



## Microsoft Azure Administration

### Module-04: Deploy and Manage Azure Compute Resources

# Contents

- Overview of Azure Virtual Machines
- Azure VM States
- Azure VM: Extensions
- Azure VM: Boot Diagnostics
- Azure VM: Pricing
- Azure VM: Disks
- Azure VM: Disk Encryption methods
- Azure VM: Disk Performance
- Azure VM: Disk Backup
- Azure VM: Availability Sets
- Azure VM: Scale-sets
- Azure VM: Load Balancing
- Azure VM: Best Practices



# Azure Virtual Machines (VM)

# Overview of Azure Virtual Machines

- Azure Virtual Machines (VM) is one of several types of on-demand, scalable computing resources that Azure offers
- It is a Compute service on MS Azure platform
- Azure Virtual Machine is Infrastructure-as-a-Service (IaaS)
- An Azure VM gives you the flexibility of virtualization without having to buy and maintain the physical hardware that runs it
- You need to maintain the VM by performing tasks, such as configuring, patching, and installing the software that runs on it



# Considerations before creating a Virtual Machine?

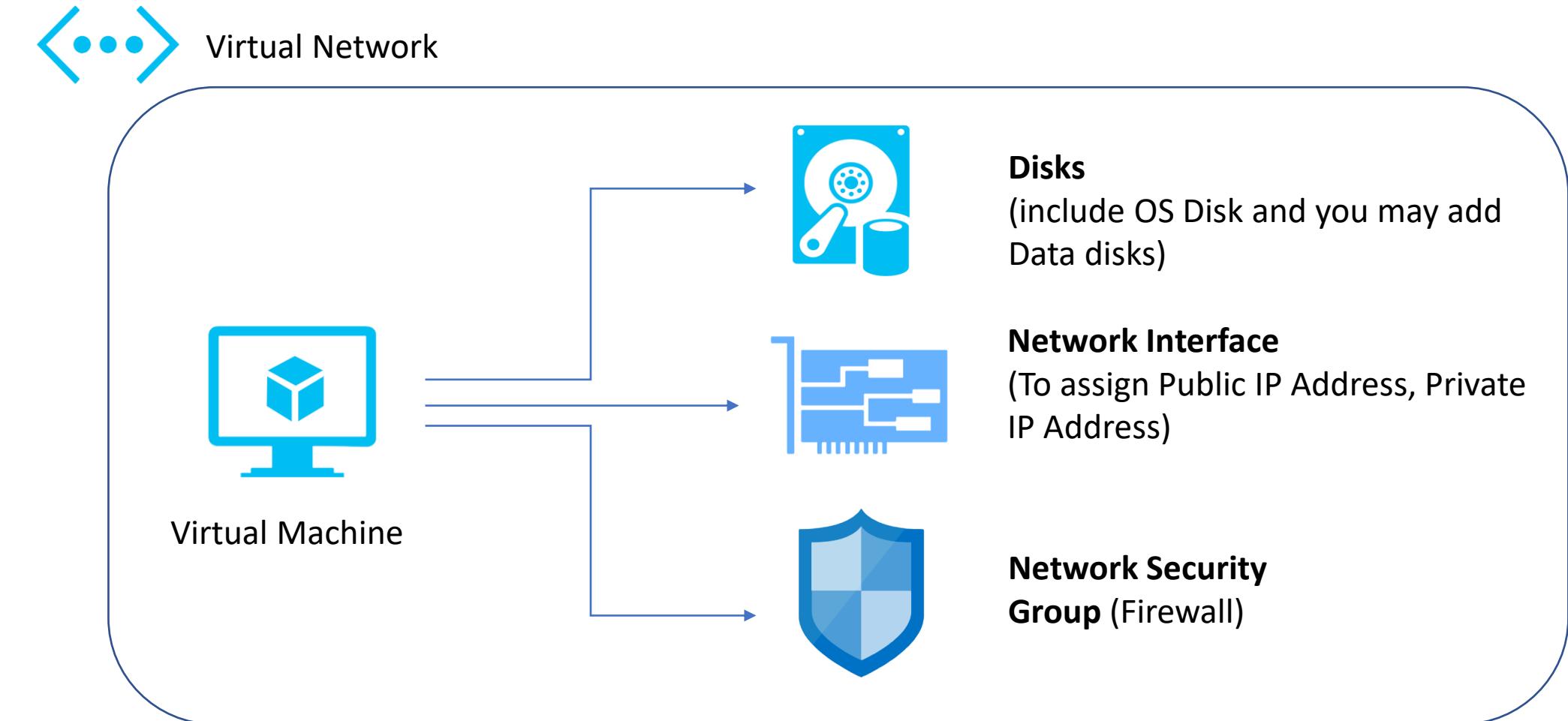
These aspects of an Azure VM are important to think about before you start:

1. The **name** of your application resources.
2. The **location** where the resources are stored
3. The **Size** of the VM
4. The **maximum number of VMs** that can be created
5. The **Operating system** that the VM runs
6. The configuration of the VM after it starts (extensions)
7. The related resources that the VM needs



Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/overview>

# Azure Virtual Machine components



# Azure Virtual Machine Sizes

Type	Sizes	Description
General purpose	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2, Dv4, Dsv4, Ddv4, Ddsv4	Balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute optimized	F, Fs, Fsv2, FX	High CPU-to-memory ratio. Good for medium traffic web servers, network appliances, batch processes, and application servers.
Memory optimized	Esv3, Ev3, Easv4, Eav4, Ev4, Esv4, Edv4, Edsv4, Mv2, M, DSv2, Dv2	High memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage optimized	Lsv2	High disk throughput and IO ideal for Big Data, SQL, NoSQL databases, data warehousing and large transactional databases.
GPU	NC, NCv2, NCv3, NCasT4_v3, ND, NDv2, NV, NVv3, NVv4	Specialized virtual machines targeted for heavy graphic rendering and video editing, as well as model training and inferencing (ND) with deep learning. Available with single or multiple GPUs.
High performance compute	HB, HBv2, HBv3, HC, H	Our fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA).



Ref: <https://azure.microsoft.com/en-us/pricing/details/virtual-machines/series/>

# Azure virtual machine sizes naming conventions

[Family] + [Sub-family]\* + [# of vCPUs] + [Constrained vCPUs]\* + [Additive Features] + [Accelerator Type]\* + [Version]

Family	Indicates the VM Family Series
*Sub-family	Used for specialized VM differentiations only
# of vCPUs	Denotes the number of vCPUs of the VM
*Constrained vCPUs	<a href="#">Used for certain VM sizes only. Denotes the number of vCPUs for the constrained vCPU capable size</a>
Additive Features	<p>One or more lower case letters denote additive features, such as:</p> <p>a = AMD-based processor</p> <p><a href="#">d = diskfull (local temp disk is present); this is for newer Azure VMs, see Ddv4 and Dds4-series</a></p> <p>i = isolated size</p> <p>l = low memory; a lower amount of memory than the memory intensive size</p> <p>m = memory intensive; the most amount of memory in a particular size</p> <p>t = tiny memory; the smallest amount of memory in a particular size</p> <p><a href="#">s = Premium Storage capable, including possible use of Ultra SSD (Note: some newer sizes without the attribute of s can still support Premium Storage e.g. M128, M64, etc.)</a></p>
*Accelerator Type	Denotes the type of hardware accelerator in the specialized/GPU SKUs. Only the new specialized/GPU SKUs launched from Q3 2020 will have the hardware accelerator in the name.
Version	Denotes the version of the VM Family Series

# Azure Virtual Machine Series

Tip

Try the [Virtual machines selector tool](#) to find other sizes that best fit your workload:

<https://aka.ms/vm-selector>

# B series burstable Virtual machine sizes

- B-series VMs are ideal for workloads that do not need the full performance of the CPU continuously.
- Example Web servers, proof of concepts, small databases and development build environments.
- You can purchase a VM size with baseline performance that can build up credits when it is using less than its baseline.
- VM can burst above the baseline using up to 100% of the vCPU when your application requires higher CPU performance.

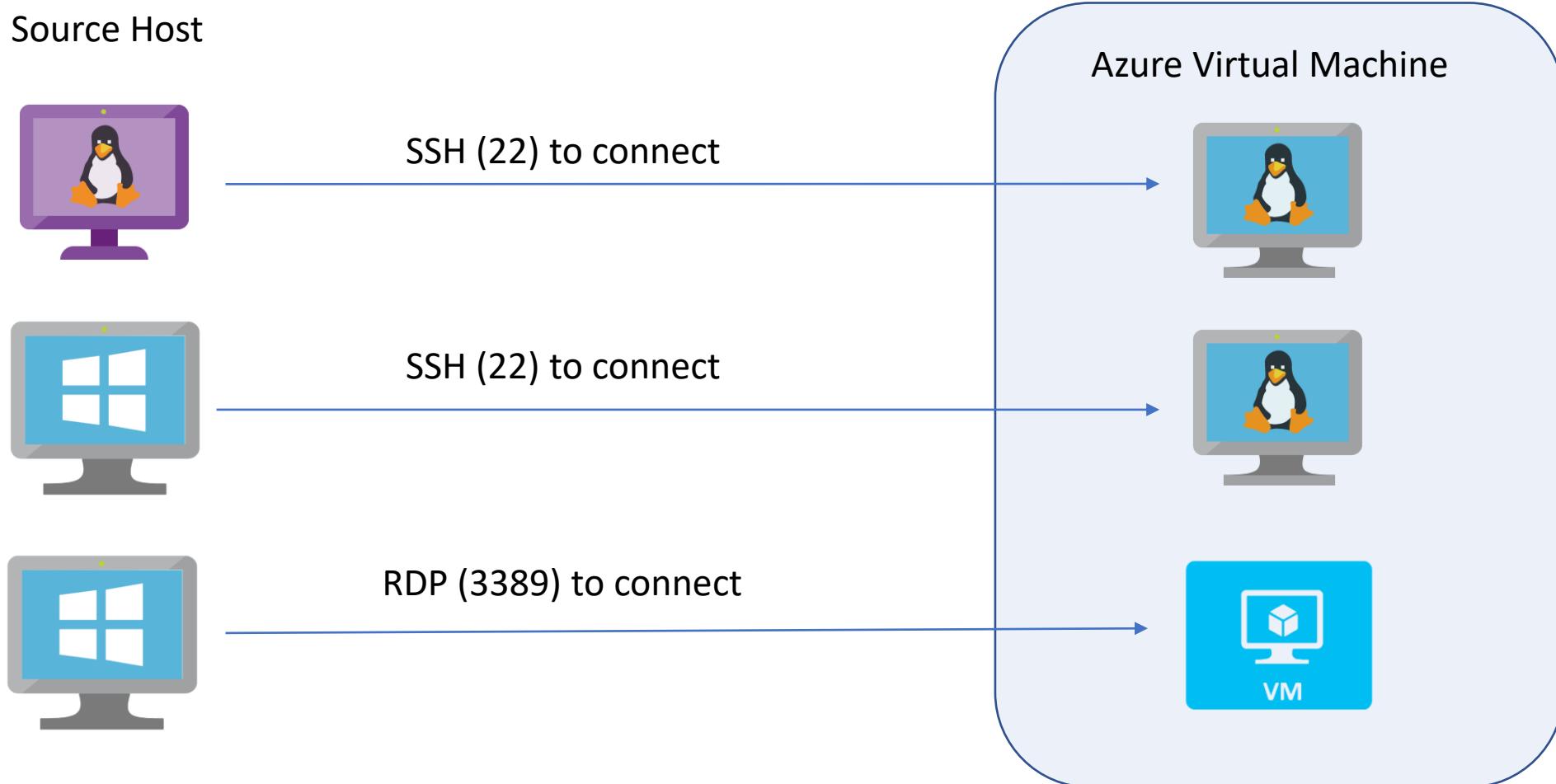
Size	vCPU	Memory: GiB	Temp storage (SSD) GiB	Base CPU Perf of VM	Max CPU Perf of VM	Initial Credits	Credits banked/hour	Max Banked Credits
Standard_B1ls <sup>1</sup>	1	0.5	4	5%	100%	30	3	72
Standard_B1s	1	1	4	10%	100%	30	6	144
Standard_B1ms	1	2	4	20%	100%	30	12	288
Standard_B2s	2	4	8	40%	200%	60	24	576
Standard_B2ms	2	8	16	60%	200%	60	36	864
Standard_B4ms	4	16	32	90%	400%	120	54	1296
Standard_B8ms	8	32	64	135%	800%	240	81	1944
Standard_B12ms	12	48	96	202%	1200%	360	121	2909
Standard_B16ms	16	64	128	270%	1600%	480	162	3888
Standard_B20ms	20	80	160	337%	2000%	600	203	4860

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/sizes-b-series-burstable>

# Azure VM Authentication method

- The default approach to administering Linux VMs hosted in Azure is **SSH (22)**
- The default approach to administering Windows VMs hosted in Azure is **RDP (3389)**

# Azure VM Login scenarios



# What is SSH?

- **Secure Shell (SSH)** is an encrypted connection protocol that allows secure sign-ins over unsecured connections.
- SSH allows you to connect to a terminal shell from a remote location using a network connection.
- There are two approaches we can use to authenticate an SSH connection:
  1. **Username and Password**
  2. **SSH key pair**

# How to create SSH Key Pair?

- On Windows 10, Linux, and macOS, you can use the built-in ssh-keygen command to generate the SSH public and private key files
- Follow below command to generate the key pair for an Azure VM:  
**ssh-keygen -m PEM -t rsa -b 4096**
- The command creates two files: **id\_rsa** and **id\_rsa.pub** in the **~/.ssh** directory. The files are overwritten if they exist
- This creates an SSH protocol 2 (SSH-2) RSA public-private key pair. The minimum length is 2048, but for the sake of understanding we'll use 4096

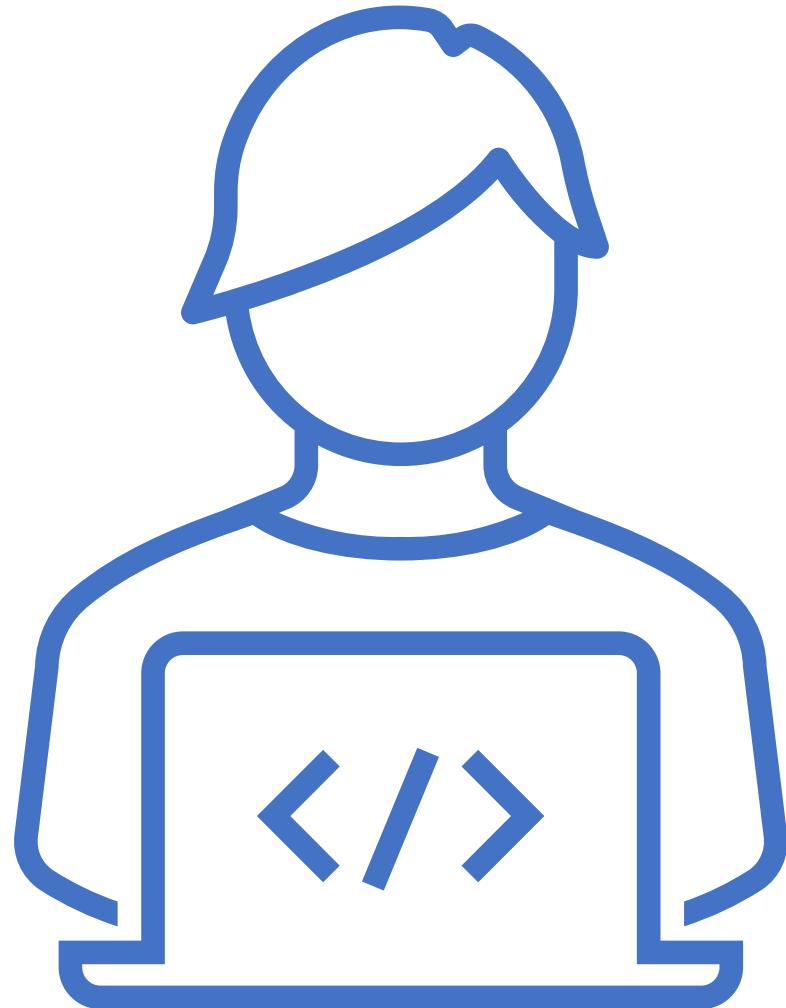
# Provisioning Azure Virtual Machine

Azure virtual machines (VMs) can be provisioned by below listed ways:

- 1) **Azure portal:** This method provides a browser-based user interface to create VMs and their associated resources.
- 2) **PowerShell:** The Azure PowerShell module (Az) is used to create and manage Azure resources from the PowerShell command line or in scripts.
- 3) **Azure CLI:** The Azure CLI is used to create and manage Azure resources from the command line or in scripts.

# Hands-on Labs

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# Lab: Provision Windows Virtual Machine using Azure Portal

This method provides a browser-based user interface to create VMs and their associated resources

- I. As part of this lab, you have to deploy a Virtual machine (VM) in Azure that runs **Windows Server Datacenter 2016**
- II. To see your VM in action, do RDP to the VM and install the IIS role on the Virtual Machine to make it a web server

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/quick-create-portal>

# Lab: Provision a Linux VM using Azure Portal

- 1) Provision a Linux Virtual Machine with **Authentication type as username and password**
- 2) Once the VM provisioning is complete, login to the VM using putty utility (SSH client tool)
- 3) Install a httpd server on the Virtual Machine
- 4) Open the 80 port for VM's **Network Security Group Inbound rule**.
- 5) Now try accessing the httpd default webpage from your localhost

## Ref:

You can download the putty tool from here: <https://www.putty.org/>

This command will install the nginx web server: [sudo apt-get install nginx](#)

# Lab: Provision Virtual Machine (Windows/Linux) using PowerShell

This method provides a PowerShell console to create VM and their associated resources

- I. As part of this lab, you have to deploy a Linux Virtual machine (VM) in Azure that runs Ubuntu 18.04 LTS
- II. To see your VM in action, you also SSH to the VM and install the NGINX web server

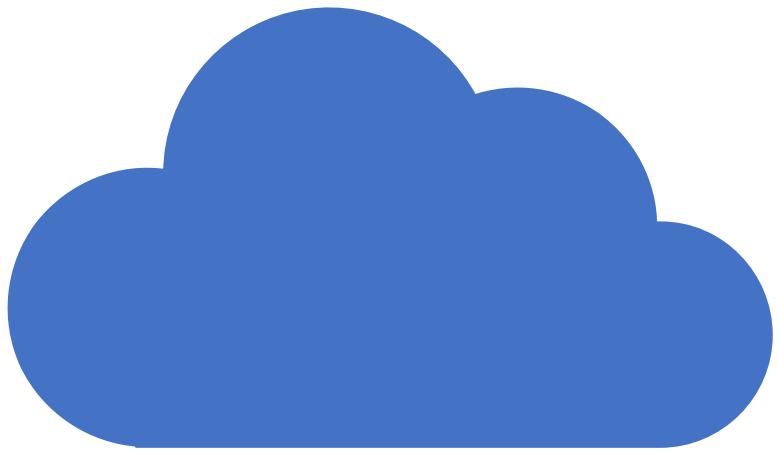
[Tip: You can use `lsb_release -a` or `cat /etc/os-release` Linux commands after login to verify the OS version]

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/quick-create-powershell>

# Azure VM Generation1 and Generation2

- The generation of a virtual machine defines the virtual hardware of a virtual machine and adds some additional and modern functionality
- In Hyper-V, there are two virtual machine generations, generation 1 and generation 2. Generation 2 virtual machines support Unified Extensible Firmware Interface (UEFI) firmware instead of BIOS-based firmware
- The Hyper-V team also removed a lot of the legacy devices and replaced them with a simplified virtual machine model

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/generation-2>

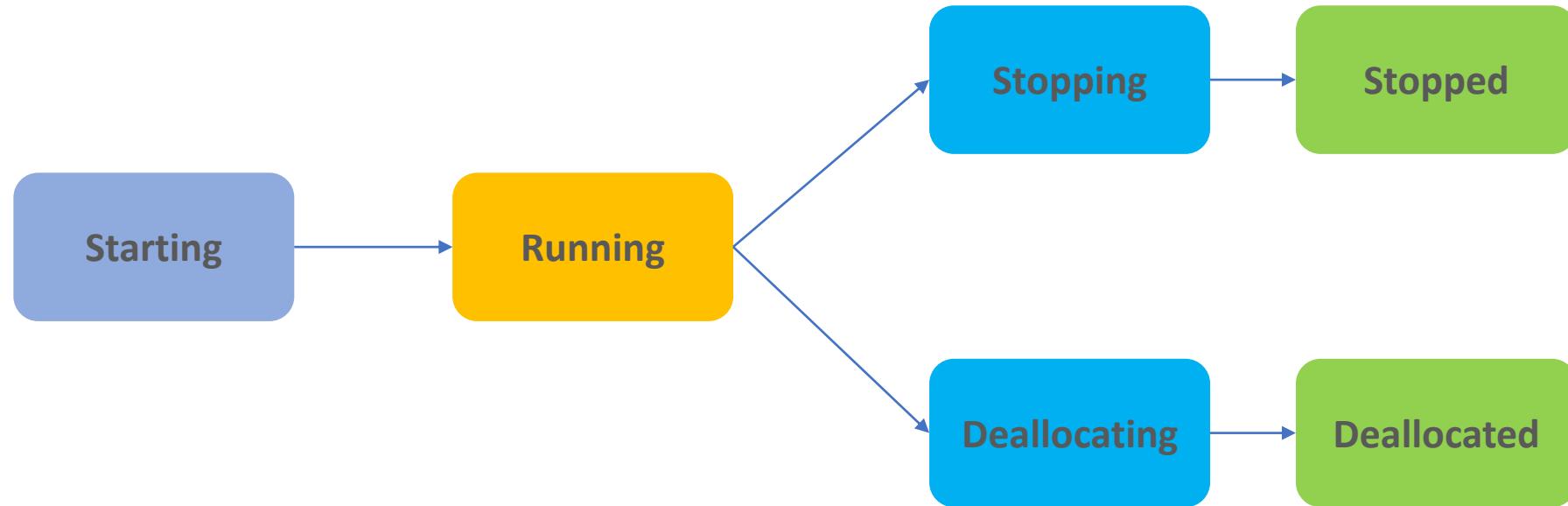


# Azure VM: States and Billing States

# States and Billing States of Azure Virtual Machine

- ✓ Azure Virtual Machines (VMs) go through different states that can be categorized into provisioning and power states
- ✓ This section will describe these states and specifically highlight when customers are billed for instance usage

# Power State of the Azure Virtual Machine



The power state represents the last known state of the VM

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/states-billing>

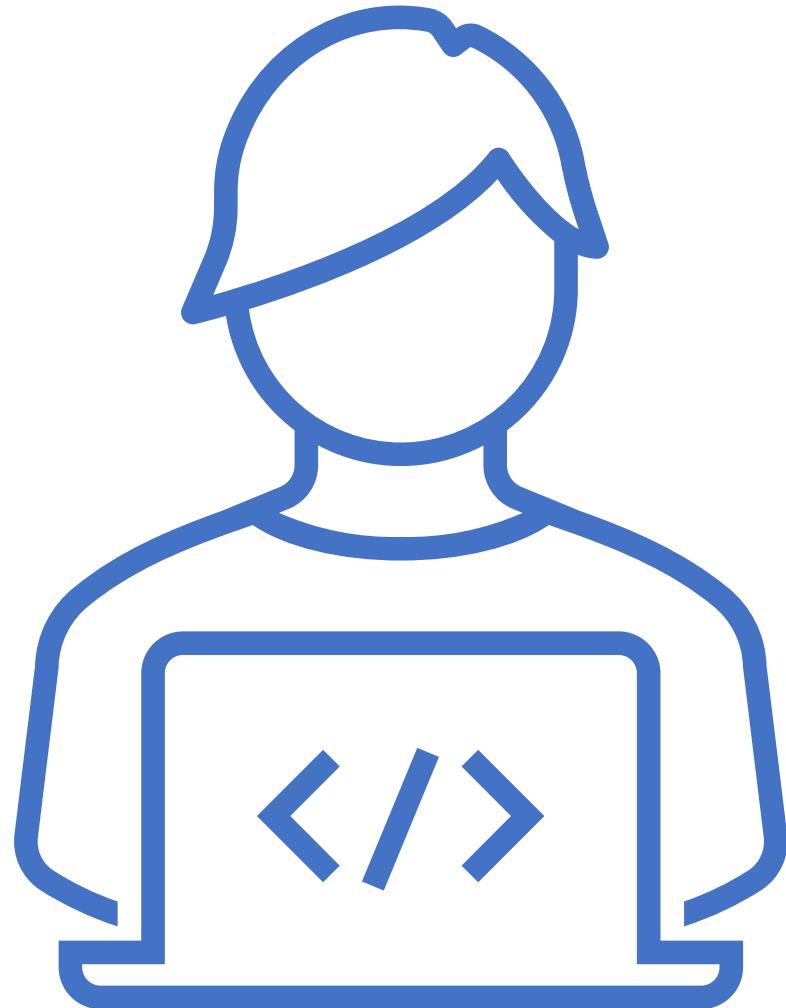
# Azure Virtual Machine: Provisioning States

The following table provides a description of each instance state and indicates whether it is billed for instance usage or not

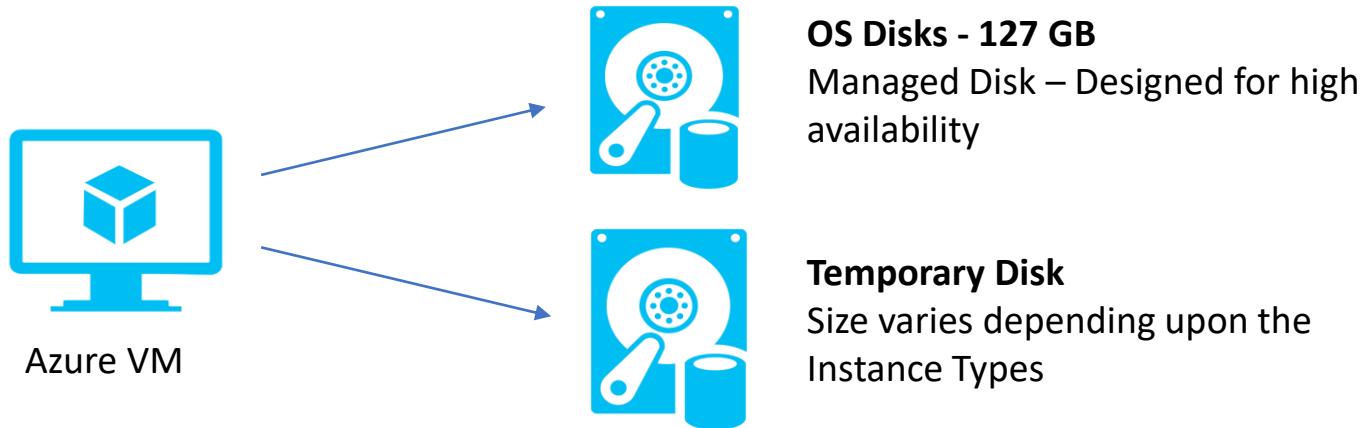
Power state	Description	Billing
Starting	Virtual Machine is powering up	Billed
Running	Virtual Machine is fully up. This is the standard working state	Billed
Stopping	This is a transitional state between running and stopped	Billed
Stopped	The Virtual Machine is allocated on a host but not running. Also called PoweredOff state or Stopped (Allocated). This can be result of invoking the PowerOff API operation or invoking shutdown from within the guest OS. The Stopped state may also be observed briefly during VM creation or while starting a VM from Deallocated state	Billed
Deallocating	This is the transitional state between running and deallocated	Not billed*
Deallocated	The Virtual Machine has released the lease on the underlying hardware and is completely powered off. This state is also referred to as <b>Stopped (Deallocated)</b>	Not billed*

# Hands-on Labs

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# Lab: States of the Azure Virtual Machine



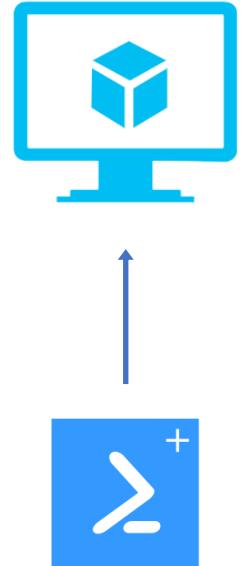
- 1) Provision a Windows Azure Virtual Machine and Login
- 2) Go to **Temporary Storage** drive and check the DATALOSS\_WARNING\_README.txt file
- 3) Create a dummy file in D:\ drive and Restart the machine. Check the file status after restart
- 4) Create a dummy file in D:\ drive and shutdown the machine. Start the VM again and check the file status after start
- 5) Check the behavior of Azure VM in Stopped and Stopped (deallocated) status



# Azure VM: Extensions

# Azure VM: Extensions

- Azure virtual machine (VM) extensions are small applications that provide post-deployment configuration and automation tasks on Azure VMs
- For example, if a virtual machine requires software installation, antivirus protection, or the ability to run a script inside it, you can use a VM extension
- You can run Azure VM extensions by using the Azure CLI, PowerShell, Azure Resource Manager templates (ARM templates), and the Azure portal

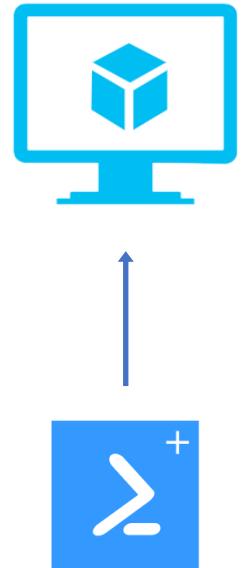


VM Extension

# Azure VM Extensions: Use Cases

Each Azure VM extension has a specific use case. Examples include:

1. Apply PowerShell desired state configurations (DSCs) to a VM by using the DSC extension for Windows
2. Configure monitoring of a VM by using the Log Analytics Agent VM extension
3. Configure an Azure VM by using Chef
4. Configure monitoring of your Azure infrastructure by using the Datadog extension



VM Extension

# Azure VM Extensions: Discover VM Extensions

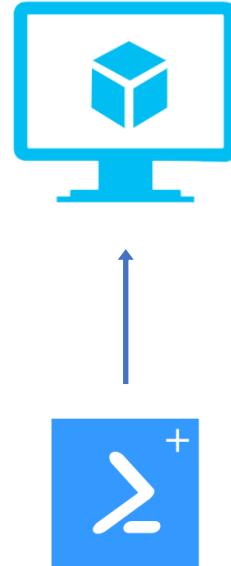
Many VM extensions are available for use with Azure VMs. To see a complete list, use ***Get-AzVMExtensionImage***

The following example lists all available extensions in the WestUS location:

```
Get-AzVmImagePublisher -Location "WestUS" |
```

```
Get-AzVMExtensionImageType |
```

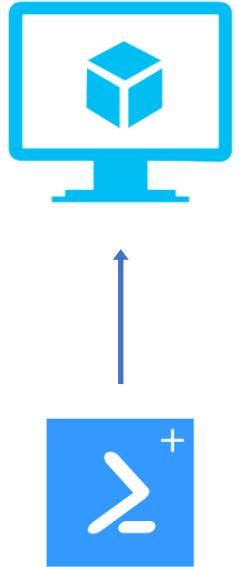
```
Get-AzVMExtensionImage | Select Type, Version
```



VM Extension

# Azure VM Extensions: Run VM Extensions

- Azure VM extensions run on existing VMs
- That's useful when you need to make configuration changes or recover connectivity on an already deployed VM
- VM extensions can also be bundled with ARM template deployments



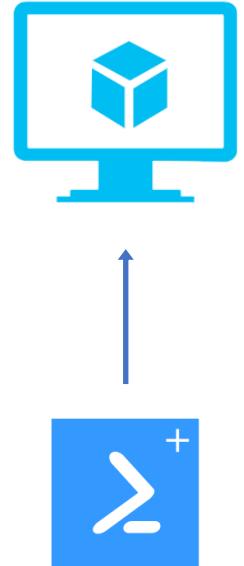
VM Extension

To see a list, use **Get-Command** and filter on Extension:

**Get-Command Set-Az\*Extension\* -Module Az.Compute**

# Azure VM: Custom script Extensions

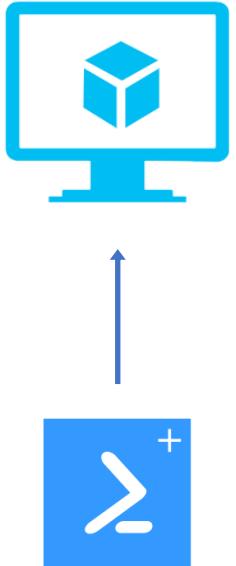
- In addition to process-specific extensions, a Custom Script extension is available for both Windows and Linux virtual machines
- The Custom Script extension for Windows allows any PowerShell script to be run on a VM
- Custom scripts are useful for designing Azure deployments that require configuration beyond what native Azure tooling can provide.



VM Extension

# Azure VM: Custom script Extensions

- Custom script extension can be used on Azure VM to download or execute scripts
- This is ideal when you want to deploy any custom configuration or software installation on a VM
- The time duration of 90 mins is allowed for the script to run.
- It is not ideal for the scripts in which reboots are required. In those use-cases, you may opt configuration management tools like chef or ansible



# Azure VM Extensions: Reference Links

## ➤ Windows VM Extensions

<https://docs.microsoft.com/en-us/azure/virtual-machines/extensions/features-windows>

<https://docs.microsoft.com/en-us/azure/virtual-machines/extensions/agent-windows>

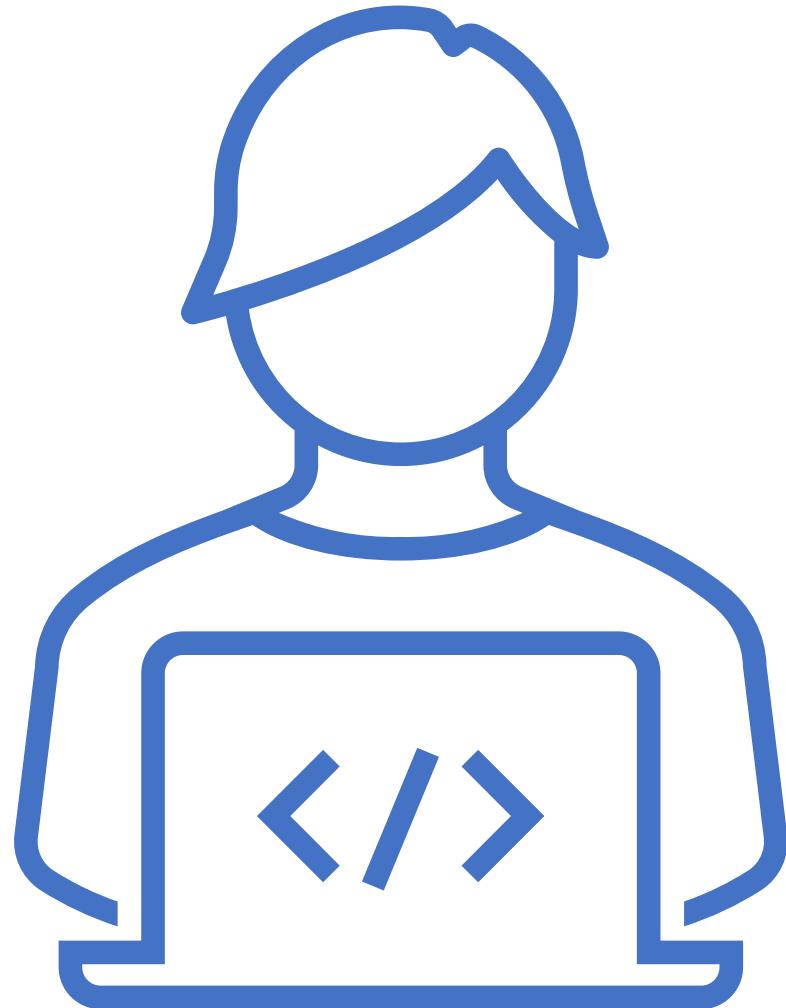
## ➤ Linux VM Extensions

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

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

# Hands-on Labs

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# Azure VM: Custom script Extensions

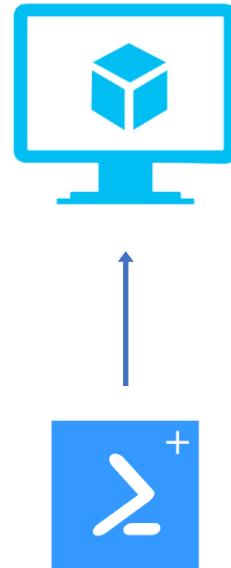
1. Create a new PowerShell file “InstallIIS.ps1” with the below code:

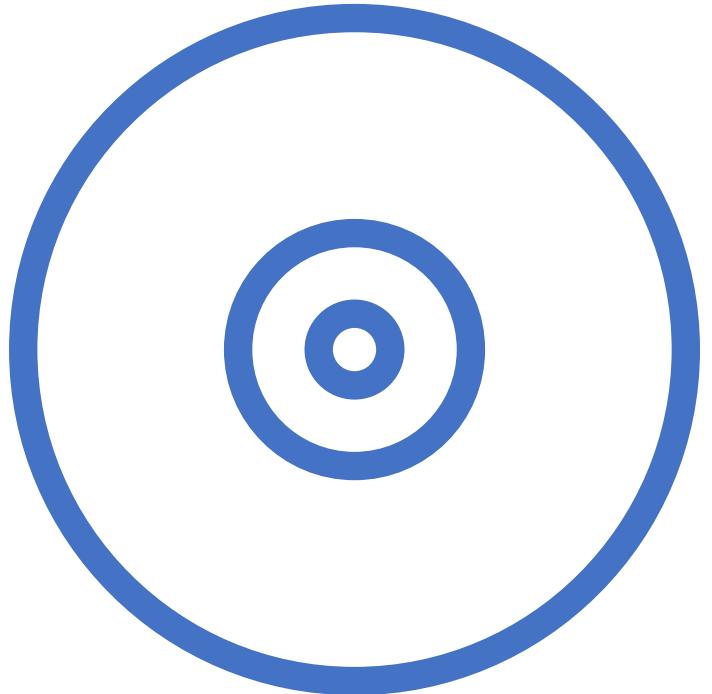
```
Import-module servermanager
```

```
Install-WindowsFeature -Name Web-Server -IncludeAllSubFeature
```

2. Create a Storage account + container to store the PowerShell script

3. Go to Virtual Machine’s Extensions section and execute

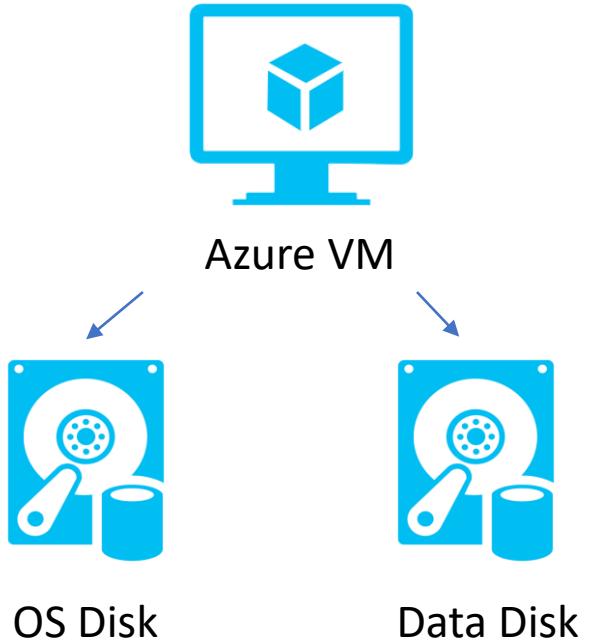




# Azure VM: Disks

# Introduction to Azure Disks (managed)

- Azure managed disks are block-level storage volumes that are managed by Azure and used with Azure Virtual Machines
- Managed disks are like a physical disk in an on-premises server but, virtualized
- With managed disks, all you have to do is specify the disk size, the disk type, and provision the disk



# Disks for Azure Virtual Machine

- Managed vs Unmanaged Disks
- If you decide to use un-managed disks, then you need to manage the storage account that would be used to store the Disks
- The storage account can be a General Purpose-v1 or General Purpose-v2 account but must be of the Premium
- Microsoft recommends the use of Managed disks
- With Managed disks, the durability and availability of the disks are managed by Azure
- The Managed disks are designed for 99.999% availability

# Azure Virtual Machine Disks

By default, two virtual hard disks (VHDs) will be created for your Linux VM:

- **The Operating system Disk:** This is your primary drive, and it has a **maximum capacity of 2048 GB**. It will be labeled as `/dev/sda` by default.
- **Temporary Disk:** This provides temporary storage for the OS or any apps. On Linux virtual machines, the disk is `/dev/sdb` and is formatted and mounted to `/mnt` by the Azure Linux Agent. It is sized based on the VM size and is used to store the swap file.

# Azure Disks Roles

There are three main disk roles in Azure:

## 1) Operating System (OS) Disk

- Every virtual machine has one attached operating system disk; labeled as /dev/sda
- Has a maximum capacity of 4,095 GiB

## 2) Data Disk (persistent storage)

- A data disk is a managed disk can be used to store application data or any other data
- Maximum capacity of 32,767 gibibytes (GiB)
- The size of the virtual machine determines how many data disks you can attach to it

## 3) Temporary Disk

- The temporary disk provides short-term storage for applications and processes
- It is intended to only store data such as page or swap files
- Temporary disk is typically /dev/sdb and on Windows VMs the temporary disk is D: by default

# Azure Disks Types

The available types of disks are:

- 1) Ultra disks
- 2) Premium solid-state drives (SSD)
- 3) Standard SSDs
- 4) Standard hard disk drives (HDD)

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

# Azure Disks Types

## Disk comparison

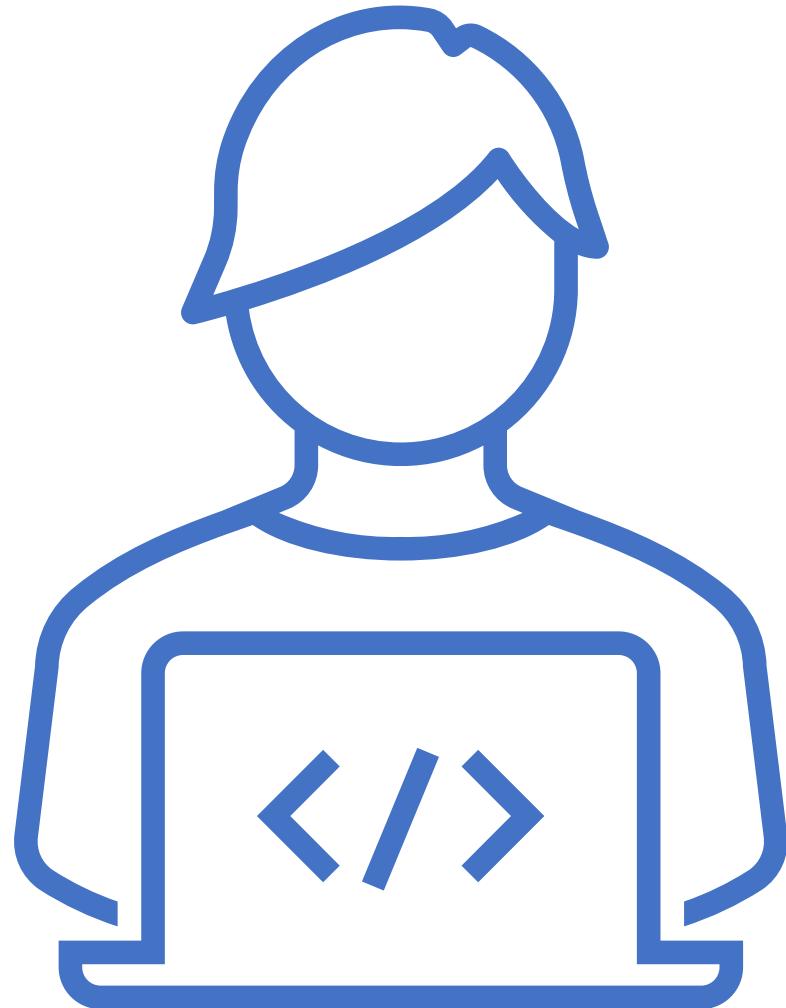
The following table provides a comparison of ultra disks, premium solid-state drives (SSD), standard SSD, and standard hard disk drives (HDD) for managed disks to help you decide what to use.

Detail	Ultra disk	Premium SSD	Standard SSD	Standard HDD
Disk type	SSD	SSD	SSD	HDD
Scenario	IO-intensive workloads such as SAP HANA, top tier databases (for example, SQL, Oracle), and other transaction-heavy workloads.	Production and performance sensitive workloads	Web servers, lightly used enterprise applications and dev/test	Backup, non-critical, infrequent access
Max disk size	65,536 gibibyte (GiB)	32,767 GiB	32,767 GiB	32,767 GiB
Max throughput	2,000 MB/s	900 MB/s	750 MB/s	500 MB/s
Max IOPS	160,000	20,000	6,000	2,000

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

# Hands-on Labs

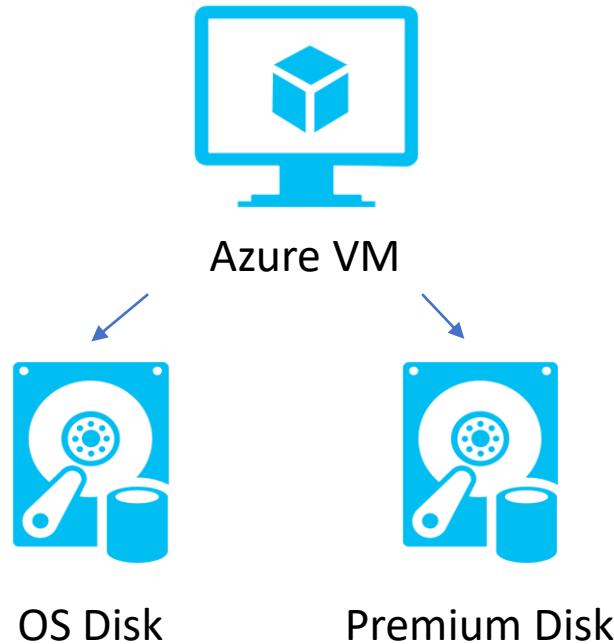
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# Lab: Adding Data Disks to Azure Virtual Machine

- 1) Add one **Data disk** to the previously provisioned Virtual Machine
- 2) Initialize the Disk from **Server Manager**
- 3) Create the Volume from initialized Disk and verify it

# Lab: Create a VM with Premium Disks



1. Get the clarity over the use-cases where **Premium Disks** are used
2. Check the compatibility of Premium Disk with any Azure VM
3. Provision an Azure Virtual Machine with the **Premium Disk**
4. Once the VM is provisioned, connect to it and create a Volume with the Premium Data Disk

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1010

# Disks (managed) Encryption Options

# Azure Disk Encryption options

There are several types of encryption available for your managed disks, and are as follows:

- 1. Azure Disk Encryption (ADE)**

ADE provides volume encryption for the OS and data disks of Azure virtual machines (VMs) using feature DM-Crypt of Linux or the BitLocker feature of Windows

- 2. Server-Side Encryption (SSE) (<https://docs.microsoft.com/en-us/azure/virtual-machines/disk-encryption>)**

Automatically encrypts data stored on Azure managed disks (OS and data disks) when persisting it to the cloud

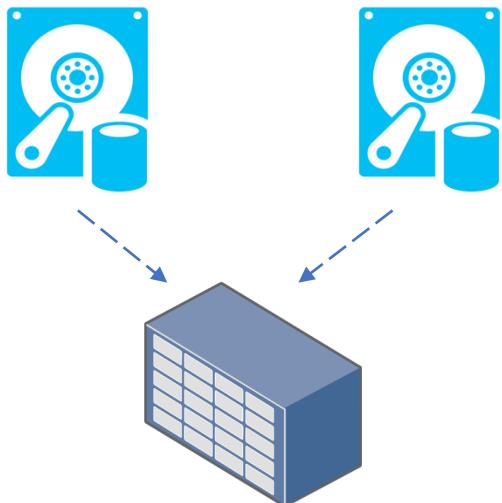
- 3. Encryption at host**

ensures that data stored on the VM host is encrypted at rest and flows encrypted to the Storage service

# Azure Disk Storage: Server-side Encryption

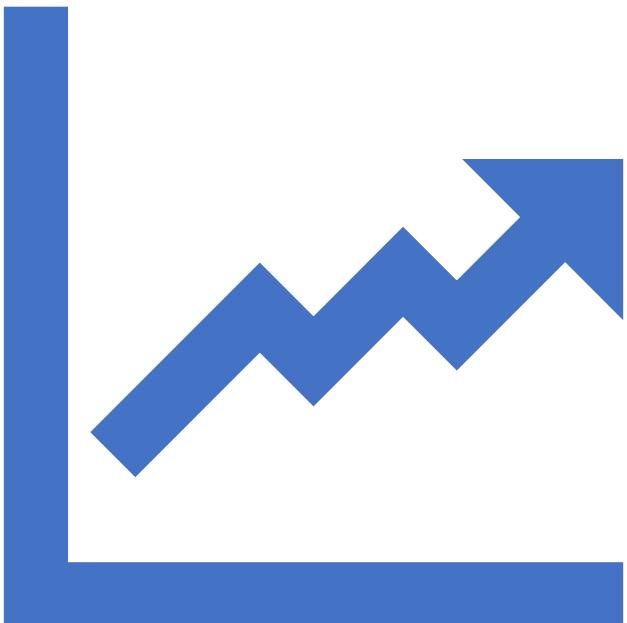


Azure VM



Storage Unit – Azure Datacenter

- With SSE your data is automatically encrypted using 256-bit AES encryption
- This protects the data at rest
- This is done for Managed Disks – OS and Data disks



## Disks (managed) Performance

# Performance Indicators: Important Terminologies

## 1) IOPS

IOPS, or Input/output Operations Per Second, is the number of requests that your application is sending to the storage disks in one second

## 2) Throughput

Throughput, or bandwidth is the amount of data that your application is sending to the storage disks in a specified interval. If your application is performing input/output operations with large IO unit sizes, it requires high throughput

## 3) Latency

Latency is the time it takes an application to receive a single request, send it to the storage disks and send the response to the client

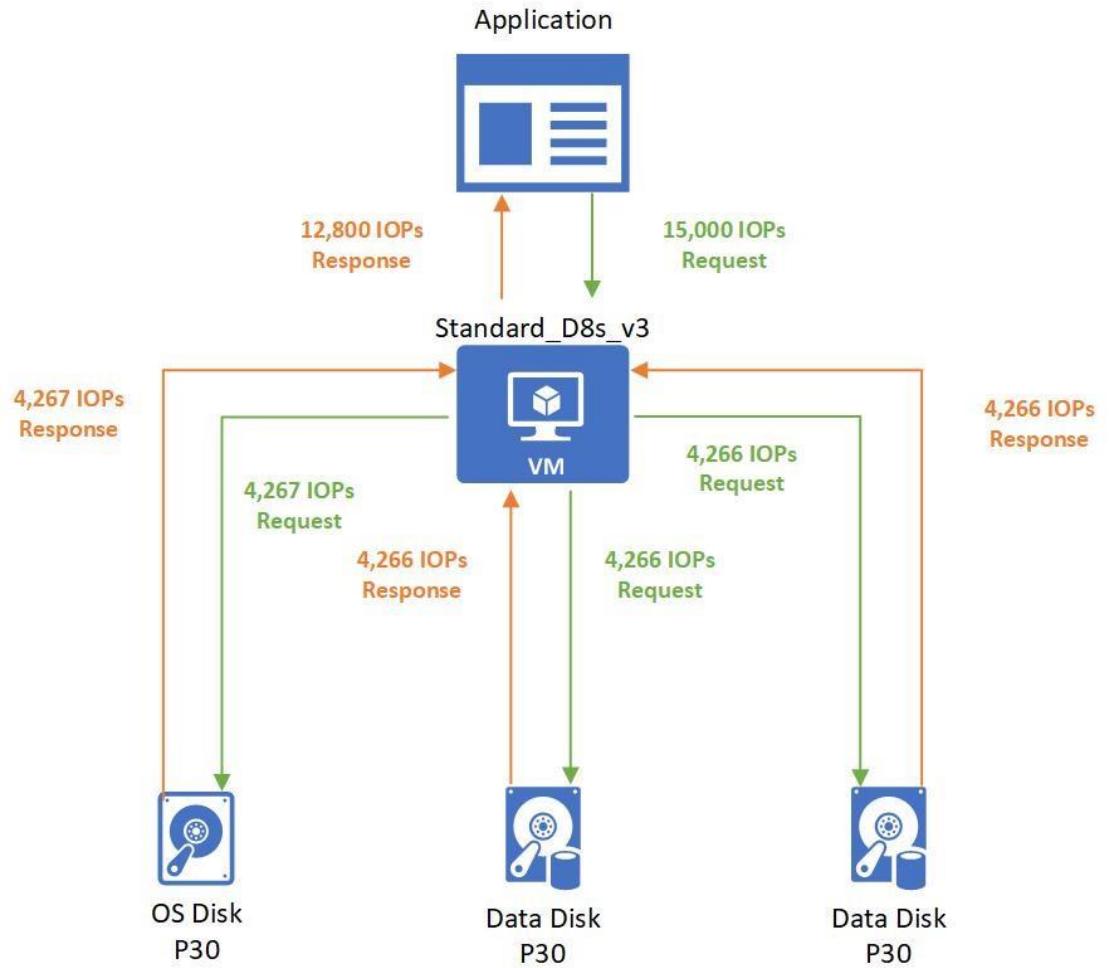
# How does disk performance work?

- Azure virtual machines have input/output operations per second (IOPS) and throughput performance limits based on the virtual machine type and size
- OS disks and data disks can be attached to virtual machines
- The disks have their own IOPS and throughput limits
- Your application's performance gets capped when it requests more IOPS or throughput than what is allotted for the virtual machines or attached disks
- When capped, the application experiences suboptimal performance
- This can lead to negative consequences like increased latency

# Disks: Understanding the IOPS and Throughput

- Azure virtual machines have input/output operations per second (IOPS) and throughput performance limits based on the virtual machine type and size
- The disks have their own IOPS and throughput limits

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



# Lab: Adding Data disks using PowerShell

```
$resourcegroup = 'lab-rg'  
$machinename = 'labvm'  
$location = 'North Europe'  
$storageType = 'Standard_LRS'  
$dataDiskName = 'newdisk01'  
$dataDiskSize = 20
```

---

```
$datadiskConfig = New-AzDiskConfig -SkuName $storageType -Location $location -CreateOption Empty -  
DiskSizeGB $dataDiskSize
```

```
$dataDisk01 = New-AzDisk -DiskName $dataDiskName -Disk $datadiskConfig -ResourceGroupName  
$resourcegroup
```

```
$vm = Get-AzVM -Name $machinename -ResourceGroupName $resourcegroup
```

```
$vm = Add-AzVMDataDisk -VM $vm -Name $dataDiskName -CreateOption Attach -ManagedDiskId $dataDisk01.Id  
-Lun 1
```

```
Update-AzVM -VM $vm -ResourceGroupName $resourcegroup
```



# Azure Disk Backup

# Overview of Azure Disk Backup

- Native, cloud-based backup solution that protects data in managed disks
- Enables you to configure protection for managed disks in a few steps
- It assures that you can recover your data in a disaster scenario
- You can manage the disk snapshots with zero infrastructure cost and without the need for custom scripting or any management overhead
- This is a crash-consistent backup solution that takes point-in-time backup of a managed disk using incremental snapshots with support for multiple backups per day
- It's also an agent-less solution and doesn't impact production application performance
- It supports backup and restore of both OS and data disks (including shared disks), whether they're currently attached to a running Azure virtual machine

# How the Backup process works?

The first step in configuring backup for Azure Managed Disks is creating a **Backup vault**. The vault gives you a consolidated view of the backups configured across different workloads

Then create a **Backup policy** that allows you to configure backup frequency and retention duration

To configure backup, go to the Backup vault, assign a backup policy, select the managed disk that needs to be backed up and provide a resource group where the snapshots are to be stored and managed

Azure Backup automatically triggers scheduled backup jobs that create an incremental snapshot of the disk according to the backup frequency

# How the Restore process works?

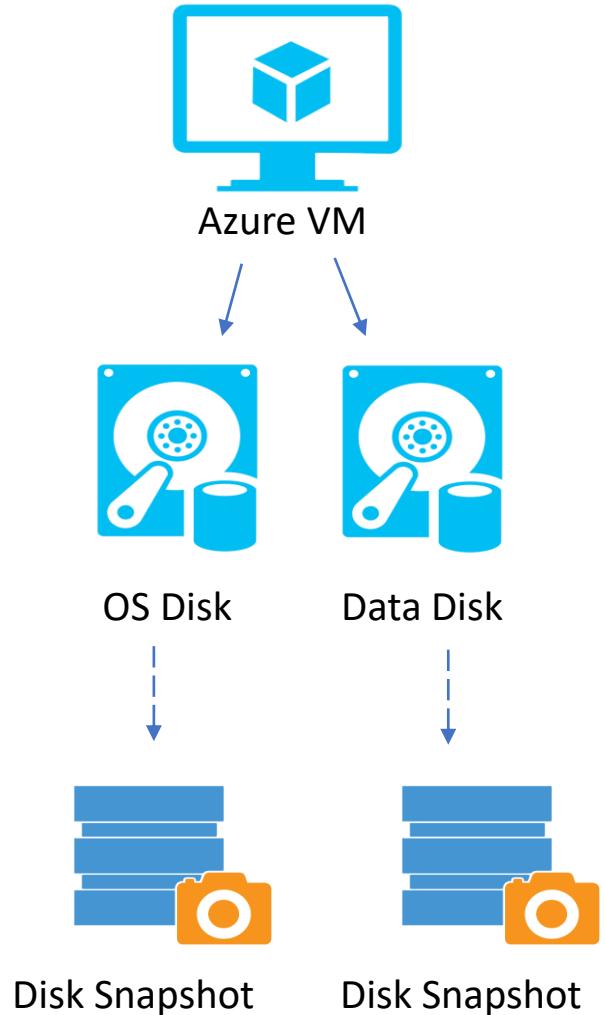
- The first step in configuring backup for Azure Managed Disks is creating a Backup vault. The vault gives you a consolidated view of the backups configured across different workloads
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# Azure Disk Backup: Reference Links

- <https://docs.microsoft.com/en-us/azure/backup/disk-backup-overview>

# Azure Disk Snapshot

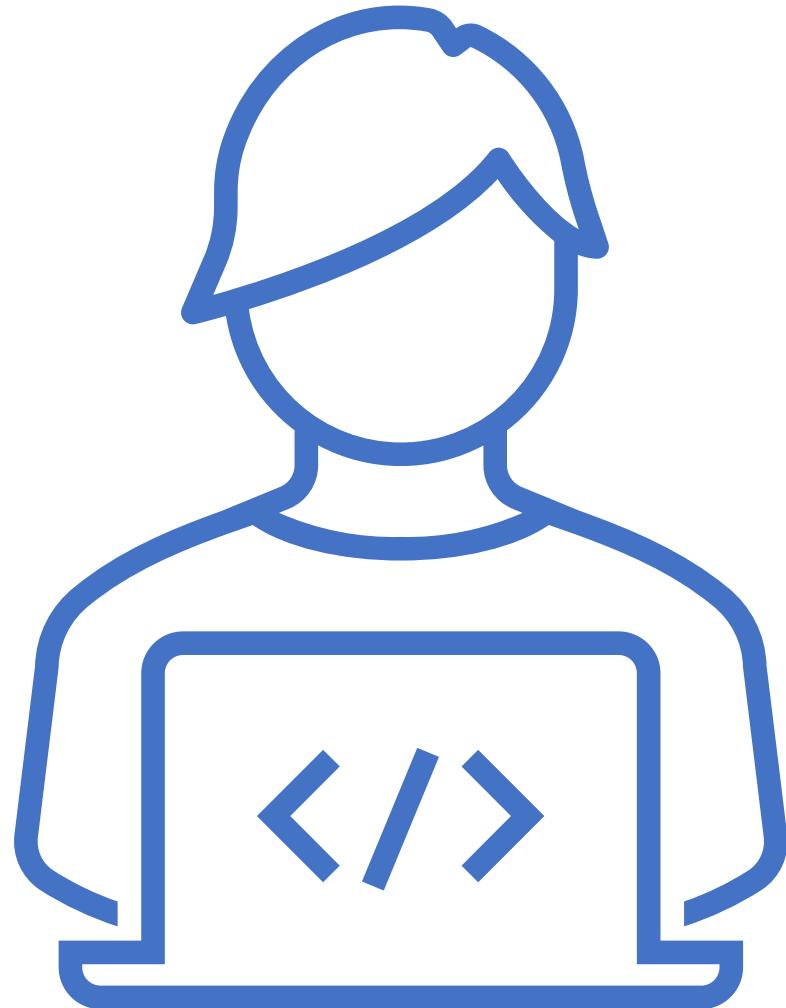
- A snapshot is a full, read-only copy of a virtual hard drive (VHD)
- You can take a snapshot of an OS or data disk VHD to use as a backup, or to troubleshoot virtual machine (VM) issues
- If you are going to use the snapshot to create a new VM, it is recommended that you cleanly shut down the VM before taking a snapshot, to clear out any processes that are in progress



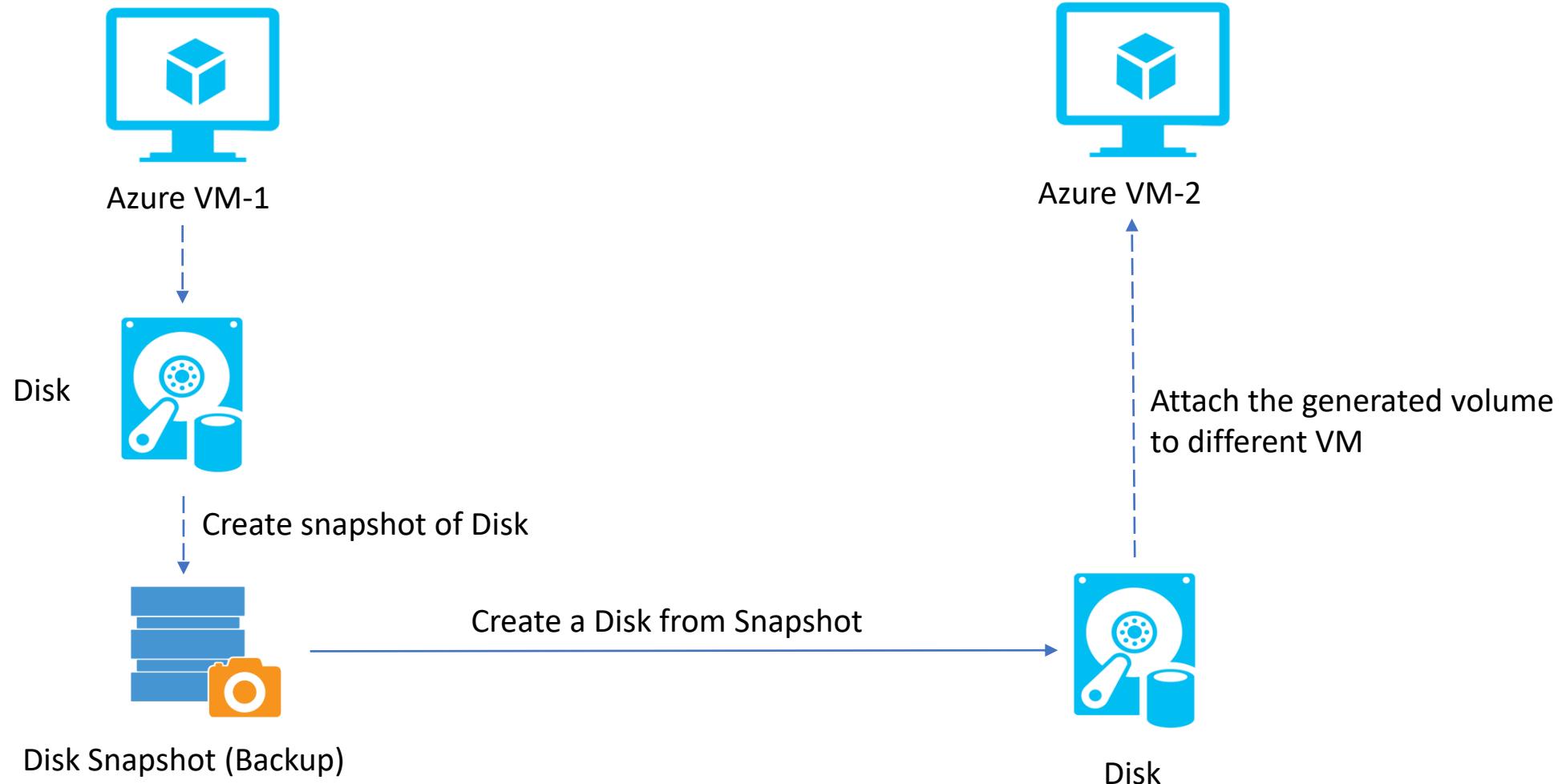
Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/snapshot-copy-managed-disk>

# Hands-on Labs

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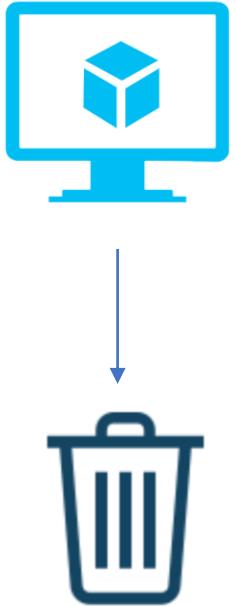


# Lab: Azure Disk Snapshot



# Deleting the Resources

- Since we are following pay-as-you-go billing model for all our labs, you will be charged for all the resources you have provisioned.
- Make sure you Delete all the resources which are not required.





# Azure VM: Boot Diagnostics

# Azure VM: Boot Diagnostics

- **Boot diagnostics** is a debugging feature for Azure virtual machines (VM) that allows diagnosis of VM boot failures
- **Boot diagnostics** enables a user to observe the state of their VM as it is booting up by collecting serial log information and screenshots
- When creating a VM in Azure portal, boot diagnostics is enabled by default
- The recommended boot diagnostics experience is to use a managed storage account, as it yields significant performance improvements in the time to create an Azure VM

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/boot-diagnostics>



# Azure VM: Backup

# Azure Backup Service

- The Azure Backup service provides simple, secure, and cost-effective solutions to back up your data and recover it from the Microsoft Azure cloud.
- **What can you back up?**
  1. On-premises workloads
  2. Azure VMs
  3. Azure Managed Disks
  4. SQL Server in Azure VMs
- Ref: <https://docs.microsoft.com/en-us/azure/backup/backup-overview>

# Why use Azure Backup?

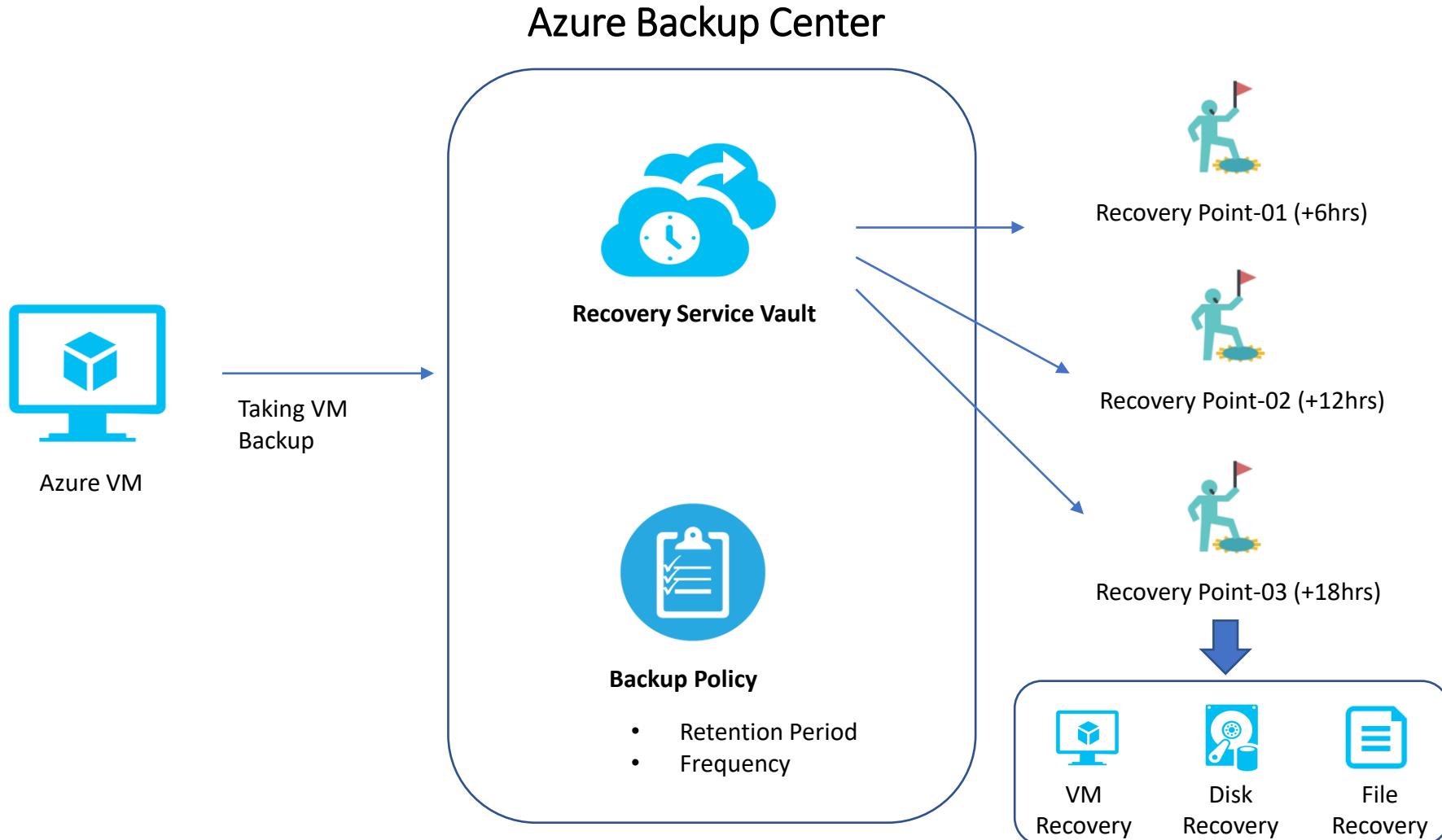
Azure Backup delivers these key benefits:

1. Back up Azure IaaS VMs
2. Offload on-premises backup
3. Scale easily
4. Get unlimited data transfer (no limit on the amount of inbound or outbound data transfer)
5. Keep data secure
6. Retain short and long-term data
7. Multiple storage options: LRS, GRS, ZRS

# Does Azure Backup protect from Ransomware?

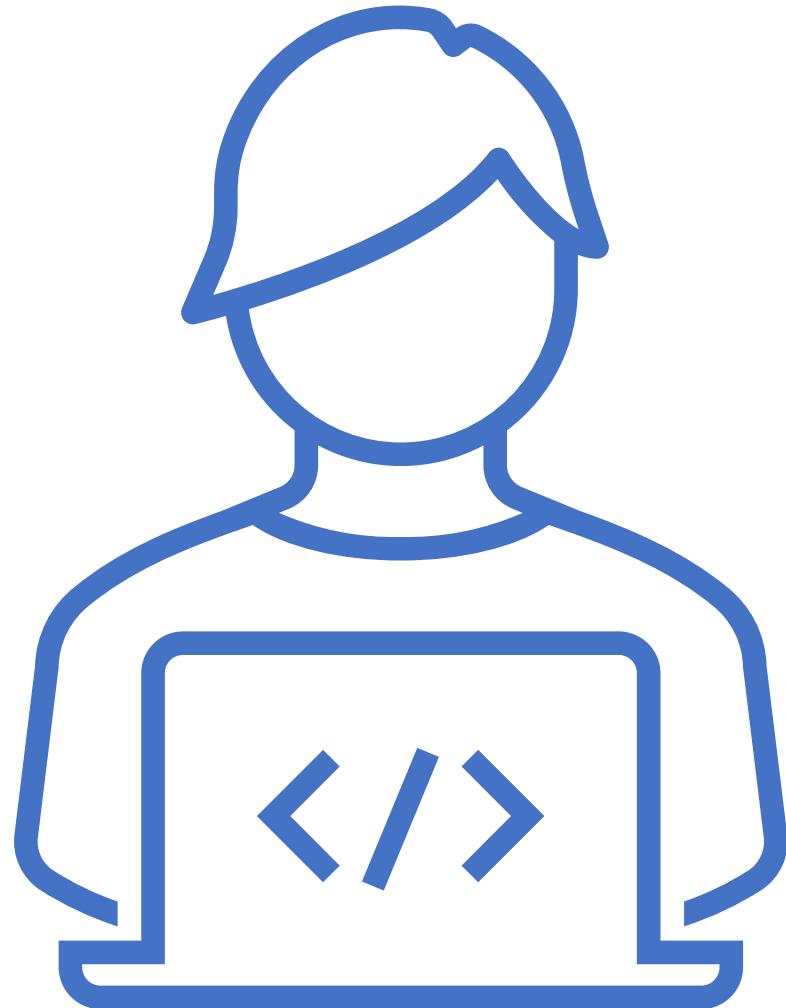
- Azure Backup helps protect your critical business systems and backup data against a ransomware attack by implementing preventive measures and providing tools that protect your organization from every step that attackers take to infiltrate your systems
- It provides security to your backup environment, both when your data is in transit and at rest

# Azure Backup Service



# Hands-on Labs

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# Lab: Azure Backup Service

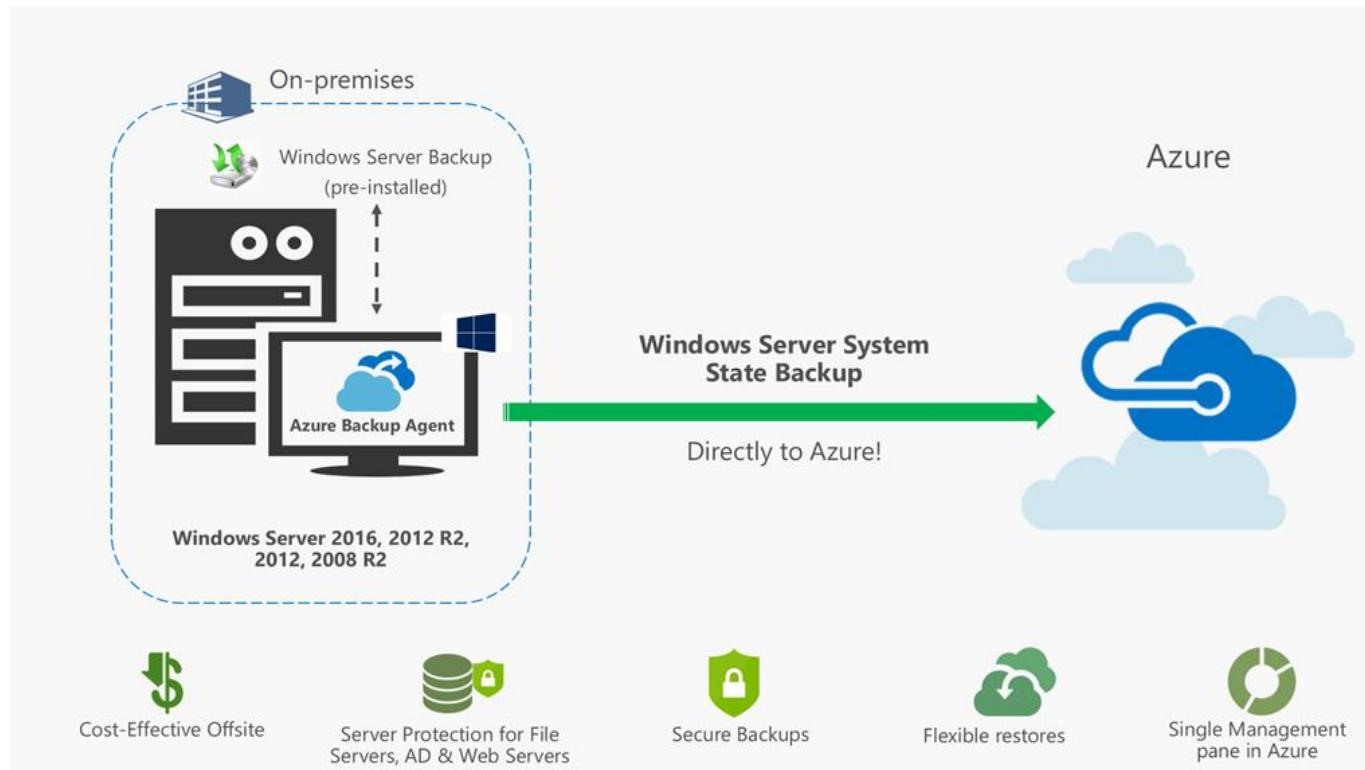
Create a Virtual Machine with Recovery Services Vault and a Backup Policy (Daily at 19:00pm,  
Retention period: 180 days)

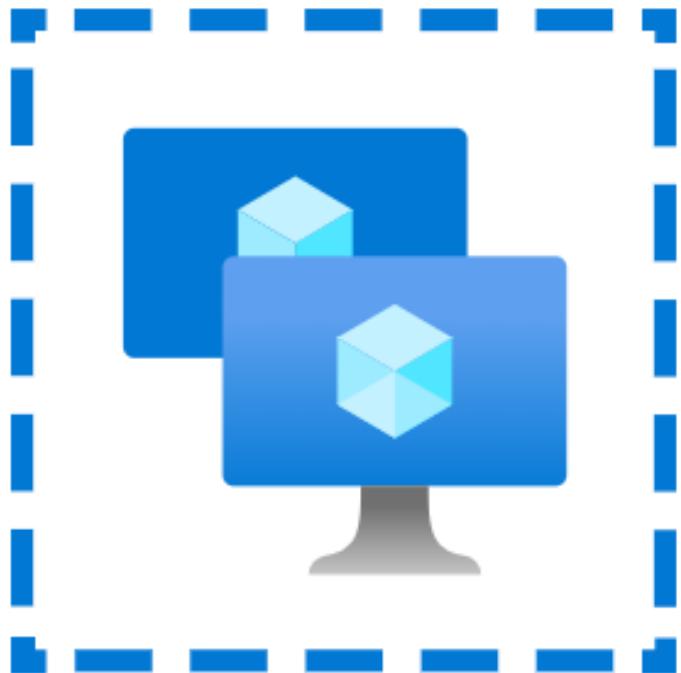
# Soft Delete Feature: Azure Recovery Service Vault

- Concerns about security issues, like malware, ransomware, and intrusion, are increasing.  
These security issues can be costly, in terms of both money and data
- To guard against such attacks, Azure Backup now provides security features to help protect backup data even after deletion
- One such feature is soft delete
- With soft delete, even if a malicious actor deletes a backup (or backup data is accidentally deleted), the backup data is retained for 14 additional days, allowing the recovery of that backup item with no data loss
- The additional 14 days of retention for backup data in the "soft delete" state don't incur any cost to you

# Azure Backup: MARS Agent (for VM and On-prem)

Microsoft Azure Recovery Services (MARS) Agent and Azure Backup service can be used to take backup of Windows machines.





# Availability Options for Azure VM

# Availability Options for Azure VM



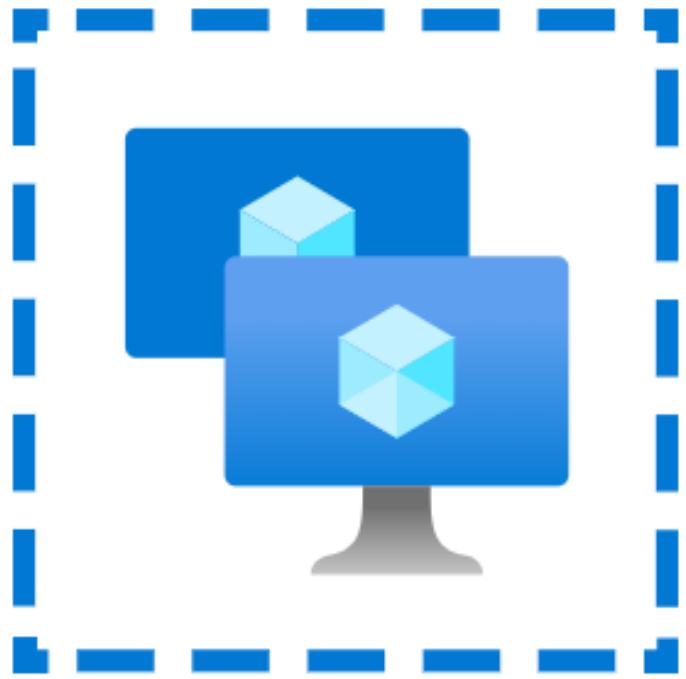
Availability Zones



Availability Sets



Virtual Machine Scale-sets



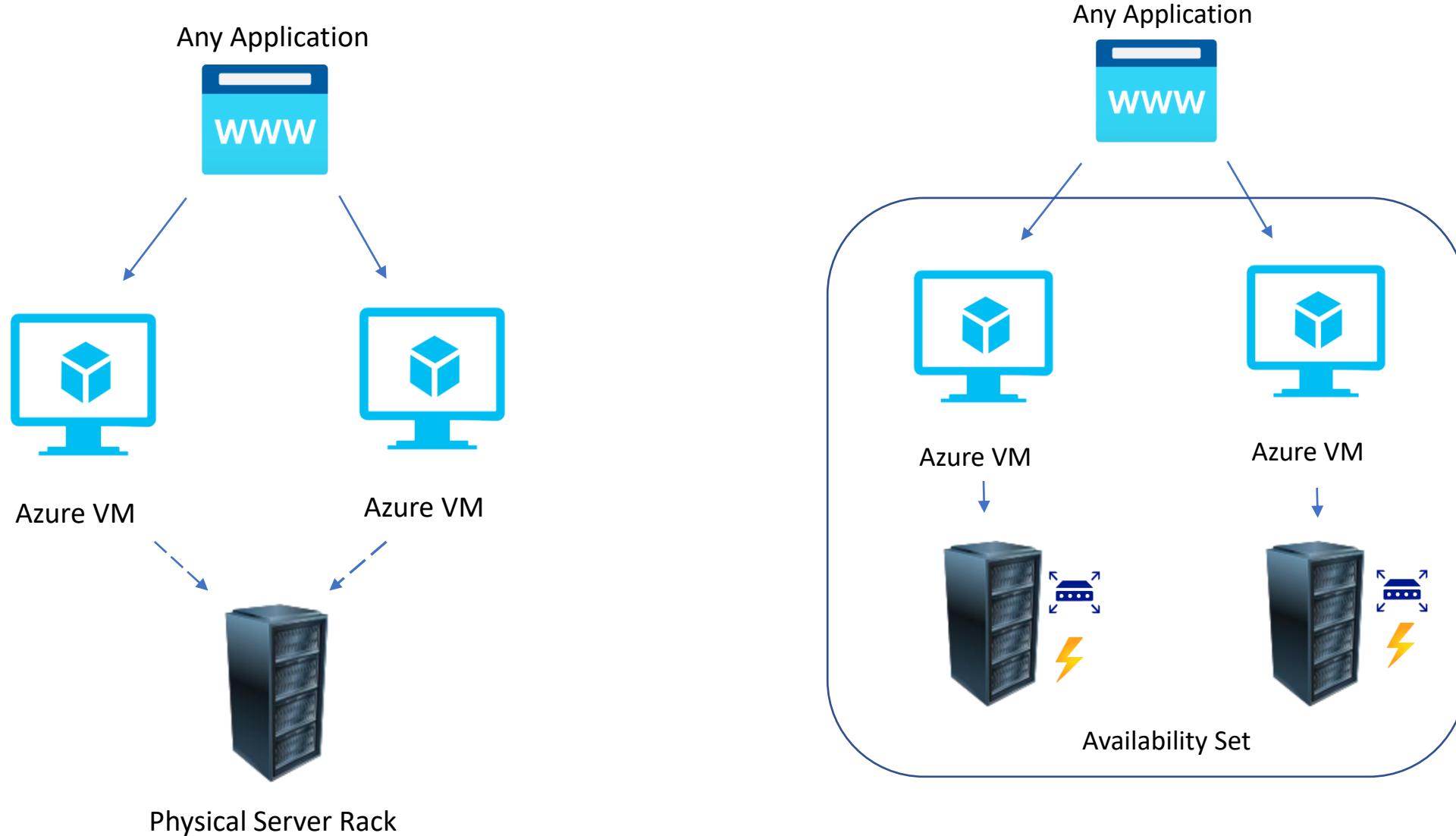
# Azure VM: Availability Sets

# Availability sets

- An **Availability set** is a logical grouping of VMs that allows Azure to understand how your application is built to provide for redundancy and availability.
- It is recommended that two or more VMs are created within an availability set to provide for a highly available application and to meet the **99.95% Azure SLA**.
- There is **no cost for the Availability Set** itself, you only pay for each VM instance that you create.
- Each virtual machine in your availability set is assigned an **Update domain** and a **Fault domain** by the underlying Azure platform. Each availability set can be configured with up to three fault domains and twenty update domains.

Ref: <https://docs.microsoft.com/en-us/azure/virtual-machines/availability-set-overview>

# Availability sets: Fault Domain Diagram



# How do Availability sets work?

## Update Domains

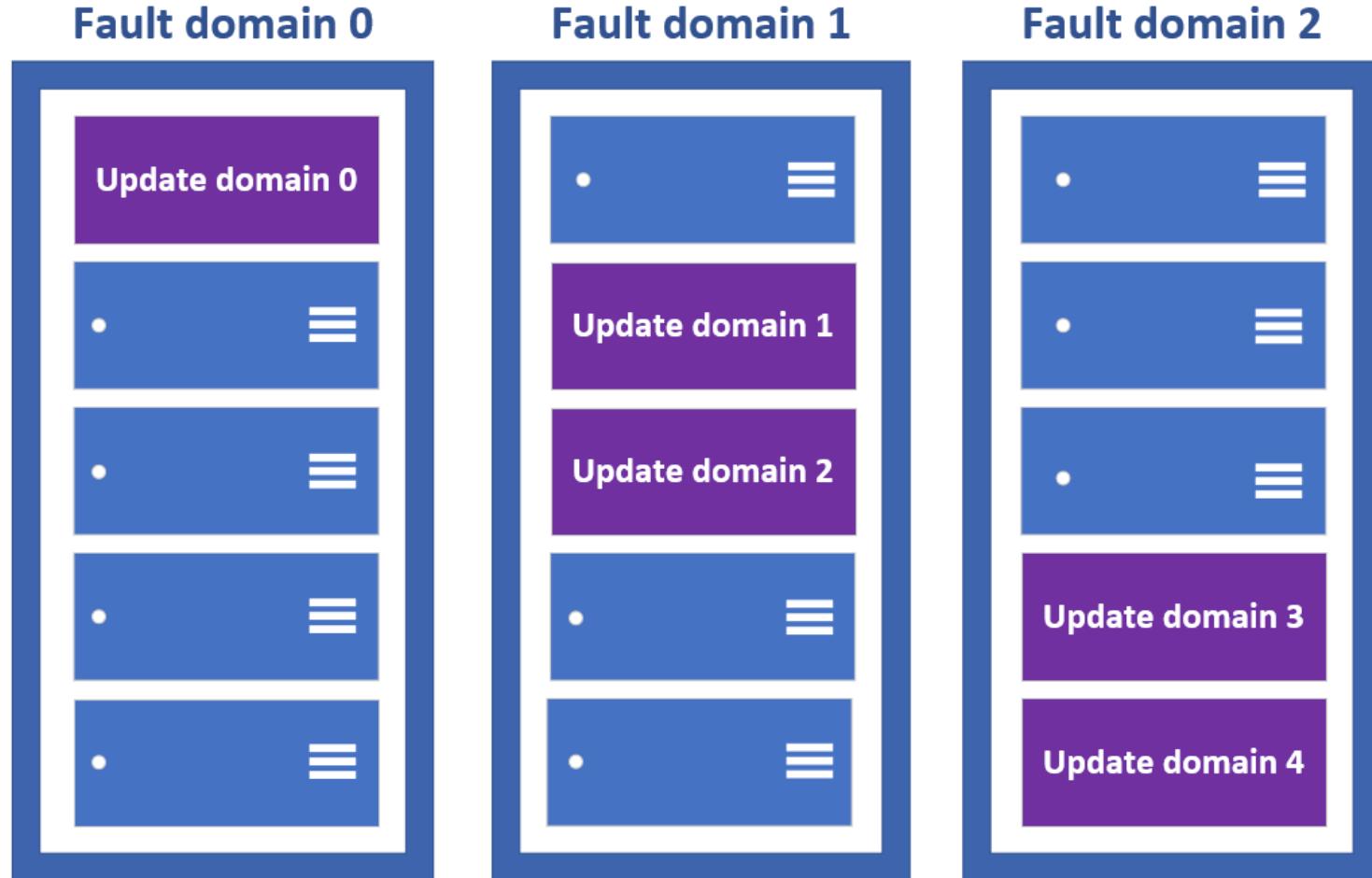
- Update domains indicate groups of virtual machines and underlying physical hardware that can be rebooted at the same time.
- When more than five virtual machines are configured within a single availability set, the sixth virtual machine is placed into the same update domain as the first virtual machine, the seventh in the same update domain as the second virtual machine, and so on.
- The order of update domains being rebooted may not proceed sequentially during planned maintenance, but only one update domain is rebooted at a time.

# How do Availability sets work?

## Fault domains

- Fault domains define the group of virtual machines that share a common power source and network switch.
- By default, the virtual machines configured within your availability set are separated across up to three fault domains.
- When placing your virtual machines into an availability set does not protect your application from operating system or application-specific failures, it does limit the impact of potential physical hardware failures, network outages, or power interruptions.

# Availability sets: Fault Domain & Update Domain



# Availability sets: Points to remember

- An unplanned event wherein the underlying infrastructure fails unexpectedly. The failures could be attributed to network failures , local disk failures or even rack failures.
- Planned maintenance events , wherein Microsoft needs to make planned updates to the underlying physical environment. In such cases , a reboot might be required on your virtual machine.
- You can increase the availability of your application by making use of availability sets. **Fault domains** are used to define the group of virtual machines that share a common source and network switch. You can have up to 3 fault domains.
- **Update domains** are used to group virtual machines and physical hardware that can be rebooted at the same time. You can have up to 20 update domains.

# Lab: Working with Availability sets

1. Create an Availability set with 2 Fault domains and 3 Update domains.
2. Provision a new Azure VM with the created Availability set.
3. On successful deployment of the Azure VM, check the Availability set Overview section for the Fault and Update domain specifications.
4. Now provision 2<sup>nd</sup> Azure VM within the same Availability set and repeat step-03 to see the Fault and Update domain specs for both the VMs.

**Note:** You cannot add an existing Virtual Machine to the Availability Set. Can only be added while provisioning the VM.

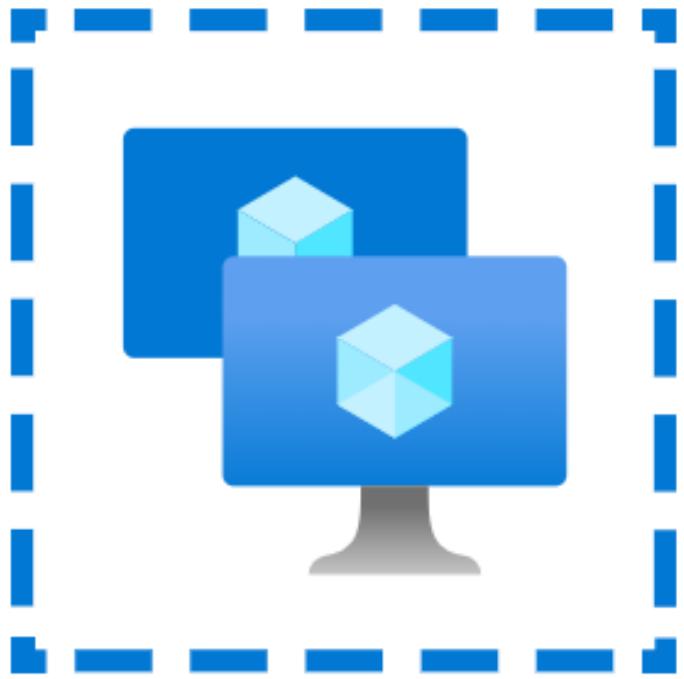
# Lab: Working with Availability sets

<b>Virtual Machine #</b>	<b>Fault Domain # (2 fault domains)</b>	<b>Update Domains (3 update domains)</b>
VM 01	0	0
VM 02	1	1
VM 03	0	2
VM 04	1	3

# Use case scenario: Availability sets

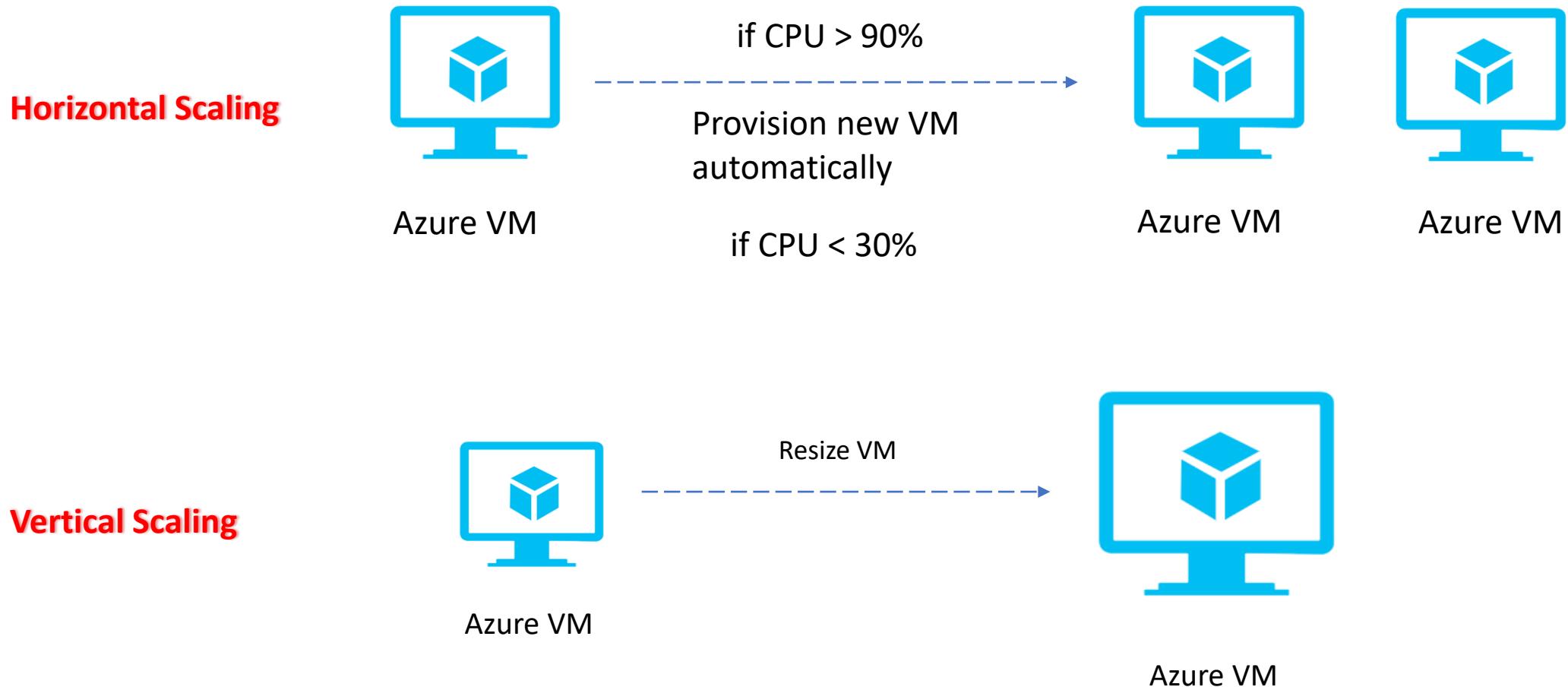
- You have to move an on-premises application onto an Azure Subscription
- The application will be hosted on several Azure Virtual Machines
- You have to ensure that the application will always be running on at least three virtual machines during a planned Azure maintenance period
- Consider update domain for maintenance scenarios
- Consider fault domain for underlying hardware faults scenarios



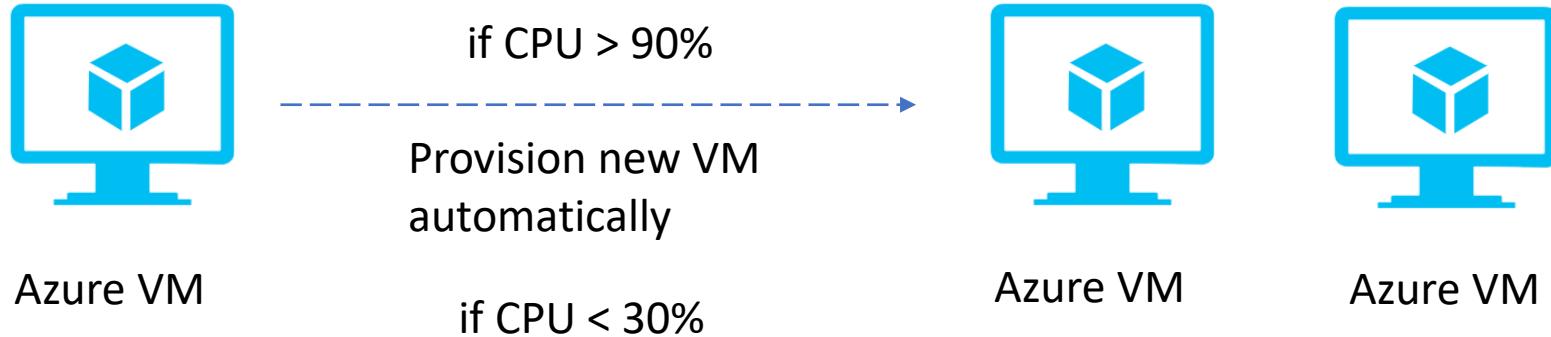


# Azure VM: Scale sets

# Vertical Scaling vs Horizontal Scaling



# Azure VM - Scale Sets (Scale-out and Scale-in)



- ✓ The Virtual Machine scale set will automatically scale-out the number of machine based on the resource utilization (demand)
- ✓ You would define the configuration of the Virtual Machine that would be part of the Scale set
- ✓ You then define the scaling conditions

# Overview of Azure VM Scale Sets

- ✓ Azure virtual machine scale sets let you create and manage a group of load balanced VMs
- ✓ The number of VM instances can automatically increase or decrease in response to demand or a defined schedule
- ✓ Scale sets provide high availability to your applications, and allow you to centrally manage, configure, and update many VMs
- ✓ There is no cost for the scale set itself, you only pay for each VM instance that you create
- ✓ Virtual machines in a scale set can also be deployed into multiple availability zones, a single availability zone, or regionally
- ✓ Availability zone deployment options may differ based on the orchestration mode

# Overview of Azure VM Scale Sets

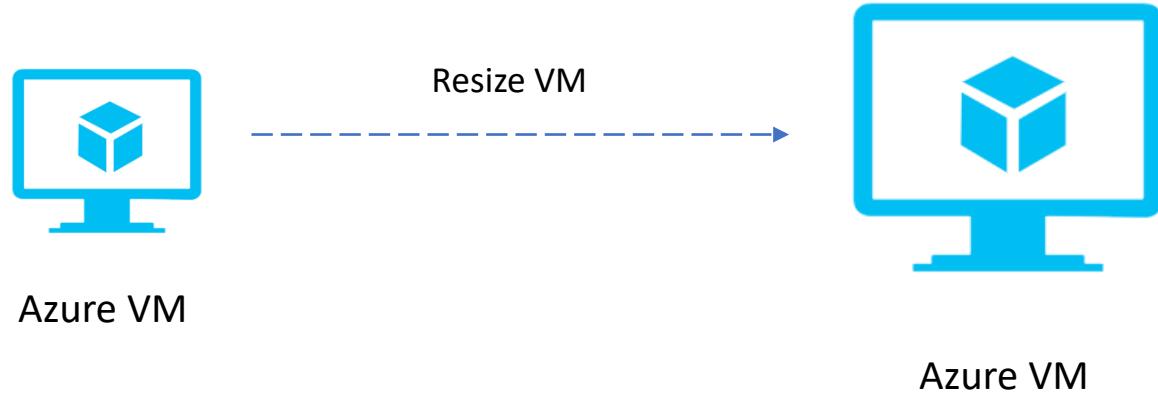
- ✓ Virtual machines in a scale set can also be deployed into **multiple availability zones, a single availability zone, or regionally**
- ✓ Availability zone deployment options may differ based on the **orchestration mode**

# Azure VM Scale Sets: Orchestration Mode

Choose how virtual machines are managed by the scale set. In flexible orchestration mode, you manually create and add a virtual machine of any configuration to the scale set. In uniform orchestration mode, you define a virtual machine model and Azure will generate identical instances based on that model.

- 1) Uniform Orchestration
- 2) Flexible Orchestration

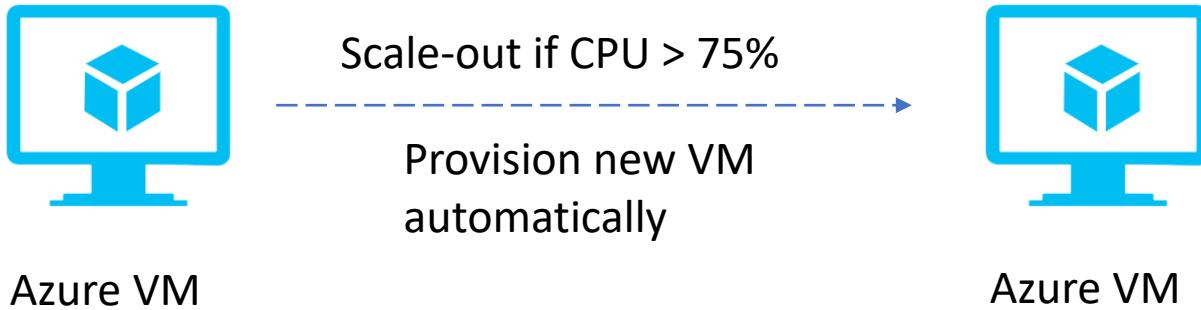
# Lab: Resizing an Azure VM (Vertical Scaling)



1. Provision an Azure Virtual Machine
2. Go to **Size** section -> Select the size you want -> Click on **Resize** button.

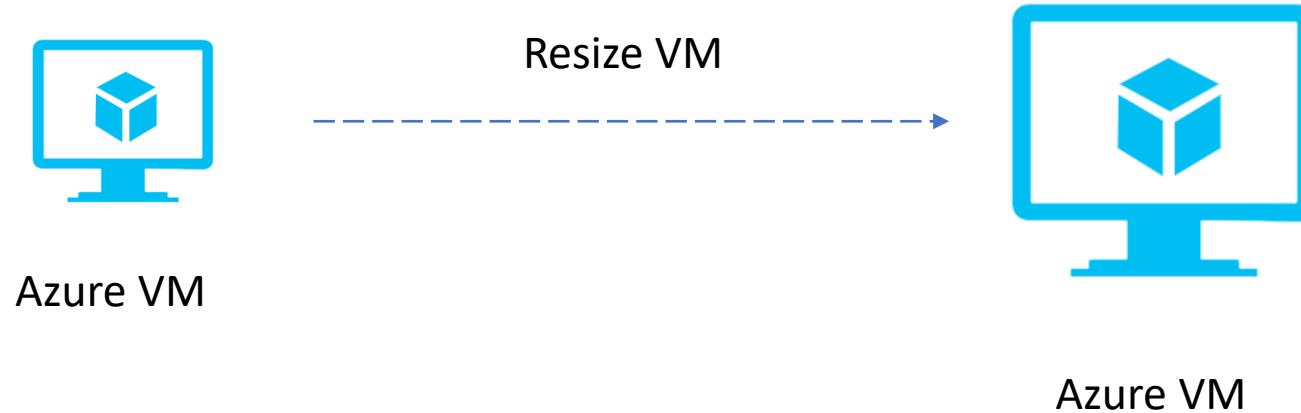
**Note:** Resizing the VM will cause it to be restarted. Stopping the VM may reveal additional sizes

# Lab: Azure VM - Scale Sets (Horizontal Scaling)



1. Create an Azure Scale set with Linux image (Ubuntu 18x), Scale-out and Scale-in condition.
2. Login to Azure VM and create an artificial stress (with below command) to meet the scale-out condition:  
`sudo apt-get install -y stress`  
`sudo stress --cpu 70`
3. Verify if the Scale-set provisions a new VM

# Lab: Resizing an Azure VM using PowerShell

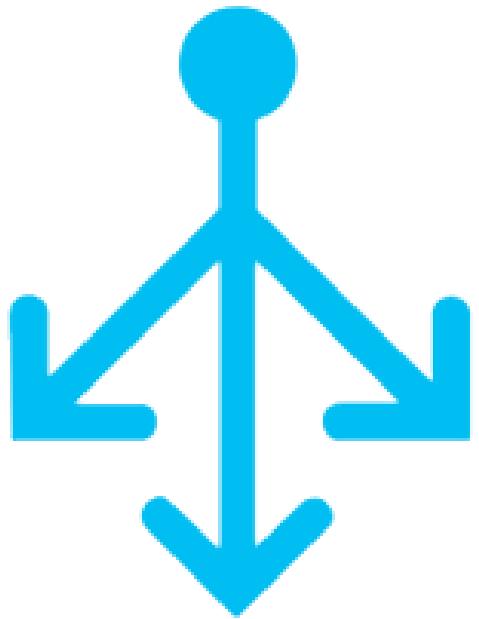


Execute below PowerShell commands to resize the VM:

```
$vm = Get-AzVM -ResourceGroupName azuredemo -VMName newvm
```

```
$vm.HardwareProfile.VmSize ="Standard_DS1_v2"
```

```
Update-AzVM -VM $vm -ResourceGroupName azuredemo
```



# Azure Load Balancing services

# Why Load Balancing?

Define well known endpoints for your customers

Assure, scale, and secure your applications

Simplify scenarios with fully managed products

# Azure Load Balancing services



Load Balancer  
aka.ms/lbpreview

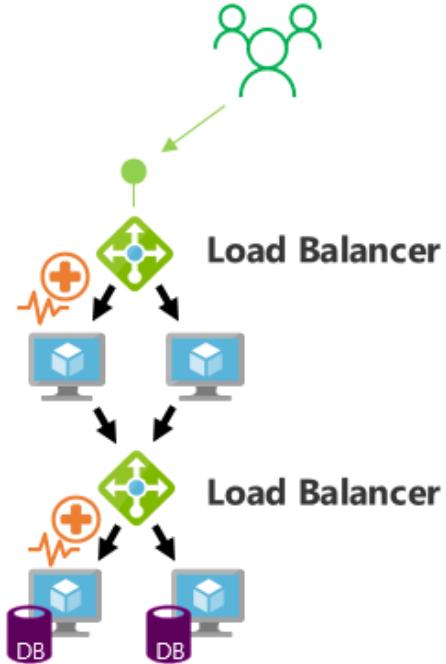


Traffic Manager  
aka.ms/trafficmanager

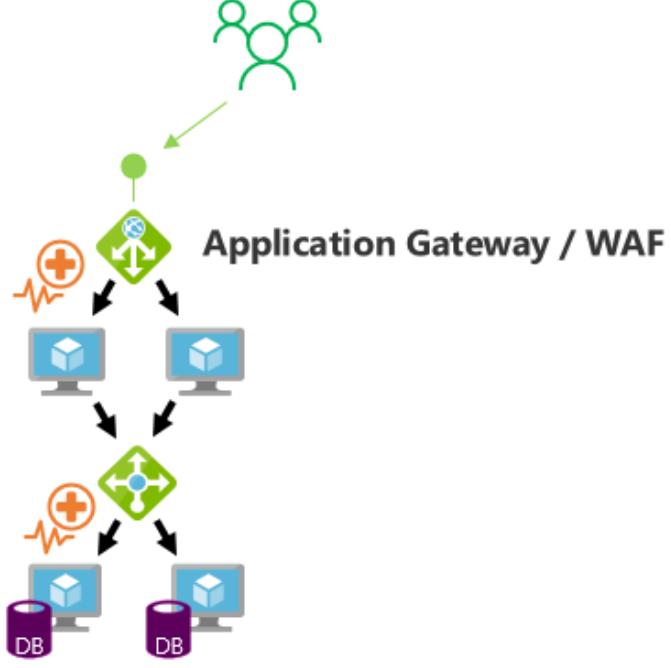


Application Gateway  
aka.ms/appgw

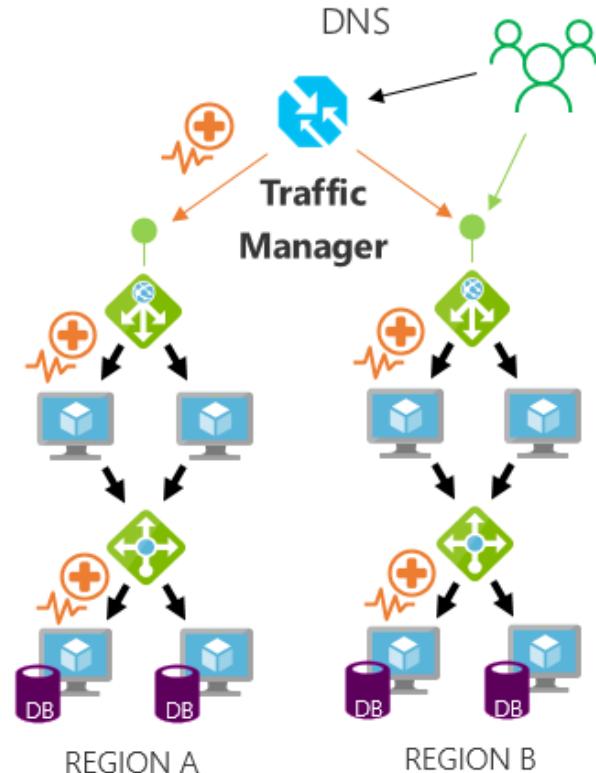
# Azure Load Balancing Scenarios



**Scalable  
Redundant**



**Scalable  
Redundant  
+ Protection**



**+ Global  
with multiple  
Azure Regions**

# What's New?

## Load Balancer

- New Load Balancer, SKUs
- Pool up to 1000 instances in VNet, incl. 1000 instance VMSS
- Multiple VMSS
- Zone-redundant data path with single IP
- Zonal frontends
- Cross-zone load balancing
- Cross-zone VMSS
- HA Ports for NVAs and more
- Advanced analytics (Traffic Counters, Per Endpoint health probe status, Continuous in-band data plane health, Inbound connection attempts, Outbound connections)

## Traffic Manager

- Real User Measurements
- Traffic Flow
- EDNS Client Subnet
- Azure Monitor Metrics
- Fast Failover
- Geographic Routing



## Application Gateway

- SSL Policy with cipher suites
- Redirection
- Multitenant (WebApp) backend
- Health probe enhancements
- Multiple VMSS
- Path override
- Idle timeout and domain label
- WAF: OWASP ModSecurity CRS 3.0
- WAF: Rule configurability
- WAF ASC and OMS log analytics

# Overview of Azure Load Balancer

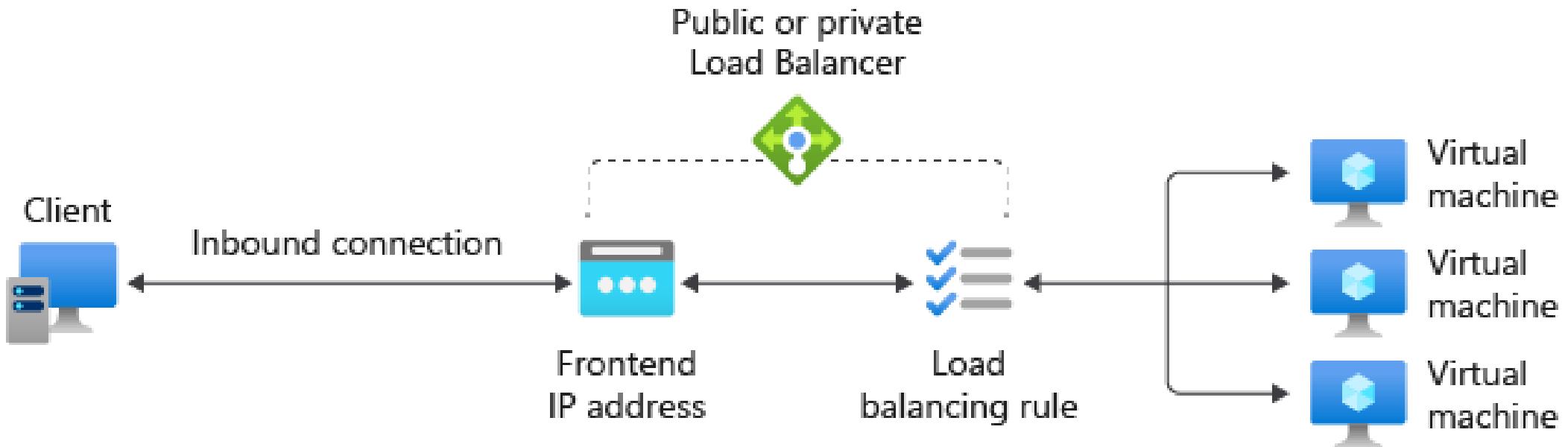
- Load balancing refers to evenly distributing load (incoming network traffic) across a group of backend resources or servers
- Azure Load Balancer operates at **layer 4** of the OSI model
- It's the single point of contact for clients
- Load balancer distributes inbound flows that arrive at the load balancer's front end to backend pool instances
- These flows are according to configured load-balancing rules and health probes
- The backend pool instances can be Azure Virtual Machines or instances in a virtual machine scale set

# Azure Load Balancer Components

- **Frontend IP Configuration:** The IP address of your Azure Load Balancer
- **Backend Pool:** The group of virtual machines or instances in a virtual machine scale set that is serving the incoming request
- **Health Probe:** A health probe is used to determine the health status of the instances in the backend pool
- **Load Balancer Rules:** A load balancer rule is used to define how incoming traffic is distributed to all the instances within the backend pool (listening ports of VMs etc)

Ref: <https://docs.microsoft.com/en-us/azure/load-balancer/components>

# Azure Load Balancer Components





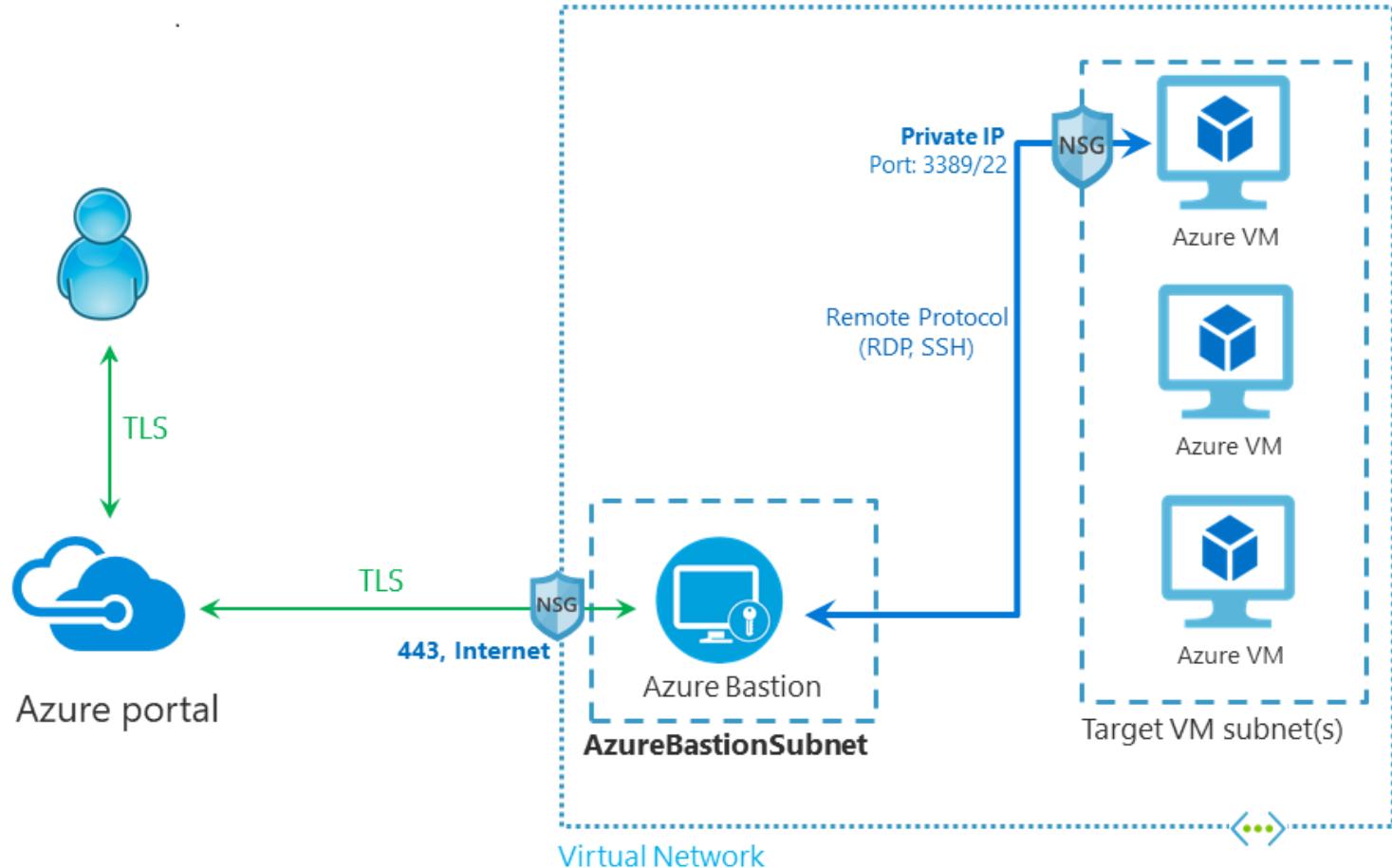
# Azure Bastion Service

# Overview of Azure Bastion service

- 1) Azure Bastion is a service you deploy that lets you connect to a virtual machine using your browser and the Azure portal
- 2) The Azure Bastion service is a fully platform-managed PaaS service that you provision inside your virtual network
- 3) It provides secure and seamless RDP/SSH connectivity to your virtual machines directly from the Azure portal over TLS
- 4) When you connect via Azure Bastion, your virtual machines do not need a public IP address, agent, or special client software

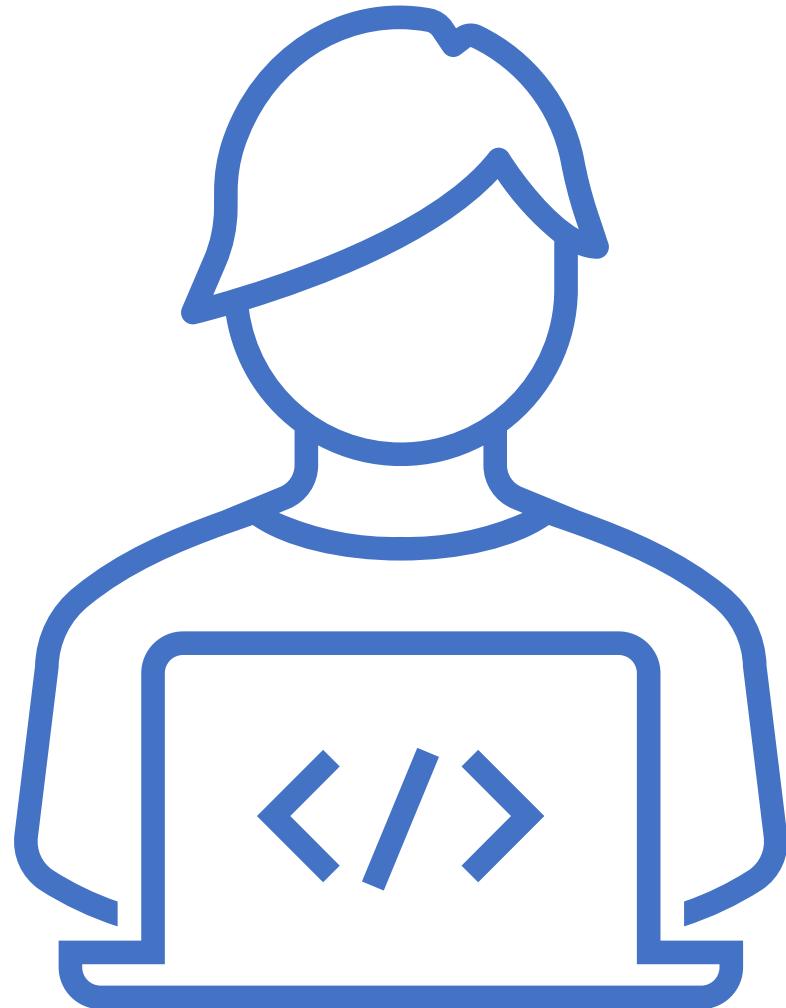
Ref: <https://docs.microsoft.com/en-us/azure/bastion/bastion-overview>

# Overview of Azure Bastion service



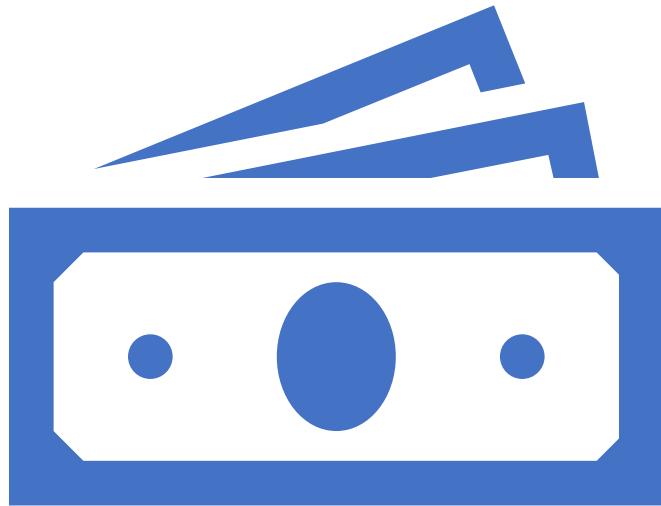
# Hands-on Labs

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# Lab: Deploying and Configuring Azure Bastion service & connect to a Windows VM

- 1) Create a bastion host by providing Project, Instance, Network details
- 2) Create a new Virtual Machine in the same Virtual Network as of Bastion host
- 3) Connect to created Azure VM using Bastion service



# Virtual Machine: Pricing

# Azure Virtual Machines: Pricing (Linux/Windows)

## On-Demand Instance (Pay-as-you-Go)

- Pay for compute capacity by the second, with no long-term commitment or upfront payments. Increase or decrease compute capacity on demand.

## Reserved Instances

- Significantly reduce costs—up to 72 percent<sup>1</sup> compared to pay-as-you-go prices—with one-year or three-year terms on Windows and Linux virtual machines (VMs)

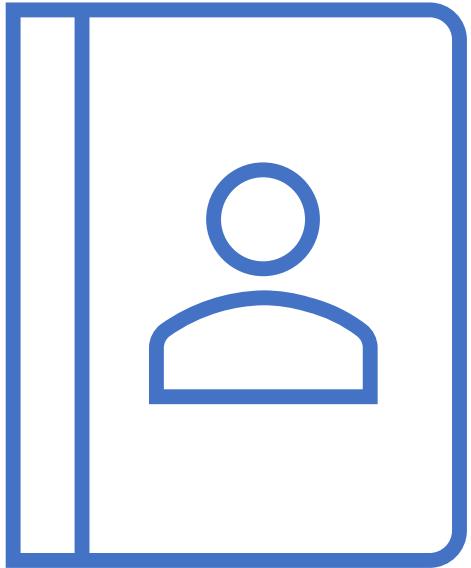
## Spot Instance

- Purchase unused compute capacity at deep discounts - up to 90 percent compared to pay as you prices.

## On-Demand Capacity Reservation

- On-demand Capacity Reservation enables you to reserve Compute capacity in an Azure region or an Availability Zone for any duration of time. Unlike Reserved Instances, you don't have to sign up for a 1-year or a 3-year term commitment.

Ref: <https://azure.microsoft.com/en-in/pricing/details/virtual-machines/windows/>  
<https://azure.microsoft.com/en-in/pricing/details/virtual-machines/Linux/>



# Azure Virtual Machine: Best Practices

# Azure VM best practices

- Protect VMs by using authentication and access control
- Use multiple VMs for better availability (using Availability sets or Availability Zones)
- Protect against malware (using Microsoft Antimalware or partner endpoint solutions)
- Manage your VM updates (Use Azure Automation's Update Management service)
- Manage your VM security posture (use Microsoft Defender for Cloud)
- Monitor VM performance (using Azure Monitor)
- Encrypt your virtual hard disk (VHDs) files (Enable encryption on VMs)
- Restrict direct internet connectivity (identify and remediate exposed VMs that allow access from “any” source IP address)

Ref: <https://docs.microsoft.com/en-us/azure/security/fundamentals/iaas>



# Azure Subscription: Service Limits

# Azure Service Limits

Let's understand the limit we have for Virtual Machines:

1. First go to your Subscriptions -> Select the Subscription
2. Go to **Usage + quotas**
3. You will then see the quotas

Ref: <https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/azure-subscription-service-limits>

