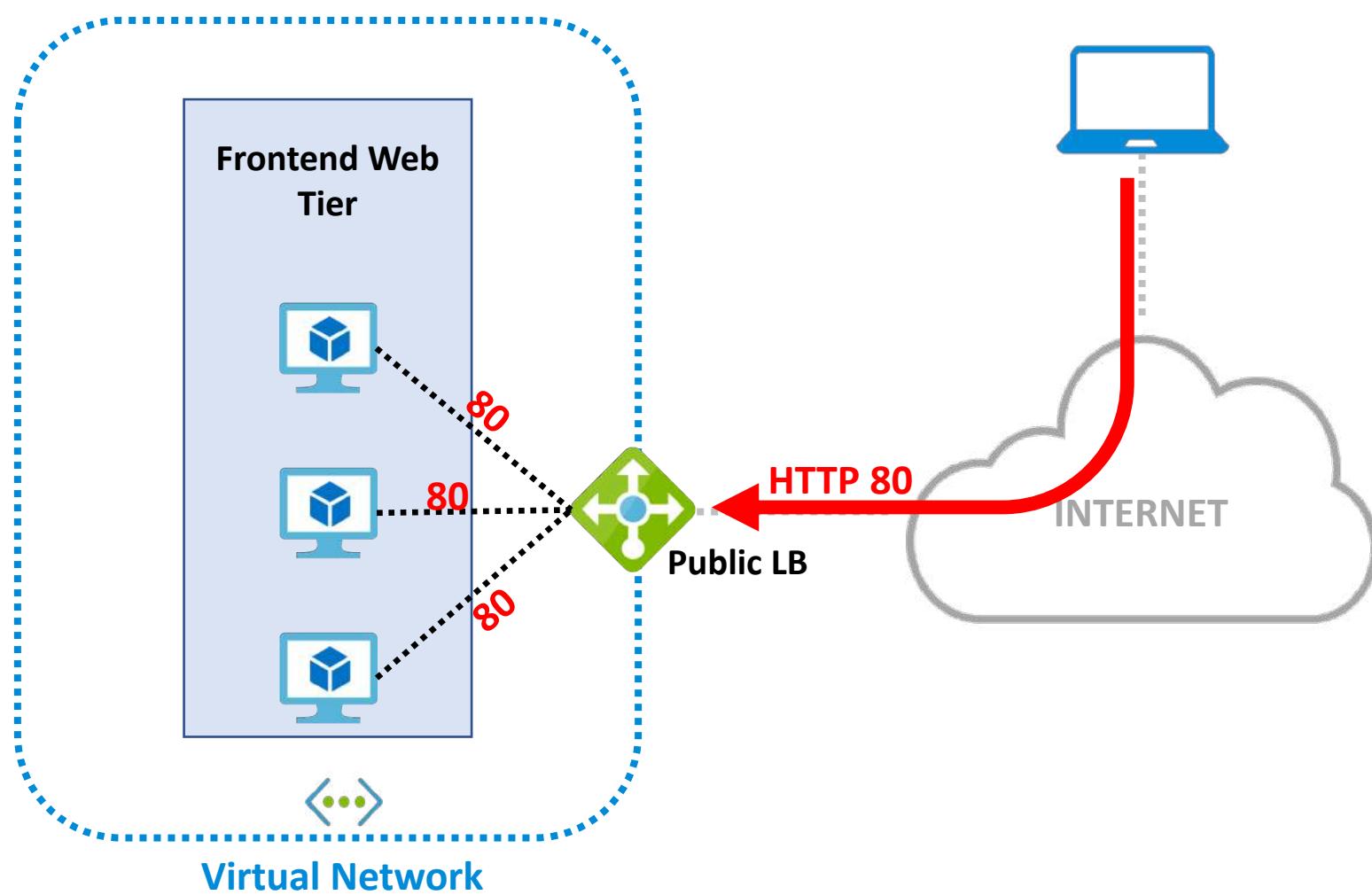
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Load Balancer



Azure Load Balancer – Configuration steps



Configuration steps:

1. Load Balancer
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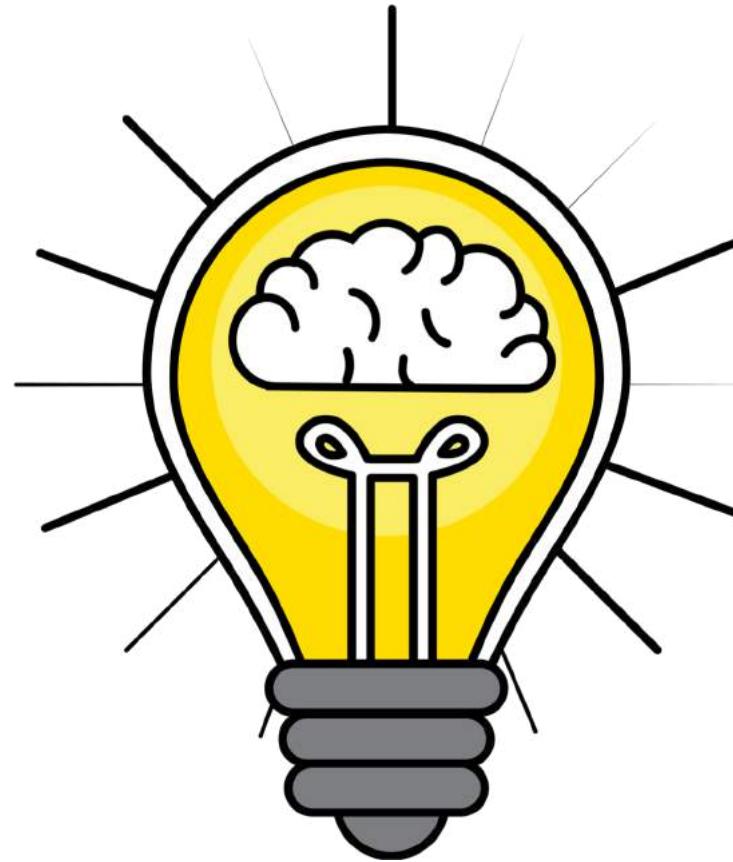


Load Balancer



Microsoft Azure Fundamentals

Azure Virtual Machines - Quiz



Microsoft Azure Fundamentals



Module 4 – Additional Computing Options

Azure Container Instances (ACI) Fundamentals 101

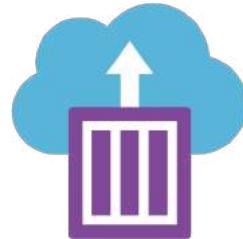
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



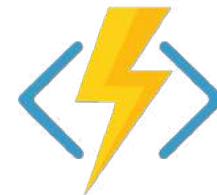
Containers



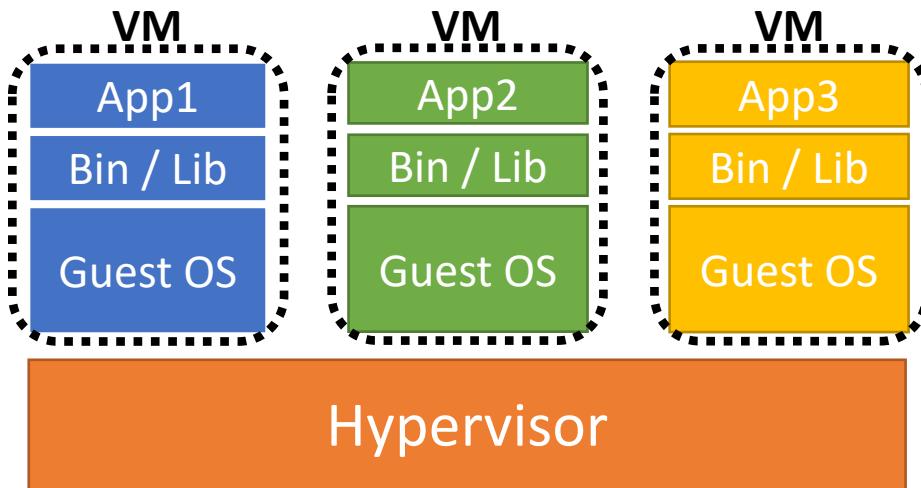
Azure App Service



Serverless Computing



Virtual Machines VS Containers



i.e. VMware Workstation, ESXi

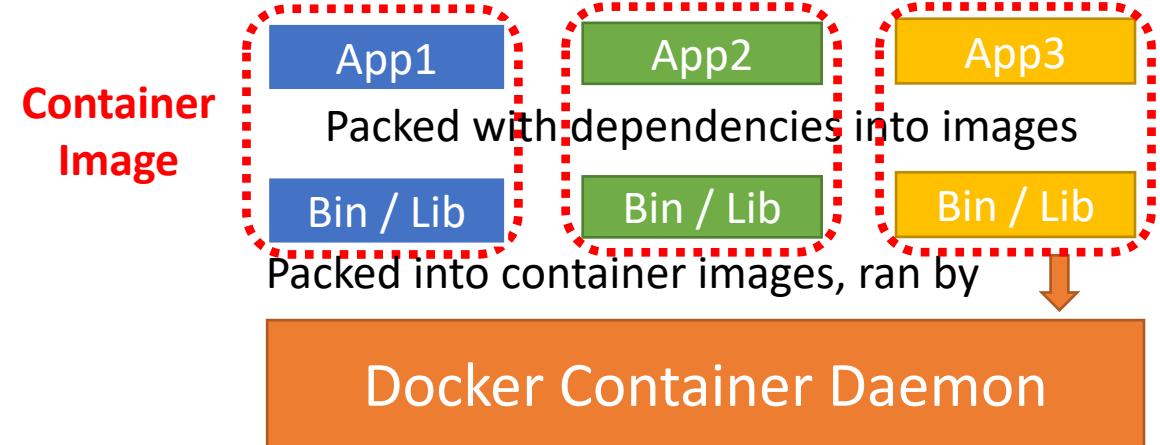
Host Operating System

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



Virtual Machines VS Containers

	Virtual Machines	Containers
Boot Time	minutes	ms or seconds
Guest OS	Yes	No
Resources	High (CPU, RAM, Storage)	Low
Use Case	Isolate systems (environment)	Isolate Applications



Virtual Machines VS Containers Analogy

VM



Container



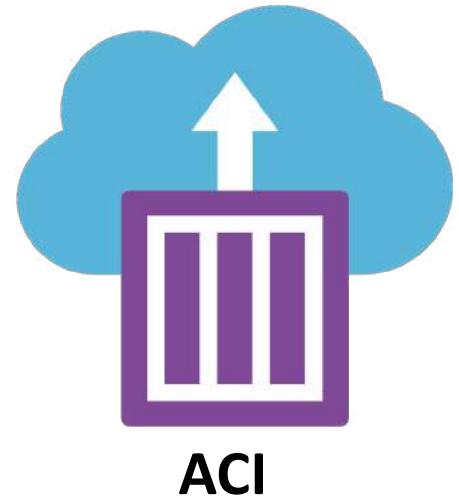
- Totally separate
- Own infrastructure
 - Electricity
 - Heating, etc.

- Shared infrastructure
 - Electricity
 - Heating, etc.
- Multiple sizes available



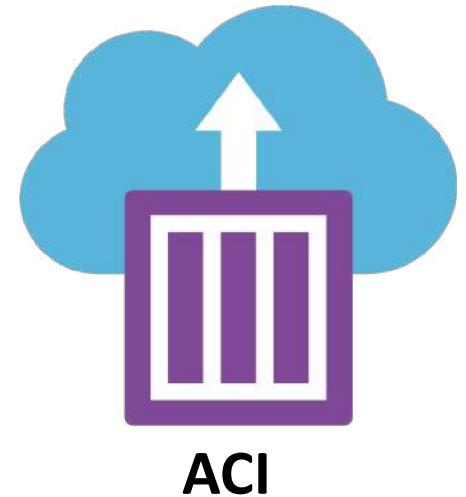
Azure Containers Instances (ACI) Overview

- 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
 - Custom sizes
 - Persistent storage
 - vNET deployment
 - Linux and Windows available





Module 4 – Additional Computing Options

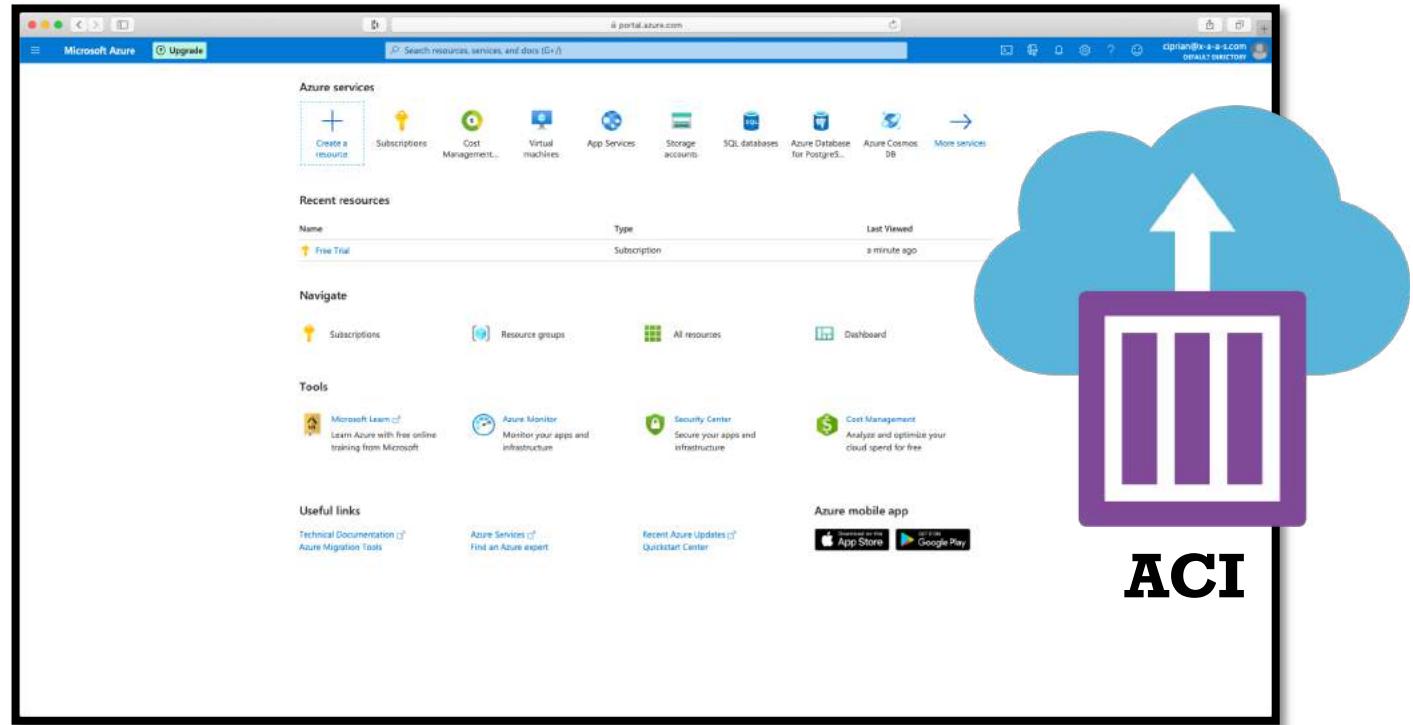
Hands-on Lab - Deploy a Container Instance Using Azure Portal

Hands-on Lab Overview

☐ Deploy a container instance using Azure Portal



<https://portal.azure.com>



Microsoft Azure Fundamentals

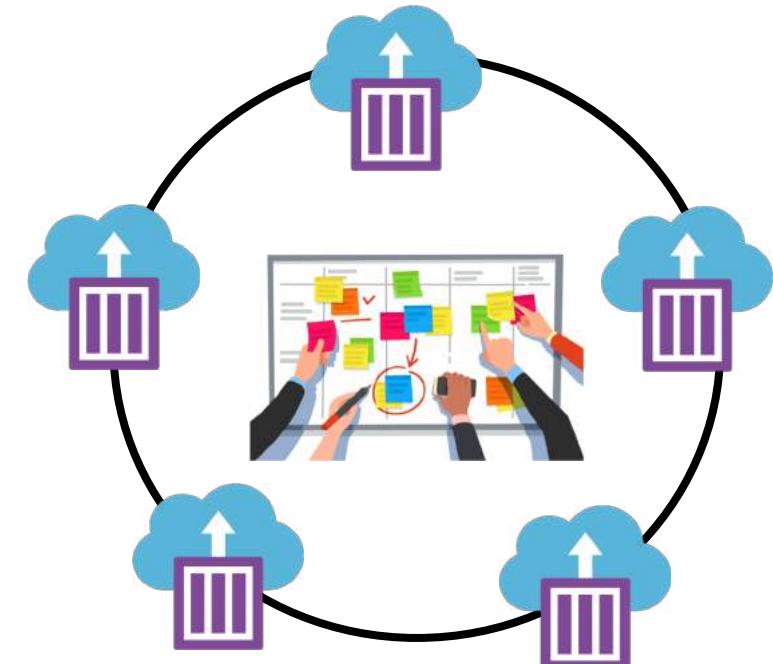


Module 4 – Additional Computing Options

Azure Kubernetes Service (AKS) Fundamentals 101

Container Management Introduction

- ❑ Containers have a distinct lifecycle 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 is an open-source container orch. system for automating app 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



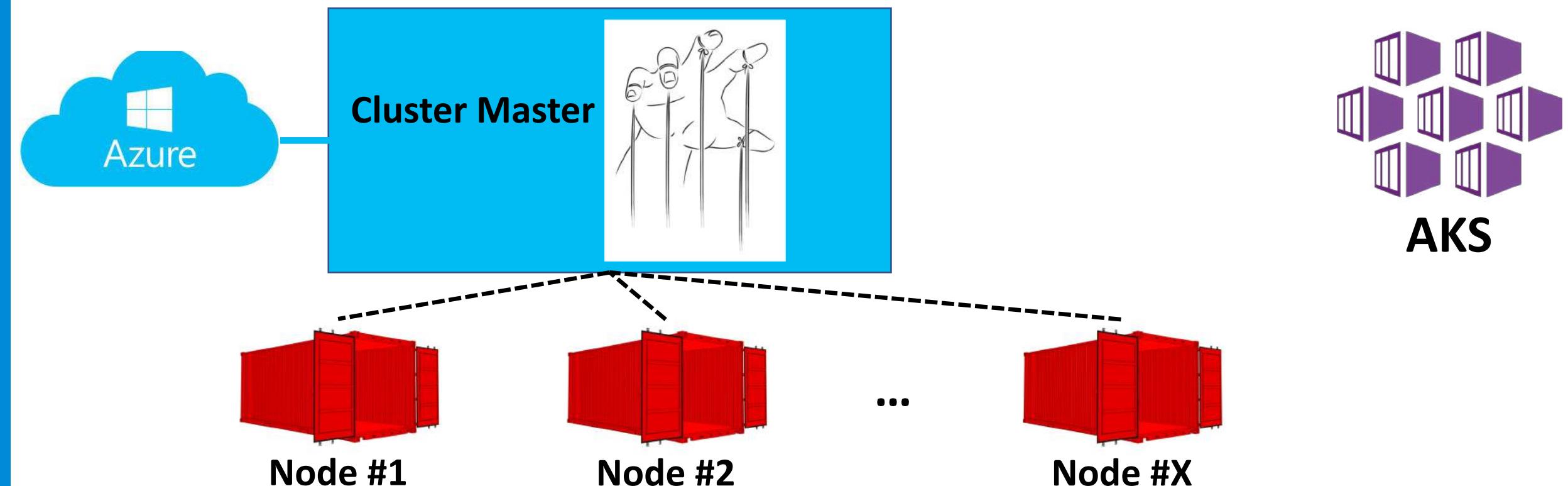
Kubernetes



Microsoft Azure Fundamentals

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 4 – Additional Computing Options

Azure App Service Fundamentals 101

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



Microsoft Azure Fundamentals

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



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 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





Module 4 – Additional Computing Options

Azure Serverless Computing Fundamentals 101

Serverless Computing Introduction

- With serverless computing, you can build applications faster by eliminating the need to manage infrastructure
- What is serverless ? Why the name ?
- Infrastructure provisioning and management are transparent to the user, hence the name ... serverless
- Servers but still run the code, but ... everything is run behind the scenes by Azure Cloud



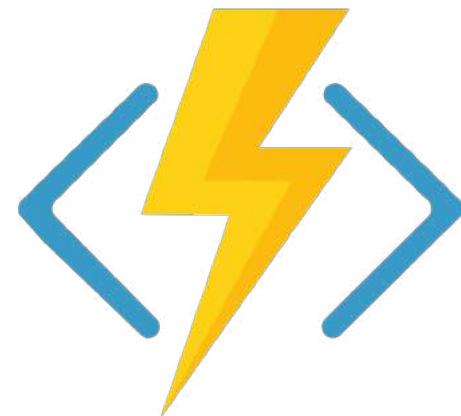
Serverless Computing Main Pillars

- ❑ Abstraction of servers
 - ❑ No servers to manage
- ❑ Event-driven & Schedule, automate, orchestrate tasks
 - ❑ App code is run based on triggers or events
 - ❑ i.e. Run a function when it receives an HTTP request
 - ❑ i.e. Send email notification based on event occurrence
- ❑ Pay by the run time
 - ❑ You pay only for the duration your code runs
 - ❑ Times it was executed

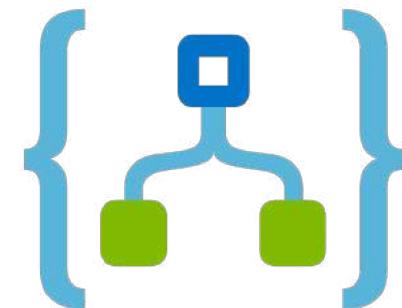


Azure Serverless Computing

- With Azure, when talking about serverless computing, we need to refer to two Azure services



Azure Functions

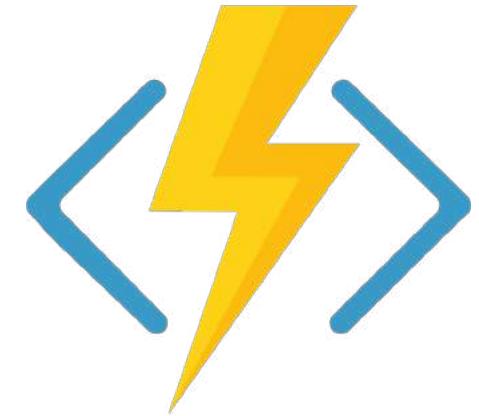


Azure Logic App



Azure Functions

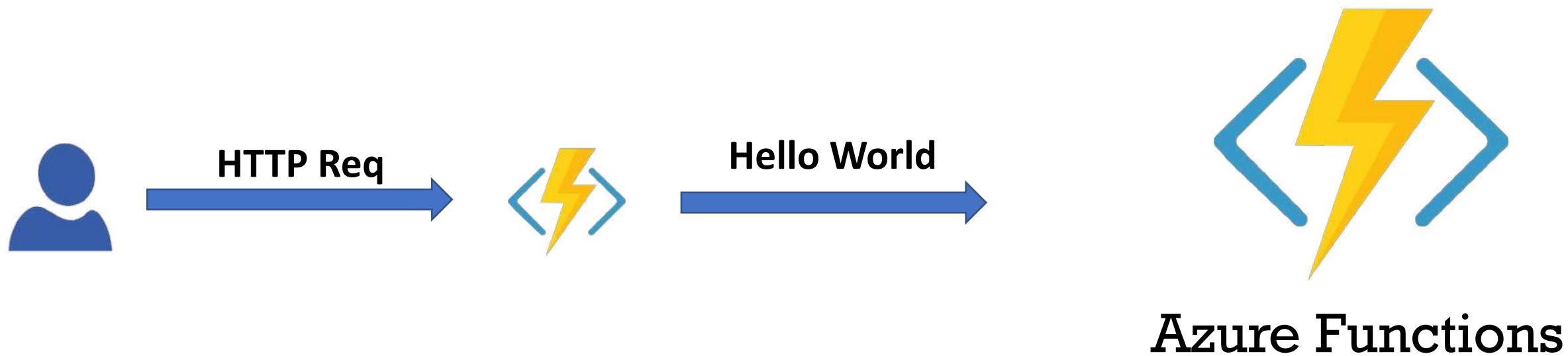
- With Azure Functions you can run small pieces of code ("functions") without worrying about application infrastructure
- The function is triggered by an event
- Trigger examples:
 - Respond to data changes
 - Run a task on schedule
 - Run a function as response to HTTP request



Azure Functions

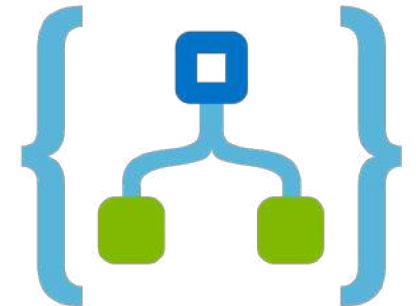


Azure Functions Examples



Azure Logic App Introduction

- Azure Logic Apps is similar to Azure Functions, just that you don't have to write code



- With Azure Logic Apps you can:
 - Schedule
 - Automate and orchestrate tasks
 - Business processes and *workflows*

when you need to integrate apps, data, systems and services across enterprises or organizations

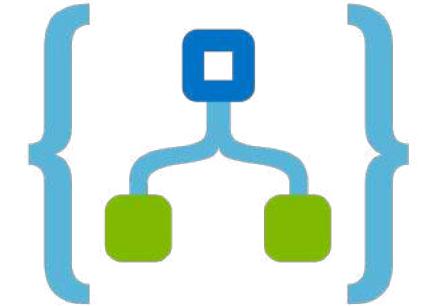
Azure Logic Apps

- What does workflow mean ?



Azure Logic App Introduction

- ❑ Workflow - Visualize, design, build, automate and deploy business processes as series of steps



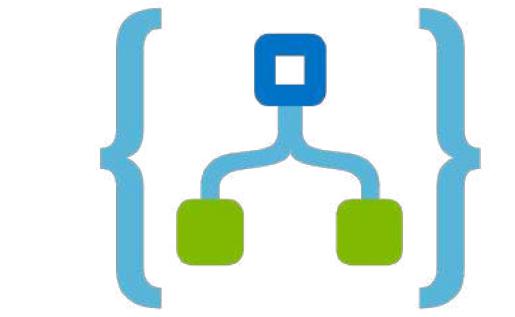
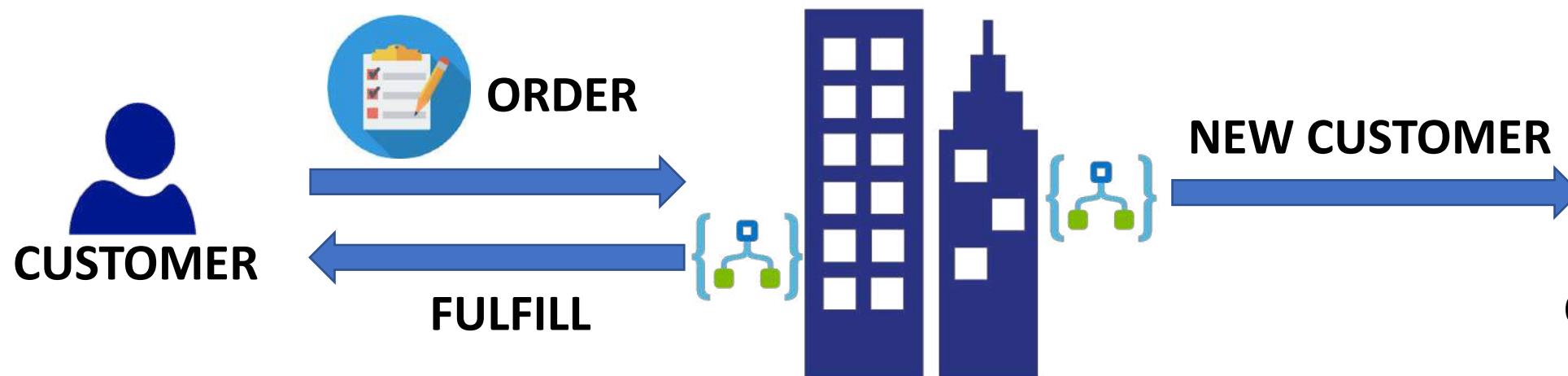
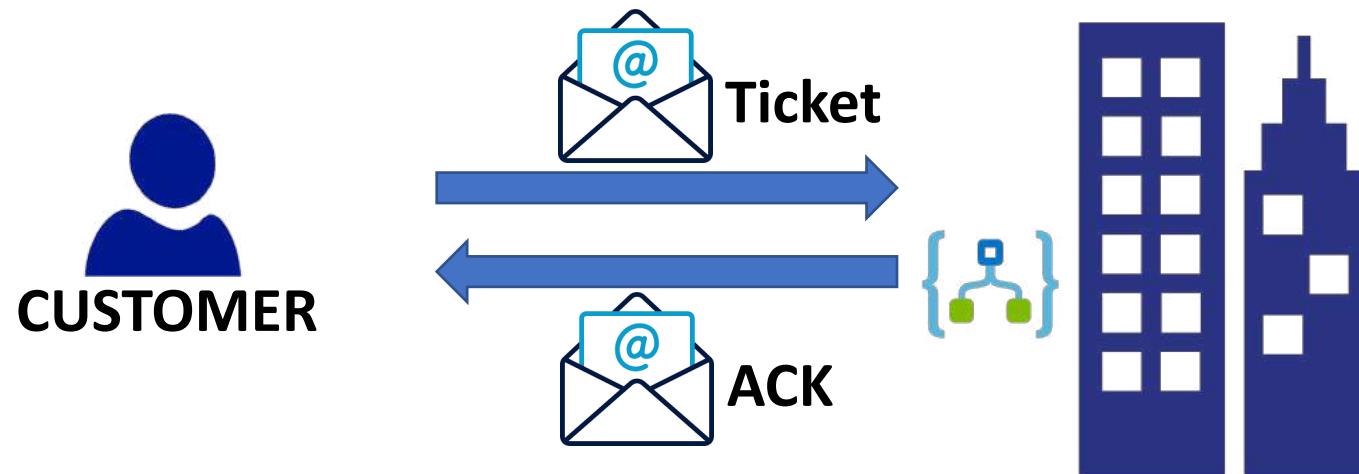
- ❑ Azure Functions executes code, while Azure Logic Apps executes workflows, using prebuilt logic blocks

Azure Logic Apps

- ❑ You create Logic Apps workflows using a visual designer on Azure Portal or Visual Studio



Azure Logic Apps Examples



Azure Logic Apps



Microsoft Azure Fundamentals

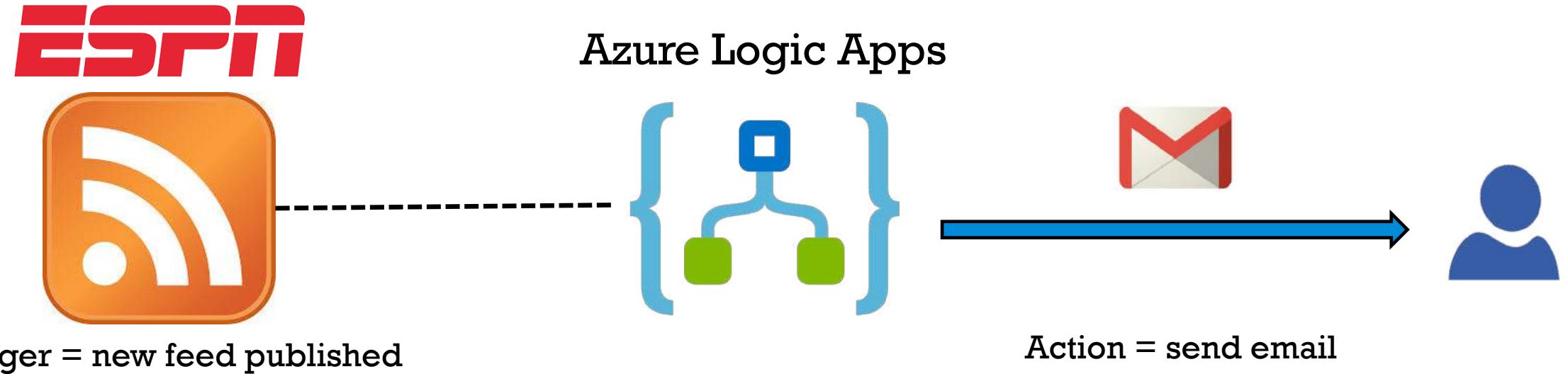


Module 4 – Additional Computing Options

Hands-on Lab - Create a Workflow using Azure Logic Apps

Hands-on Lab Overview

- Create a workflow using Azure Logic Apps



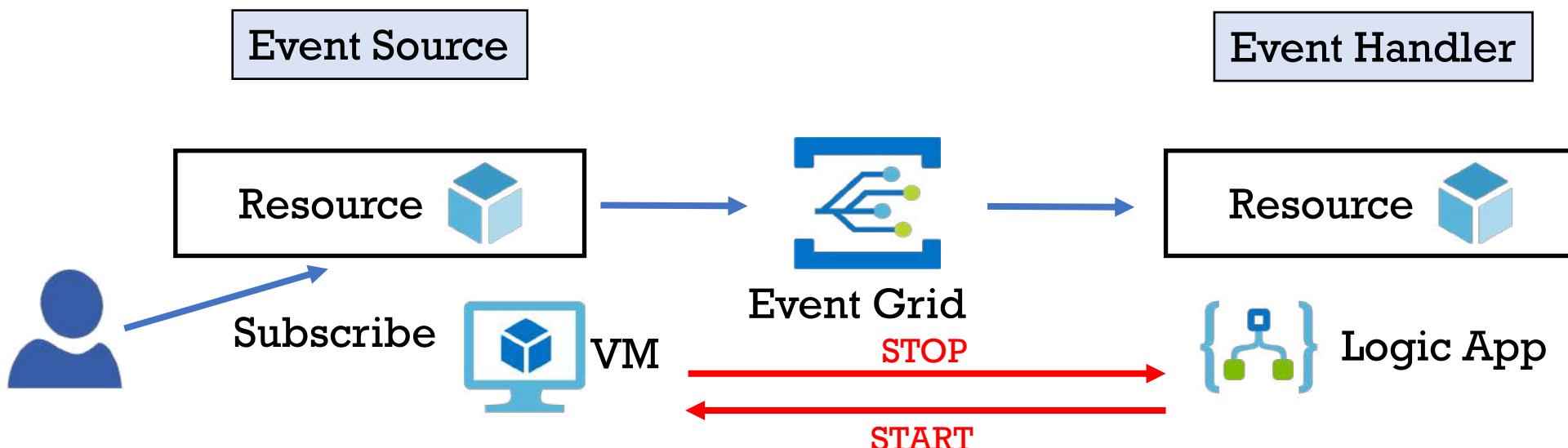


Module 4 – Additional Computing Options

Azure Event Grid Fundamentals 101

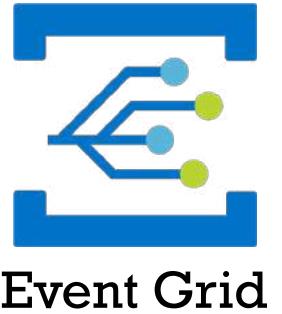
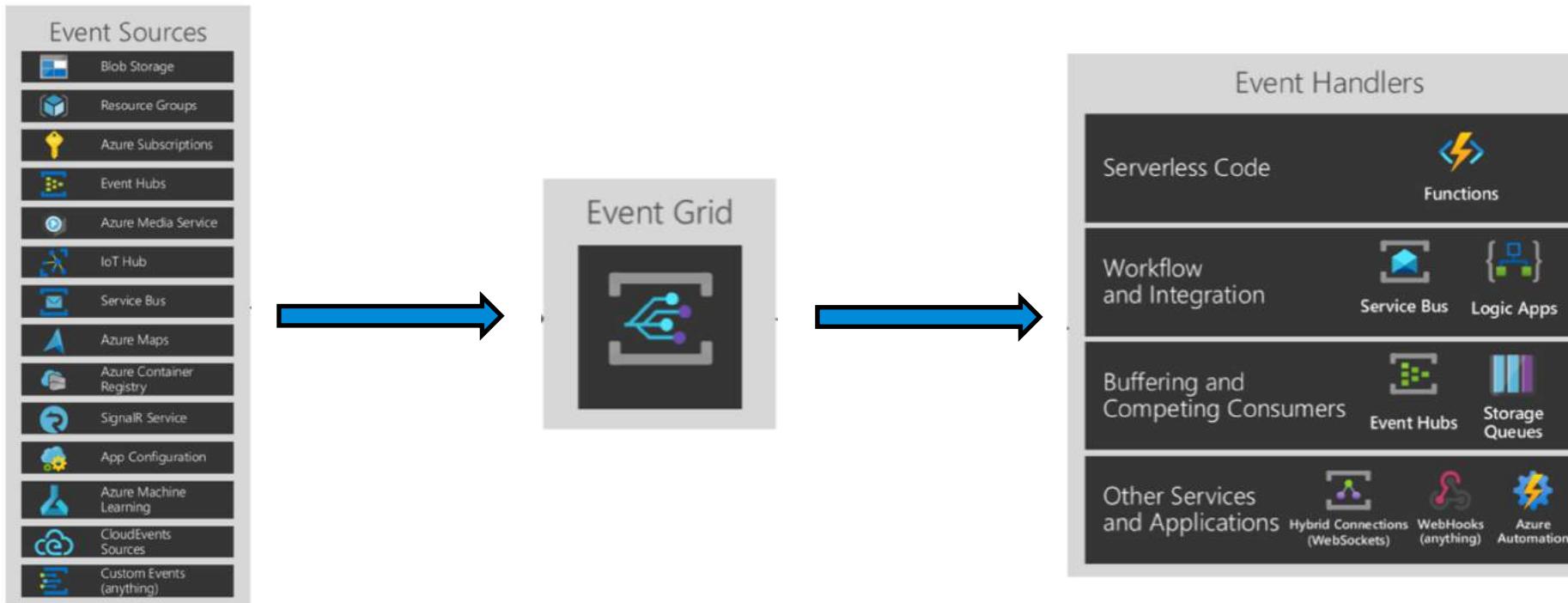
Azure Event Grid Overview

- Azure Event Grid allows you to easily build applications with event-based architectures
- Event-based ?
 - “Event” occurs -> take action, do smth.



Azure Event Grid Overview

- Event Grid has built-in support for events coming from Azure services and your own events



Event Grid

- <https://docs.microsoft.com/en-us/azure/event-grid/overview>





Module 4 – Additional Computing Options

Module Completion & Exam Hints

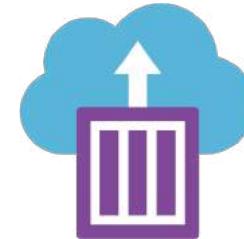
Azure Compute Options

Azure compute is delivered through:

Virtual Machines



Containers



Azure App Service



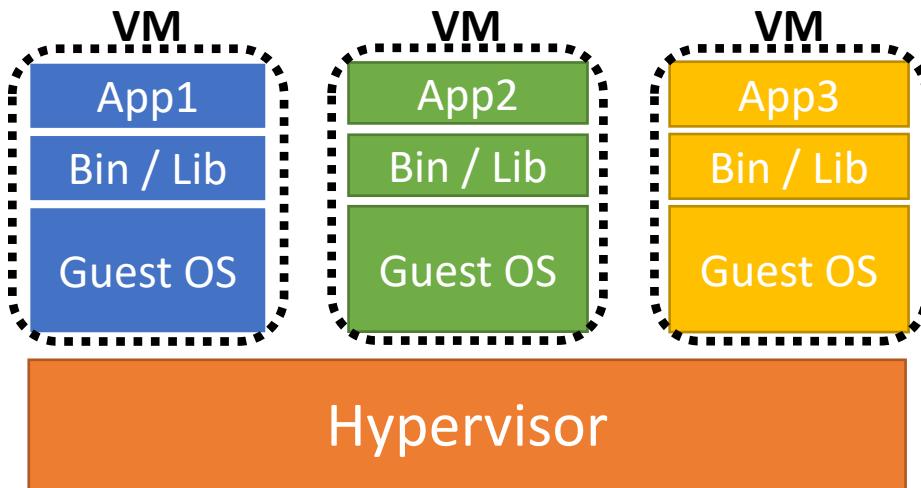
Serverless Computing





Azure Container Instances (ACI)

Virtual Machines VS Containers



i.e. VMware Workstation, ESXi

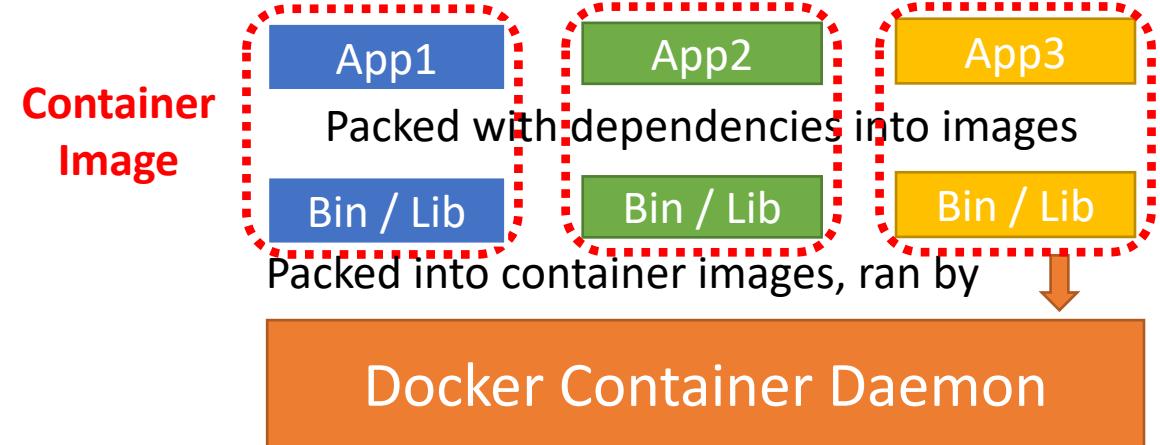
Host Operating System

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

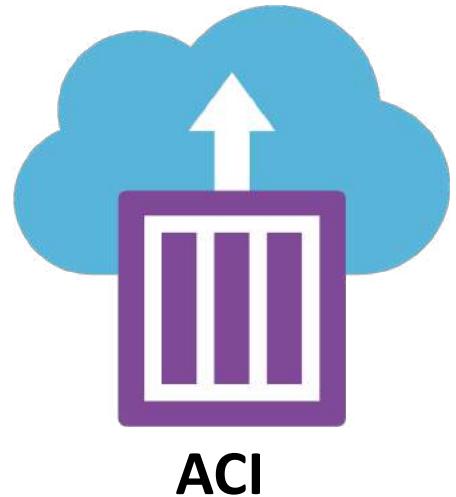
Infrastructure

Containers



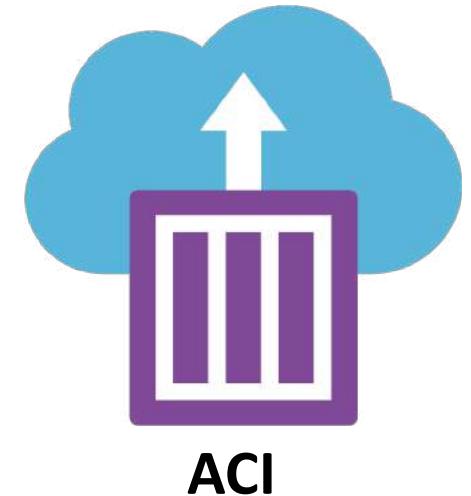
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- Orchestration needed ? -> Azure Kubernetes Service (AKS)





Azure Kubernetes Service (AKS)

What is Kubernetes?

- ❑ Kubernetes is an open-source container orch. system for automating app deployment, scaling, and management
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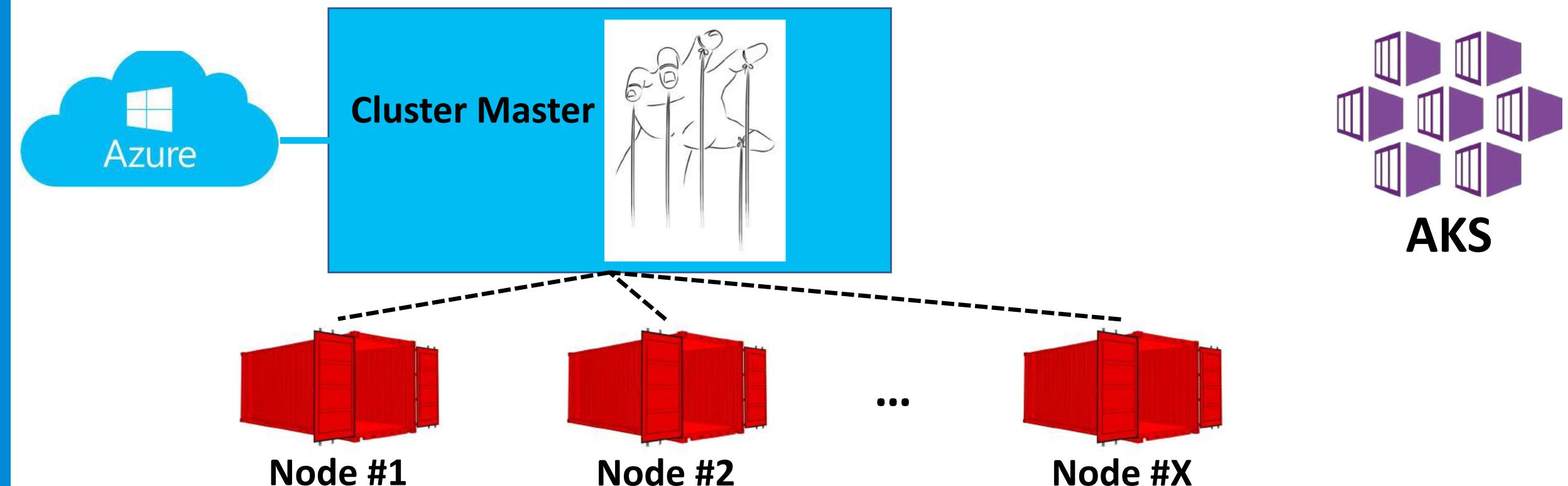
Kubernetes



Microsoft Azure Fundamentals

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





Azure 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



Microsoft Azure Fundamentals

App Service Key Features

- 1. Multiple languages and frameworks
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- 3. Containerize app and run in App Service
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- Pricing – based on App Service Plan



App Service



App Service Plan Overview

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- An App Service Plan defines:
 - An Azure region
 - Number & Size of VM instances (small, medium, large)
 - Pricing tier
 - shared compute
 - dedicated compute
 - isolated



App Service
Plan





Azure Serverless Computing

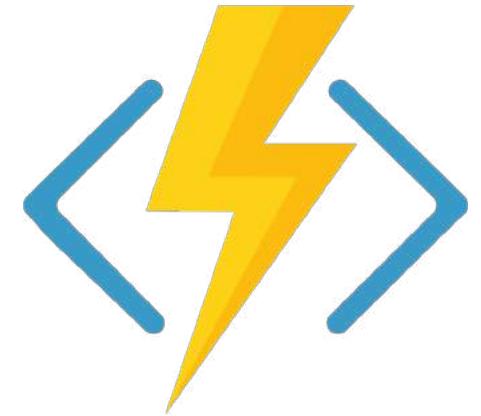
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Azure Functions

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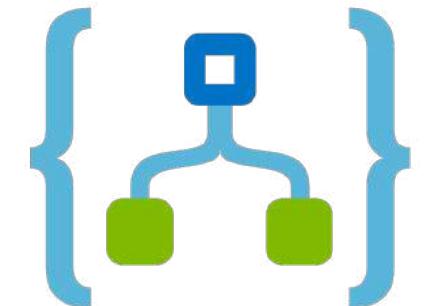


Azure Functions



Azure Logic Apps Overview

- Azure Logic Apps is similar to Azure Functions, just that you don't have to write code
- You create Logic Apps workflows using a visual designer
- Workflow - Visualize, design, build, automate and deploy business processes as series of steps
- Azure Functions executes code, while Azure Logic Apps executes workflows, using prebuilt logic blocks



Azure Logic Apps

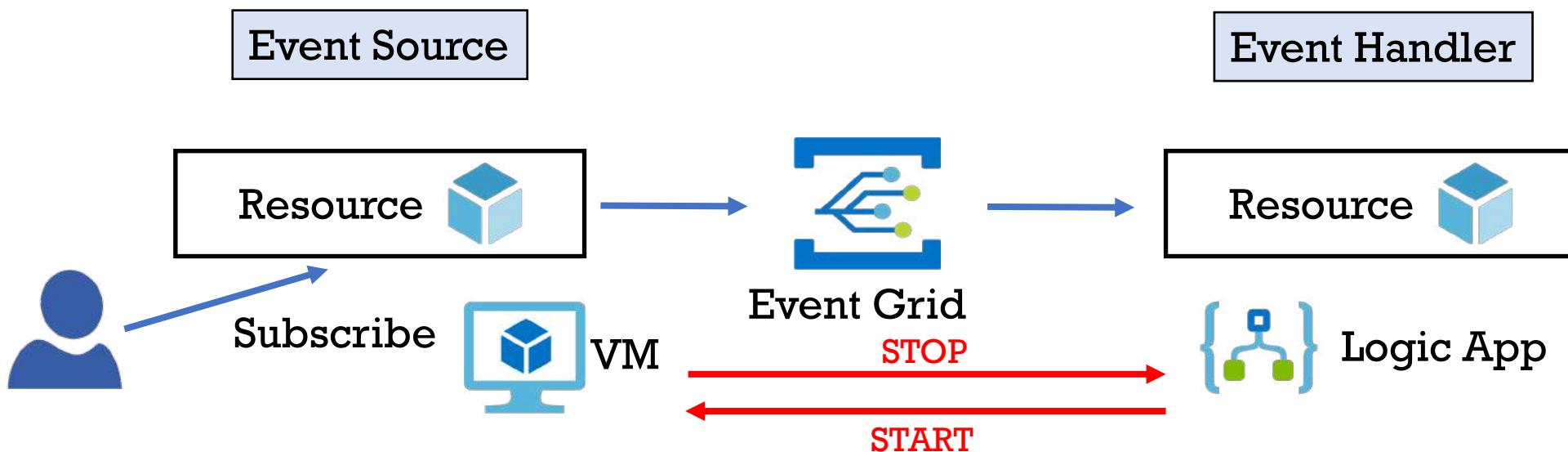
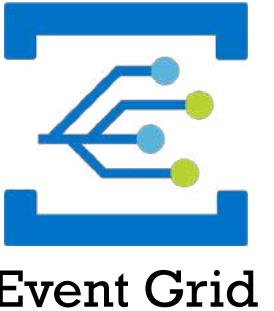




Azure Event Grid

Azure Event Grid Overview

- Azure Event Grid allows you to easily build applications with event-based architectures
- Event occurs -> take action, do something



Azure Computing Options - Quiz



Microsoft Azure Fundamentals



Module 5 – Azure Core Services - 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

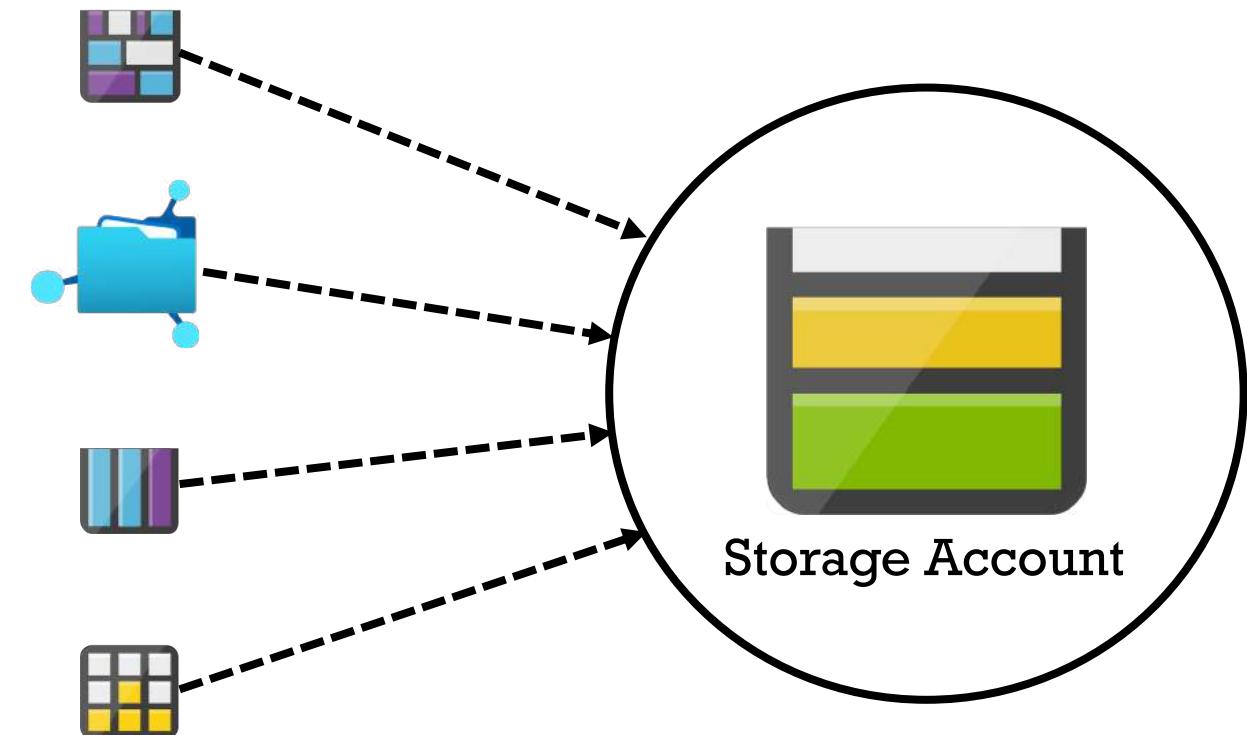


Storage Account



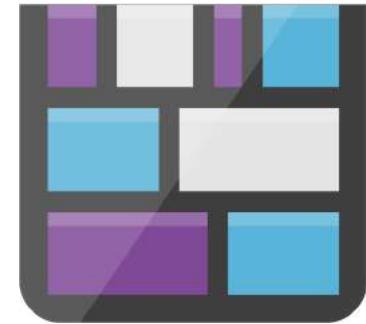
Azure Storage Services Overview

- 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 Blob



Azure Blobs Hands-on Lab

Storage Account



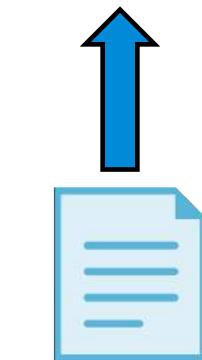
- unique namespace in Azure for your data

Container



- similar to a directory in a file system; organizes blobs

Blobs - Files

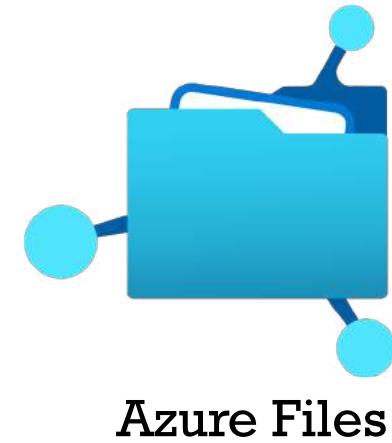


- actual file

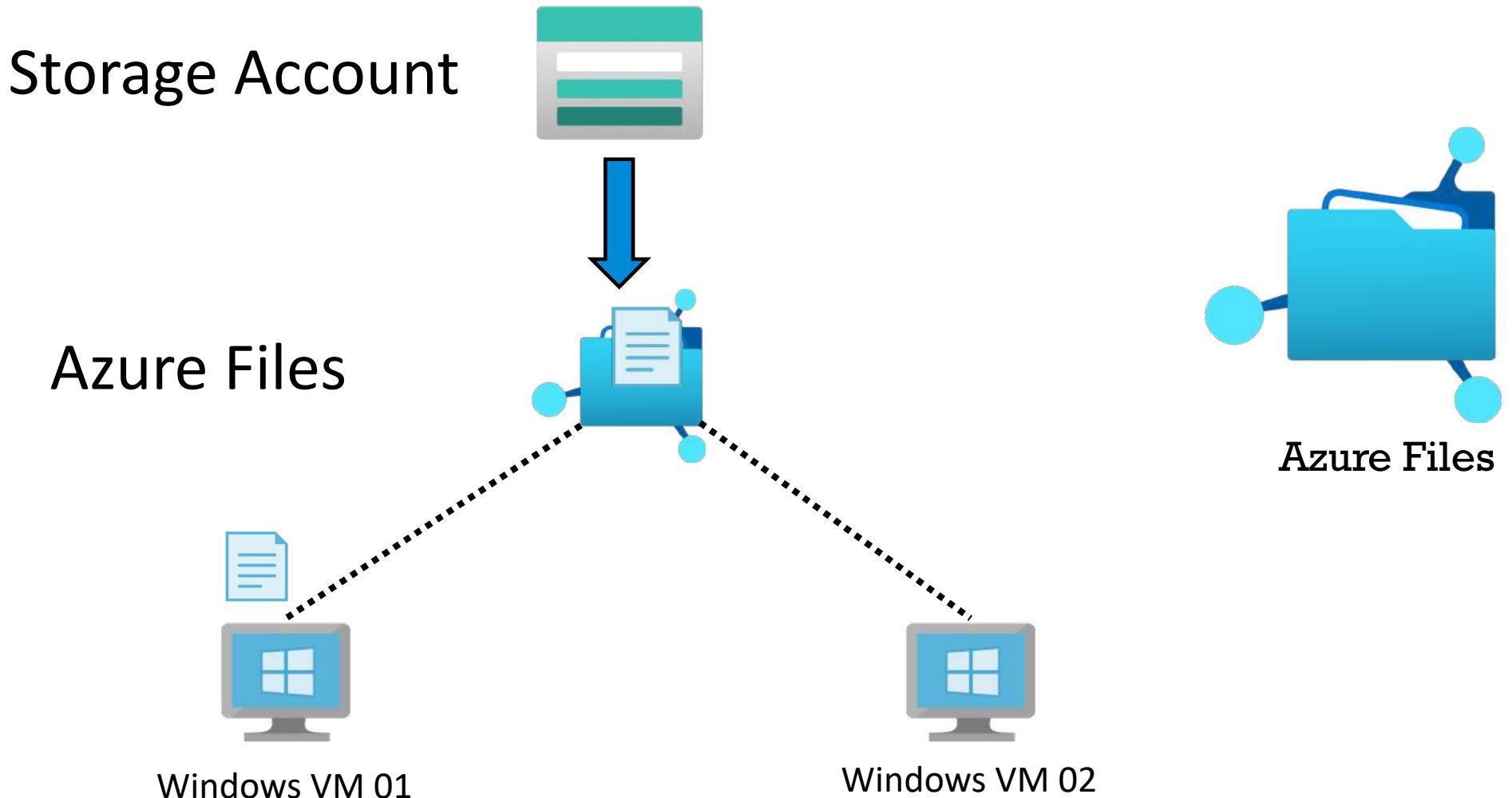


Azure Files Overview – SMB File Share

- 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 Hands-on Lab



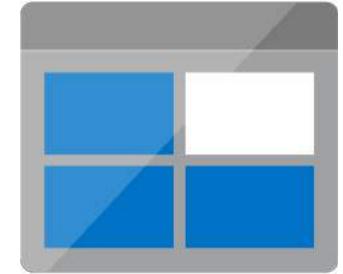


Module 5 – Azure Core Services - Storage

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

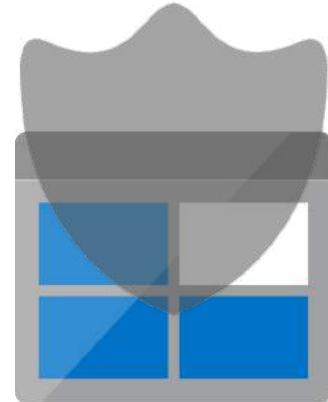


Blob Storage



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)

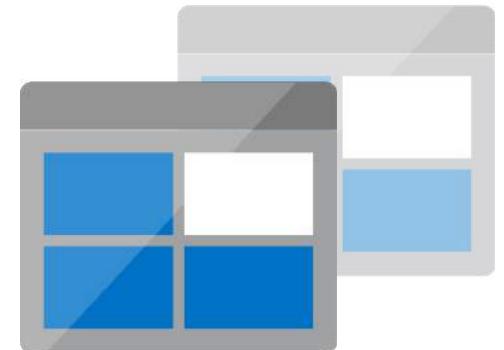


Storage Encryption



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)



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)

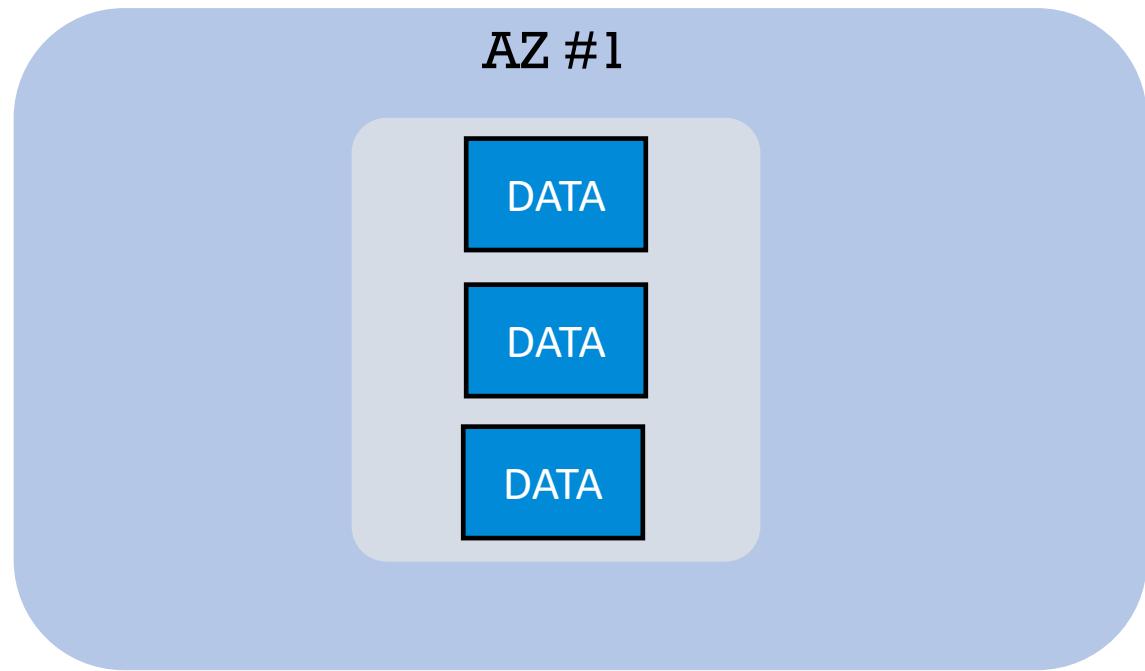
Read-access geo-zone-redundant storage (RA-GZRS) (preview)

- **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**



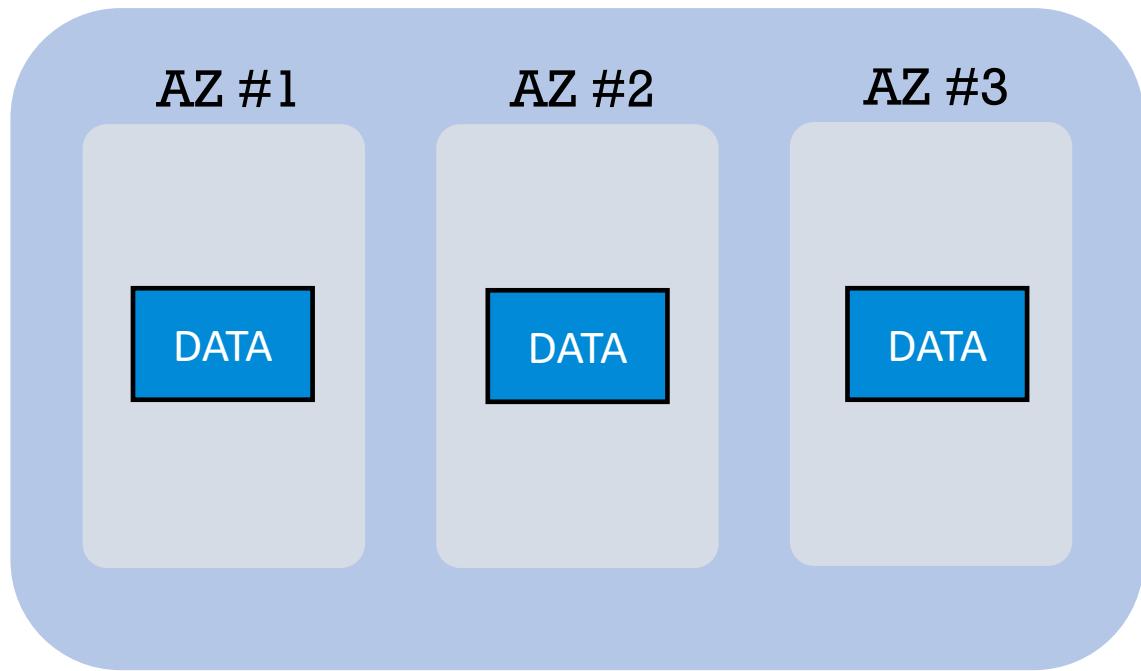
Azure Storage Replication – LRS and ZRS

Locally Redundant Storage (LRS)



Primary Region

Zone Redundant Storage (ZRS)



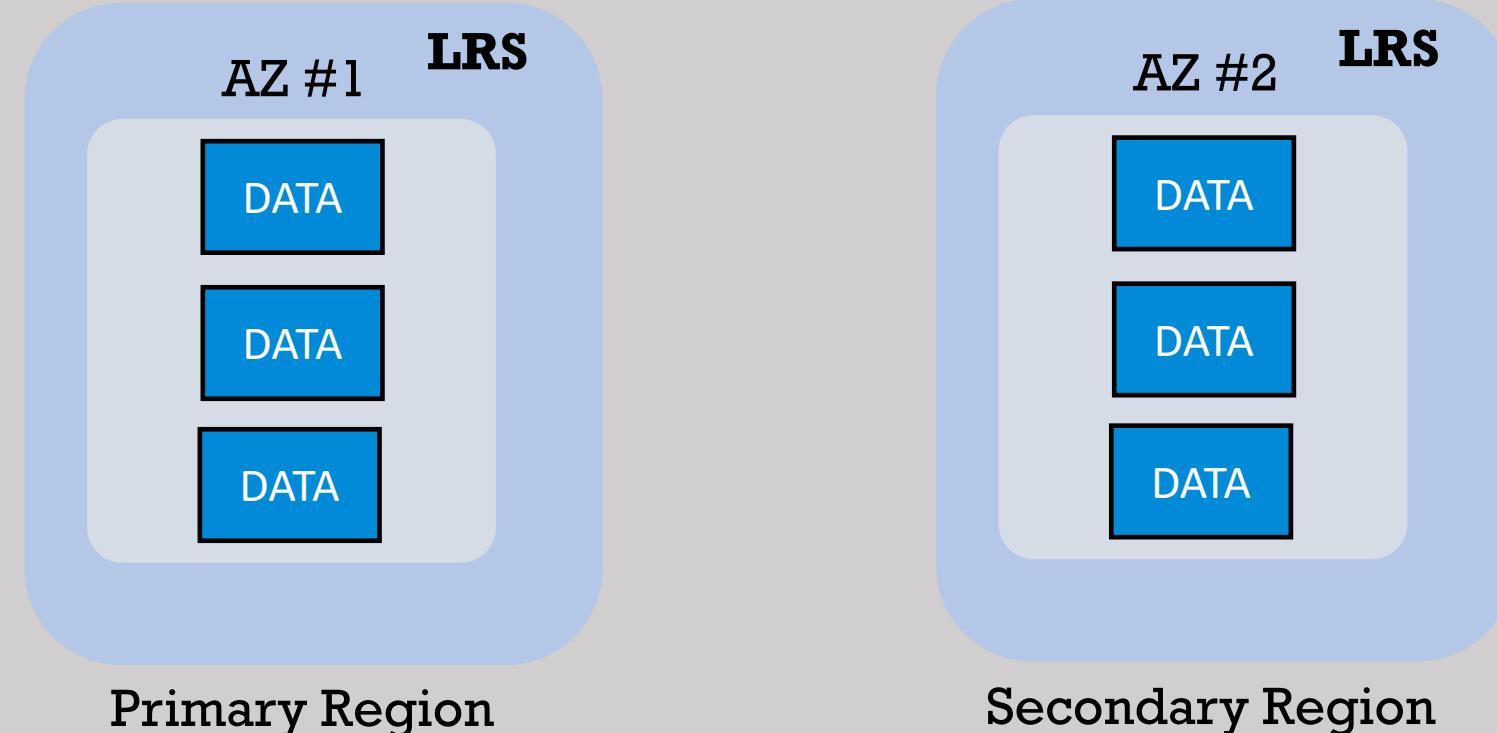
Primary Region



Microsoft Azure Fundamentals

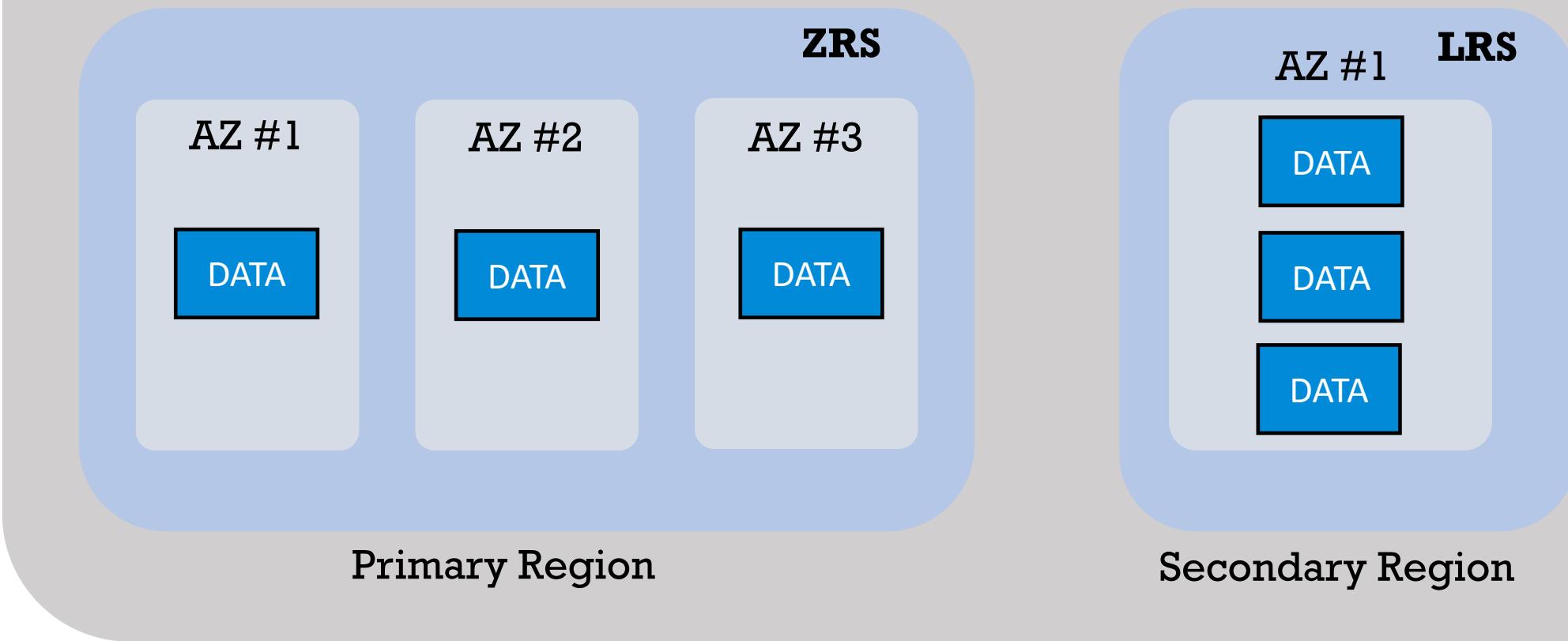
Azure Storage Replication - GRS

Geo-redundant storage (GRS) = 2 x LRS

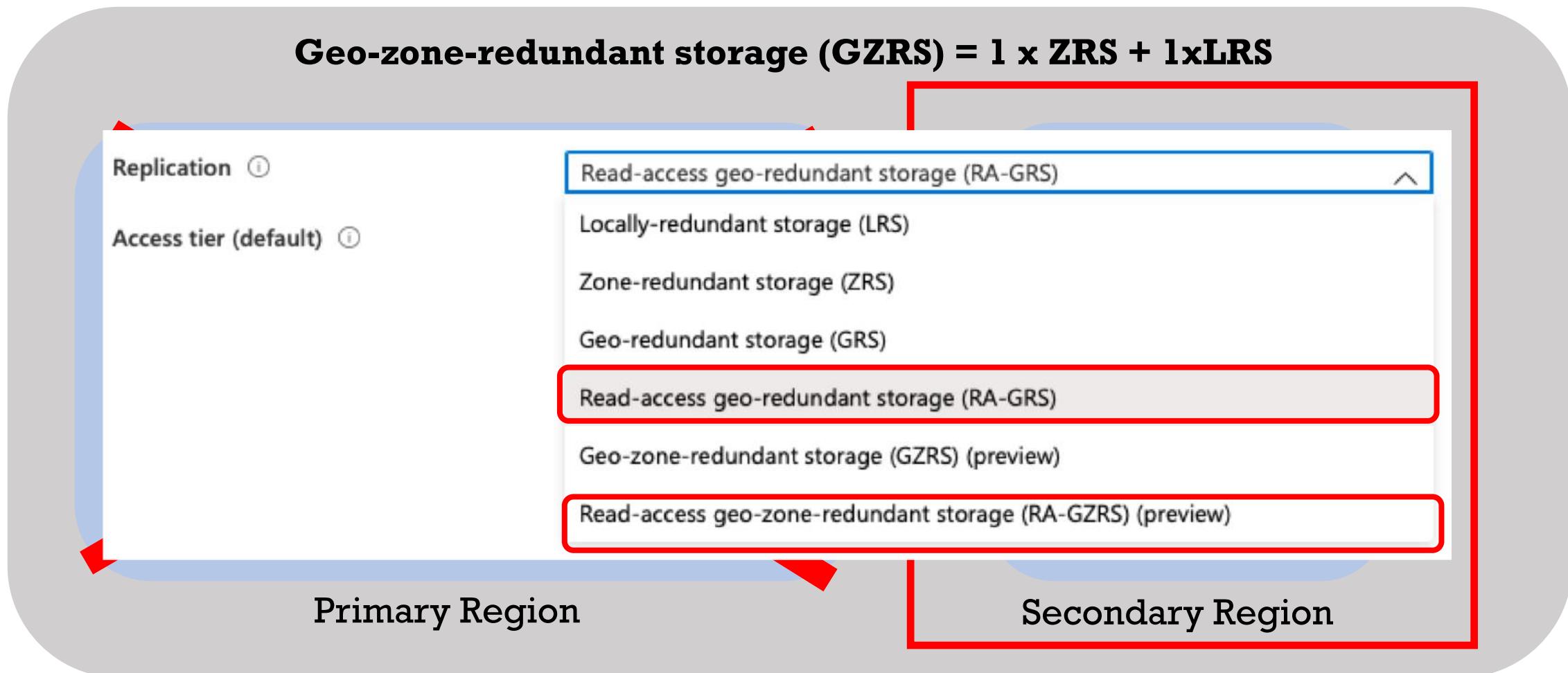


Azure Storage Replication - GZRS

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



Azure Storage – Read Access in Secondary Region



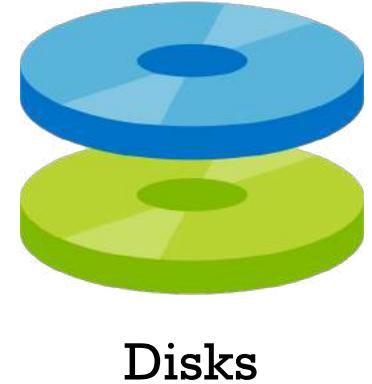


Module 5 – Azure Core Services - Storage

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

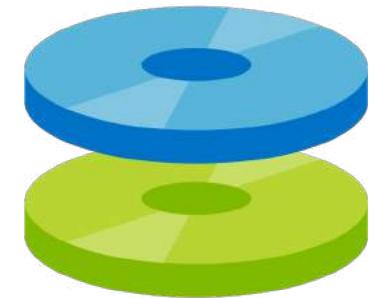


Disks



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



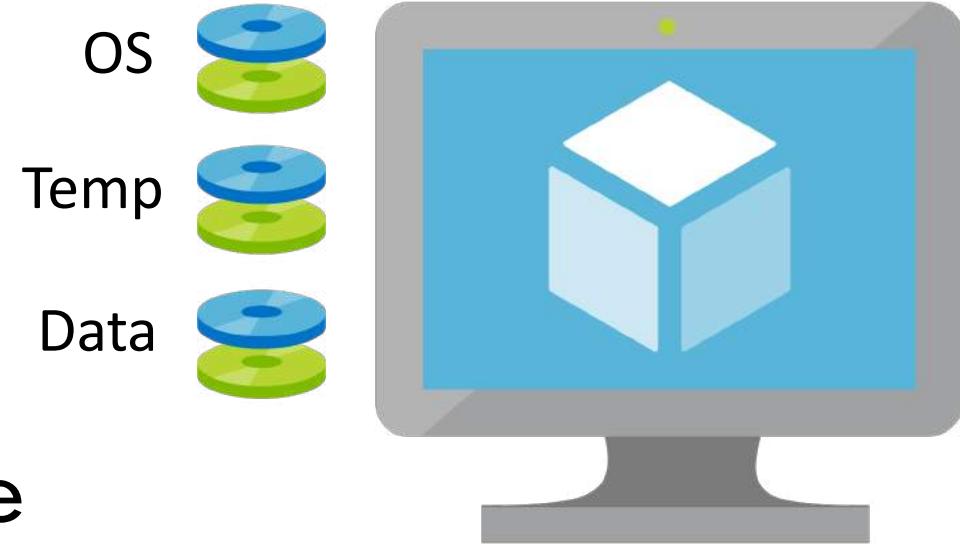
Azure Disk Types

- 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) -> LRS, 16 9's with Geo-ZRS
- Deploy VMs simple and highly scalable
 - 50,000 VM disks of a type in a subscription per region
- Fully integrated with availability zones (AZs)
- Granular access control
 - Assign permissions for managed disk to one/more users

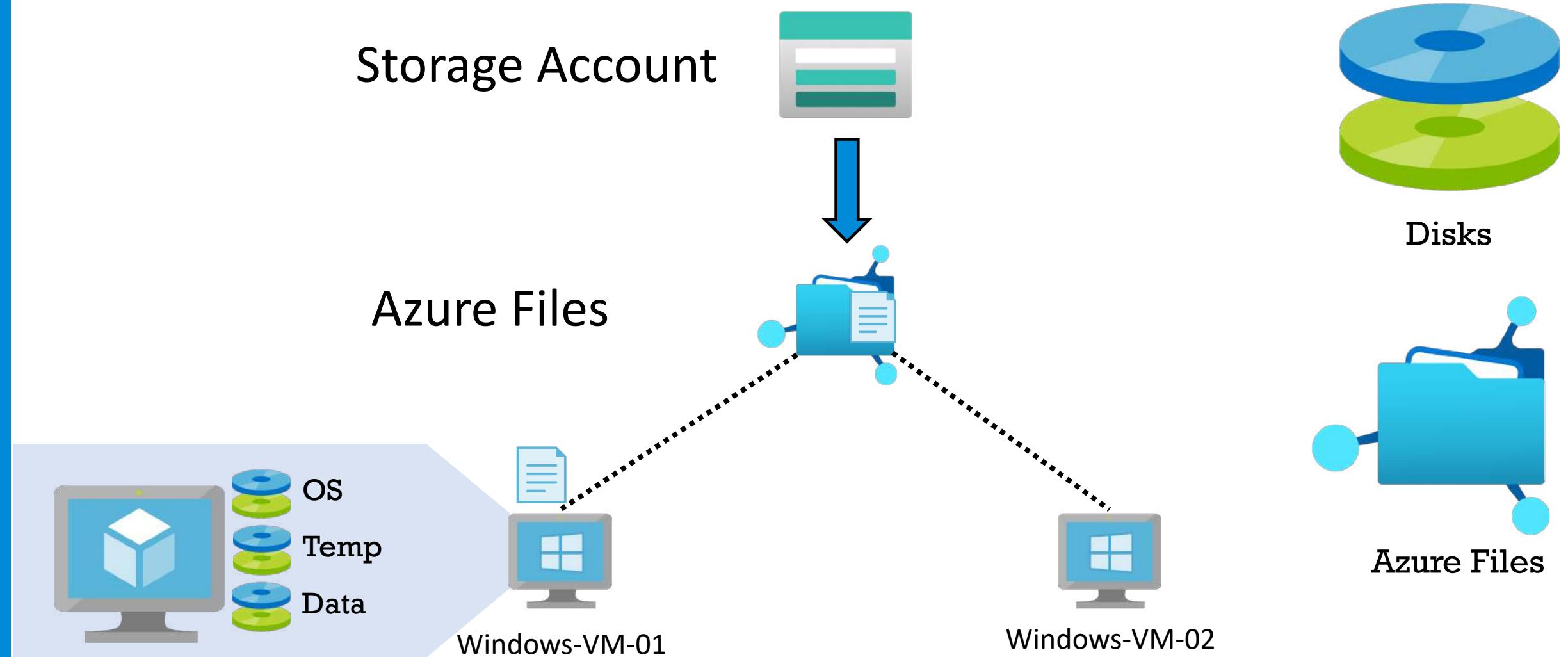




Module 5 – Azure Core Services - Storage

Hands-on Lab - Launch Windows VMs in Azure Portal

In the next hands-on labs ...





Module 5 – Azure Core Services - Storage

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

Microsoft Remote Desktop Client

☐ Check the below URL:

- ☐ <https://docs.microsoft.com/en-us/windows-server/remote/remote-desktop-services/clients/remote-desktop-mac>



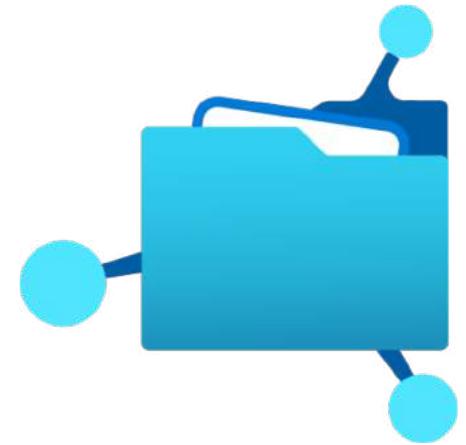


Module 5 – Azure Core Services - Storage

Azure Files Storage Fundamentals 101

Azure Files Introduction

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

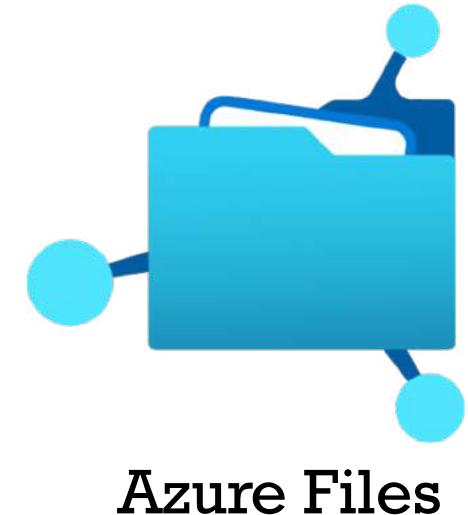


Azure Files



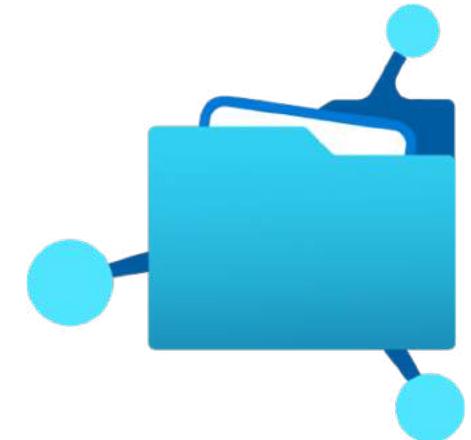
Azure Files Benefits –Why Azure Files is Useful ?

- Traditional file servers can be replaced with Azure Files or additional capacity can be added
 - Azure file shares can be mounted from any location
 - Works on Windows, Mac and Linux
- Lift and shift the Apps
 - Both the app and the data in Azure
 - App on-prem and data in Azure Files
- Plug and play compatibility – SMB industry standard



Azure Files Benefits –Why Azure Files is Useful ?

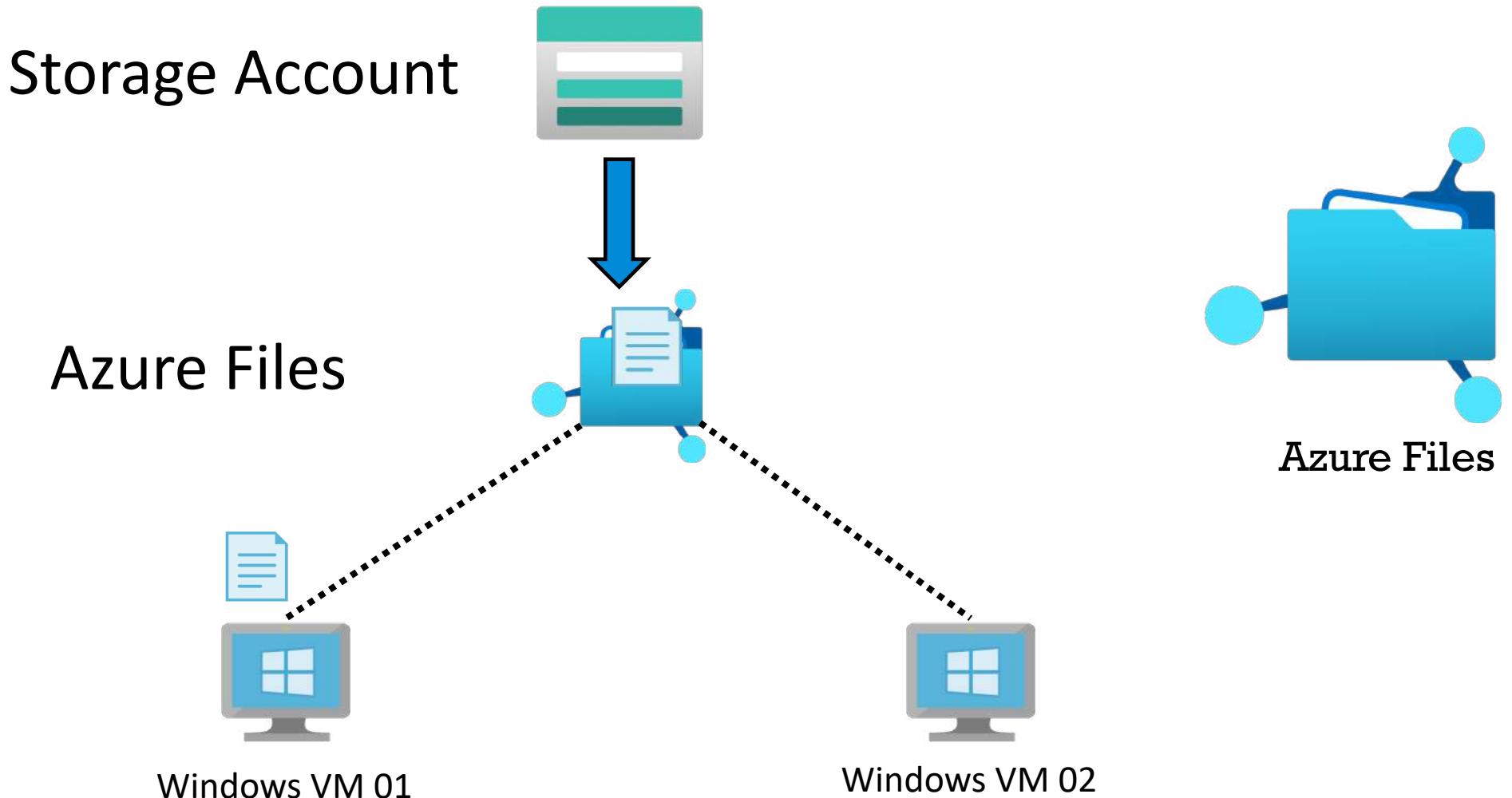
- Managed service – Azure takes care of hw or sw updates, necessary upgrades and system patching
- Automate work
 - Multiple tools available for scripting
 - i.e. Azure CLI, PowerShell
- Always-on File Share
 - High available, highly scalable
 - No maintenance windows, planned or unplanned



Azure Files



Azure Files Hands-on Lab



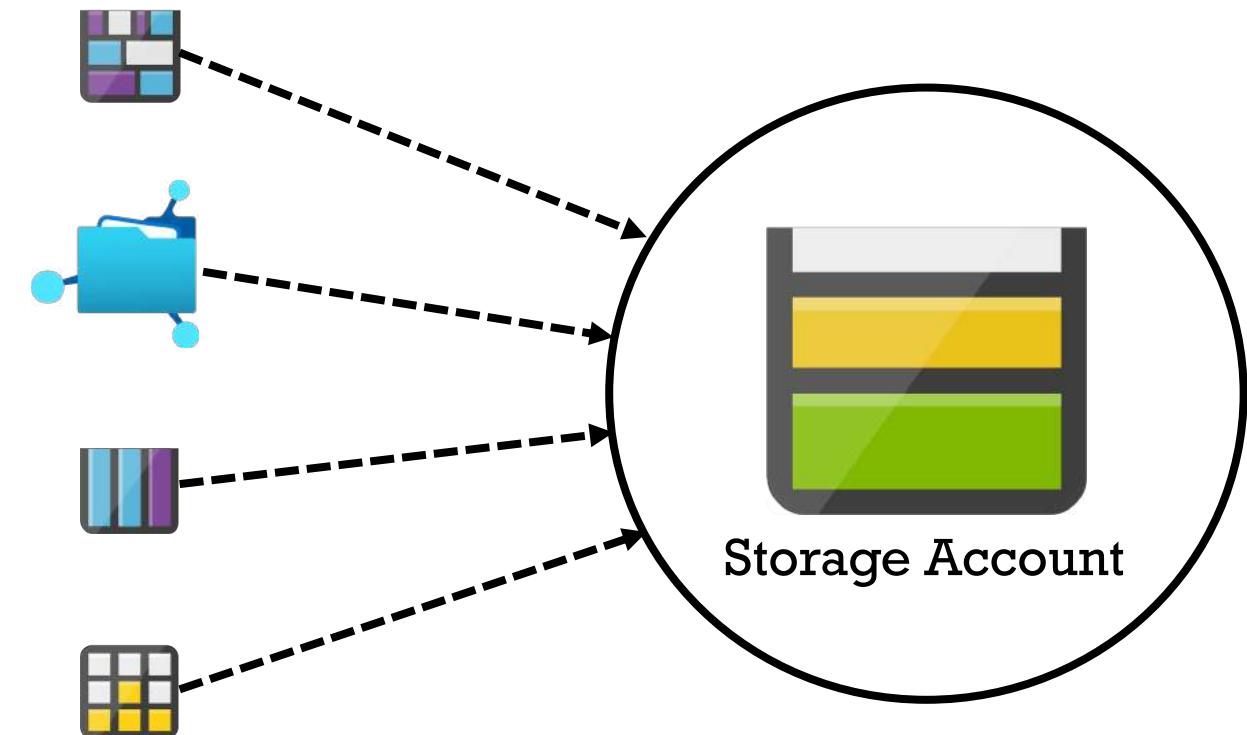


Module 5 – Azure Core Services - Storage

Module Completion & Exam Hints

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

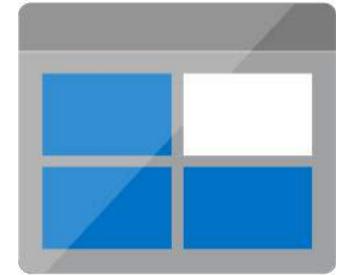




Azure Blob Storage

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

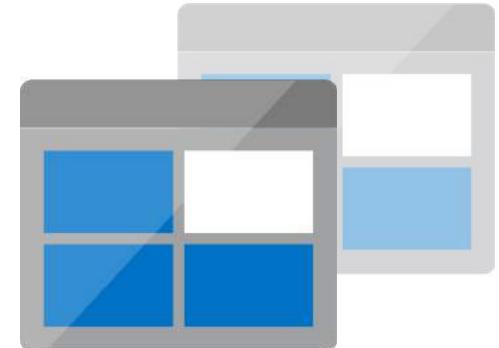


Blob Storage



Azure Storage 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

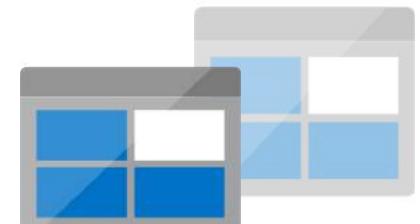


Storage Replication



Azure Storage Replication Options - Summary

- Locally Redundant Storage (LRS) – 3 copies – same AZ/R
- Zone Redundant Storage (ZRS) – 3 copies – 3 AZs – 1R
- Geo-Redundant storage (GRS) = 6 copies – 2 AZs – 2 R
 - 3 copies in 1 AZ – primary region
 - 3 copies in 1 AZ – secondary region
- Geo-Zone-Redundant Storage (GZRS) = 6 copies
 - 3 copies in 3 AZs – primary region
 - 3 copies in 1 AZ – secondary region



Storage Replication

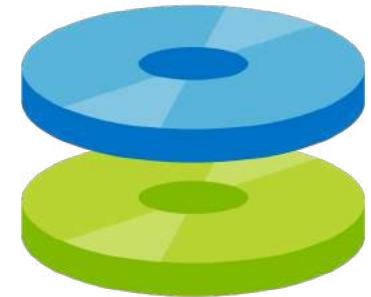




Azure Managed Disks

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 stores 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

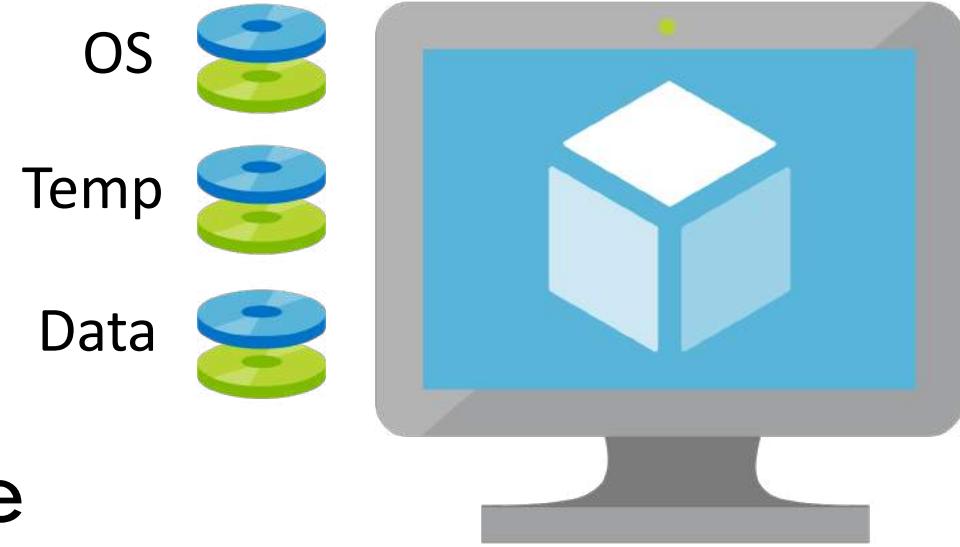


Disks



Azure Disk Roles

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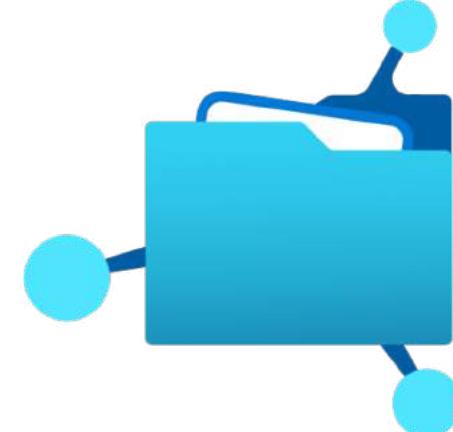




Azure Files Storage

Azure Files Overview and Benefits

- Azure Files offers fully managed file shares in the cloud that are accessible via SMB protocol – plug and play
- Azure Files shares can be mounted (attached) by both on-premises and cloud machines
- Traditional file servers can be replaced with Azure Files or additional capacity can be added
 - Azure file shares can be mounted from any location
 - Works on Windows, Mac and Linux

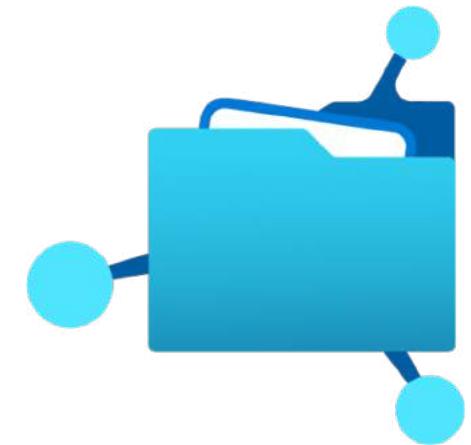


Azure Files



Azure Files Benefits –Why Azure Files is Useful ?

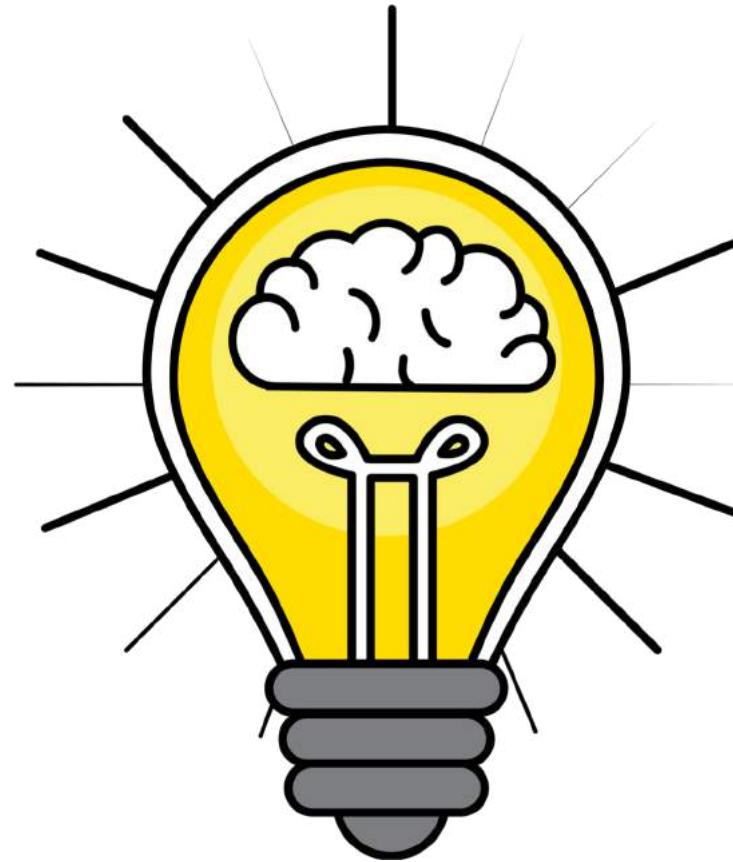
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- Automate work
 - Multiple tools available for scripting
 - i.e. Azure CLI, PowerShell
- Always-on File Share
 - High available, highly scalable



Azure Files



Azure Storage - Quiz



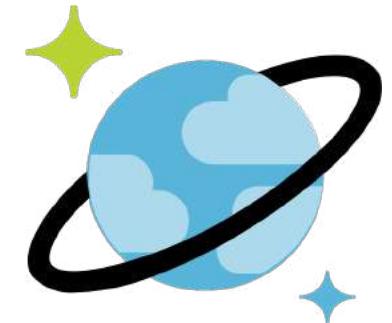


Module 6 – Databases in Azure

Azure Cosmos Database Fundamentals 101

Azure Cosmos Database Introduction

- Azure Cosmos DB is Microsoft's globally distributed, multi-model database service – PaaS service
- It is designed for high scale, global replication, low latency database
- How does Azure Cosmos DB store data ?
- It's just a document DB
 - Document format JSON (JavaScript Object Notation)



Azure Cosmos DB



JSON Document Example

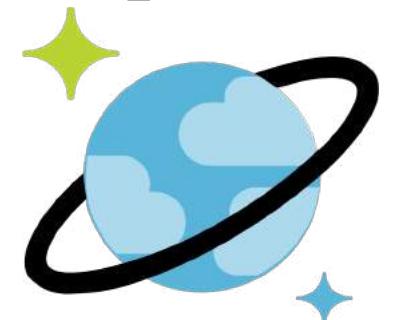
- JSON (JavaScript Object Notation) is an open-standard file format that uses human-readable syntax, consisting of attribute-value pairs
- Key-value pair
 - Key=id, value=1
 - Key=category, value=CAR

```
{  
  "id": "1",  
  "category": "CAR",  
  "name": "BMW",  
  "description": "7 series",  
  "isComplete": false  
}
```



Azure Cosmos Database - Key Features

- Global distribution and regional presence – 99,999%
- Elastic scale
 - From thousands to hundreds of millions of requests/sec around the globe
- Low latency guarantee - less than 10-ms – 99% of requests
- No schema or index management
 - Just operate on the documents, which can have different properties/formats

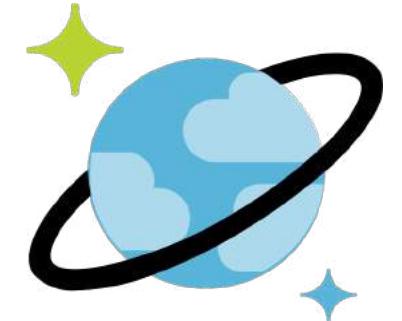


Azure Cosmos DB



Azure Cosmos Database - Key Features

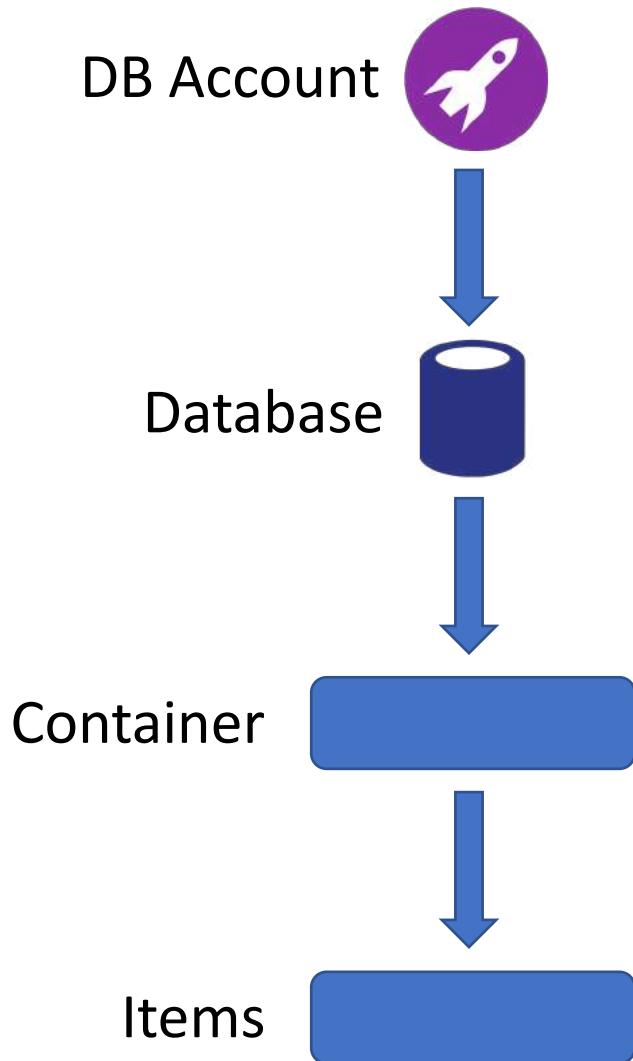
- Multiple APIs available
 - SQL (core API) – query your data just like you would do with any “normal” DB
 - Cassandra
 - MongoDB
 - Gremlin
 - Azure Table Storage



Azure Cosmos DB



Azure Cosmos Database – The Structure

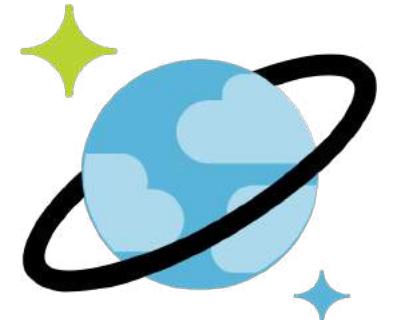


- ❑ Start with Database Account
- ❑ Container – e.g. table
- ❑ Items – e.g. rows of data
- ❑ Cosmos API chosen reflects what container (table) and item (row) are realized of
- ❑ E.g. -SQL API – collection & docs



Azure Cosmos Database – Request Units

- ❑ The cost of all database operations is expressed by Azure Cosmos DB in Request Units (RUs) - e.g. operations: read, insert, delete, query
- ❑ Think of RUs per second as the currency for throughput
- ❑ You don't pick how much CPU, RAM, etc you only pick one aggregate measure, the throughput measure, which is the RUs

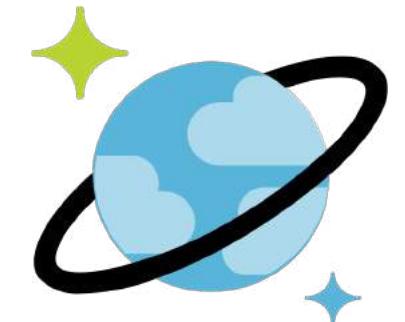
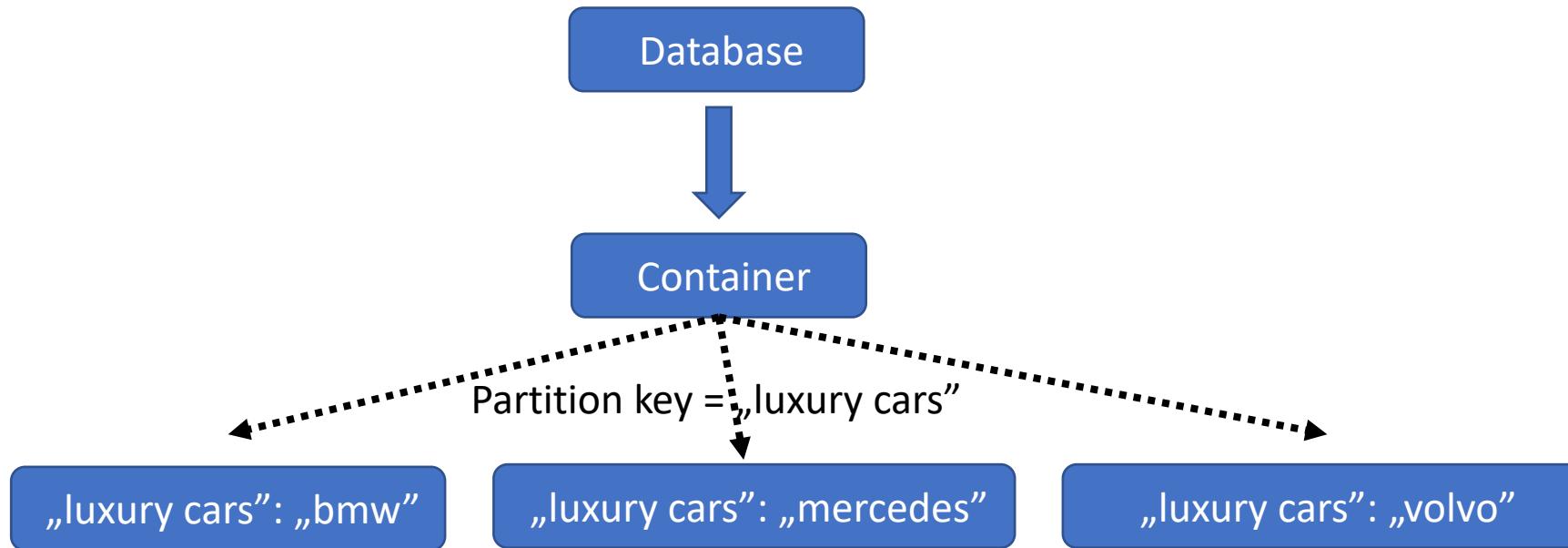


Azure Cosmos DB



Azure Cosmos Database – Partitions

- ❑ Items in a container are divided into distinct subsets called logical partitions



Azure Cosmos DB





Module 6 – Databases in Azure

Azure SQL Database Fundamentals 101

Azure SQL Database Overview

- Azure SQL DB is a general-purpose relational database-as-a-service (DBaaS) based on the latest stable version of Microsoft SQL Server Database engine – PaaS service
- Provided as a managed service, you can create a highly available and high-performance data storage layer for the applications and solutions in Azure
- What's a relational database ?



Azure SQL DB



Relational Database Example

F12 ▾ ✎ fx

	A	B	C	D	E	F	G	H
1	Courses			Students			Registration	
2	Course Name	Course ID		Student Name	Student ID		Registration ID Number	
3	Math	123		Mary	135		Course ID	
4	History	234		John	246		Student ID	
5	Physics	456		Gabriel	357			
6								

Course Table

Courses	
Course Name	Course ID
Math	123
History	234
Physics	456

Students Table

Students	
Student Name	Student ID
Mary	135
John	246
Gabriel	357

Registration Table

Registration	
Registration ID Number	
Course ID	
Student ID	



Azure SQL Database Deployment Models

- Azure SQL DB provides three deployment models:
 - Single
 - Fully managed, isolated database
 - Elastic Pool
 - Collection of single databases with a shared set of resources
 - Managed instance
 - Fully managed instance of SQL Server
 - Full SQL server capabilities (vs. Single)

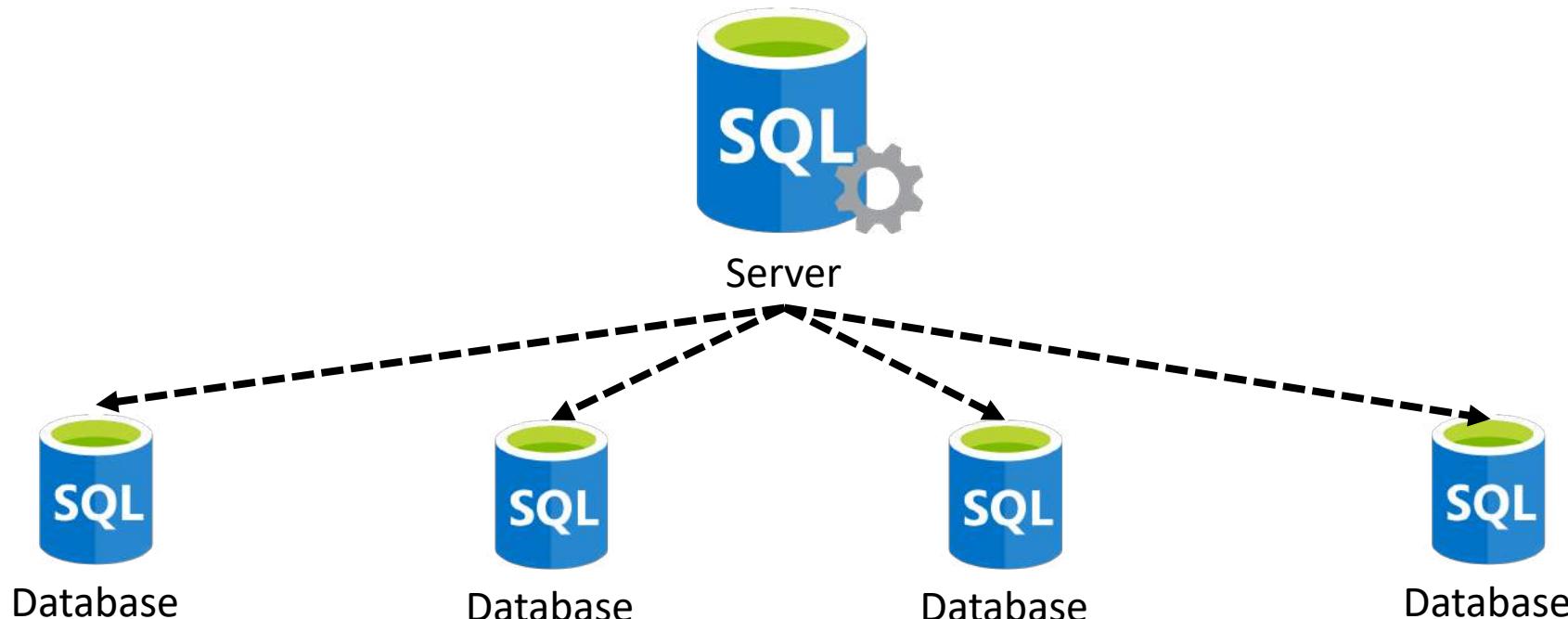


Azure SQL DB



SQL Database Server vs SQL Database

- Azure SQL Database Server is the central administrative point for multiple single or pooled databases
- Similar to on-prem. traditional SQL server



Azure SQL Database – Purchasing Options

- Azure SQL Database - three pricing models:
 - Database Transaction Unit (DTU)
 - Virtual Core (vCore) – recommended
 - Serverless model – vCore based
- With DTU, you scale storage with compute at the same time; with vCore you can scale storage independently from compute
- Any existing SQL license can be used with vCore model



Azure SQL DB





Module 6 – Databases in Azure

Azure Database for MySQL Basics 101

Azure Database for MySQL Overview

- Azure Database for MySQL is a relational database service based on the MySQL Community Edition database engine (v5.6, v5.7 and v8.0) – fully managed
- What are the key benefits ?
 - Built-in high availability
 - Pay-as-you-go pricing
 - Scaling in just seconds
 - Built-in security for data at-rest and in-transit
 - Automatic bkp. and point-in-time-restore up to 35 days
 - Enterprise-grade security and compliance



Azure MySQL DB





Module 6 – Databases in Azure

Hands-on Lab - Create Azure DB for MySQL in Azure Portal

MySQL Workbench – Download page

- ❑ MySQL Workbench download page:
 - ❑ <https://dev.mysql.com/downloads/workbench/>





Module 6 – Databases in Azure

Azure Database for PostgreSQL Basics 101

Azure Database for PostgreSQL Overview

- Azure Database for PostgreSQL is a relational database service based on the community version of open source PostgreSQL database engine – fully managed!
- Currently three deployment options are available:
 - Single Server
 - Hyperscale
 - Flexible server (preview)



Azure PostgreSQL DB



Azure Database for PostgreSQL – Single Server

❑ Key benefits:

- ❑ Built-in HA – 99.99% SLA
- ❑ Enterprise-grade security and compliance
- ❑ Built-in security for data at-rest or in-motion
- ❑ Automatic bkp. and point-in-time-restore up to 35 days
- ❑ Vertical scale as needed in seconds



Azure PostgreSQL DB

❑ Three pricing tiers are available:

- ❑ Basic, General purpose, Memory optimized (vCore, RAM, storage)



Azure Database for PostgreSQL – Hyperscale

- ❑ PostgreSQL Hyperscale - scales the DB horizontally (multiple machines of same size are added)
- ❑ Servers are actually part of a server group, coordinator node and worker node roles are available
- ❑ Start with minimum 3 nodes and grow as needed



Azure
PostgreSQL DB





Module 6 – Databases in Azure

Hands-on Lab - Create Azure PostgreSQL DB in Azure Portal

Azure pgAdmin PostgreSQL – Download page

- ❑ PostgreSQL download page, includes pgAdmin tool:
 - ❑ <https://www.enterprisedb.com/downloads/postgres-postgresql-downloads>





Module 6 – Databases in Azure

Azure SQL Managed Instance Fundamentals 101

Azure SQL Managed Instance Overview

- ❑ Azure SQL Managed Instance is a fully managed instance-as-a-service, with almost 100% feature parity with the SQL Server database engine
- ❑ Best for most migrations to Azure cloud:
 - ❑ allows existing SQL Server customers to lift and shift their on-prem apps to the cloud
- ❑ Reduce management overhead and TCO – PaaS offering
 - ❑ Automatic patching, versioning and updates, HA - high availability



Managed
Instance



Azure SQL MI – Key Features and Benefits

- Combines best features of SQL Database & Server Engine
- 1. It's a PaaS offering
- 2. Business continuity
- 3. Security and compliance
- 4. Management



Managed
Instance



SQL MI Purchasing Model & Service Tiers

- ❑ vCore - Allows you to change compute, memory, and storage, based on your workload needs
- ❑ Azure SQL MI is available in two service tiers:
 - ❑ General purpose
 - ❑ Typical performance and I/O latency
 - ❑ Business critical
 - ❑ Low I/O latency
 - ❑ 99.99% availability



Managed
Instance



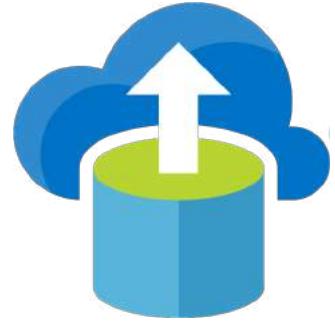


Module 6 – Databases in Azure

Azure Database Migration Service Introduction

Azure DMS Overview

- ❑ Azure Database Migration Service is a fully managed service designed to enable seamless migrations from multiple database sources to Azure Cloud
- ❑ Azure Database Migration Service is designed to support different migration scenarios for both offline (one-time) and online (continuous sync) migrations
- ❑ <https://docs.microsoft.com/en-us/azure/dms/resource-scenario-status>



Azure DMS





Module 6 – Databases in Azure

Module Completion & Exam Hints

Databases in Microsoft Azure

- Azure Databases briefly covered in this Module:
 - Azure Cosmos Database
 - Azure SQL Database
 - Azure Database for MySQL
 - Azure Database for PostgreSQL
 - Azure SQL Managed Instance
 - Azure Database Migration Service

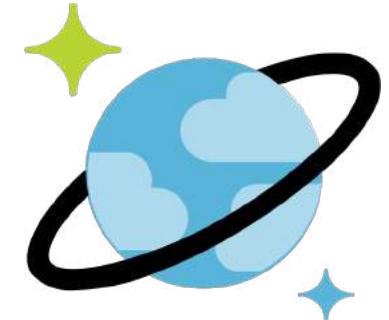




Azure Cosmos Database

Azure Cosmos Database Overview

- Azure Cosmos DB is Microsoft's proprietary globally-distributed, multi-model database service "for managing data at planet-scale" (May 2017)
- It is schema-agnostic, horizontally scalable and generally classified as a NoSQL database
- It's a document DB
 - Document format JSON (JavaScript Object Notation)



Azure Cosmos DB





Azure SQL Database

Azure SQL Database Overview

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Azure SQL DB



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Azure SQL DB





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Azure MySQL DB

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Azure PostgreSQL DB





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Instance



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Instance





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Azure DMS



Azure Databases - Quiz



Microsoft Azure Fundamentals



Module 7 – Other Azure Core Services

Networking Services in Azure Fundamentals 101

Azure Networking Overview

- Azure Networking covers a broad range of networking services that can be used together or separately
- Azure Networking provides the following key capabilities:
 - *Connectivity services* – in this Module
 - vNET, ExpressRoute, VPN gateway
 - *Application protection services* – Module 10
 - DDoS protection, Firewall, NSGs, WAF, etc.



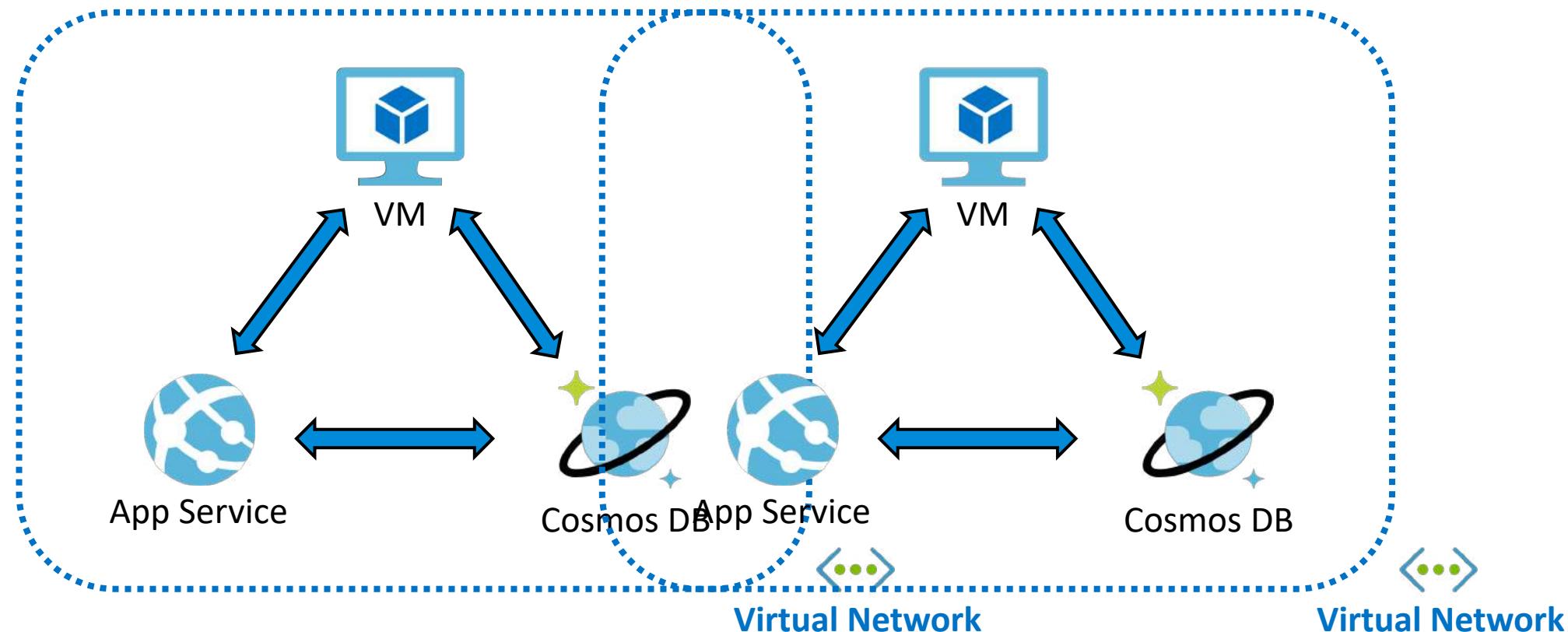
Azure Networking Overview

- ❑ *Application delivery services* – in this lecture
 - ❑ CDN, Load Balancer, Application Gateway
- ❑ *Network monitoring* – Module 9
 - ❑ Azure Monitor, Azure Service Health, Network Watcher, etc.



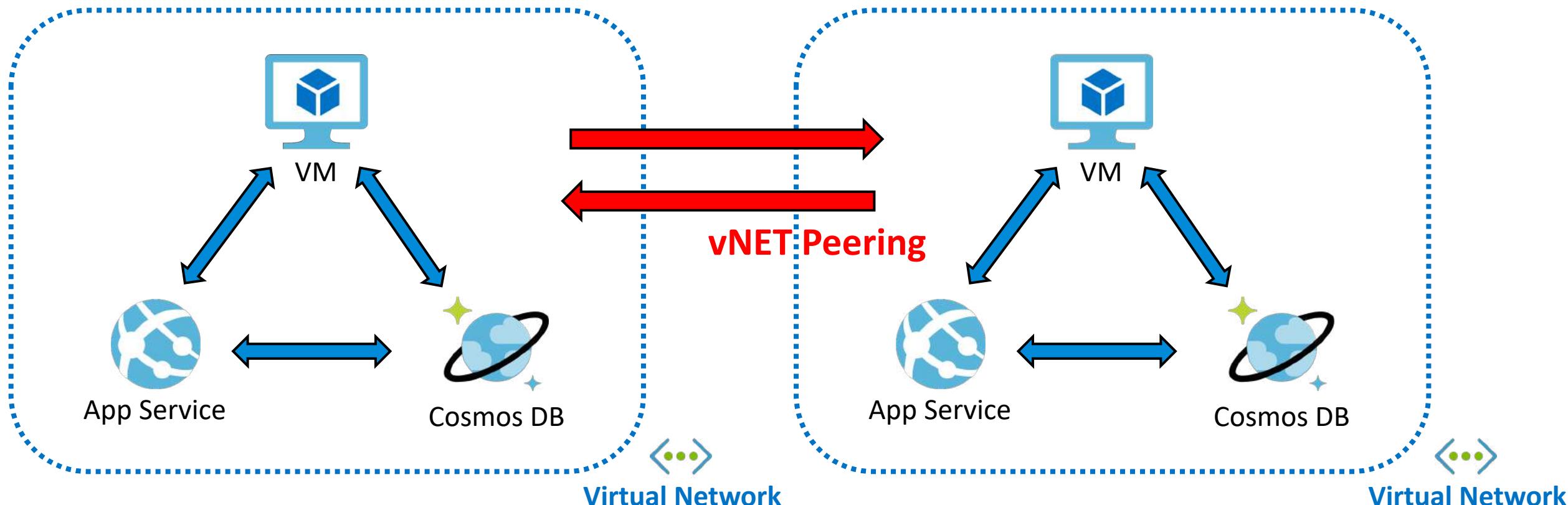
Azure Connectivity Services – Virtual Network

- Virtual Network (vNET) - the fundamental building block for your private network in Azure (“private DC”)



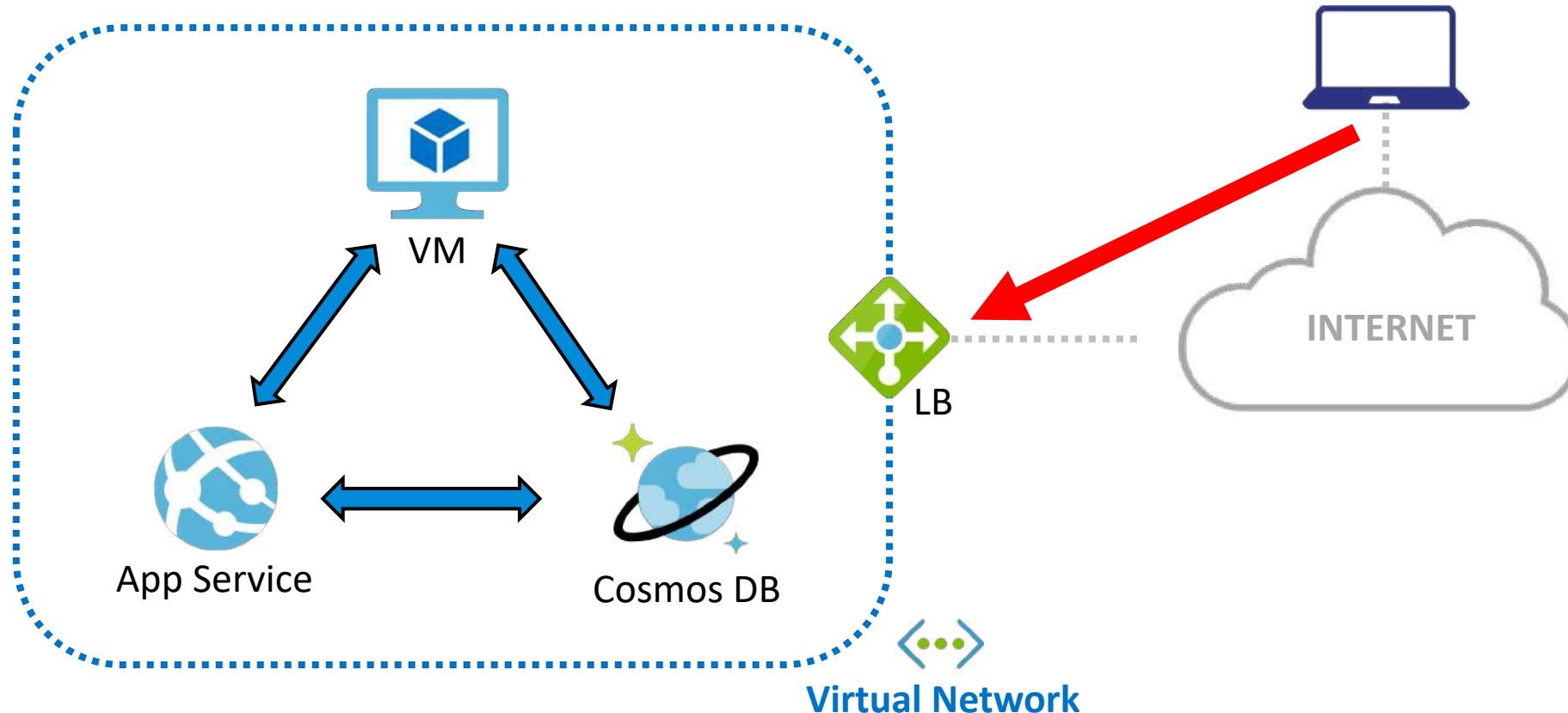
Azure Connectivity Services – vNET Peering

- Communicate between each other, within the same or different Azure Regions



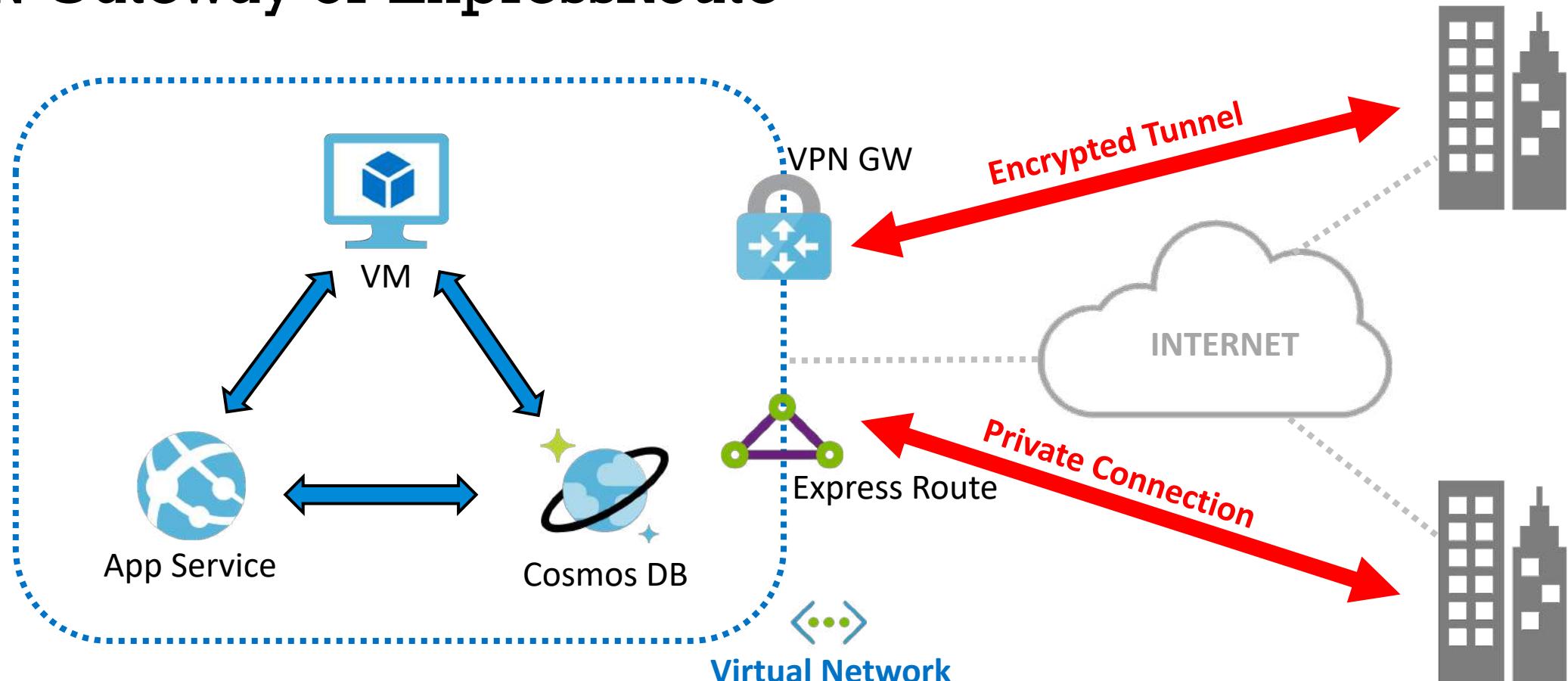
Azure Connectivity Services – Load Balancer

- Communicate inbound to a resource by assigning a public IP address or a public Load Balancer.



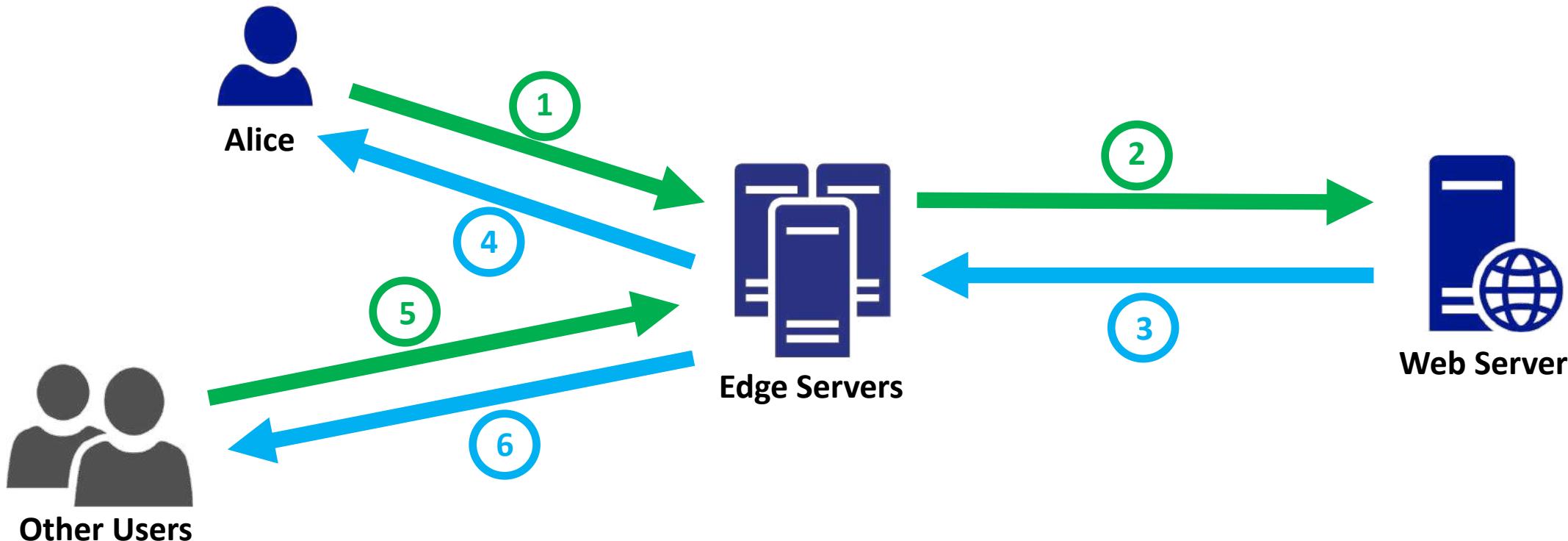
Azure Connectivity Services – On-Prem DC

- Connect your on-premises network to a virtual network using VPN Gateway or ExpressRoute



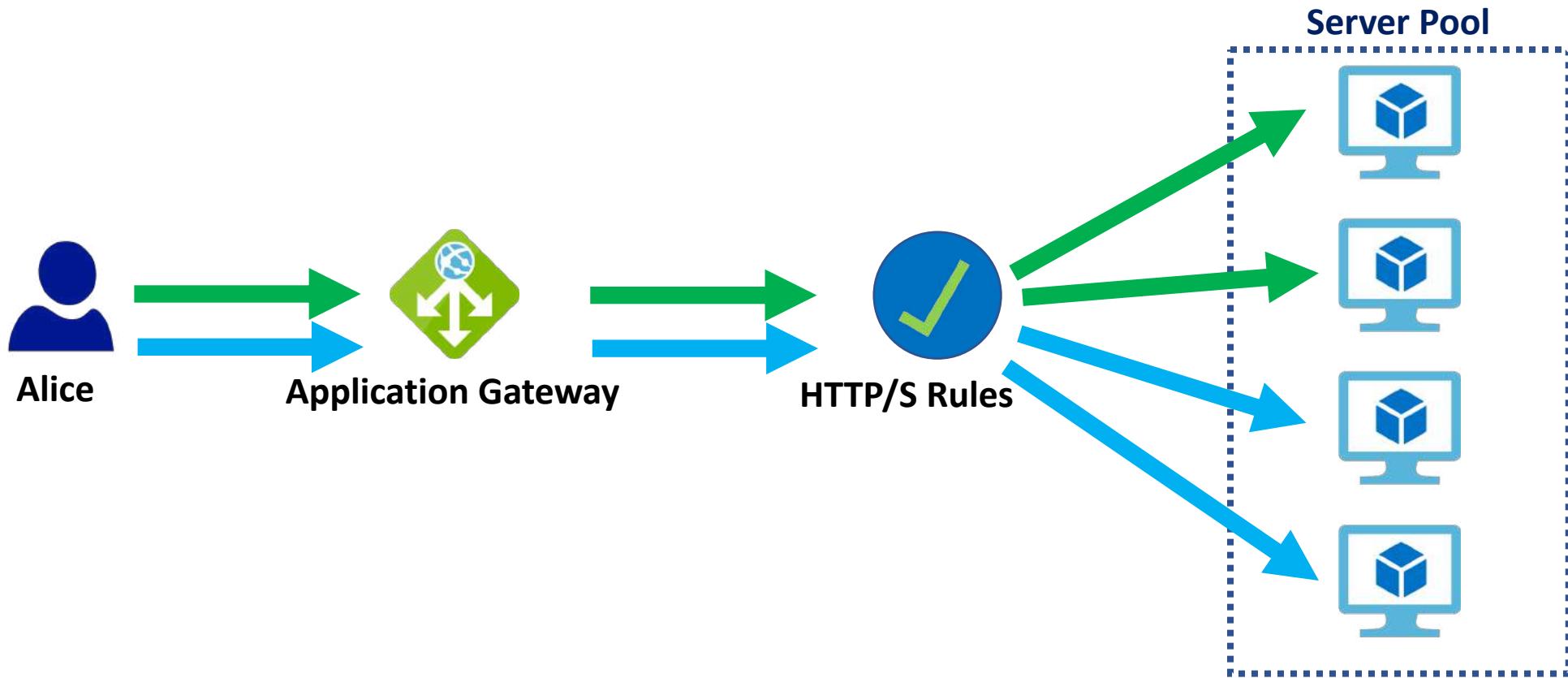
Azure Application Delivery Services

- Azure Content Delivery Network (CDN) delivers high-bandwidth content to users by caching their content at strategically placed physical nodes across the world



Azure Application Delivery Services

- Azure Application Gateway is a web traffic load balancer that enables you to manage traffic to your web applications



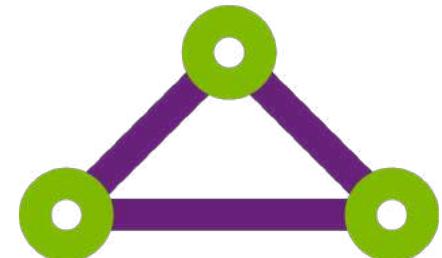


Module 7 – Other Azure Core Services

Azure ExpressRoute Fundamentals 101

What is Azure ExpressRoute?

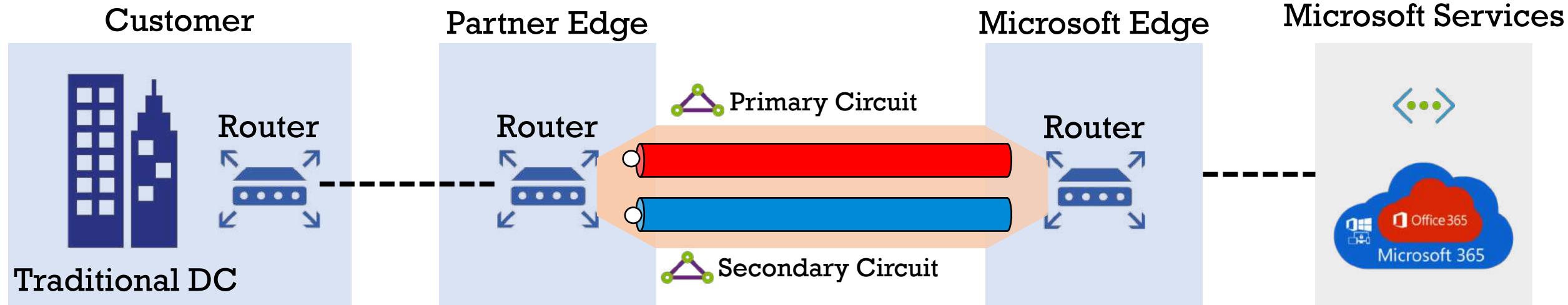
- ExpressRoute lets you extend your on-premises networks into the Microsoft cloud
- ExpressRoute vs VPN ?!
 - ExpressRoute connections don't go over the public Internet network
 - Faster speeds, consistent latencies and higher security



ExpressRoute

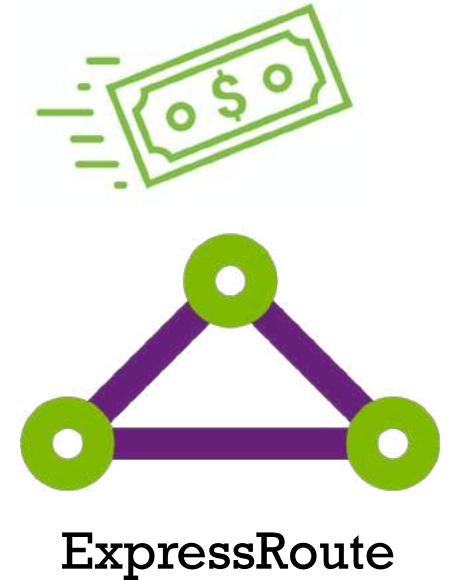


ExpressRoute Architecture – How it works



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



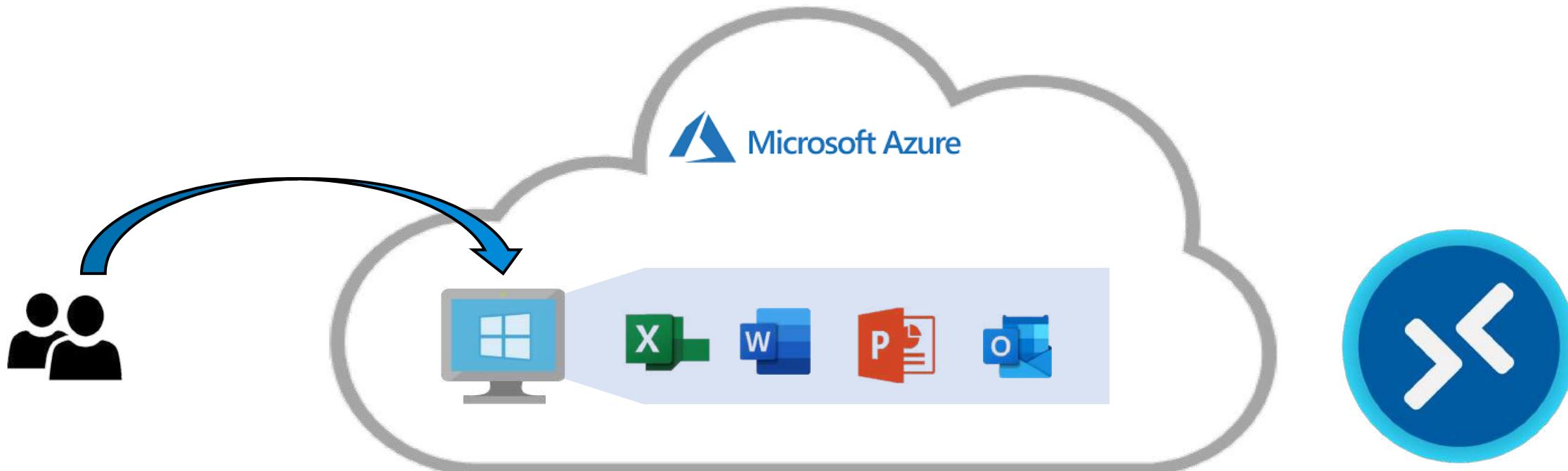


Module 7 – Other Azure Core Services

Azure Windows Virtual Desktop Fundamentals 101

What is Windows Virtual Desktop?

- Windows Virtual Desktop on Microsoft Azure is a desktop and app virtualization service that runs on the cloud

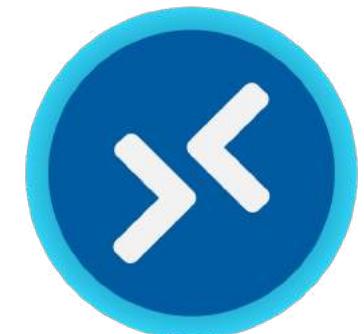


Windows Virtual
Desktop



Windows Virtual Desktop – Key Benefits

- ❑ Windows Virtual Desktop – Why to use?
 - ❑ Enhanced Security
 - ❑ Data stored centrally; secure connectivity method
 - ❑ Management - centrally managed environment
 - ❑ Windows 10 multi-session
 - ❑ BYOL – save money with existing license
 - ❑ Cost saving - up to 72%



Windows Virtual
Desktop





Module 7 – Other Azure Core Services

IoT and Azure Sphere Fundamentals 101

Azure IoT Overview

- The Azure Internet of Things (IoT) is a collection of Microsoft-managed cloud services that connect, monitor, and control billions of IoT assets
- In simpler terms, an IoT solution is made up of one or more IoT devices that communicate with one or more back-end services hosted in Azure Cloud
- New to IoT ? Let's clarify the concept and the overall setup within Microsoft Azure Cloud

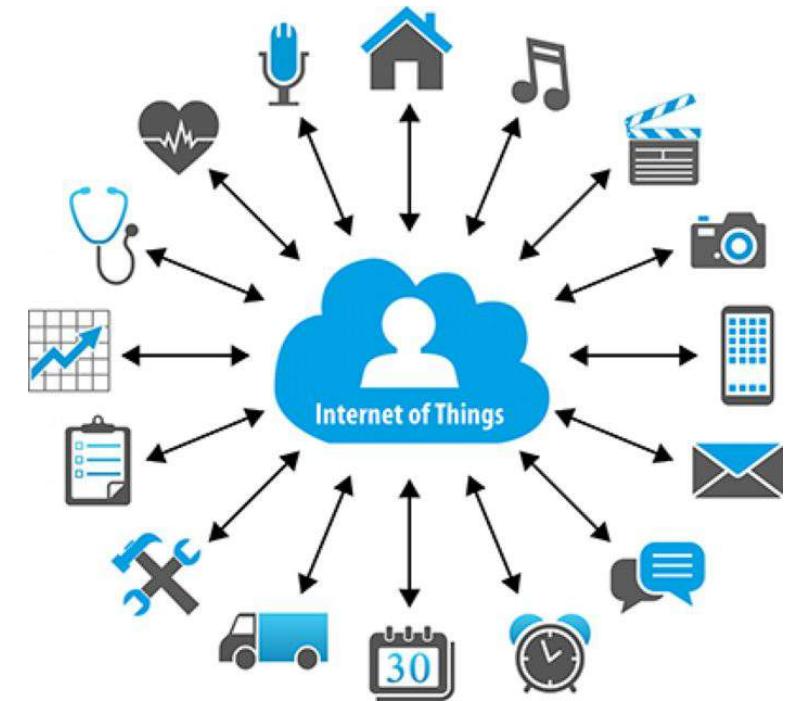


What's an IoT Device ? What's IoT ?

- An IoT device is typically made up of a circuit board, with different sensors attached, connected to the internet
- How does an IoT sensor look like ?

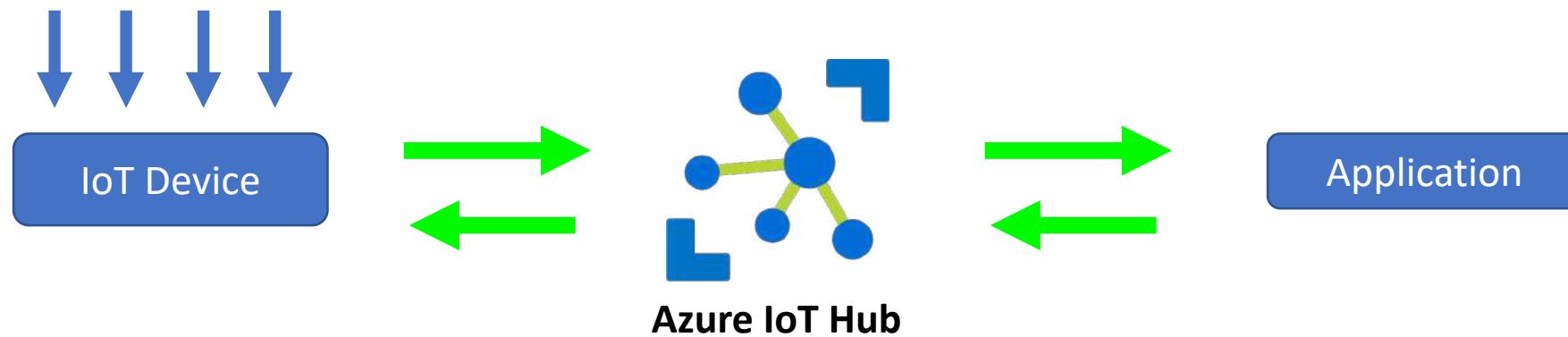


Plugable MXChip AZ3166 IoT DevKit Compatible with Microsoft Visual Studio and Azure



Azure IoT Hub

- IoT Hub is a managed service that acts as a central message hub for bi-directional communication between your IoT application and the devices it manages



Azure IoT Central

- ❑ IoT Central is an IoT application platform that reduces the burden and cost of developing, managing, and maintaining enterprise-grade IoT solutions (PaaS)
- ❑ You can use IoT Central to create a custom, cloud-hosted IoT solution for your organization, typically consists of:
 - ❑ A cloud-based application that receives data from your devices and enables you to manage those devices
 - ❑ IoT devices connected to your cloud-based application



Azure Sphere Overview

- ❑ Sphere - secure platform to develop, deploy, and maintain secure internet connected IoT solutions
- ❑ Security is the main value proposition for Azure Sphere
 - ❑ securely and remotely maintain connected IoT devices
 - ❑ protection against spoofing and DoS attacks
 - ❑ automatic software updates
 - ❑ centralized management
 - ❑ support for legacy IoT devices



Azure Sphere





Module 7 – Other Azure Core Services

Big Data and Analytics in Azure Fundamentals 101

Big Data and Analytics – What it is ?

- Today we are dealing with massive amounts of data, in real time; think back to IoT, data is continuously delivered
- What if you are managing data from 10.000 trucks ? What about 1 million AC devices ? Or 10m smartphones?
- What do you do with all this data ? You want to analyze it, and get FAST insights ! Outcome and Results ?
- Deliver intelligent actions that improve customer engagement, increase revenue and lower costs



Microsoft Azure – Azure Synapse Analytics

- ❑ Azure Synapse Analytics is a cloud-based enterprise data warehouse that you can use to quickly run complex queries across petabytes of data (Exactly, PB of data ☺)
- ❑ Import data into Synapse Analytics and run high-performance analytics
- ❑ More and more businesses are relying today on Big Data and Analytics solutions in order to extract real insights from the market and drive business in the right direction

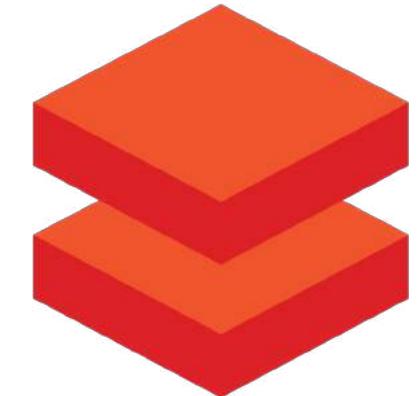


Synapse Analytics



Microsoft Azure – Azure Databricks

- ❑ Azure Databricks is an Apache Spark-based analytics platform optimized for the Microsoft Azure cloud platform
- ❑ Azure Databricks
 - ❑ analyze data and generate meaningful insights
- ❑ Where does Databricks read data from ?
 - ❑ Synapse Analytics (SQL Data Warehouse)
 - ❑ Azure Blob Storage
 - ❑ Azure Data Lake Storage
 - ❑ Azure Cosmos DB

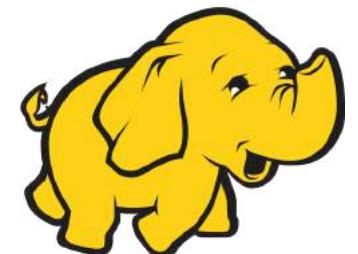


Azure Databricks



Microsoft Azure – Azure HDInsight

- ❑ Azure HDInsight - cost-effective enterprise-grade service for open source analytics; with Azure HDInsight, I would like you to think open source
- ❑ Run popular open source frameworks – including Apache Hadoop, Spark and Kafka, process massive amounts of data and get all the benefits of the broad open source ecosystem with the global scale of Azure
- ❑ It integrates with other Azure services, for example Data Factory and Data Lake Storage



Azure HDInsight





Module 7 – Other Azure Core Services

AI, ML and Cognitive Services Fundamentals 101

ML and AI. What is this all about?

- ❑ Machine learning is a data science technique that allows computers to use existing data to forecast future behaviors, outcomes, and trends
- ❑ By using machine learning, computers learn without being explicitly programmed



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1 million



It's a CAT,
I am 80% sure



ML and AI. What is this all about?

- ❑ Artificial Intelligence is the capability of a machine to imitate intelligent human behavior
- ❑ Through AI, machines can analyze images, comprehend speech, interact in natural ways and make predictions using data
- ❑ What is the Azure offering on this segment ?
 - ❑ Azure Machine Learning
 - ❑ Azure Machine Learning Studio (classic)



Azure Machine Learning Studio (classic)

- ❑ Machine Learning Studio (classic) is a collaborative, drag-and-drop visual workspace where you can build, test, and deploy ML solutions without needing to write code
- ❑ This is the "classic" (old) offering for Machine Learning



All services

Overview

All

General

Machine Learning Studio (classic) web service plans

Machine Learning
Keywords: Machine Learning

CloudSimple Virtual Machines

Machine Learning Studio (classic) web services

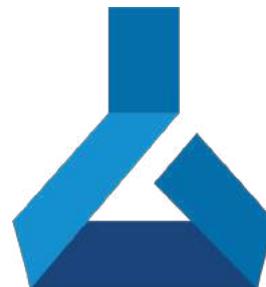
HDInsight clusters
Keywords: Machine Learning Server

SQL virtual machines
Keywords: virtual machine



Azure Machine Learning

- Azure Machine Learning provides both a web interface called the designer and several SDKs and CLI to quickly prep data, train and deploy machine learning models
- Azure Machine Learning designer provides drag and drop ML modules plus scalability, version control and enterprise security
- Resource is available in new portal:
 - <https://ml.azure.com>



Azure Machine Learning



Microsoft Azure Fundamentals

Azure Cognitive Services

- ❑ Azure cognitive services - comprehensive family of AI services and APIs that help building intelligent apps
- ❑ Azur Cognitive Services examples:
 - ❑ Computer vision - analyze content in images and video
 - ❑ Face - Detect and identify people in images
 - ❑ Speech translation - translates speech in real time
 - ❑ Text Analytics - detect sentiment, key phrases and named entities



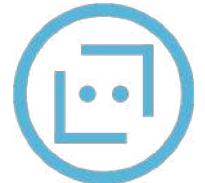


Module 7 – Other Azure Core Services

Azure Bot Service Fundamentals 101

What is a Bot?

- ❑ A bot is an app that users interact with in a conversational way, using text, graphics (i.e. images), or speech
- ❑ A bot interaction can be a quick question and answer, or it can be a sophisticated conversation that intelligently provides access to services
- ❑ Azure Bot Service and Bot Framework offer an integrated set of tools and services to build Bots in Azure

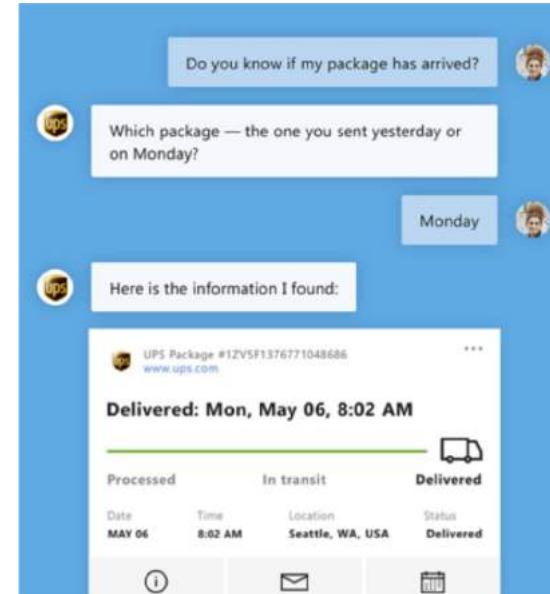
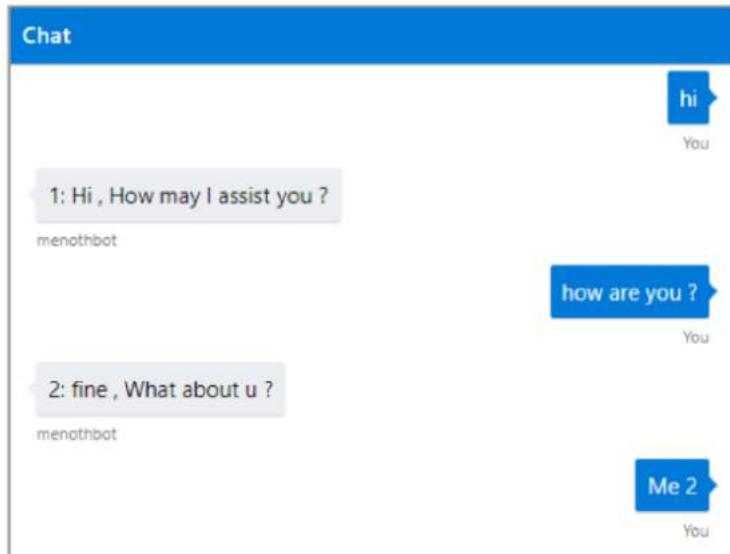


Bot Service



Azure Bot Service Overview

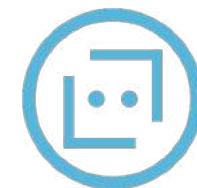
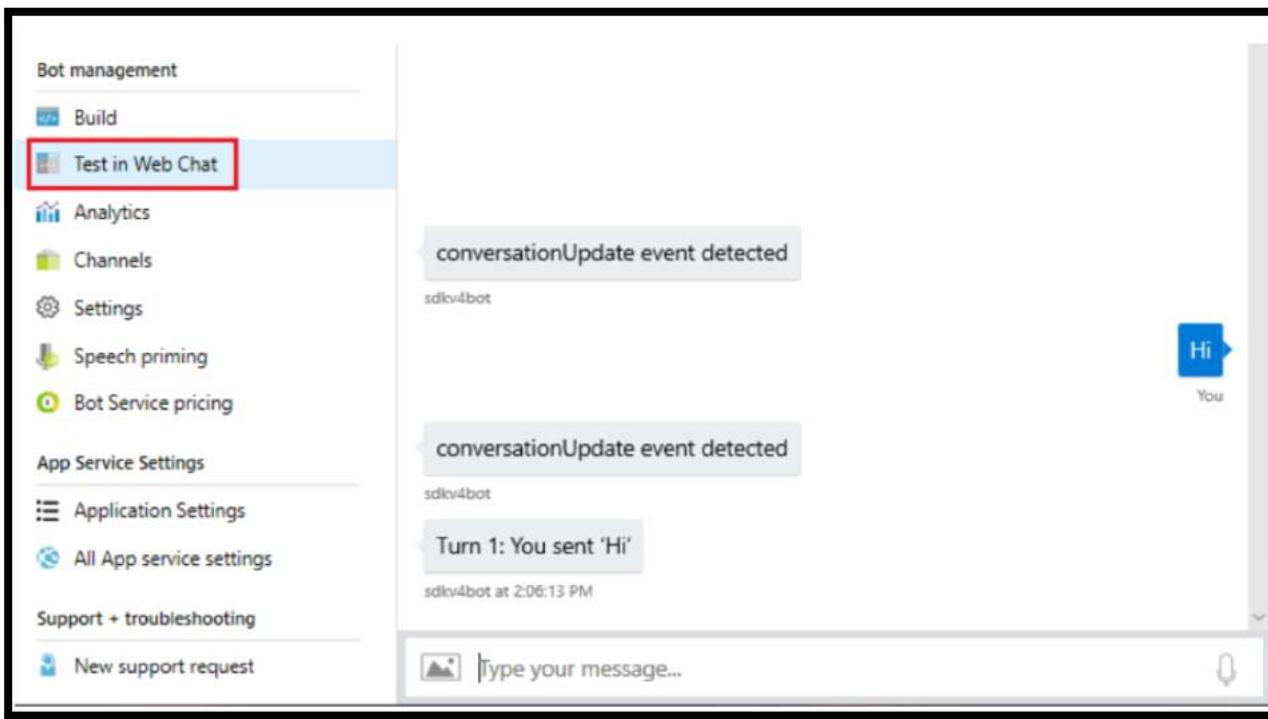
- Azure Bot Service is Microsoft's artificial intelligence (AI) chatbot offered as-a-service
- Start simple ... and grow in sophistication



Azure Bot Service – Optional Further Learning

☐ Create a bot with Azure Bot Service

- ☐ <https://docs.microsoft.com/en-us/azure/bot-service/absquickstart?view=azure-bot-service-4.0>



Bot Service



Microsoft Azure Fundamentals



Module 7 – Other Azure Core Services

Azure DevOps and DevTest Labs Fundamentals 101

Introduction to DevOps

- DevOps is a set of practices that combines software development (Dev) and information-technology operations (Ops) which aims to shorten the systems development lifecycle and provide continuous delivery with high software quality (wikipedia.org)
- DevOps is the union of people, process, and products to enable continuous delivery of value to our customers
- With DevOps, you deploy code more frequently, reduce lead time, reduce change failure rate



How can Azure DevOps help ?

- Azure DevOps provides several tools you can use for better team collaboration
- Azure DevOps is a suite of services, that provide a solution to anyone who wants a tool to create a step-by-step production and continuous improvement chain
- What are the Azure tools that we can use in DevOps ?
- Let's briefly touch on the subject ...



Azure Tools for DevOps

- Azure Boards - These are agile tools that help us plan, track and discuss our work, even with other teams



Azure Boards

- Azure Pipelines - These will let us build, test and deploy with CI/CD that works with any language, platform and cloud



Azure Pipelines

- Azure Test Plans – These are manual and exploratory testing tools



Azure Test Plans



Azure Tools for DevOps

- Azure Repos - provides unlimited, cloud-hosted private and public Git repos



Azure Repos

- Azure Artifacts - create, host and share packages

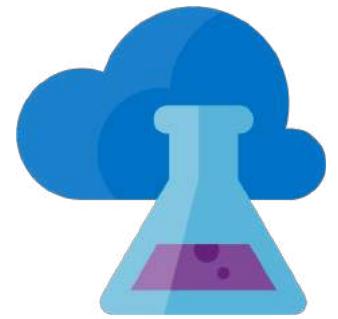


Azure Artifacts



Azure DevTest Labs

- ❑ Azure DevTest Labs enables developers to efficiently self-manage virtual machines (VMs) and PaaS resources without waiting for approvals
- ❑ With Azure DevTest Labs developers become autonomous and can create labs consisting of pre-configured resources
- ❑ So, by using DevTest Labs, you can easily test the latest versions of your applications and speed up the process of creating and terminating the testing environments



Azure DevTest Labs





Module 7 – Other Azure Core Services

GitHub and GitHub Actions Fundamentals 101

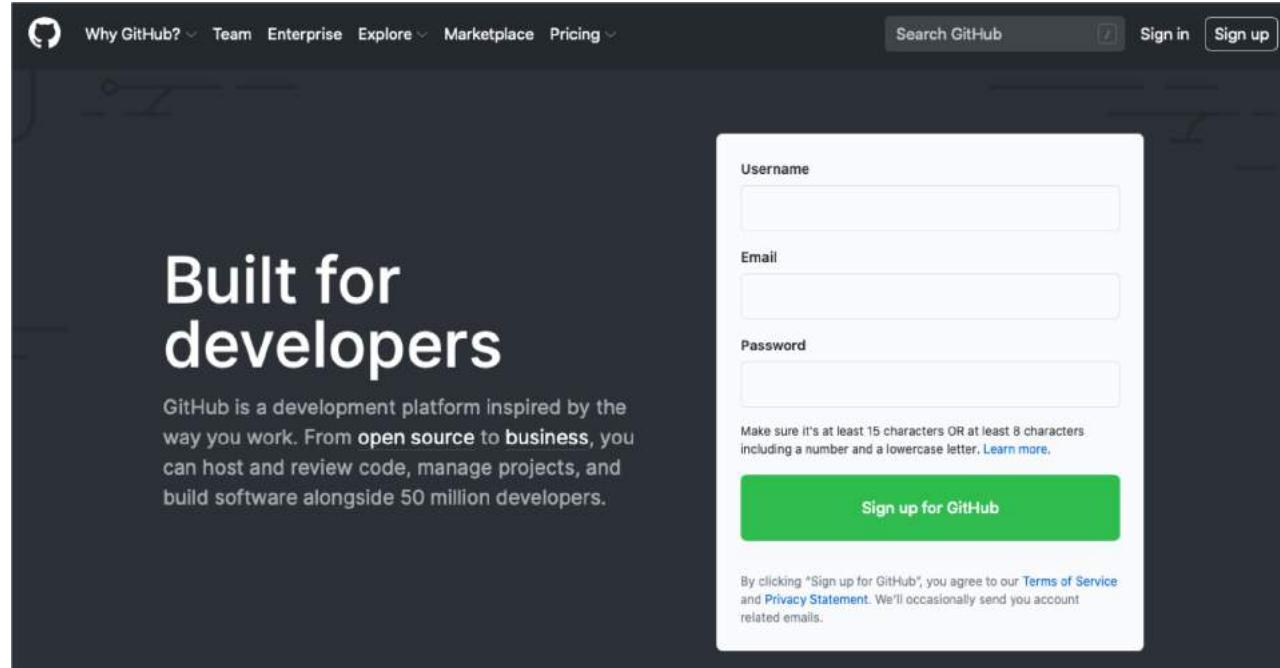
What is Git ?

- 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>



GitHub



Microsoft Azure Fundamentals



Module 7 – Other Azure Core Services

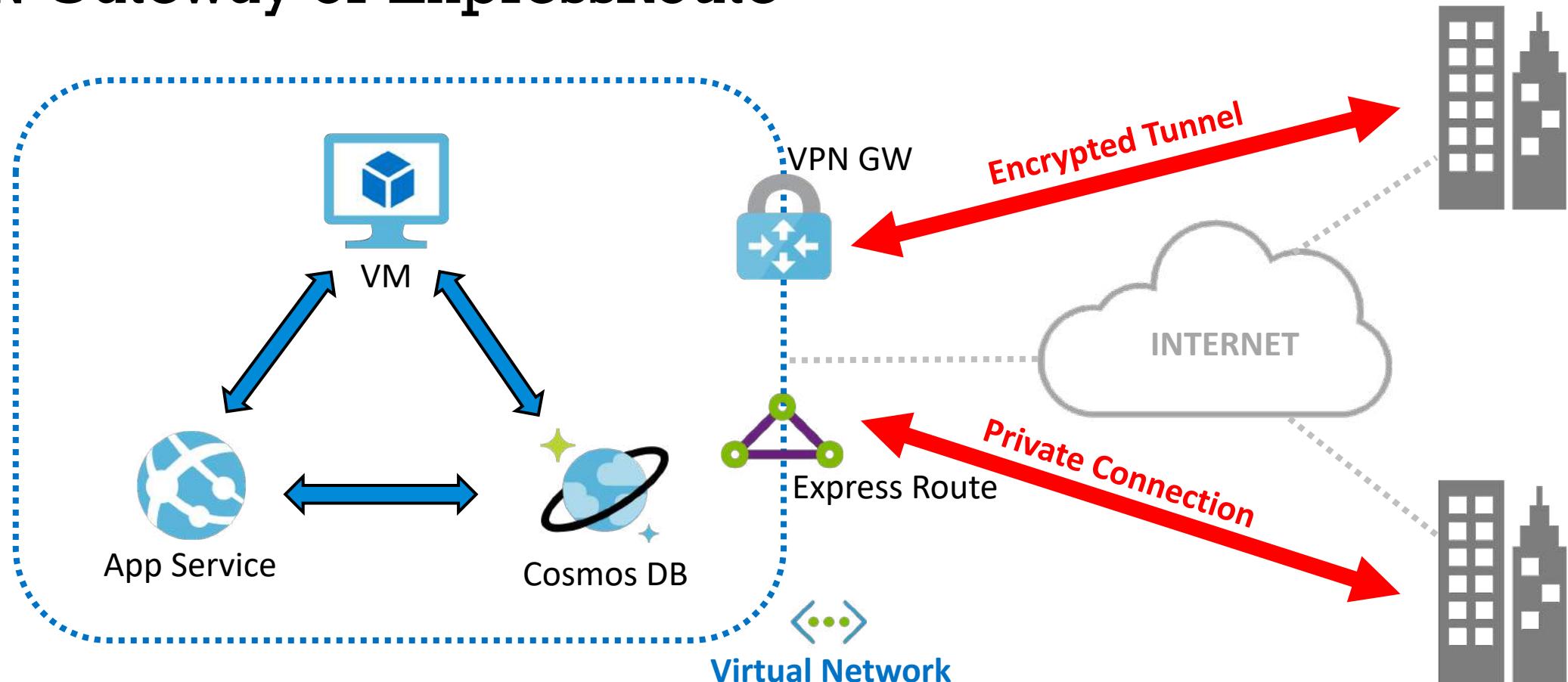
Module Completion & Exam Hints



Azure VPNs & ExpressRoute

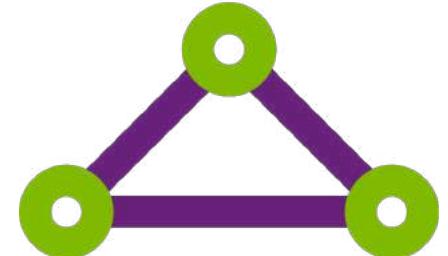
Azure Connectivity Services – On-Prem DC

- Connect your on-premises network to a virtual network using VPN Gateway or ExpressRoute



Azure ExpressRoute Overview

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



ExpressRoute



Exam Hints!

- ☐ When using Azure ExpressRoute connection, inbound data traffic from on-premises network to Azure is always free
- ☐ Copying data to Azure from on-premises network to Azure over a VPN is free – no additional costs are incurred
- ☐ Why ?
 - ☐ Inbound data transfer to Azure is free, outbound data traffic is charged!

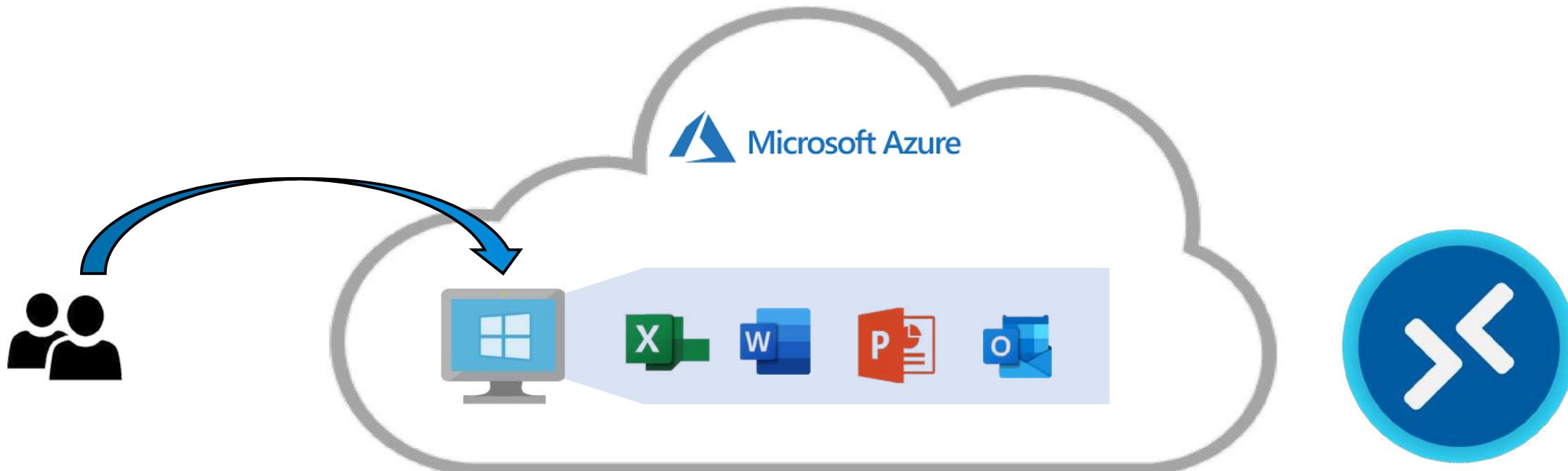




Azure Windows Virtual Desktop

What is Windows Virtual Desktop?

- Windows Virtual Desktop on Microsoft Azure is a desktop and app virtualization service that runs on the cloud



Windows Virtual
Desktop

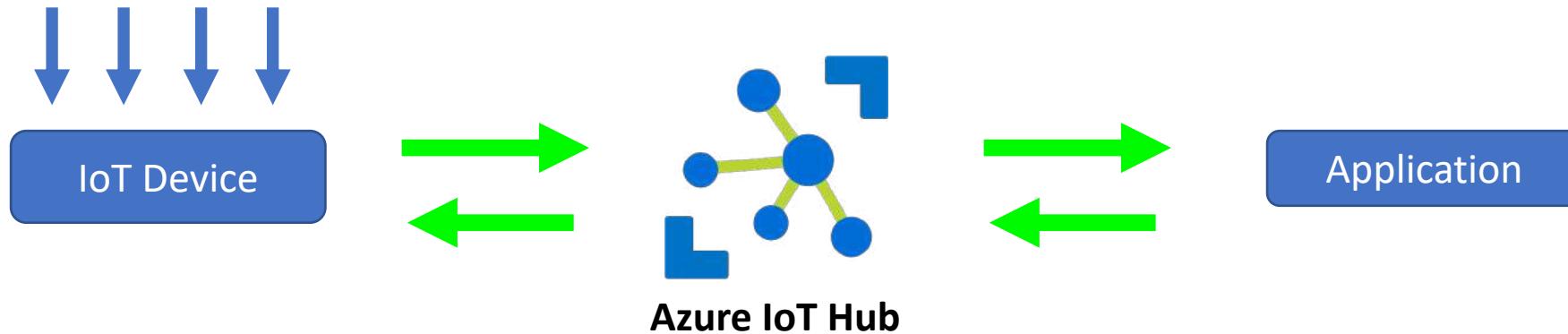




IoT in Azure

Azure IoT Hub & Azure Sphere

- ❑ IoT Hub is a managed service that acts as a central message hub for bi-directional communication between your IoT application and the devices it manages



- ❑ Azure Sphere - secure platform to develop, deploy, and maintain secure internet connected IoT solutions



Exam Hints!

- ❑ IoT Hub and Azure Data Lake work great together !
 - ❑ IoT Hub can receive data from millions of IoT devices
 - ❑ IoT Hub sends data to Azure Data Lake Gen 2 (storage purposes)

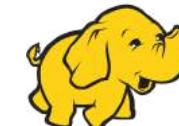




Big Data and Analytics in Azure

Big Data and Analytics in Azure

- Azure Synapse Analytics is a cloud-based enterprise data warehouse that you can use to quickly run complex queries across petabytes of data
- Azure Databricks is an Apache Spark-based analytics platform optimized for Microsoft Azure cloud platform
- Azure HDInsight - cost-effective enterprise-grade service for open source analytics; remember the open source benefit!



Exam Hints!

- Benefits - Azure Synapse Analytics (former name SQL Data Warehouse) is that HA is built into the platform
- Azure SQL Synapse Analytics
 - Cloud based service that leverages massively parallel processing (MPP) to quickly run complex queries across petabytes of data in a relational database
- Azure Databricks - Apache Spark-based analytics service
- Azure Databricks – big data analysis service for ML



Exam Hints!

- ☐ Azure HDInsight – open source framework for the distributed processing and analysis of big data sets in clusters





AI, ML and Cognitive Services in Azure

Machine Learning Overview

- Machine learning is a data science technique that allows computers to use existing data to forecast future behaviors, outcomes, and trends
- By using machine learning, computers learn without being explicitly programmed



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AI and Cognitive Services in Azure

- ❑ Artificial Intelligence is the capability of a machine to imitate intelligent human behavior
- ❑ Through AI, machines can analyze images, comprehend speech, interact in natural ways and make predictions using data
- ❑ Azure cognitive services - comprehensive family of AI services and APIs that help building intelligent apps
 - ❑ Computer vision, face, speech translation, text analytics



Exam Hints!

- ❑ Machine Learning – uses past trainings to provide predictions that have high probability
- ❑ Machine Learning in Azure
 - ❑ Azure Machine Learning Designer – build, test and deploy predictive analytics solutions
- ❑ Azure Cognitive Services
 - ❑ Simplified tools to build intelligent Artificial Intelligence (AI) applications

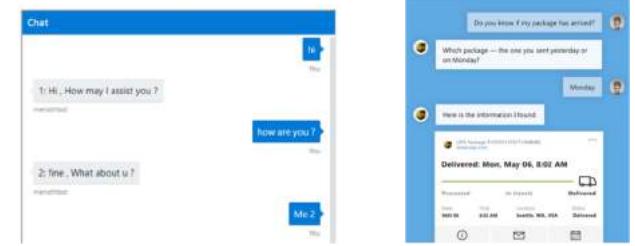




Azure Bot Service

Azure Bot Service Overview

- Azure Bot Service is Microsoft's artificial intelligence (AI) chatbot offered as-a-service
- Start simple ... and grow in sophistication
- Azure Bot Service
 - Digital online assistant that provides speech support





Azure DevOps and DevTest Labs

How can Azure DevOps help ?

- Azure DevOps provides several tools you can use for better team collaboration
- Azure DevOps is a suite of services, that provide a solution to anyone who wants a tool to create a step-by-step production and continuous improvement chain
- 5 tools to remember:
 - Azure Boards, Azure Pipelines, Azure Test Plans, Azure Repos and Azure Artifacts



Azure Tools for DevOps

- Azure Boards - These are agile tools that help us plan, track and discuss our work, even with other teams



Azure Boards

- Azure Pipelines - These will let us build, test and deploy with CI/CD that works with any language, platform and cloud



Azure Pipelines

- Azure Test Plans – These are manual and exploratory testing tools



Azure Test Plans



Azure Tools for DevOps

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Azure Repos

- Azure Artifacts - create, host and share packages

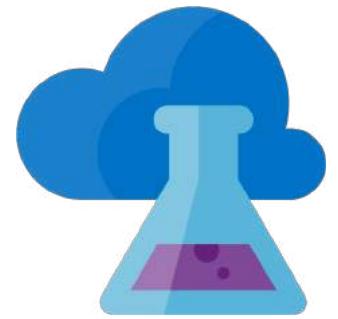


Azure Artifacts



Azure DevTest Labs

- Azure DevTest Labs enables developers to efficiently self-manage virtual machines (VMs) and PaaS resources without waiting for approvals
- With Azure DevTest Labs developers become autonomous and can create labs consisting of pre-configured resources
- So, by using DevTest Labs, you can easily test the latest versions of your applications and speed up the process of creating and terminating the testing environments



Azure DevTest Labs



Exam Hints!

- Azure DevOps – integrated solution for the deployment of code
- Azure Repos – provides a set of version control tools that you can use to manage your code
- Azure DevTest Lab - minimize the administrative effort required to deploy and remove virtual machines – testing environments





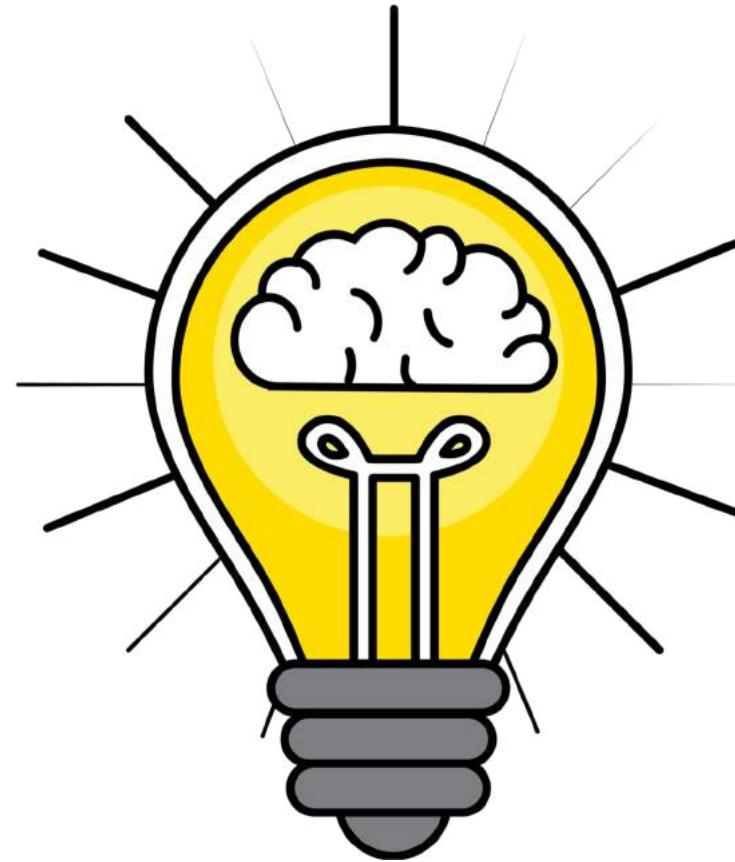
GitHub and GitHub Actions

GitHub and GitHub Actions

- ❑ GitHub is a graphical app repository system;
 - ❑ repo - location where all the files for a particular project are stored – access by URL
- ❑ 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)



Other Azure Core Services - Quiz



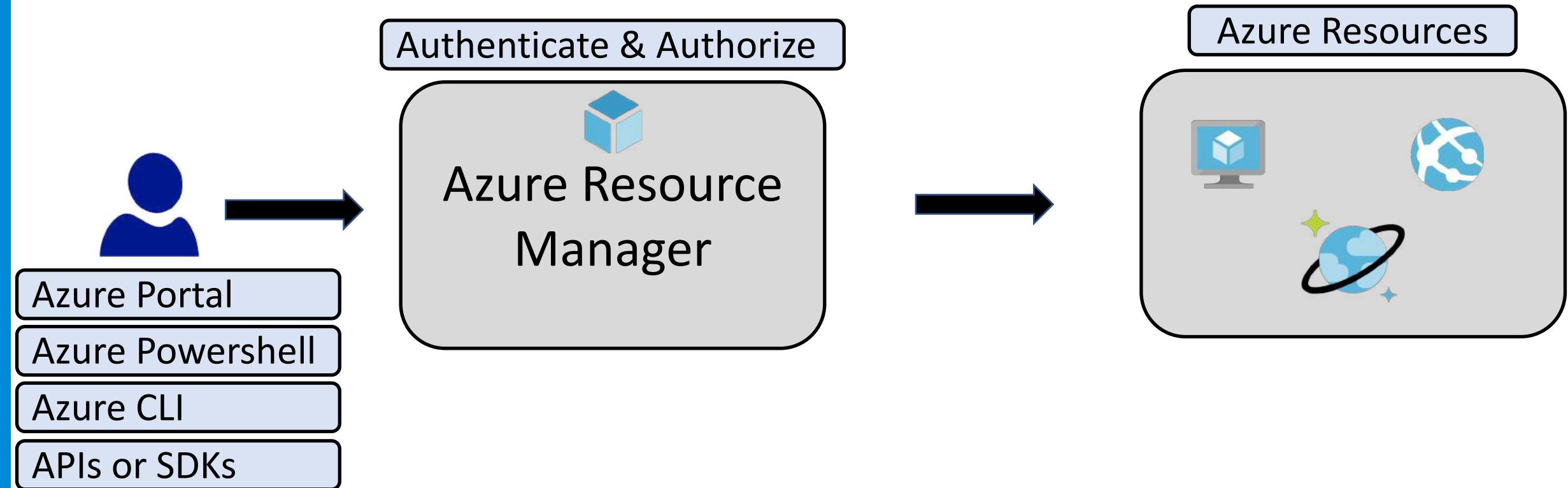


Module 8 – ARM, Policies and Locks

Azure Resource Manager and ARM Templates Fundamentals

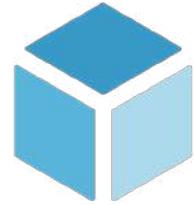
Azure Resource Manager Overview

- ❑ 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

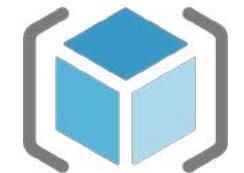


Azure Resource Manager Key Terminology

- **Resource** – service available in Azure Cloud
 - e.g. VMs, databases, storage accounts, etc.



- **Resource groups** – container that encompasses 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



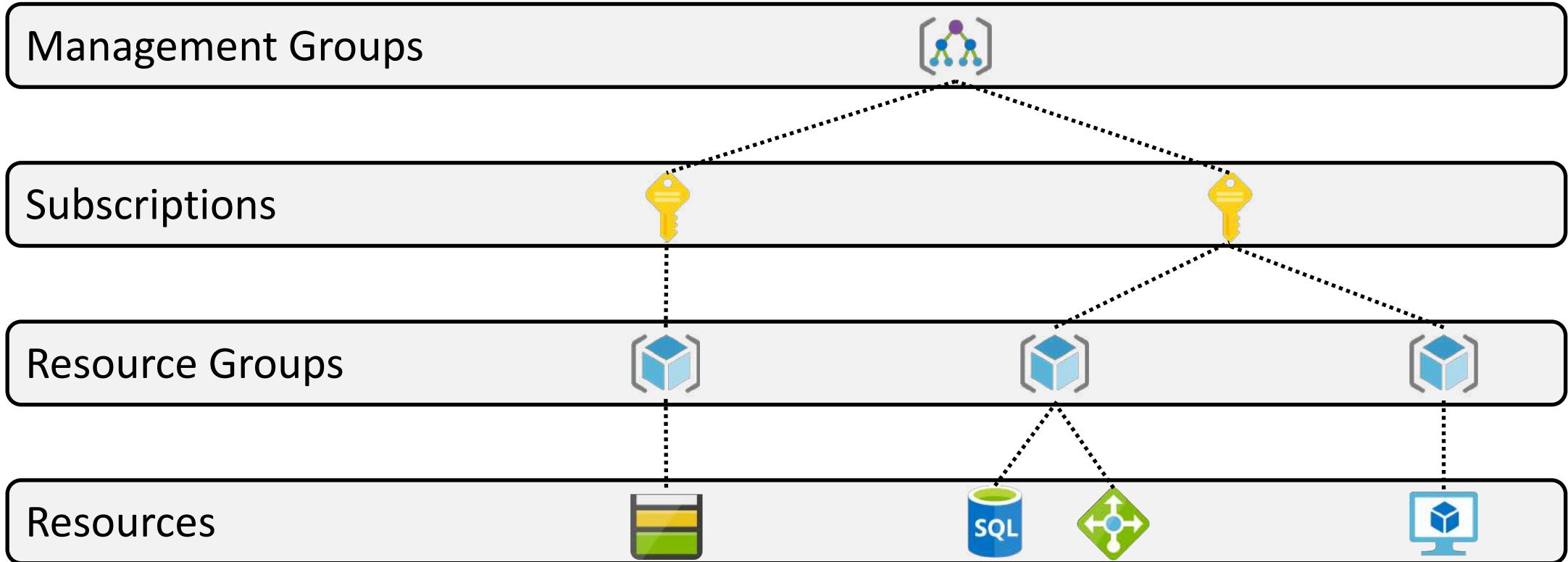
Azure Resource Manager Benefits

- 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 any of these 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



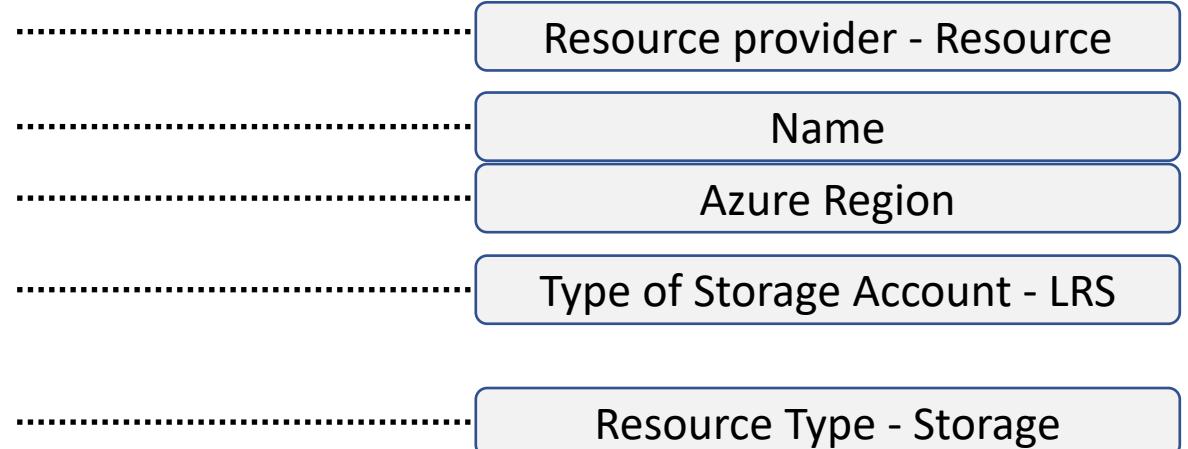
Azure Resource Manager (ARM) Templates

- ❑ Declarative syntax
 - ❑ Deploy an entire infrastructure (vNET, VMs, etc.)
- ❑ Deployment Orchestration
 - ❑ Orchestrate the deployment of interdependent resources, so that they are deployed in the correct order
- ❑ Template is first validated, then deployed
- ❑ Create any resource in Azure and also supports integration with CI/CD tools



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 8 – ARM, Policies and Locks

Azure Blueprints Basics 101

Azure Blueprints Overview

- Azure Blueprints enables cloud architects to define repeatable sets of Azure resources that implement and follow an org.'s standards, patterns and requirements
- Azure Blueprints is a declarative way to orchestrate the deployment of various resource templates and other artifacts, such as:
 - Role assignments
 - Policy assignments
 - Azure Resource Manager templates
 - Resource groups



Azure Blueprints



Azure Blueprints Overview

- With Azure Blueprints, you deploy and update cloud environments in a repeatable manner, using composable artifacts – ARM templates, RGs, policy assignments, RBAC
- Azure Blueprints vs ARM templates ?
- With ARM templates, you execute the deployment and once resources are deployed, there is no active connection or relationship to the template
- What's the advantage with blueprints ?



Azure Blueprints



Microsoft Azure Fundamentals

Azure Blueprints Overview

- With Blueprints, the relationship between the blueprint definition (what should be deployed) and the blueprint assignment (what was deployed) is preserved
- Great for tracking and auditing of deployments
- Also, with Blueprints you can also upgrade several subscriptions at once, that are governed by the same blueprint
- Multiple templates can be used with a Blueprint



Azure Blueprints



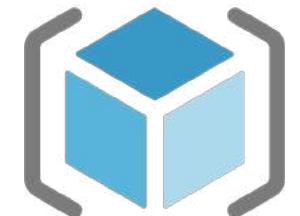


Module 8 – ARM, Policies and Locks

Resource Groups Fundamentals 101

Resource Groups Introduction

- Resource Groups - logical containers for resources deployed in Azure
- All deployed resources (Azure services) are part of a single resource group; can be moved between RGs later on
- 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

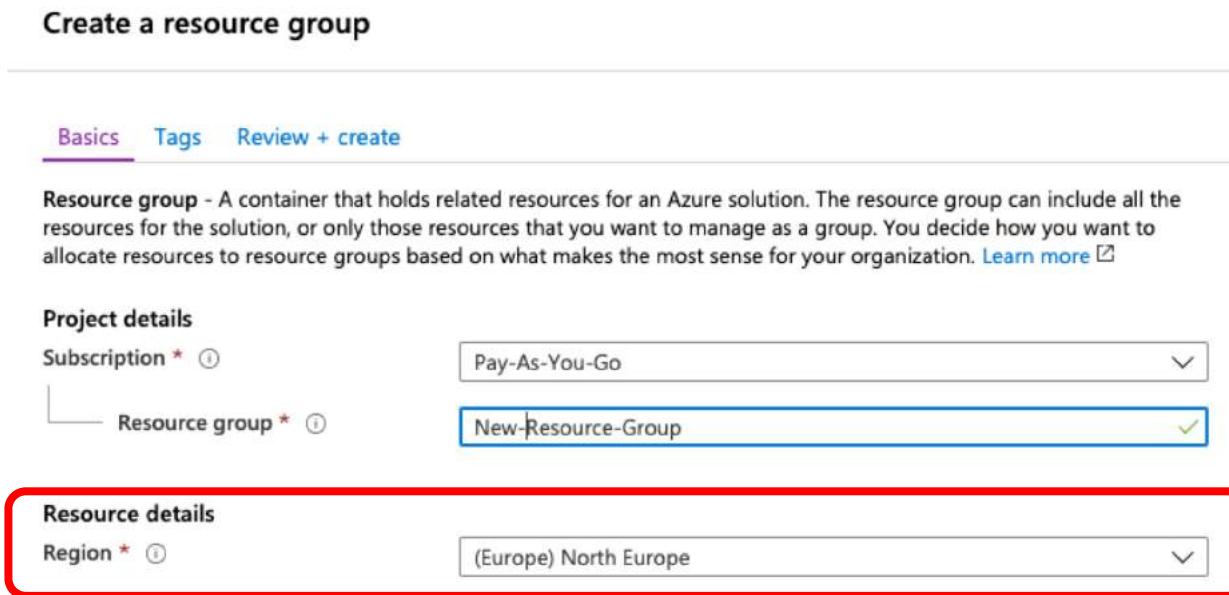


Resource Group



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-Shared01-WestUS
- ❑ <http://bit.ly/Microsoft-RG-NamingConvention>



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





Module 8 – ARM, Policies and Locks

Azure Tags Fundamentals 101

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 8 – ARM, Policies and Locks

Azure Policy Fundamentals 101

Azure Policy Overview

- Azure Policy is a service you can use to create, assign, and manage policies – 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”



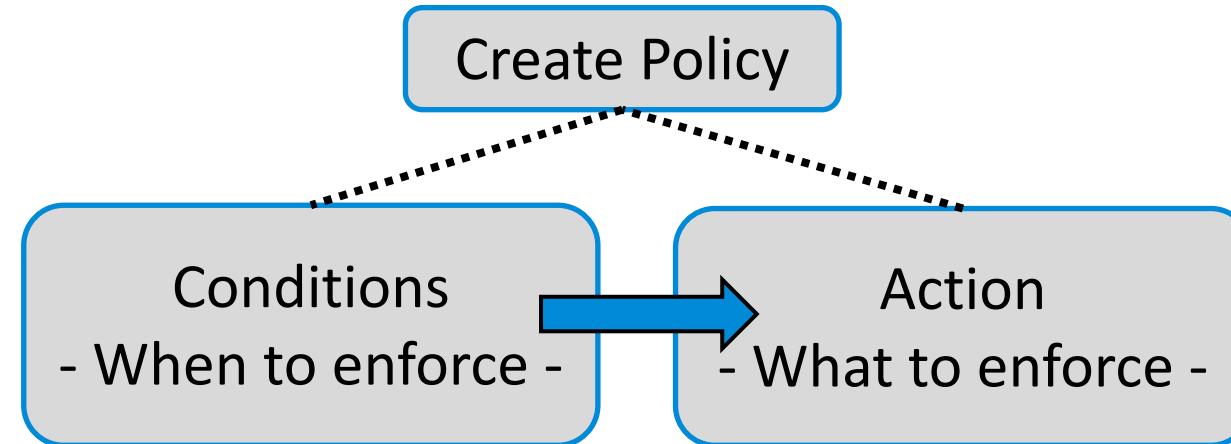
Azure Policy



Microsoft Azure Fundamentals

Azure Policy – Definition & Assignment

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

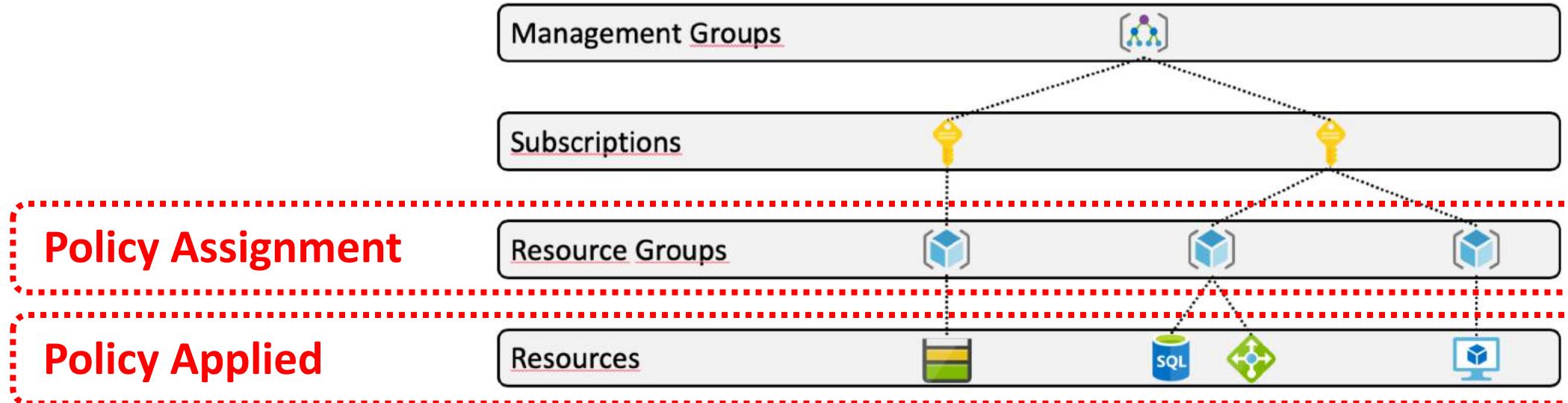


- ❑ Policy assignment - assign the policy definition to a specific scope - where is the policy enforced ? what is the scope ?



Azure Policy – Policy Assignment Scope

- ❑ Policy assignment is assigned to take place within a specific scope, from management group down to 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
 - Allowed Locations
 - New resources to be deployed in specific locations
 - Allowed Virtual Machines SKUs
 - Only specific VM SKUs to be used (B1S)
 - Require a tag and its value on resources
 - Enforces a required tag and its value to a resource

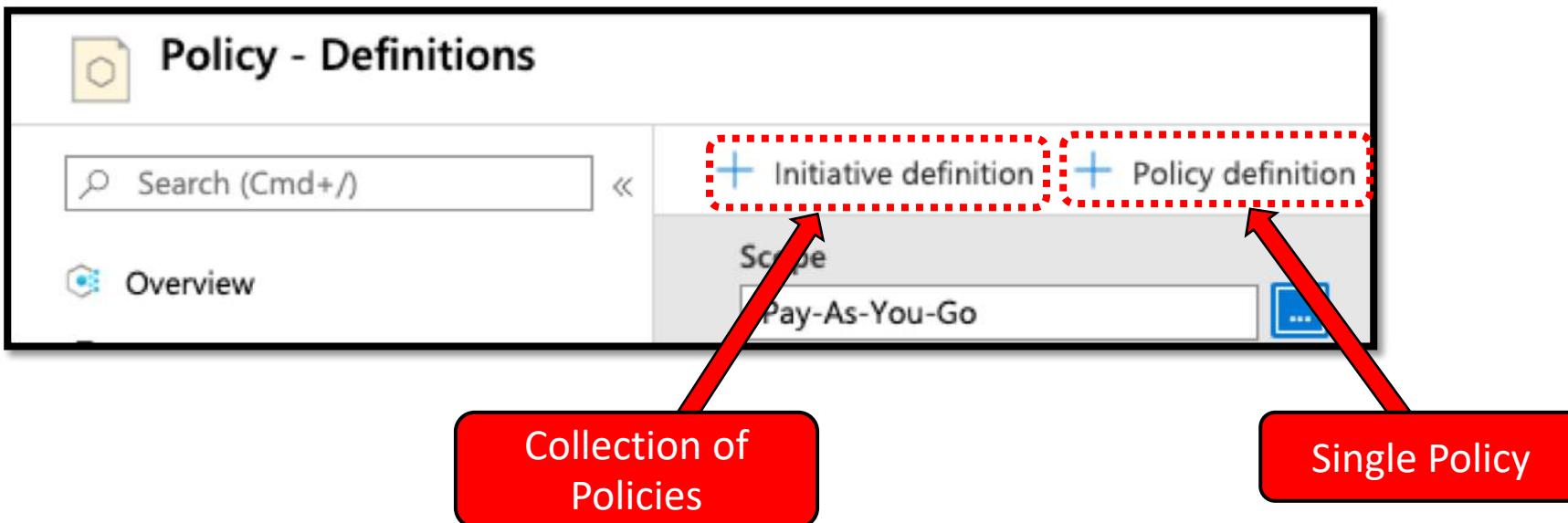


Azure Policy



Initiative Definitions in Azure

- 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



Azure Policy



Microsoft Azure Fundamentals

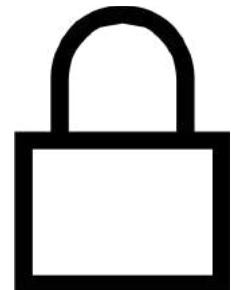


Module 8 – ARM, Policies and Locks

Azure Locks Fundamentals 101

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 8 – ARM, Policies and Locks

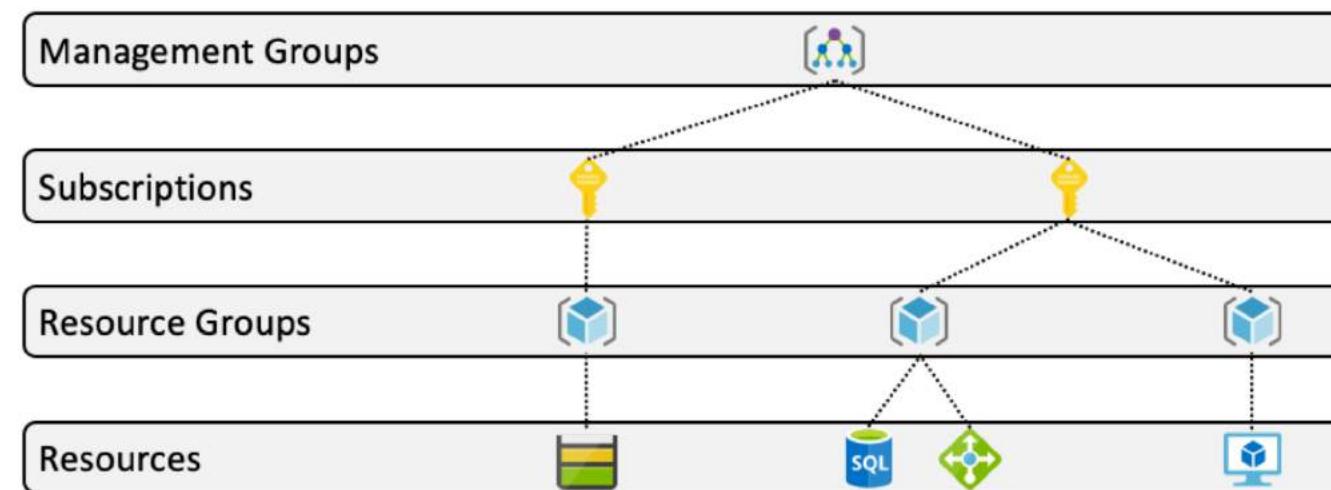
Module Completion & Exam Hints



Azure Resource Manager

Azure Resource Manager 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
- ❑ Management settings can be applied at any of these levels



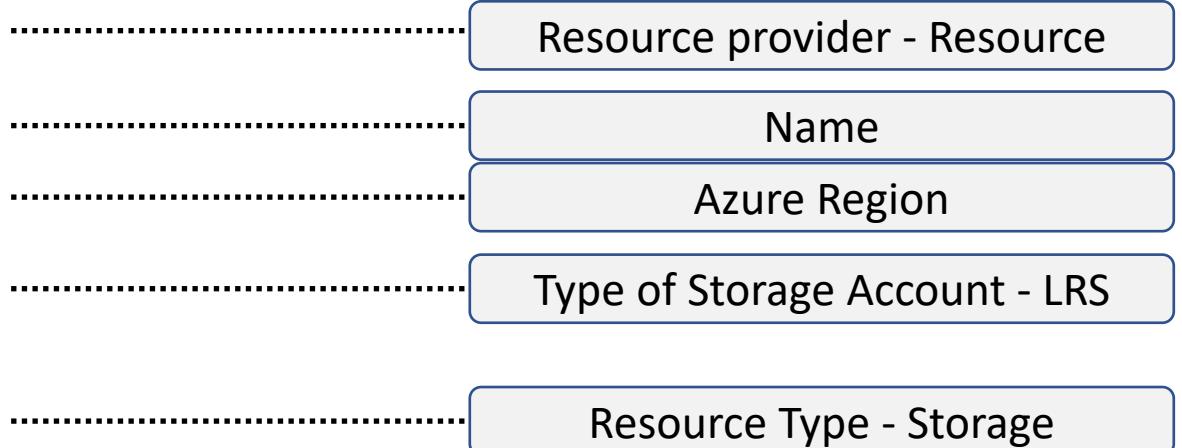
Azure Resource Manager (ARM) Templates

- ❑ Declarative syntax
 - ❑ Deploy an entire infrastructure (vNET, VMs, etc.)
- ❑ Deployment Orchestration
 - ❑ Orchestrate the deployment of interdependent resources, so that they are deployed in the correct order
- ❑ Template is first validated, then deployed
- ❑ Create any resource in Azure and also supports integration with CI/CD tools



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": {}  
  }  
]
```





Azure Blueprints

Azure Blueprints Overview

- Azure Blueprints enables cloud architects to define repeatable sets of Azure resources that implement and follow an org.'s standards, patterns and requirements
- With Azure Blueprints, you deploy and update cloud environments in a repeatable manner, using composable artifacts – ARM templates, RGs, policy assignments, RBAC
- With Blueprints, the relationship between the blueprint definition and the blueprint assignment is preserved



Azure Blueprints

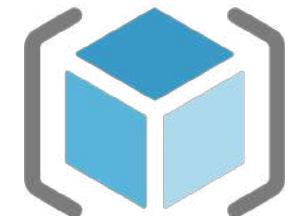




Azure Resource Groups

Resource Groups Introduction

- Resource Groups - logical containers for resources deployed in Azure
- All deployed resources (Azure services) are part of a single resource group; can be moved between RGs later on
- 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 – Organizing Principles

- ❑ Consistent Naming Convention for RGs
 - ❑ What it is used for ?
 - ❑ Types of resources in container ?
 - ❑ Type of the resource itself
- ❑ 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





Azure Tags

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

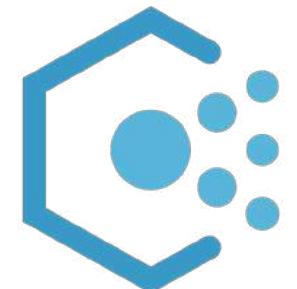




Azure Policy

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 - Allowed Virtual Machines SKUs
 - Require a tag and its value on resources

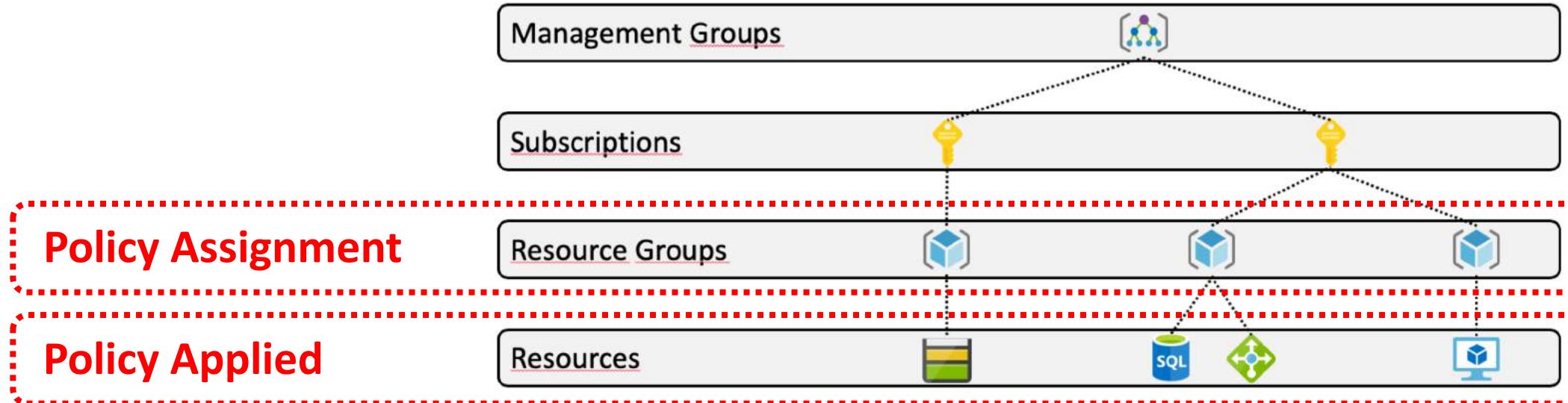


Azure Policy



Azure Policy – Policy Assignment Scope

- Through policy assignment you apply the policy definition to a specific management scope

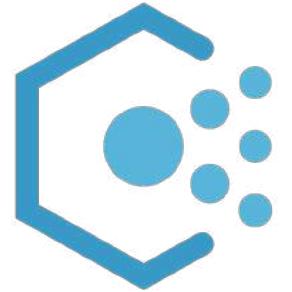
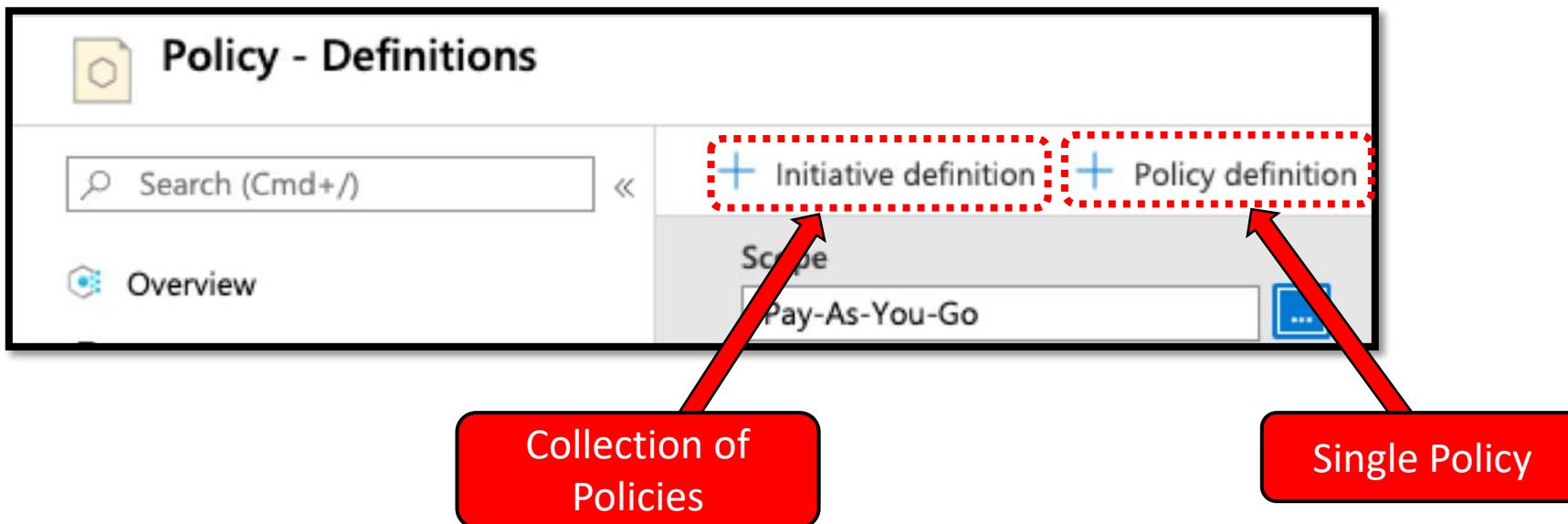


- Policy assignments are inherited by all child resources
 - Example: apply policy at RG level, then policy is applied to all resources in that specific RG (inheritance)



Initiative Definitions in Azure

- ☐ Initiative definitions group multiple policies together as one single item - initiative

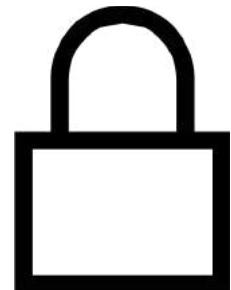




Azure Locks

Azure Locks Overview

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- Two options are available:
 - Delete
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- Read-only
 - Read a resource, can't Modify or Delete



Azure Locks





Exam hints

Exam hints

- ARM templates provide a common platform for deploying objects to a cloud infrastructure and for implementing consistency across the Azure environment
- Azure Resource Manager templates is a great choice for automating the creation of the Azure resources
- Tags are NOT inherited by resources in a resource group
- Azure Policies enforce rules and guidelines, which take effect on new created resources

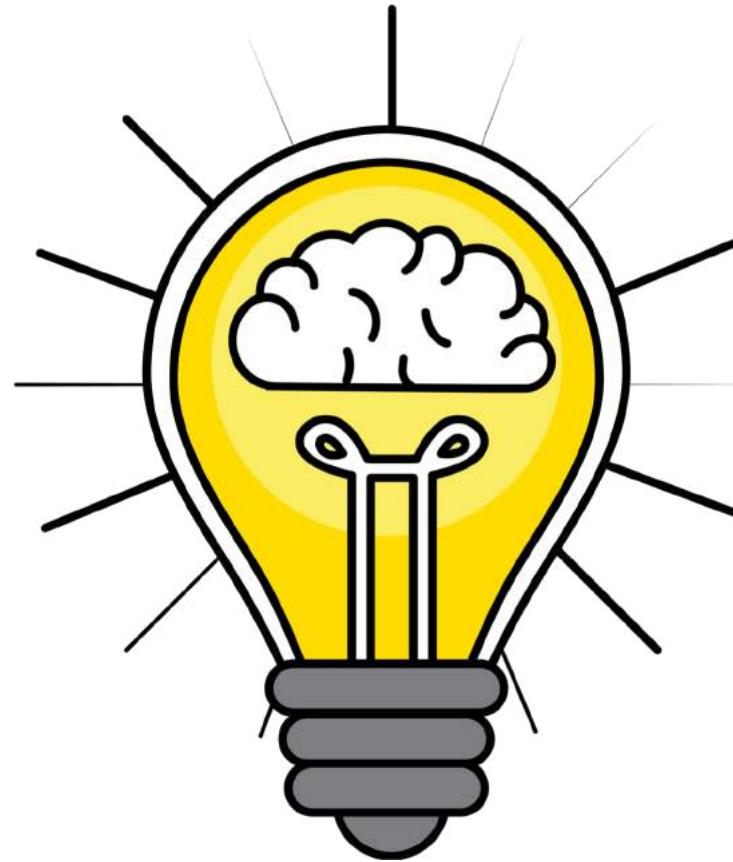


Exam hints

- ❑ Azure Locks apply to everyone, including global admins.
- ❑ If you want to delete a resource or resource group that has a Delete lock applied, the lock must be removed first



ARM, Policies and Locks - Quiz





Module 9 – Monitoring, Privacy & Compliance

Microsoft Cloud Adoption Framework for Azure

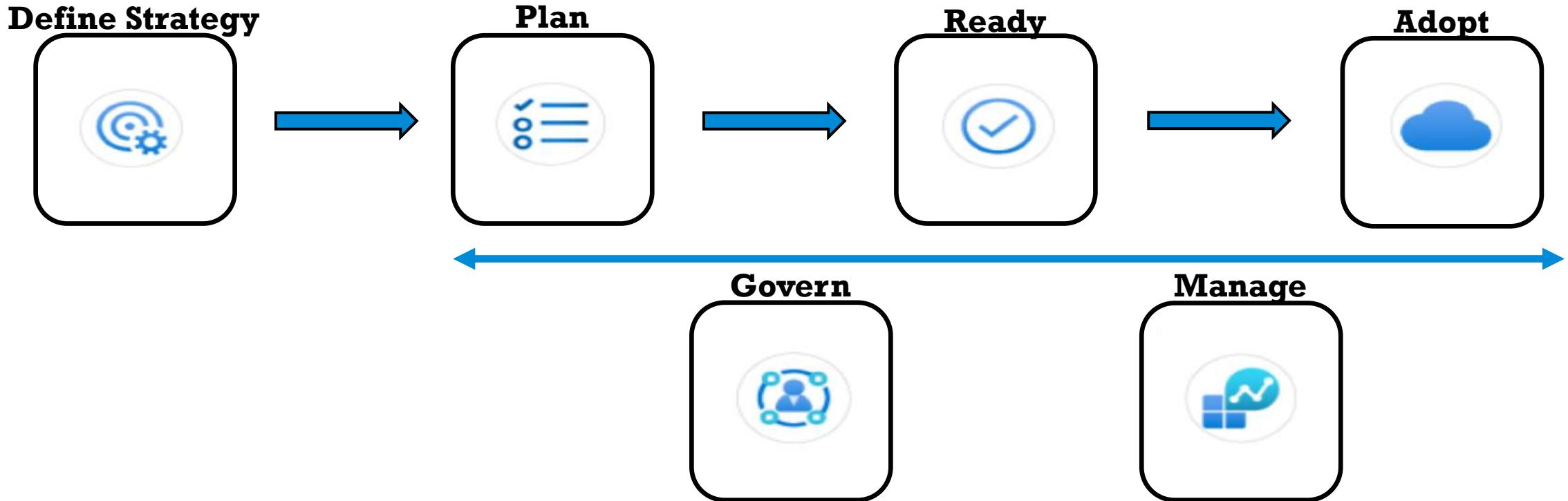
What is the Cloud Adoption Framework ?

- Microsoft Cloud Adoption Framework for Azure is proven guidance designed to help you succeed in the cloud
 - Best practices
 - Documentation
 - Multiple tools
- It brings together cloud adoption best practices from Microsoft employees, partners, and customers
- This guidance aligns to the many phases of the cloud adoption lifecycle



Cloud Adoption Lifecycle

- Cloud Adoption Framework is a full lifecycle framework



- Optional further reading:

- <https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/>





Module 9 – Monitoring, Privacy & Compliance

Azure Compliance, Regulations & Standards Overview

Azure Compliance, Regulations & Standards

- ❑ Whatever the size, organizations need to comply with regulations and standards
- ❑ Microsoft Azure – the cloud platform leading the industry with 90+ compliance offerings
 - ❑ 50+ specific to regions or countries
 - ❑ 35+ compliance offerings specific to the needs of key industries, including health, government, finance, education, manufacturing and media



Compliance Offerings Examples

- ❑ GDPR – General Data Protection Regulation - Europe
 - ❑ European privacy law that imposes new rules on companies that collect and analyze data tied to EU residents
- ❑ HIPAA - Health Insurance Portability and Accountability Act
 - ❑ US federal law that regulates patient Protected Health Information (PHI)
- ❑ ISO - International Organization for Standardization and IEC - International Electrotechnical Commission 27018
 - ❑ processing of personal information by cloud providers



Compliance Offerings Examples

- ❑ NIST CSF - National Institute of Standards and Technology Cybersecurity Framework
 - ❑ Standards, guidelines, and best practices to manage cybersecurity-related risks
- ❑ Azure Government
 - ❑ Dedicated public cloud for federal and state agencies in USA
- ❑ UK Government G-Cloud - government entities in the UK
- ❑ <http://bit.ly/Azure-Compliance>





Module 9 – Monitoring, Privacy & Compliance

Azure Advisor Fundamentals 101

Azure Advisor Overview

- ❑ Azure Advisor helps you follow best practices and optimize your Azure deployments
- ❑ Resource configuration and Usage are analyzed and recommendations are provided:
 - ❑ Reliability
 - ❑ Security
 - ❑ Performance
 - ❑ Cost
 - ❑ Operational Excellence
- ❑ Think of it as your private consultant in Azure!



Azure Advisor



Azure Advisor Overview

- ❑ Advisor is available in Azure Portal and recommendations are split into 5 categories:
 - ❑ Reliability (previously named High Availability)
 - ❑ Ensure and improve the continuity of your business critical apps
 - ❑ Security
 - ❑ To detect threats and vulnerabilities



Azure Advisor



Azure Advisor Overview

- **Performance**
 - Improve the speed of your apps
- **Cost**
 - Optimize and reduce your overall Azure spending
- **Operational Excellence**
 - Achieve process and workflow efficiency, resource manageability and deployment best practices



Azure Advisor



Microsoft Azure Fundamentals



Module 9 – Monitoring, Privacy & Compliance

Azure Monitor & Azure Service Health Fundamentals 101

Azure Monitor Overview

- Azure Monitor collects, analyzes and acts on telemetry from your cloud and on-premises environments
- With Azure Monitor you can understand how your apps are performing and proactively identify issues affecting them and the resources they depend on
- Azure Monitor will monitor your cloud environment and then perform different functions such as analysis, alerting and streaming to external systems



Azure Monitor



Azure Monitor Use Cases

- Create smart alerts and automated actions
- Monitor resources and drill into monitoring data with Azure Log Analytics
- Detect and diagnose issues across applications and dependencies with Application Insights
- Create visualizations with Azure Dashboards



Azure Monitor



Azure Service Health Overview

- ❑ Azure Service Health combines three separate services:
 - ❑ Azure Status
 - ❑ Azure Service Health
 - ❑ Azure Resource Health
- ❑ Let's dig more on the subject ...



Azure Service Health



Azure Status Overview

- ❑ Azure Status informs you of service outages in Azure; service impacting events, planned maintenance activities and any other changes that may affect apps availability
 - ❑ <https://status.azure.com/en-us/status>
- ❑ Azure Status page is a global view of the health of all Azure services across all Azure regions
- ❑ Azure Status represents a global view, what about your own resources ?



Azure Service Health



Azure Service Health Overview

- Azure Service Health provides a personalized view of the health of your Azure services and regions you're using
- As a best practice, you may want to configure Service Health alerts to be notified of any service issues, planned maintenance or changes in Azure



Azure Service Health



Microsoft Azure Fundamentals

Azure Resource Health Overview

- Azure Resource Health provides information about the health of your individual cloud resources
- You can combine Azure Resource Health usage with Azure Monitor, in order to configure alerts to be notified of any availability changes of your cloud resources
- All together, Azure Status, Azure Service Health and Azure Resource Health, provide a comprehensive view into the health Azure in general and your resources particularly



Azure Service Health





Module 9 – Monitoring, Privacy & Compliance

Microsoft Privacy Statement, OST and DPA

Microsoft Privacy Statement

- ❑ Privacy statement explains the personal data Microsoft processes, how it's processed, and for what purposes
- ❑ Personal data collected
 - ❑ Data you provide
 - ❑ Data from interactions, use and experiences with Microsoft products
- ❑ How Microsoft uses data collected
 - ❑ Improve, develop and personalize Microsoft products
 - ❑ Make recommendations, advertise and market to you



Microsoft Online Services Terms

- “Online Service” means a Microsoft-hosted service to which Customer subscribes under a Microsoft volume licensing agreement
- OST - The Online Services Terms provides terms for Online Services that are currently available
- <http://bit.ly/Microsoft-OST>
- OST includes general terms and online service specific terms, related to different Microsoft services



Microsoft Data Protection Addendum

- DPA defines rules and obligations with respect to the processing and security of customer data and personal data in connection with Microsoft online services
- DPA includes:
 - Definitions, general terms related to compliance with laws, data protection terms
- <https://bit.ly/Microsoft-DPA>



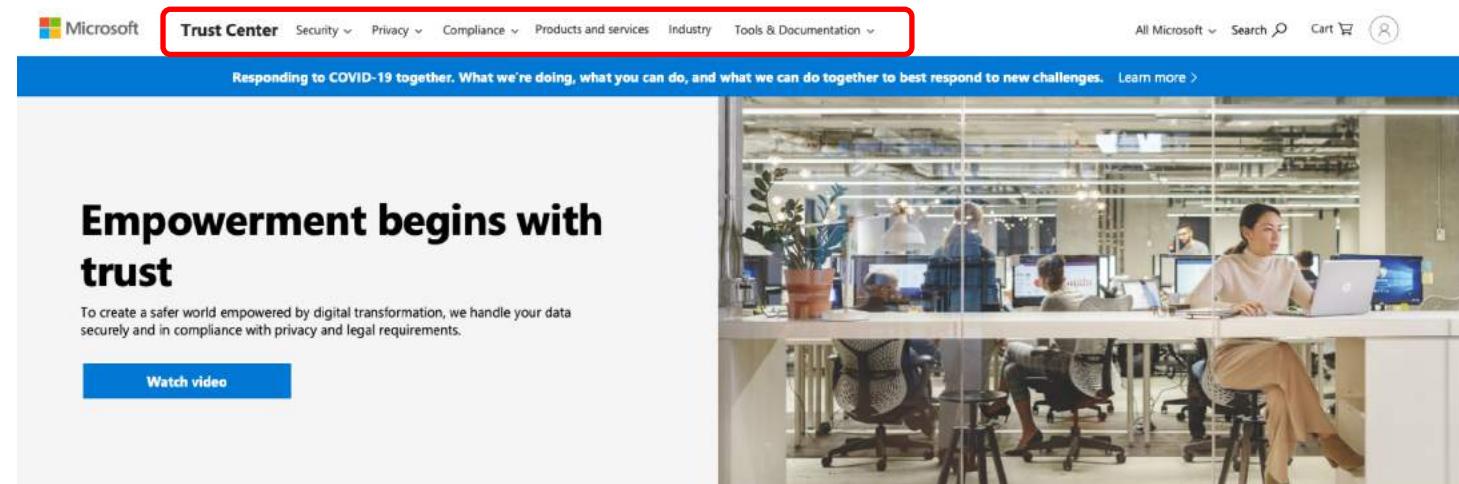


Module 9 – Monitoring, Privacy & Compliance

Microsoft Trust Center, STP and Compliance Manager

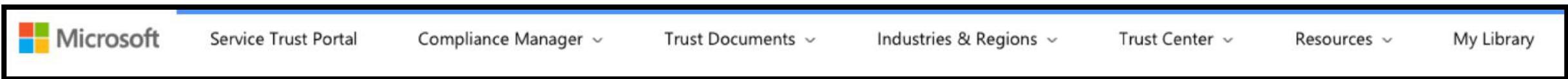
Microsoft Trust Center

- Trust Center - portal containing information and details about how Microsoft implements and supports security, privacy, compliance, and transparency in all Microsoft cloud products and services
- Available here: <https://www.microsoft.com/en-gb/trust-center>



Microsoft Service Trust Portal

- ❑ Service Trust Portal - site for publishing audit reports and other compliance-related information relevant to Microsoft's cloud services; ISO, SOC, NIST, FedRamp
- ❑ Available here: <https://servicetrust.microsoft.com>

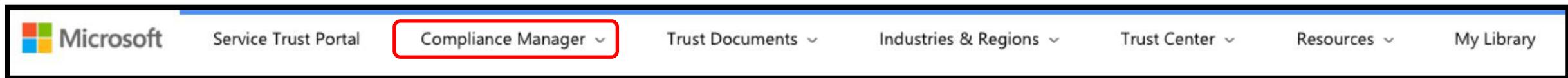


- ❑ Service Trust Portal allows to:
 - ❑ Access audit reports
 - ❑ Access compliance guides
 - ❑ Access trust documents



Microsoft Compliance Manager

- ❑ Compliance Manager - risk assessment tool that enables you to track, assign, and verify your organization's regulatory compliance activities – Azure, O365, D365



- ❑ Compliance Manager provides:
 - ❑ ongoing risk assessment, results delivered to dashboard
 - ❑ create assessments for regulations/standards
 - ❑ recommended actions to improve regulatory compliance





Module 9 – Monitoring, Privacy & Compliance

Module Completion & Exam Hints



Azure Compliance, Regulations & Standards

Azure Compliance, Regulations & Standards

- ❑ ISO – International Organization for Standardization
 - ❑ organization that defines international standards across all industries
- ❑ NIST – National Institute of Standards and Technology
 - ❑ organization that defines standards used by US government
- ❑ GDPR – General Data Protection Regulation
 - ❑ European policy that regulates data privacy and data protection





Azure Advisor

Azure Advisor – Exam Hints

- ❑ Azure Advisor
 - ❑ Tool that provides guidance and recommendations to improve an Azure environment – personal consultant
- ❑ Common use cases Azure Advisor covers:
 - ❑ View security recommendations
 - ❑ Reduce the cost of running VMs





Azure Monitor & Azure Service Health

Azure Monitor – Exam Hints

- ❑ Azure Monitor
 - ❑ monitor the health of Azure services
- ❑ Use cases Azure Monitor:
 - ❑ Monitor performance for Azure & on-prem resources
 - ❑ Monitor resources deployed in multiple subscriptions
 - ❑ Create and send alerts
 - ❑ i.e. based on data in Log Analytics Workspaces



Azure Service Health- Exam Hints

- Azure Service Health
 - View the health of all services in your Azure setup
 - Create rules to be notified if a service fails
 - Check planned maintenance events that affect your Azure resources
- Azure Service Health components:
 - Azure Status, Service Health and Resource Health





Microsoft Privacy Statement, OST and DPA

Privacy Statement, OST and DPA – Exam Hints

- ❑ Microsoft Privacy Statement - explains what data Microsoft processes, how Microsoft processes the data, and the purpose of processing the data
- ❑ The Online Services Terms (OST) provides terms or conditions for Online Services that are currently available
- ❑ DPA defines rules and obligations with respect to the processing and security of customer data and personal data in connection with Microsoft online services





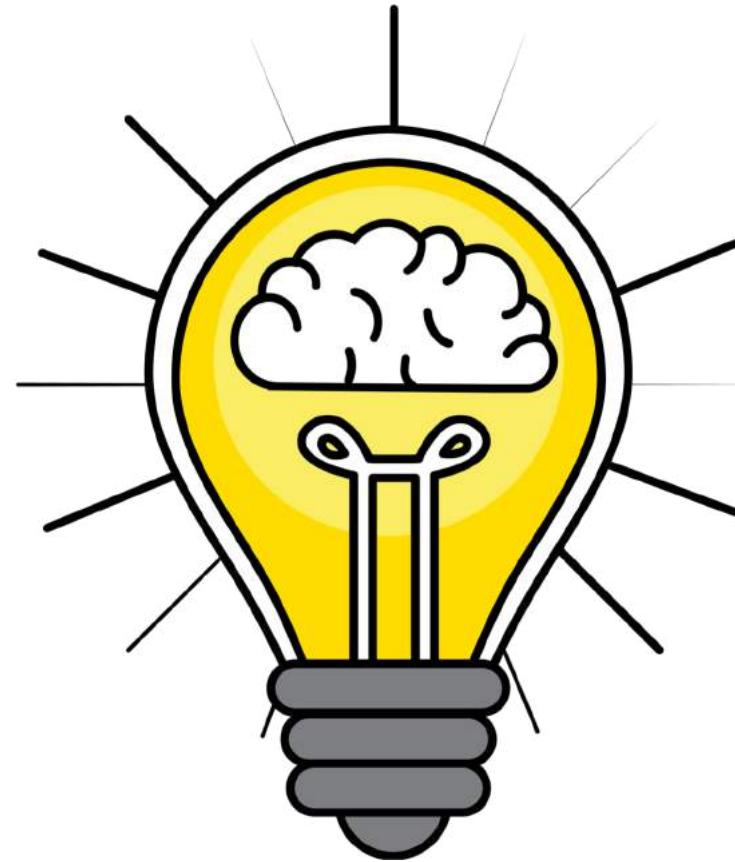
Trust Center, STP and Compliance Manager

Trust Center, STP and Compliance Manager

- ❑ Microsoft Trust Center
 - ❑ compliance certifications list - determine whether Azure meets your company's regional requirements
- ❑ Compliance Manager from Service Trust Portal
 - ❑ evaluate if your company's Azure environment meets regulatory requirements



Monitoring, Privacy and Compliance - Quiz



Microsoft Azure Fundamentals



Module 10 – Security in Azure Cloud

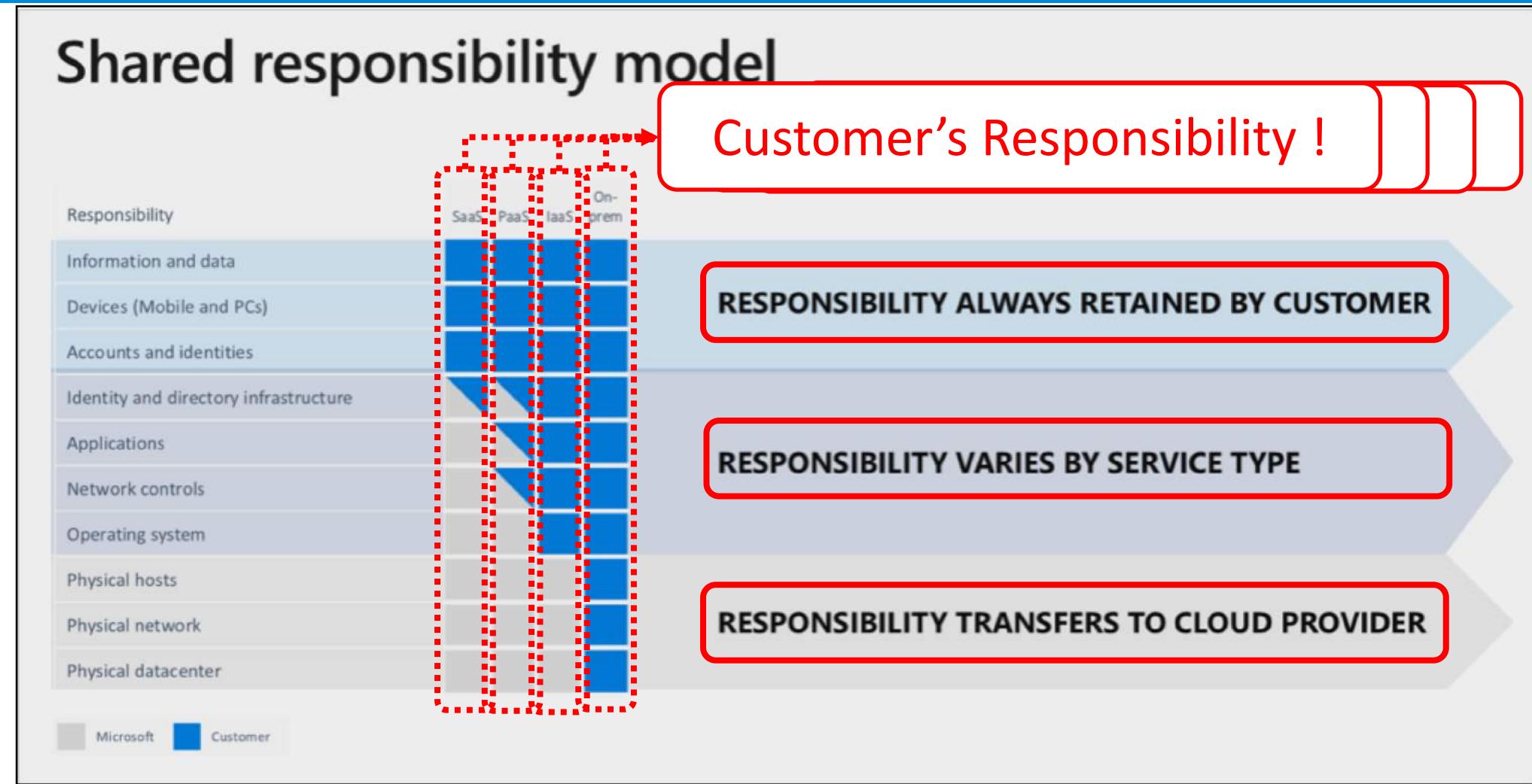
Azure Cloud Shared Responsibility Model & DiD

Azure Cloud Shared Responsibility Model

- ❑ Azure Cloud Shared Responsibility Model
 - ❑ very important topic!
- ❑ Azure cloud shared responsibility model
 - ❑ Responsibility + SECURITY; it's about responsibilities and who manages SECURITY in your cloud or hybrid environment
- ❑ In general, responsibility is shared between the cloud provider and the client and the responsibility level depends on type of apps and cloud computing model



Security – A Shared Responsibility

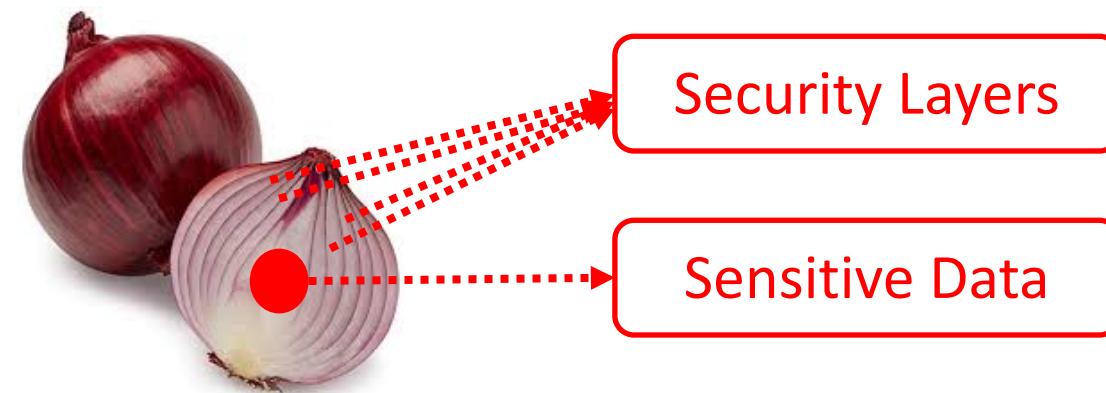


<https://docs.microsoft.com/en-us/azure/security/fundamentals/shared-responsibility>



Security – Defense in Depth - Layer over Layer ...

- The best way to implement security, in the cloud or traditional infrastructures, is to consider using multiple security layers
- As an example, if you try to imagine how a security architecture should look like, maybe it's not a bad idea to think how an onion looks like 😊



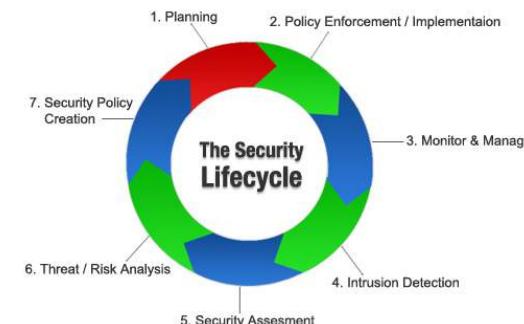
Deploy Security Using Layered Approach

- The first layer of defense is physical security
 - DC security, cameras, restricted access, etc.
- Next, you should implement identity and access-based security (SSO and MFA)
 - Control access based on identities
 - Grant minimum access
 - Keep track of events
- Network perimeter security
 - DDoS protection and Firewall security



Deploy Security Using Layered Approach

- ❑ Restrict or Limit network connectivity
 - ❑ Deny inbound internet access
 - ❑ Limit connectivity between resources
 - ❑ Security to on-prem DC
- ❑ Security for Compute
 - ❑ Patch VMs, implement endpoint protection
 - ❑ Implement secure access to VMs
- ❑ Security for Applications
 - ❑ Integrate security in app dev lifecycle



Deploy Security Using Layered Approach

- Data security
 - Customer's responsibility
 - Many tools available
- Examples of Data to be protected:
 - Data stored in DBs
 - Data stored on disks (VMs)
 - Data stored in cloud storage





Module 10 – Security in Azure Cloud

Optimize your Security with Azure Security Center

Azure Security Center Overview

- Azure Security Center is a monitoring service that provides threat protection across all of your services both in Azure and on-premises infrastructures
- Azure Security Center capabilities:
 - Strengthen security posture
 - Protect against threats
 - Get your environment secure faster



Azure
Security Center



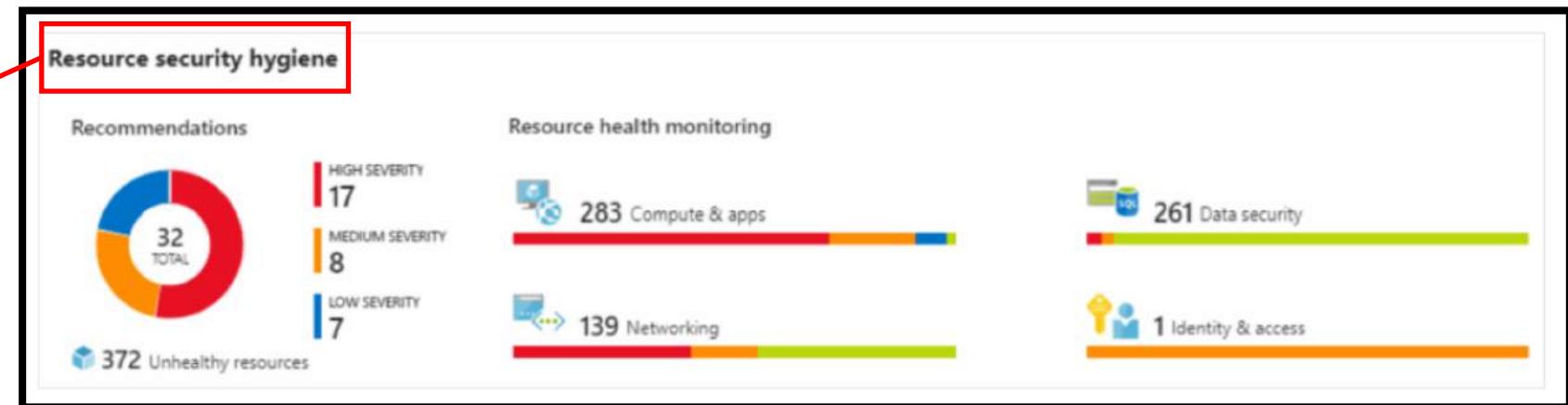
Azure Security Center – Security Posture

☐ Visibility and security posture strengthening

Secure Score



Resource security hygiene



Azure Security Center – Protect against threats

- Azure Security Center common protection capabilities:
 - Just-in-time access - Enable time-based access
 - Adaptive app controls - Allow apps to run on Azure VMs
 - Adaptive network hardening - Fine-tune NSGs
 - File integrity monitor
 - Monitor file changes on Azure VMs



Azure
Security Center



Microsoft Azure Fundamentals

Azure Security Center Tiers

- Azure Security Center is available in two options:
 - Free and Standard
- Free Tier
 - Tier limited to assessments and recommendations
 - Azure Secure Score
- Standard
 - Continuous monitoring, threat detection, etc.



Azure
Security Center

<https://azure.microsoft.com/en-us/pricing/details/security-center/>



Microsoft Azure Fundamentals



Module 10 – Security in Azure Cloud

Azure Identity Services - Azure AD Fundamentals 101

Identity and Access Overview

- The two major topics around identity and access control are authentication and authorization
- Authentication – establishes if the user (or service) is who it says it is; identity is challenged and checked through username and password or authentication keys, certs.
- Authorization – once the user or service is authenticated, authorization establishes what level of access should be provided; read-only, editor, full admin; what resources and what permissions?!



Azure Active Directory (AD) Overview

- Azure Active Directory (Azure AD) is Microsoft's cloud-based identity service, that can also integrate with your traditional on-premises infrastructure
- All your applications, running either in the cloud or on traditional infrastructures, can share the same credentials
- As a result of this, with Azure AD you centralize access control to all your apps and data, with a single pane of glass over identity management



Azure AD



Azure AD Capabilities

- Authentication**
 - Identity verification for access to apps and resources**
- Single-Sign-On (SSO)**
 - Users can use a single identity (username and password) for authentication on all company apps**
- User management**
 - Customize and control how your users sign up, sign in; manage guest users and external partners, when using your apps**



Azure AD



Azure AD Capabilities

- Conditional access to your apps
- Device management
 - Manage how your cloud and on-premises devices access your corporate data
- Privileged Identity Management (PIM)
 - Manage, control and monitor access within your organization



Azure AD



Azure Privileged Identity Management (PIM)

- ❑ Azure AD PIM is a service that enables you to manage, control and monitor access to resources in your org.
- ❑ PIM provides time-based and approval-based role activation on resources that you care about
- ❑ Examples:
 - ❑ Assign time-bound access to resources
 - ❑ Role activation upon approval
 - ❑ Enforce MFA to activate any role
 - ❑ Get notifications when privileged roles are activated



Azure PIM





Module 10 – Security in Azure Cloud

Multi-factor Authentication Fundamentals 101

MFA Overview

- ❑ The main feature of an identity platform is to verify, or authenticate credentials when a user signs in to a device, application or service
- ❑ Multi-factor authentication is a process where a user is prompted during the sign-in process for an additional form of identification
 - ❑ SMS code
 - ❑ OTP or code in an App (Microsoft Authenticator)
 - ❑ Fingerprint scan



Azure MFA Overview

- Azure Multi-factor authentication (MFA) provides additional security for your identities by requiring two or more of the following authentication methods:
 - Something you know – e.g. password
 - Something you have – App on smartphone
 - Something you are – Biometrics; fingerprint or face scan
- Azure MFA increases security of your identities, by requesting an additional authentication factor



Azure MFA





Module 10 – Security in Azure Cloud

Conditional Access and SSO in Azure

Conditional Access Overview

- Conditional Access – Azure AD capability that controls access to cloud apps based on conditions that you specify
- Conditional access policies
 - Allow or block access based on conditions
- Conditional Access policies are if-then statements



Azure AD
Conditional Access

Conditions	Controls
When any user is outside the company network	They're required to sign in with multi-factor authentication
When users in the 'Managers' group sign-in	They are required be on an Intune compliant or domain-joined device



Conditional Access Factors and Decisions

- Conditional Access Factors:
 - User or Group membership
 - IP location
 - Device



Azure AD

- Conditional access decisions:
 - Block access
 - Grant (allow) access
 - May require the user to perform an action; i.e. request user to perform MFA

Conditional Access



Microsoft Azure Fundamentals

Single Sign-on Overview

- SSO allows users to login once and have access to various applications, no need to re-authenticate again
- Web apps are delivered and used as-a-service
 - Once SSO is enabled, you sign-in once and use any app
- SSO works with hybrid clouds (cloud + on-prem)
 - On-prem: Application Proxy
 - Cloud: Azure Active Directory



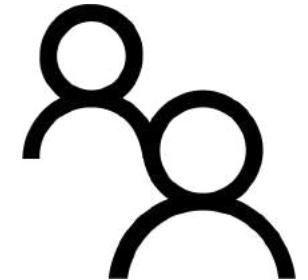


Module 10 – Security in Azure Cloud

Azure RBAC Fundamentals 101

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

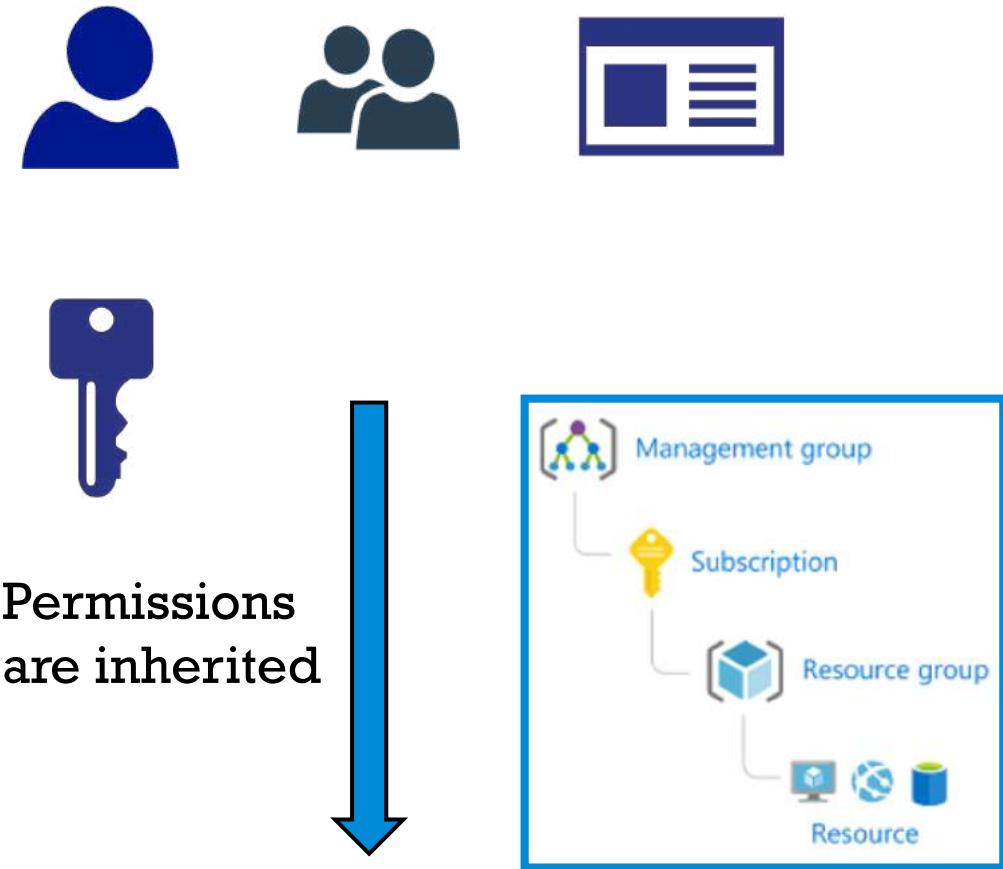


Access Control
(IAM)



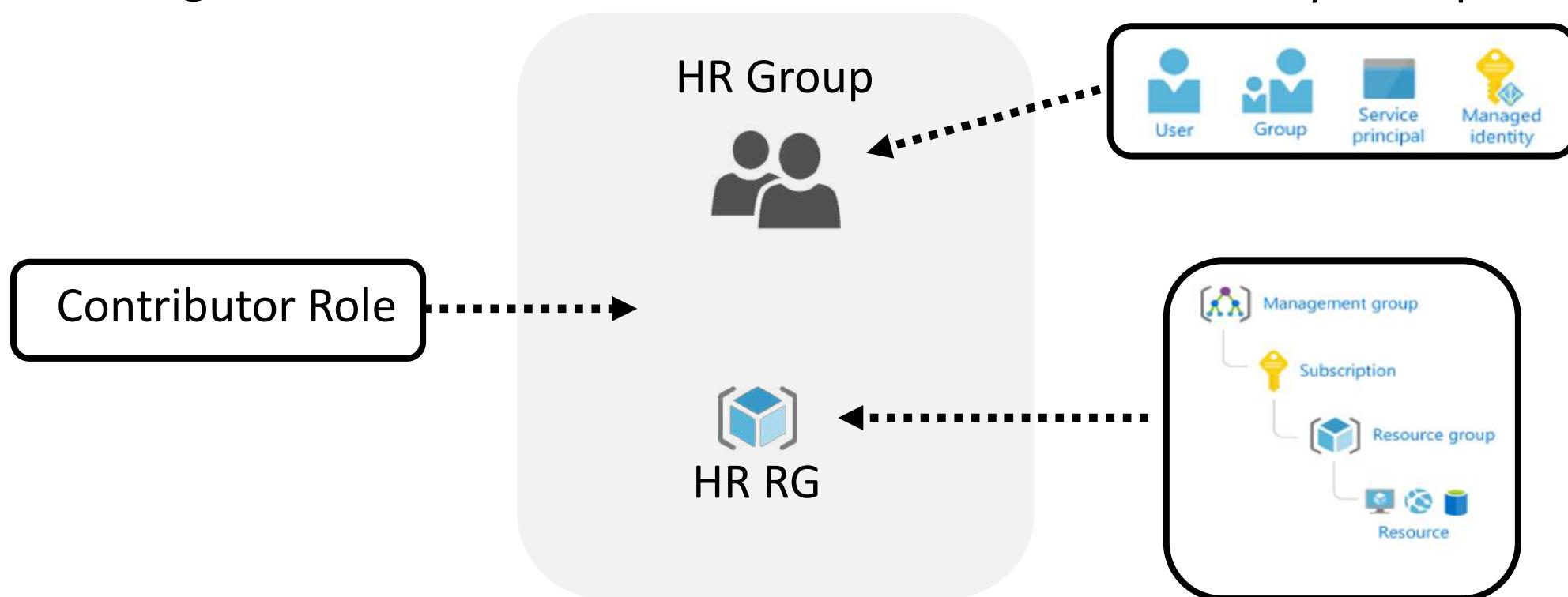
How RBAC Works – Who, What, Where ?

- 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



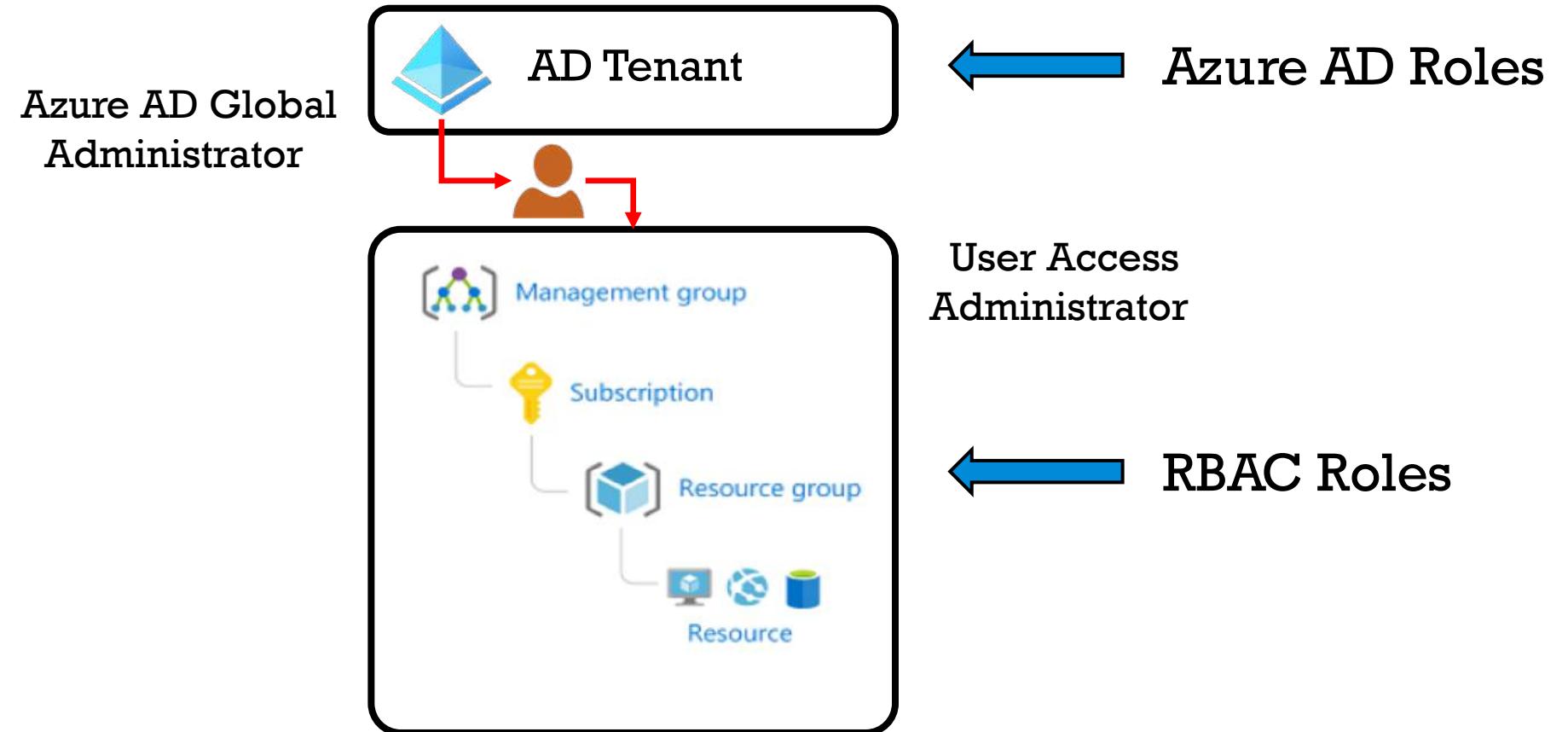
Role Assignment Example

- 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 10 – Security in Azure Cloud

Azure Security Services - Firewall and DDoS Protection

Azure Firewall Overview

- Azure Firewall is a managed, cloud-based network security service that protects your Azure Virtual Network resources
- You can use an Azure Firewall to grant access to resources in a VNET, based on the originating/source IP address
- Only sessions from these granted IP addresses will be allowed to the internal resource
- Access is permitted/denied through firewall rules, that you create and specify ranges of IP addresses

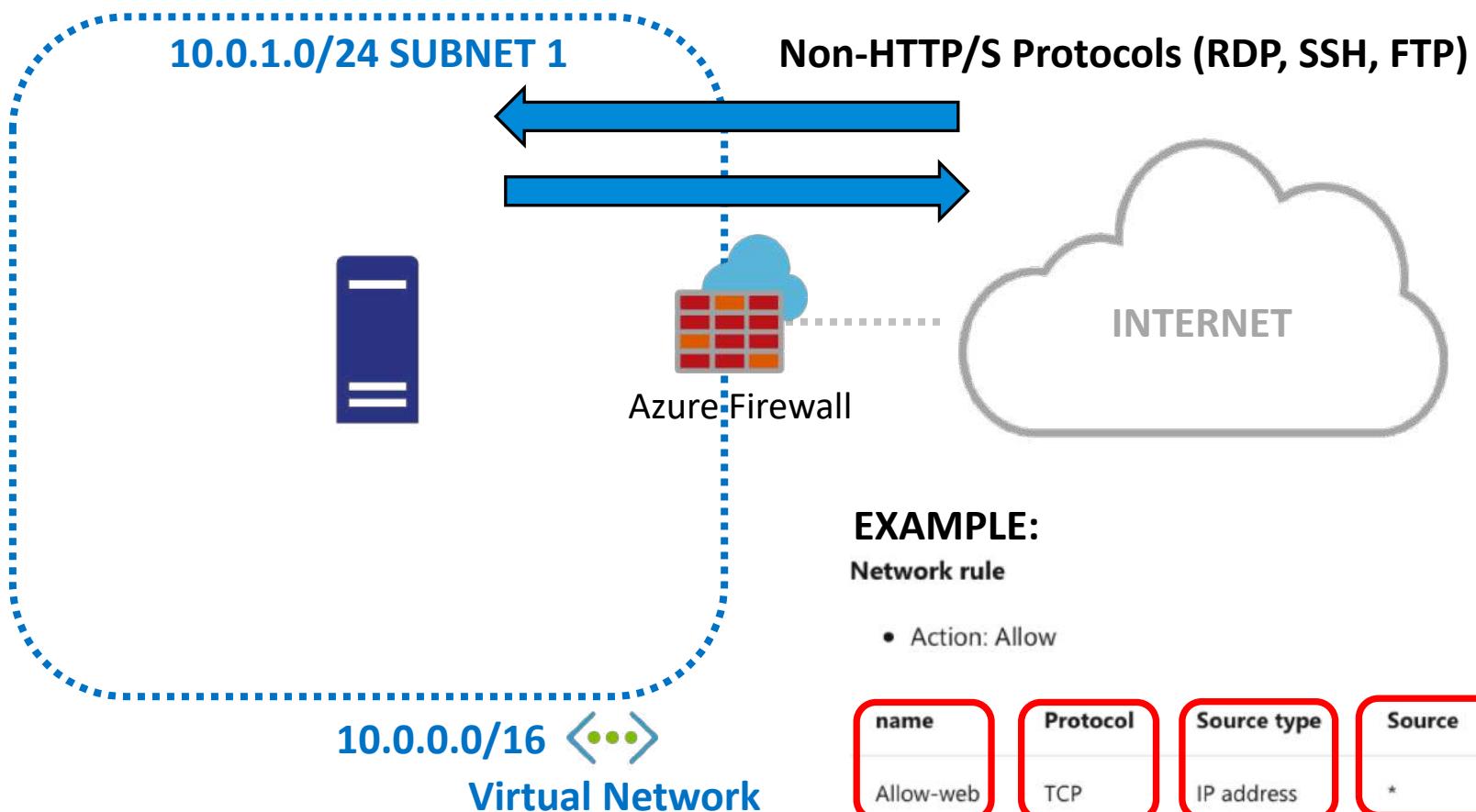


Azure Firewall



Azure Firewall Example

- Azure Firewall supports inbound and outbound filtering



What is DoS and DDoS ?

- Denial of Service (DoS) is a type of attack that aims to overwhelm a network resource by sending huge number of requests, so that the resource becomes slow/unresponsive
- A Distributed Denial of Service (DDoS) attack occurs when multiple systems flood the bandwidth or resources of a targeted system, usually one or more web servers
- Azure DDoS protection provides defense against DDoS attacks



Azure DDoS Service Tiers

- Basic**
 - Enabled by default
 - Always-on traffic monitoring and real-time mitigation of common network-level attacks
 - Free, implies no cost
- Standard**
 - Advanced mitigation capabilities over Basic tier
 - Can mitigate volumetric attacks, protocol attacks and application layer attacks
 - Price is based on usage, on a monthly basis



DDoS Attack Types

- Volumetric attacks
 - The victim is flooded (at the network layer – IP) with a huge amount of traffic, that seems to be legit
- Protocol attacks
 - Attacks target layer 3 and layer 4 protocol stack
 - Common example: SYN flood attacks (TCP, layer 4)
- Application layer attacks
 - Target web applications
 - Common examples: SQL injection, cross-site scripting





Module 10 – Security in Azure Cloud

Azure Sentinel Fundamentals 101

Azure Sentinel Overview

- Azure Sentinel – scalable, cloud-native solution
 - security information event management (SIEM)
 - security orchestration automated response (SOAR)
- Sentinel - delivers intelligent security analytics and threat intelligence
- Azure Sentinel setup:
 - First enable Azure Sentinel
 - Connect data sources



Azure Sentinel



Azure Sentinel – How it can help

- Collect data at cloud scale
 - Security data across your enterprise
- Detect previously undetected threats
 - Threats with vast threat intelligence
- Investigate threats with AI
 - Critical incidents guided by AI
- Respond to incidents
 - Rapidly and automated protection



Azure Sentinel





Module 10 – Security in Azure Cloud

Azure Dedicated Hosts Fundamentals 101

Dedicated Hosts Overview

- ❑ Azure Dedicated Hosts allow you to provision and manage a physical server within Azure, that is dedicated to your Azure subscription
- ❑ Only your VMs run on the dedicated host!
- ❑ Dedicated hosts deployment
 - ❑ You can provision dedicated hosts within a region, availability zone, and fault domain
- ❑ Pricing - per dedicated host !



Dedicated Hosts - Benefits

- ❑ Hardware isolation at the physical server level
 - ❑ Only your VMs will run on the dedicated host
- ❑ Full control over maintenance
 - ❑ You decide when to run maintenance windows
- ❑ BYOL – Licensing
 - ❑ Windows and SQL licenses



Create a dedicated host

Create dedicated host

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * ⓘ

X-A-A-S

Resource group * ⓘ

(New) AZ-900

[Create new](#)

Select Resource Group

Instance details

Name * ⓘ

Dedicated-Host-01

Dedicated Host Name

Location * ⓘ

(Europe) North Europe

Hardware profile

Host group * ⓘ

(new) Host-Group-01

Define Host Group Name

[Create new host group](#)

Size family * ⓘ

Standard DASv4 Family - Type 1

Select Family Size

Fault domain *

1

Select Fault Domain

Automatically replace host on failure * ⓘ

Enabled Disabled

Save money

Save money by using licenses you already own. [Learn more about Azure Hybrid Benefit](#)

Already have Windows Server licenses? *

Yes No

Save Money - BYOL

Already have SQL Server licenses? *

Yes No





Module 10 – Security in Azure Cloud

Encryption Fundamentals and Azure Key Vault

Encryption Overview

- ❑ Encryption is the process of encoding a message or information in such a way that only authorized parties can access it
- ❑ To use or read the encrypted data, it must be decrypted, which requires the use of a secret key
- ❑ Two types of encryption are available: symmetric and asymmetric; the difference between the two is related to the encryption key



Encryption Types

- ❑ Symmetric Encryption
 - ❑ Same encryption key is used to both encrypt and decrypt the data
- ❑ Asymmetric encryption
 - ❑ Public key and private key pair used; both can encrypt, but you can only decrypt with the “paired key”
 - ❑ More secure
 - ❑ Used in HTTPS environments (PKI and certificates)



Encryption at Rest and In Transit

- Encryption at rest**
 - Data at rest is the data that has been stored on a physical medium; data is not moving or traveling
 - Encryption of data at rest ensures that data stored is unreadable without the decryption keys
- Encryption in transit**
 - Data in transit is the data actively moving from one location to another; to on-prem DC, through the internet
 - Protects the data from outside observers and provides a mechanism to transmit data securely



Encryption in Azure

- Azure Storage Service Encryption
 - Protect data at rest
 - Data is automatically encrypted before storing it to Azure Storage and decrypted before retrieval
- Azure Transparent Data Encryption (TDE)
 - Real-time encryption and decryption for databases - Azure SQL Database and Azure Data Warehouse
 - Enabled by default
- Azure Key Vault – encrypt the actual keys



Azure Key Vault



Azure Key Vault

- With Azure Key Vault we can ensure that the keys themselves are secure and store them in a centralized cloud service (AKV)
- Common use cases for Azure Key Vault:
 - Secrets Management – store tokens, passwords, certs.
 - Key Management – create and control encryption keys
 - Certificate Management – provision, manage and deploy private or public certificates



Azure Key Vault





Module 10 – Security in Azure Cloud

Module Completion & Exam Hints



Azure Cloud Shared Responsibility Model

Azure Cloud Shared Responsibility Model

- ☐ Responsibility + Security; it's about responsibilities and who manages Security in your cloud/hybrid environment
- ☐ Responsibility is shared between the cloud provider and the client





Azure Security Center

Azure Security Center Overview

- Azure Security Center is a monitoring service that provides threat protection across all of your services both in Azure and on-premises infrastructures
- Security Center capabilities:
 - Just-in-time VM access
 - Enable time-based access
 - Adaptive app controls
 - Allow apps to run on Azure VMs
 - Adaptive network hardening - Fine-tune NSGs
 - File integrity monitor – monitors file changes on VMs



Azure

Security Center



Microsoft Azure Fundamentals

Azure Security Center Tiers

- Azure Security Center is available in two options:
 - Free and Standard
- Free Tier
 - Tier limited to assessments and recommendations
 - Azure Secure Score
- Standard
 - Continuous monitoring, threat detection, etc.



Azure
Security Center

<https://azure.microsoft.com/en-us/pricing/details/security-center/>



Microsoft Azure Fundamentals



Azure Active Directory

Azure Active Directory (AD) Overview

- Azure Active Directory (Azure AD) is Microsoft's cloud-based identity store; can integrate with your traditional on-premises Active Directory
- All your applications, running either in the cloud or on traditional infrastructures, can share the same credentials
- As a result of this, with Azure AD you centralize access control to all your apps and data, with a single pane of glass over identity management



Azure AD



Azure AD Capabilities

- ❑ Authentication
 - ❑ Identity verification for access to apps and resources
- ❑ Single-Sign-On (SSO)
 - ❑ Users can use a single identity (username and password) for authentication on all company apps
- ❑ User management
 - ❑ Customize and control how your users sign up, sign in; manage guest users and external partners, when using your apps

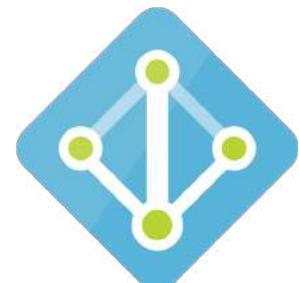


Azure AD



Azure AD Capabilities

- Conditional access to your apps
- Device management
 - Manage how your cloud and on-premises devices access your corporate data
- Privileged Identity Management (PIM)
 - Manage, control and monitor access within your organization



Azure AD





Azure Multi-factor Authentication

Azure MFA Overview

- Azure Multi-factor authentication (MFA) provides additional security for your identities by requiring two or more of the following authentication methods:
 - Something you know – e.g. password
 - Something you have – App on smartphone
 - Something you are – Biometrics; fingerprint or face scan
- Azure MFA increases security of your identities, by requesting an additional authentication factor



Azure MFA





Conditional Access and SSO

Conditional Access Overview

- Conditional Access – Azure AD capability that controls access to cloud apps based on conditions that you specify
- Conditional access policies
 - Allow or block access based on conditions
- Conditional Access policies are if-then statements



Azure AD
Conditional Access

Conditions	Controls
When any user is outside the company network	They're required to sign in with multi-factor authentication
When users in the 'Managers' group sign-in	They are required be on an Intune compliant or domain-joined device



Single Sign-on Overview

- SSO allows users to login once and have access to various applications, no need to re-authenticate again
- SSO works with hybrid clouds (cloud + on-prem)
 - On-prem: Application Proxy
 - Cloud: Azure Active Directory





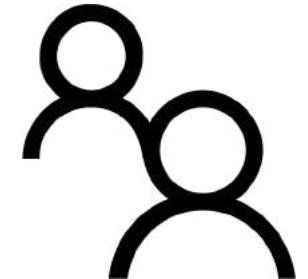
Azure Role-based Access Control (RBAC)

What is Role-based Access Control (RBAC)?

- ❑ RBAC - an authorization system that provides fine-grained access management to resources in Azure
- ❑ How ? => Role assignments!

❑ RBAC Built-in Roles:

- ❑ Owner – full access + assign permissions
- ❑ Contributor – create and manages resources
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- ❑ User Access Administrator – manage access to resources

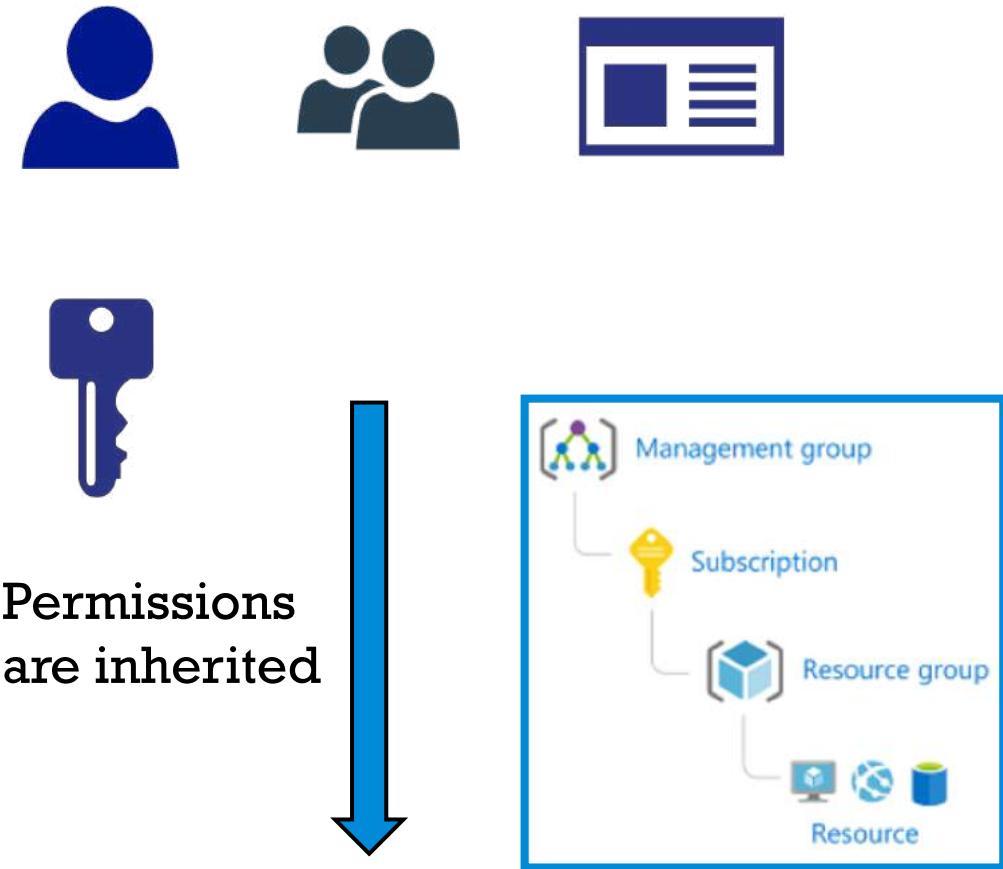


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Azure Firewall



DoS vs. DDoS, Azure DDoS Protection

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Azure Key Vault

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 - Key Management – create and control encryption keys
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Azure Key Vault



Microsoft Azure Fundamentals



Exam Tips !

Exam Tips !

- ❑ Azure Security Center can monitor Azure resources and on-premises resources
 - ❑ Not all Azure Security Center are free!
- ❑ From Azure Security Center, you can download a Regulatory Compliance report
 - ❑ Track and manage compliance over time
- ❑ Azure Security Center - Enable time-based access to VMs with Just-in-Time (JIT) VM feature (not free)



Exam Tips !

- Azure has built-in authentication/authorization services that provide secure access to Azure resources – Azure AD
- An Azure subscription is associated to only one Azure Active Directory (AD)
- Azure AD tenant is not deleted after your Azure subscription expires!
- Azure AD doesn't require implementing domain controllers on Azure virtual machines



Exam Tips !

- ❑ Azure AD supports Group Policies capability
- ❑ What devices can be Azure AD Joined?
 - ❑ Join Windows 10 devices only
 - ❑ IOS/Android not supported
- ❑ Azure Multi-factor Authentication (MFA)
 - ❑ Can be enforced for administrative and non-administrative accounts – i.e. Mary Jane and John Smith



Exam Tips !

- ❑ Azure Firewall – network traffic filtering across multiple virtual networks and multiple Azure subscriptions
- ❑ How many Azure Firewalls would you use to protect 100 VMs deployed in 10 virtual network? => only one ☺
- ❑ Azure Key Vault - Azure service that encrypts and stores credentials and certificates



Azure Security - Quiz



Microsoft Azure Fundamentals



Module 11 – Pricing and Cost Management

Factors That Can Affect Costs in Azure

Azure Pricing Overview

- ❑ Azure resources are always charged *based on usage* !
- ❑ Microsoft Azure offers transparent and competitive pricing
 - ❑ Pay only for resources that you use and cancel at any time
 - ❑ Pay directly and get the same price as you would through a Microsoft Enterprise Agreement
 - ❑ Azure matches AWS pricing for comparable services
- ❑ Great advantages on Azure pricing => you get the best value at every stage of your cloud journey



Factors that affect Costs in Azure

- ❑ Primary factors that affect your monthly cost in Azure are:
 - ❑ Resource type
 - ❑ Costs are resource-specific
 - ❑ Resource usage
 - ❑ Pay for what you use
 - ❑ Purchasing services on Azure
 - ❑ How you consume Azure (web direct, CSP, Enterprise)



Factors that affect Costs in Azure

- ❑ Location
 - ❑ Usage costs vary between locations
- ❑ Billing zone
 - ❑ Costs associated to data moving out of Azure DCs
 - ❑ Data going *into* Azure DCs is free, *outbound* data (data going out) is charged





Thank you !

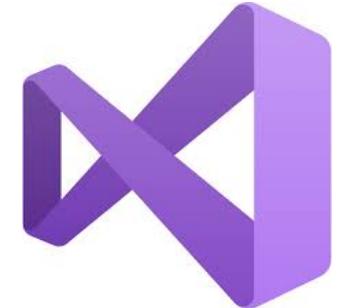


Module 11 – Pricing and Cost Management

Reducing Costs in Azure

Cost Reduction Best Practices - Infrastructure

- ❑ Cost reduction - infrastructure and licensing costs
- ❑ Use Azure Credits
 - ❑ Visual Studio subscribers receive a monthly credit (separate subscription) in Azure
 - ❑ \$50/\$150 credit to use in Azure for testing
- ❑ Use spending limits
 - ❑ Specific to subscriptions with monthly credit
 - ❑ Services disabled/turned off until next period



Visual Studio



Cost Reduction Best Practices - Infrastructure

- ❑ Use reserved instances
 - ❑ For long-term VM usage (1y/3y), reserving capacity in advance brings discounts up to 72%
- ❑ Use low-cost locations and regions
 - ❑ Cost of Azure resources vary between regions and locations, choose wisely
- ❑ Resize underutilized VMs
 - ❑ Over-sized VMs are a common unnecessary expense on Azure; make sure you right-size your VMs



Cost Reduction Best Practices - VMs

- ❑ Pay-as-you-go
 - ❑ Pay for compute capacity by the second, no long-term commitment or upfront payment; pay for what you use!
- ❑ Reserved Virtual Machine Instances
 - ❑ Purchase in advance a VM for 1y/3y in a specified region
 - ❑ Pay upfront and get up to 72% saving vs pay-as-you-go
- ❑ Spot Pricing
 - ❑ Purchase unused compute capacity
 - ❑ Up to 90% discount vs pay-as-you-go pricing



Cost Reduction Best Practices - Infrastructure

- ❑ Run the VM only when needed
 - ❑ If the VMs are only used during normal office hours (9-18), schedule automatic shutdown
- ❑ Delete unused VMs
 - ❑ Sounds obvious, but it's true ☺
- ❑ Change cloud deployment model
 - ❑ Where applicable, migrate to PaaS (vs IaaS), it's cheaper



Cost Reduction Best Practices - Licensing

- ❑ Linux vs. Windows
 - ❑ Evaluate the price when initiating a VM; do I need specifically one of them ? Which one is cheaper ?
- ❑ Reuse Windows Server licenses
 - ❑ Got a Windows server license ? Azure provides the right to use these licenses for VMs in Azure
- ❑ Reuse SQL Server licenses
 - ❑ Same here, reuse already bought SQL Server licenses



Cost Reduction Best Practices - Licensing

- ❑ Use Dev/Test subscription offers
 - ❑ Non-production environment use
 - ❑ Save money on your Windows and SQL Server VMs
- ❑ Use SQL Server Developer Edition
 - ❑ Free product for nonproduction use





Module 11 – Pricing and Cost Management

Azure Pricing Calculator Fundamentals 101

Estimate costs in Azure

- Azure Pricing Calculator – let's check this tool!
 - <https://azure.microsoft.com/en-gb/pricing/calculator/>





Module 11 – Pricing and Cost Management

Azure TCO Calculator Fundamentals 101

Azure TCO Calculator

- ❑ Analyze and predict costs
 - ❑ For new or existing services, consider using Pricing Calculator and Cost Management Advisor
- ❑ Preparing for migrating workloads to Azure
 - ❑ Consider using Total Cost of Ownership (TCO) calculator, to predict your cost savings
- ❑ <https://azure.microsoft.com/en-us/pricing/tco/>





Module 11 – Pricing and Cost Management

Azure Advisor and Azure Cost Management Fundamentals 101

Azure Advisor Overview

- Azure Advisor is a free service built into Azure that provides recommendations on cost, security, reliability, operational excellence and performance
- Advisor analyzes your deployed services and looks for ways to improve your costs, by providing cost recommendations
- Key cost recommendations covered by Advisor are next!



Azure Advisor



Azure Advisor Cost Recommendations

- 1. Optimize virtual machine spending by resizing or shutting down underutilized instances
- 2. Reduce costs by eliminating unprovisioned ExpressRoute circuits
- 3. Buy reserved virtual machine instances to save money over pay-as-you-go pricing
- 4. Delete unassociated public IP addresses, to save money



Azure Advisor



Microsoft Azure Fundamentals

Azure Cost Management & Billing

- ❑ Azure Cost Management – Azure built-in free tool, that can be used to understand more about your spending in the cloud
- ❑ Historical information is available of what services you are spending your money on and how it is tracking against budgets that you have set
- ❑ You can configure budgets, schedule reports and analyze your cost areas



Cost Management





Module 11 – Pricing and Cost Management

Module Completion & Exam Hints



Factors That Can Affect Costs in Azure

Factors that affect Costs in Azure

- ❑ Primary factors that affect your monthly cost in Azure are:
 - ❑ Resource type
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Reducing Costs in Azure

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 - ❑ Pay upfront and get up to 72% saving vs pay-as-you-go
- ❑ Spot Pricing
 - ❑ Purchase unused compute capacity
 - ❑ Up to 90% discount vs pay-as-you-go pricing
- ❑ Resize underutilized VMs
 - ❑ Over-sized VMs are a common unnecessary expense on Azure; make sure you right-size your VMs



Cost Reduction Best Practices - Infrastructure

- ❑ Run the VM only when needed
 - ❑ If the VMs are only used during normal office hours (9-18), schedule automatic shutdown
- ❑ Use low-cost locations and regions
 - ❑ Cost of Azure resources vary between regions and locations, choose wisely
- ❑ Change cloud deployment model
 - ❑ Where applicable, migrate to PaaS (vs IaaS), it's cheaper!



Cost Reduction Best Practices - Licensing

- ❑ Linux vs. Windows
 - ❑ Usually, Linux OS is cheaper
- ❑ Reuse Windows Server or SQL Server licenses
 - ❑ RTU to use existing licenses
- ❑ Use Dev/Test subscription offers – non-production
 - ❑ Save money on your Windows and SQL Server VMs
- ❑ Use SQL Server Developer Edition
 - ❑ Free product for nonproduction use





Azure Pricing & Azure TCO Calculators

Azure Pricing and TCO Calculators

- ❑ New or existing services - analyze and predict costs
 - ❑ Pricing calculator and Cost Management Advisor
- ❑ Workload migration to Azure – predict future costs/savings
 - ❑ Total Cost of Ownership (TCO) calculator





Azure Advisor & Cost Management

Azure Advisor Overview

- Azure Advisor is a free service built into Azure that provides recommendations on cost, security, reliability, operational excellence and performance
- 1. Resize or shut down underutilized VM instances
- 2. Eliminating unprovisioned ExpressRoute circuits
- 3. Buy reserved virtual machine instances
- 4. Delete unassociated public IP addresses



Azure Advisor



Azure Cost Management & Billing

- Azure Cost Management – Azure built-in free tool, that can be used to understand more about your spending in Azure
- Azure Cost Management main features:
 - Pay monthly bill
 - Download cost and usage reports
 - Cost analysis drill-down
 - Optimize spending



Cost Management





Exam Tips !

Exam Tips !

- Azure pay-as-you-go pricing is an example of OpEx, while reserved instances represent a CapEx cost
 - Deploying your own DC is also CapEx
- Payment is done on a monthly basis!
- An Azure free account has a spending limit - \$200, and can contain a limited number of resources (hard coded)
- Configure Azure Budgets – set a specific spending limit and send email alerts when threshold/value is reached



Exam Tips !

- ❑ Resource groups or users in Azure AD are free to create
- ❑ Data transfers:
 - ❑ from on-prem to Azure, over a VPN, is free (inbound)
 - ❑ from Azure to on-prem, over a VPN is charged (outbound)
- ❑ Stopped VMs still generate costs – storage; pay less for VMs using Azure Reservations
- ❑ Two VMs of the same size (i.e. B2S) may generate different costs in a month period – think storage, data transfer, etc.

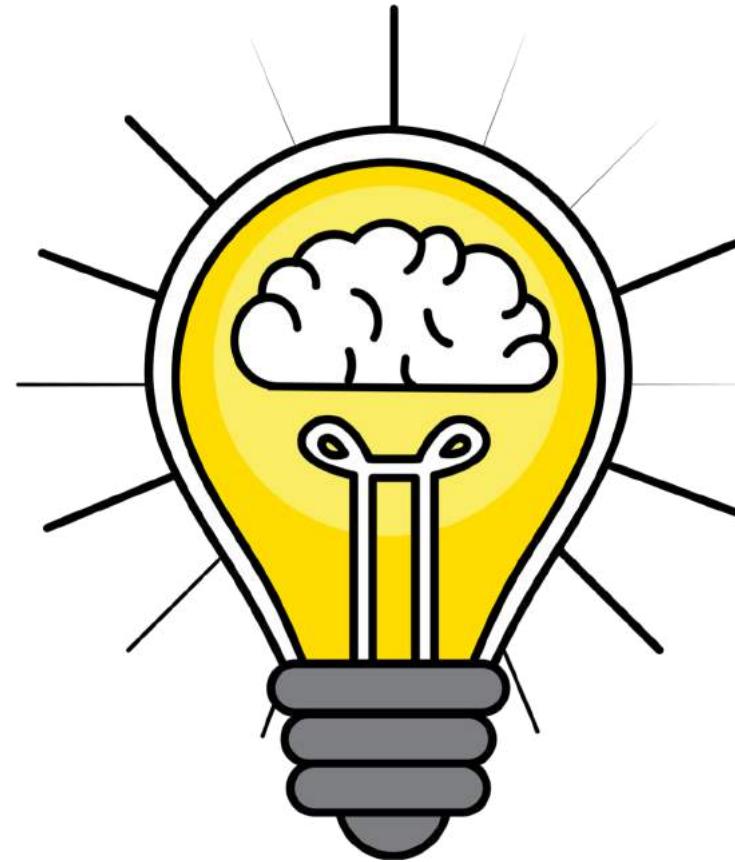


Exam Tips !

- ❑ Azure Advisor - tool that provides guidance and recommendations to improve an Azure environment
- ❑ Azure Advisor – DOES
 - ❑ how to reduce cost of running Azure VMs
- ❑ Azure Advisor - DOESN'T
 - ❑ improve your Azure AD security or VM config
 - ❑ generate list of VMs protected by Azure Backup
 - ❑ increase company secure score
 - ❑ force you to implement security recommendations



Azure Pricing and Cost Management - Quiz



Microsoft Azure Fundamentals



Module 12 – SLAs and Service Lifecycles

Azure SLA Fundamentals 101

Azure Service Level Agreements (SLAs)

- ❑ Service Level Agreement (SLA) describes Microsoft's commitments for uptime and connectivity
- ❑ SLA includes:
 - ❑ Introduction – what to expect
 - ❑ General terms – vocabulary and agreement details
 - ❑ SLA details – performance commitments
- ❑ Azure SLAs available on Service Level Agreement page:
 - ❑ <https://azure.microsoft.com/en-us/support/legal/sla/>



Total Downtime Overview

- Downtime – time duration the service is unavailable
- Total downtime duration overview:

SLA Percentage	Downtime/week	Downtime/month	Downtime/year
99%	1.68 h	7.2 h	3.65 days
99.9%	10.1 min	43.2 min	8.76 h
99.95%	5 min	21.6 min	4.38 h
99.99%	1.01 min	4.32 min	52.56 min
99.999%	6 sec	25.9 sec	5.26 min



Service Credits Overview

- Service credits - % of the payment you receive back, upon claim approval process; example below:

Monthly uptime percentage	Service credit percentage
<99.99 %	10 %
<99 %	25 %
<95 %	100 %

- Service credits are released upon claim!
 - You raise a claim
 - CSP raises a claim



Azure Service Level Agreements (SLAs)

- Service Level Agreement (SLA) describes Microsoft's commitments for uptime and connectivity
- Example:
 - >=2 instances deployed >=2 AZs in the same Azure region, VM connectivity to min. 1 instance, at least 99.99%
 - >=2 instances deployed in same AZ, VM connectivity to min. 1 instance, at least 99.95%
 - Single VM with Premium SSD, min. 99.9%





Module 12 – SLAs and Service Lifecycles

Azure Composite SLA Fundamentals 101

Azure SLA Overview

- Service Level Agreement (SLA)
 - Formal documents describe performance standards or commitments (that apply to Azure services)
- SLAs available for individual Azure products /services
 - Single VM with Premium SSD, min. 99.9%
- SLAs also specify what happens when terms are not met
 - i.e. run 2 VMs in two different AZs; if uptime <95% then Service Credit is 100% - No Cost for customer



Azure Composite SLA

- When combining SLAs across different service offerings, the resultant SLA is called a *Composite SLA*



Individual SLA 99.95% X 99.99% = 99.94%

Composite SLA



- Deploy redundant components to increase composite SLA!





Module 12 – SLAs and Service Lifecycles

Azure Service Lifecycles Fundamentals 101

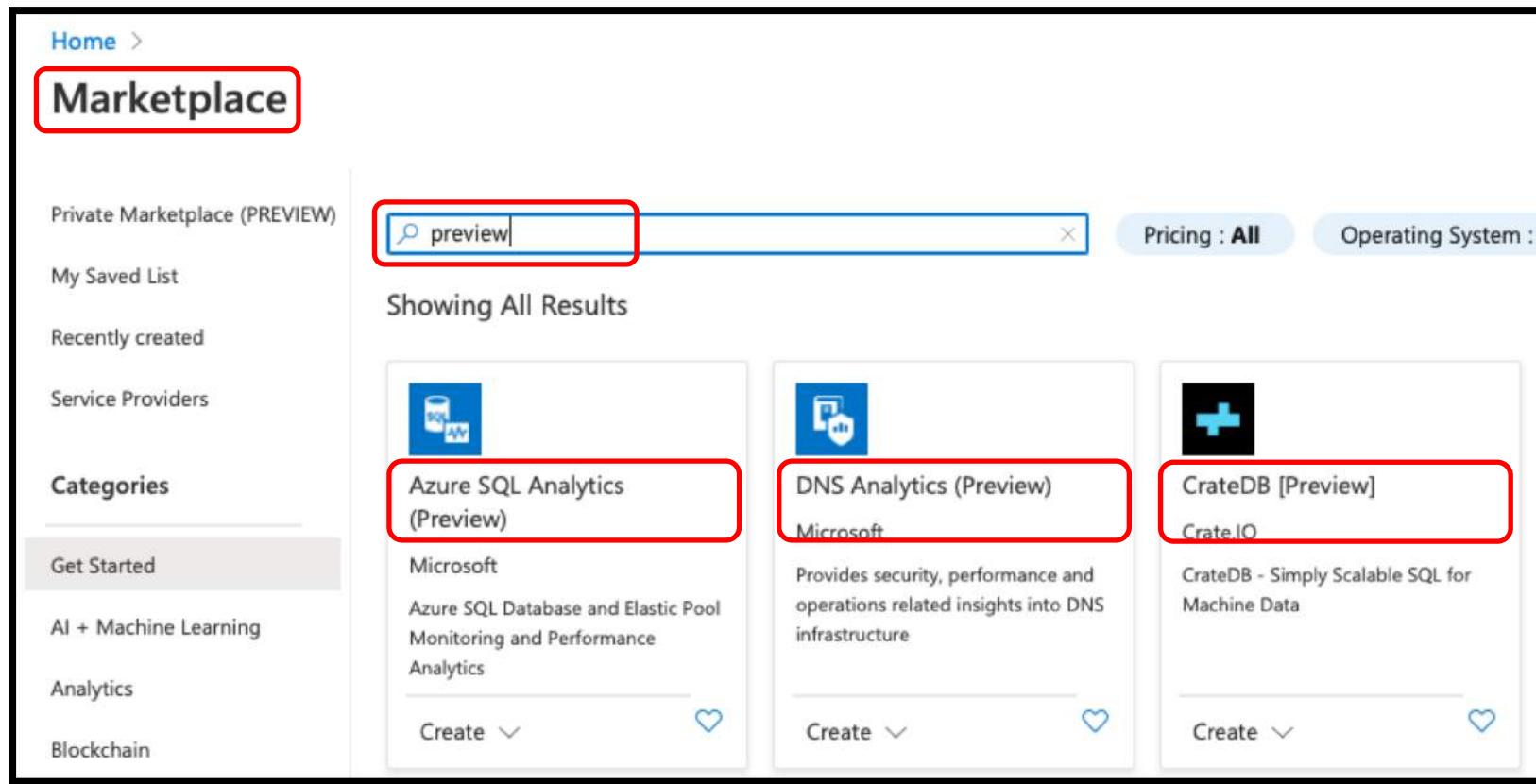
Public and Private preview features

- ❑ Microsoft offers previews of Azure services, features and functionalities, and this is for evaluation purposes
- ❑ Two preview categories available:
 - ❑ Private preview
 - ❑ Feature available to some/certain customers
 - ❑ Public preview
 - ❑ Feature available to all Azure customers
- ❑ Some previews aren't covered by customer support !



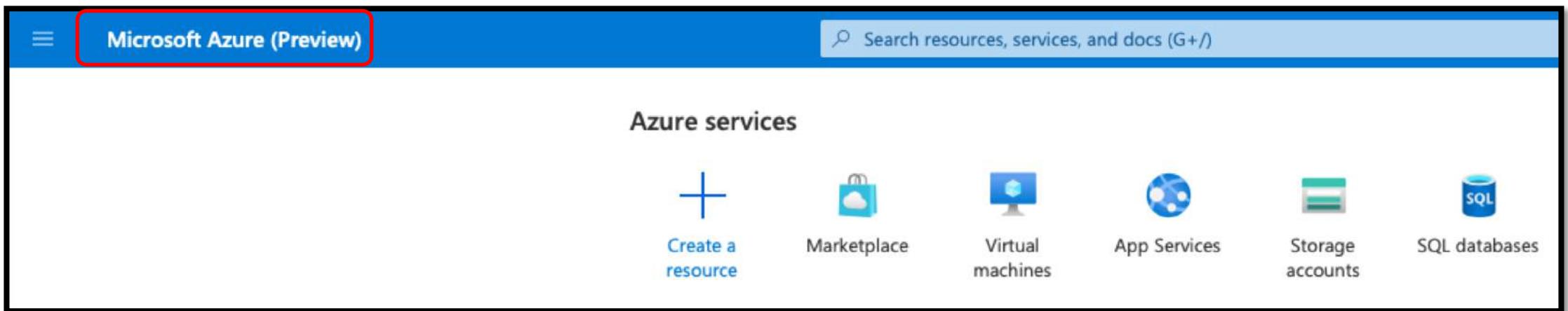
Preview features access – Option 1

- ☐ Two options available:
 - ☐ Directly in Azure portal (<https://portal.azure.com>)



Preview features access – Option 2

- Two options available:
 - Navigate <https://preview.portal.azure.com>



- Once the feature is successfully evaluated and tested, it becomes publicly available, aka general availability (GA)





Module 12 – SLAs and Service Lifecycles

Module Completion & Exam Hints



Azure Service Level Agreements (SLAs)

Azure SLA Overview

- Azure Service-level agreement (SLA) - formal agreement between Microsoft and the customer
- (Financially backed) SLA includes:
 - Commitments for uptime and connectivity
 - Service credits terms and conditions
- Composite SLA – result of multiple SLAs combined
 - $\text{SLA1} \times \text{SLA2} \times \dots \times \text{SLAn} = \text{Composite SLA}$





Azure Service Lifecycle

Azure Service Lifecycle

- ❑ Service lifecycle defines how every Azure service is released for public use, as a production-ready service
- ❑ Two or three phases before General Availability (GA):
 - ❑ Private preview - optional
 - ❑ service available to some/certain customers
 - ❑ Public preview
 - ❑ Feature available to all Azure customers
 - ❑ General availability (GA)





Exam Tips !

Exam Tips !

- An Azure Service Level Agreement guarantees uptime!
- SLA guaranteed uptime for paid services is min. 99.9%
- Customers receive a (service) credit if their monthly percentage is below the guaranteed SLA percentage
- SLA is improved by adding services to multiple regions
- Composite SLA = product of individual SLAs
 - $\text{Composite SLA} = \text{SLA1} \times \text{SLA2}$



Exam Tips !

- ❑ Services in public preview are excluded from SLAs
- ❑ Private preview services are available to some customers, Public preview and GA services are available to everybody
- ❑ Private, public or GA services are available in Azure Portal
 - ❑ No SLA for private or public preview services
- ❑ Easy to distinguish public preview services - “preview”
- ❑ All preview services are migrated by Azure to GA



SLAs and Service Lifecycles - Quiz





Module 13 – Azure Account Cleanup

Let's Cleanup your Azure Account

Next Steps and Call to Action

- ❑ Cleaning up your Azure Account
- ❑ Practice before the real exam!
 - ❑ Two Exam Practice Tests – 1hour, 70% passing score
- ❑ Booking Azure Fundamentals AZ-900 Exam !





Thank you !