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Post Graduate Program in Cloud Computing

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Cloud

Implement VMs for Windows and Linux

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Learning Objectives

By the end of this lesson, you will be able to:

- Implement Virtual Machine (VM)

- Configure high availability for a VM

- Implement Azure dedicated hosts

- Deploy and configure scale sets

- Configure Azure disk encryption

A Day in the Life of an Azure Architect

You are working for a startup as a consultant that is looking to host a website. The website will run on the internet and will require a piece of hardware. However, being a startup, your company wants to avoid the initial investment required to buy hardware and wants to host this website on a cloud server and have complete control over it.

- You are advised to help your company with a solution that will provide high availability for your applications while also allowing you to manage, configure, and update a large number of VMs from a central location.
- You can select an appropriate VM size for your apps and workloads.

- Also, to keep the data secure you have been asked to suggest a solution that can help encrypt the data.

To achieve all of the above along with some additional features, we will be learning a few concepts in this lesson that will help you find a solution for the given scenario.

Virtual Machine
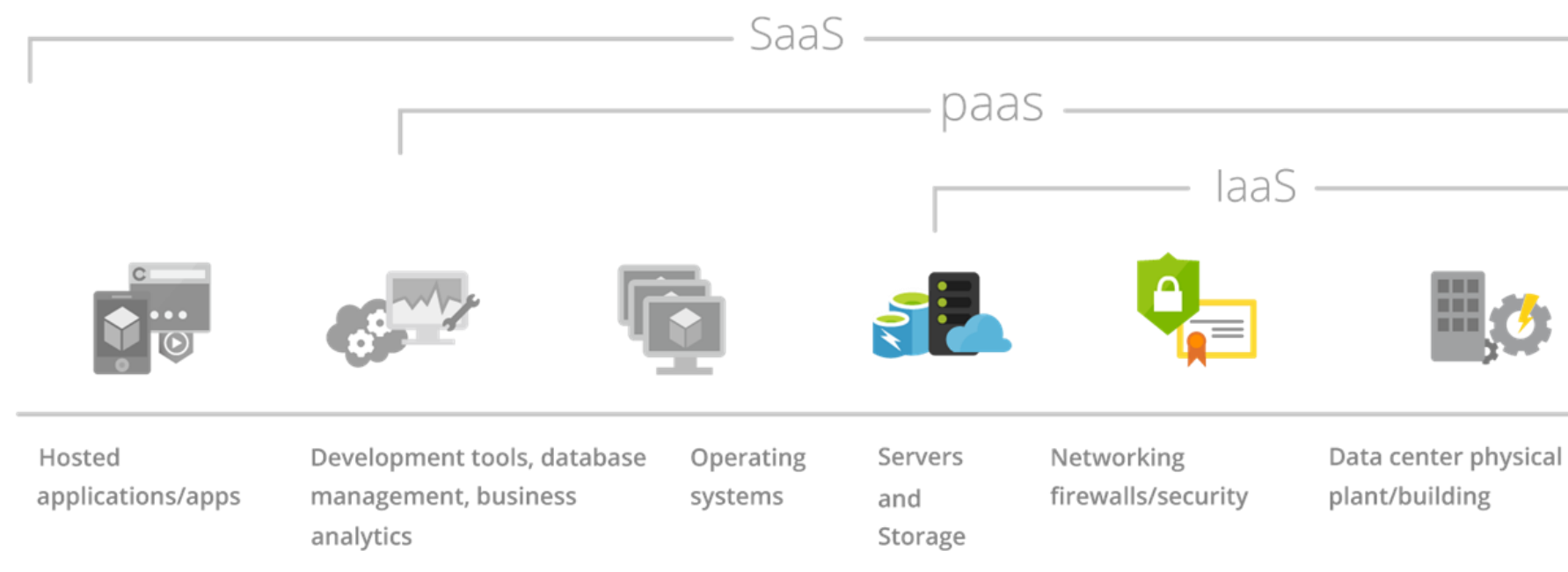
Azure Virtual Machine

The Azure Virtual Machine service is a scalable and on-demand computing resource that lets a user create virtual machines in Azure.

It provides an operating system as well as storage and networking capabilities.

IaaS Business Scenarios

Some common IaaS business scenarios are:

- Test and development
- Website hosting
- Storage, backup, and recovery
- Web apps
- High-performance computing
- Big data analysis
- Extended data center

image source: https://docs.microsoft.com/en-in/

Planning Checklist

The following things constitute the planning checklist.

- Start with the network

- Name the VM

- Choose a location for the VM

- Determine the VM's size

- Understand the pricing model

- Consider the VM's storage options

- Choose an operating system

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Virtual Network

Azure uses virtual networks (VNets) to provide secure communication between Azure Virtual Machines and other Azure services.

- Virtual machines and services in the same virtual network can interact with one another. Services from outside the virtual network cannot connect to services inside the virtual network by default.
- However, you can configure the network to enable access to the external service, including your on-premise servers.
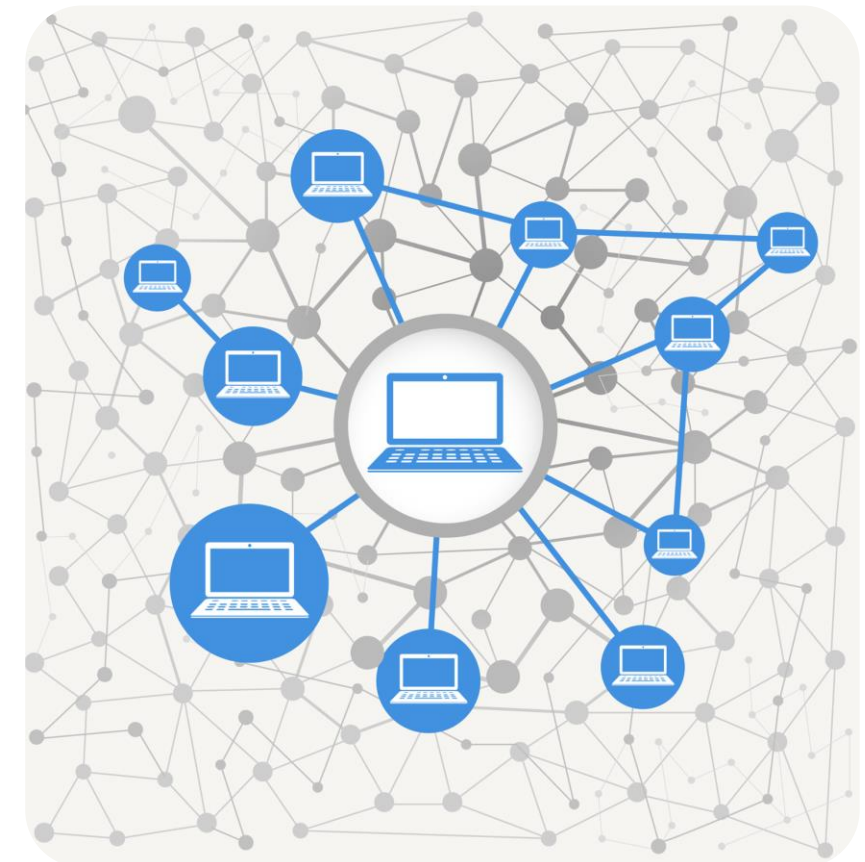
Name the VM

The name of the VM is used as the computer name, which is configured as part of the operating system.

- On a Windows VM, you can enter a name of up to 15 characters, and on a Linux VM, you can enter a name of up to 64 characters.
- That means you must name the VMs that are meaningful and clear, so you can tell what it does quickly.

Name the VM

Element	Example	Notes
Environment	dev, prod, QA	Identifies the environment for the resource
Location	uw (US West), ue (US East)	Identifies the region into which the resource is deployed
Instance	01, 02	For resources that have more than one named instance (web servers, etc.)
Product or Service	service	Identifies the product, application, or service that the resource supports
Role	sql, web, messaging	Identifies the role of the associated resource

Location and Pricing

Location

**60+ Azure regions
Available in 140 countries**

- Each region has different hardware and service capabilities.

- Select the region where you want the resources to be allocated.

- Locate virtual machines as close as possible to your users to improve performance.

- Determine the location of virtual machines to ensure legal compliance.

- The location can limit your available options.

- There are price differences between locations.

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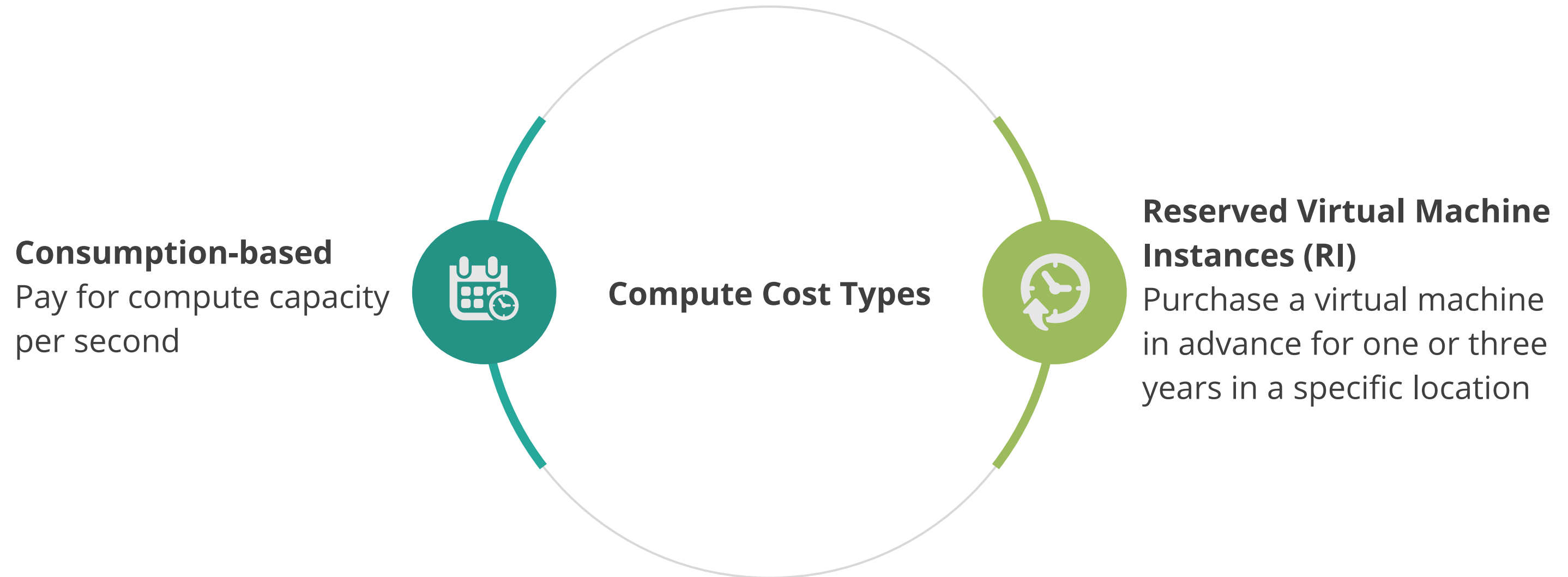
Location and Pricing

Pricing

Compute costs (consumption-based and reserved instances)

- Compute costs are priced on an hourly basis but billed on a minute basis.
- When you stop and deallocate a VM, you are not charged for compute resources since the hardware is released.
- The cost for a VM includes the charge for the operating system.

Location and Pricing

The types of compute costs are as follows:

Compute Cost Types

Consumption-based
Pay for compute capacity per second

Reserved Virtual Machine Instances (RI)
Purchase a virtual machine in advance for one or three years in a specific location

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Pricing

**54 Azure regions
Available in 140 countries**

Storage costs

- ○ The storage that the VM consumes is charged separately.
- ○ The VM's status has no impact on the storage charges that would be incurred; even if the VM is stopped/deallocated and you aren't billed for the active VM, you will be billed for the disk storage used.

Virtual Machine Sizing

VM Type	Sizes	Purpose
General Purpose	B, Dsv3, Dv3, DSv2, Dv2, Av2, DC	VMs are designed to have a balanced CPU-to-memory ratio. Testing and development, small to medium databases, and low to medium traffic web servers.
Compute Optimized	Fsv2, Fs, F	VMs are designed to have a high CPU-to-memory ratio. Medium traffic web servers, network appliances, batch processes, and application servers.
Memory Optimized	Esv3, Ev3, M, GS, G, DSv2, Dv2	VMs are designed to have a high memory-to-CPU ratio. Relational database servers, medium to large caches, and in-memory analytics.

Virtual Machine Sizing

VM Type	Sizes	Purpose
Storage Optimized	Lsv2, Ls	Storage optimized VMs are designed to have a high-disk throughput and IO. Ideal for VMs running databases.
GPU	NV, NVv2, NC, NCv2, NCv3, ND, NDv2 (Preview)	GPU VMs are specialized virtual machines targeted for heavy graphics rendering and video editing. Ideal for model training and inferencing with deep learning.
High Performance Compute	H	Fastest and most powerful CPU virtual machines with optional high-throughput network interfaces.

Note: Be cautious when resizing production VMs - they will be rebooted automatically which can cause a temporary outage and change some configuration settings such as the IP address.

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Virtual Machine Disks

The types of disks in every Azure virtual machine are:

Disks	OS disk				
Size	NAME	SIZE	STORAGE ACCOUNT...	ENCRYPTION	HOST CACHING
Security	UbuntuServer_OsDisk_1_	30 GiB	Standard_LRS	Not enabled	Read/write
Extensions	Data disks				
Continuous delivery	None				

Operating System Disks

SATA drives, labeled as C: drive, by default with a maximum capacity of 2048 GiB.

Temporary Disks

Provides short term storage. Not suitable for storing critical data.

Data Disks

SCSI drives used to store application or other data with a maximum capacity 4095 GiB

Storage Options

Premium storage supports SSD disk with high performance and low latency and can be used by VMs that have input/output (I/O)-intensive workloads.
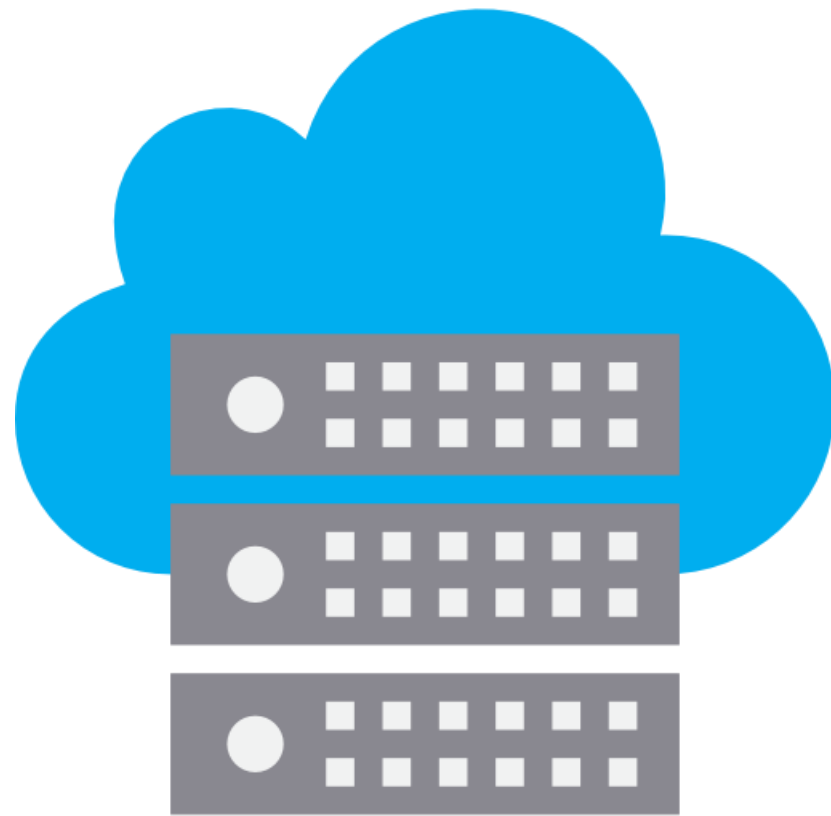
There are two kinds of discs:

- **Managed**: Azure maintains them (recommended).
- **Unmanaged**: User must handle storage accounts and VHDs on unmanaged discs. VHD files are stored in Azure storage accounts as page blobs.

Supported Operating Systems

Azure offers a variety of OS images that can be installed into the VM, including several versions of Windows and flavors of Linux.

Operating Systems

- Windows Server
  Microsoft
- Ubuntu Server
  Canonical
- Red Hat Enterprise Linux 7.5
  Red Hat
- Windows Client
  Microsoft
- SUSE Linux Enterprise Server
  software purchase
  Microsoft
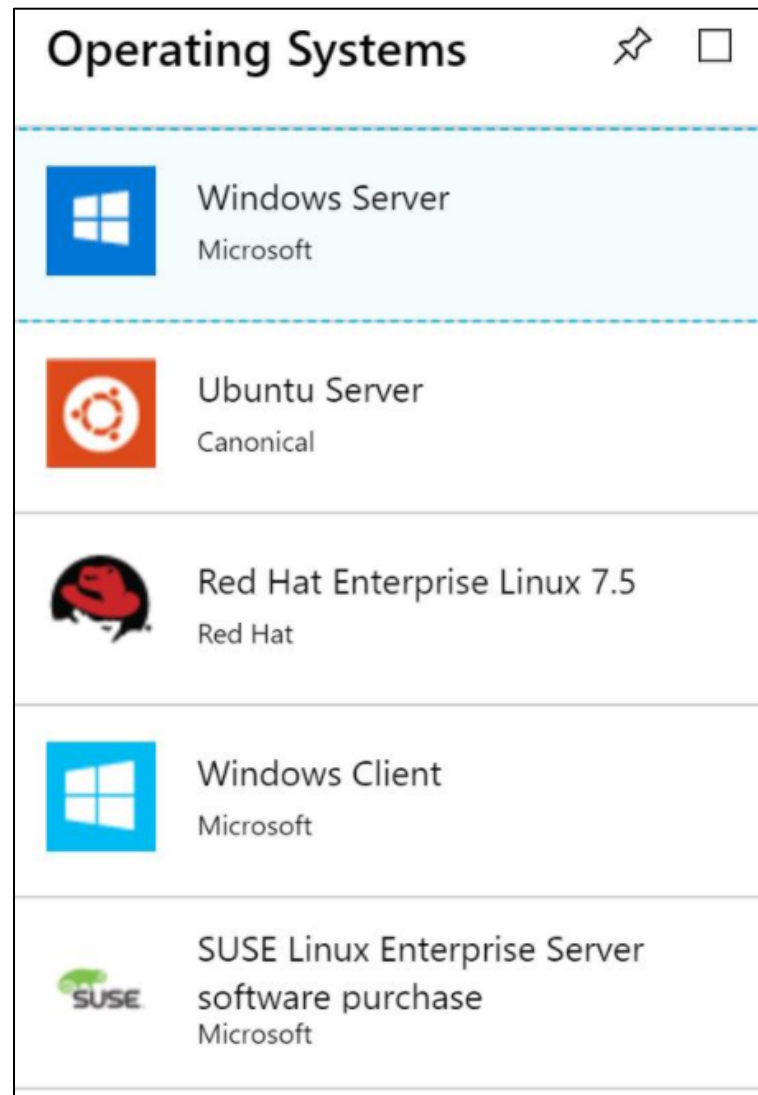
Windows Server

- Includes a license for Windows Server, Microsoft Exchange, Microsoft SQL Server, and Microsoft SharePoint Server.
- Does not support upgrading a Microsoft Azure VM's Windows operating system

Supported Operating Systems

Operating Systems

- **Windows Server**
  Microsoft

- **Ubuntu Server**
  Canonical

- **Red Hat Enterprise Linux 7.5**
  Red Hat

- **Windows Client**
  Microsoft

- **SUSE Linux Enterprise Server software purchase**
  Microsoft

Linux Distributions

- CentOS by OpenLogic, Core OS, Debian, Oracle Linux, Red Hat Enterprise Linux, and Ubuntu are supported.
- Linux endorsed distributions support an update of the operating system of a Microsoft Azure VM (If open source).

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Azure VM Architecture

Apart from the VM itself, provisioning a virtual machine (VM) in Azure requires the use of networking and storage resources.

image source: https://docs.microsoft.com/en-in/
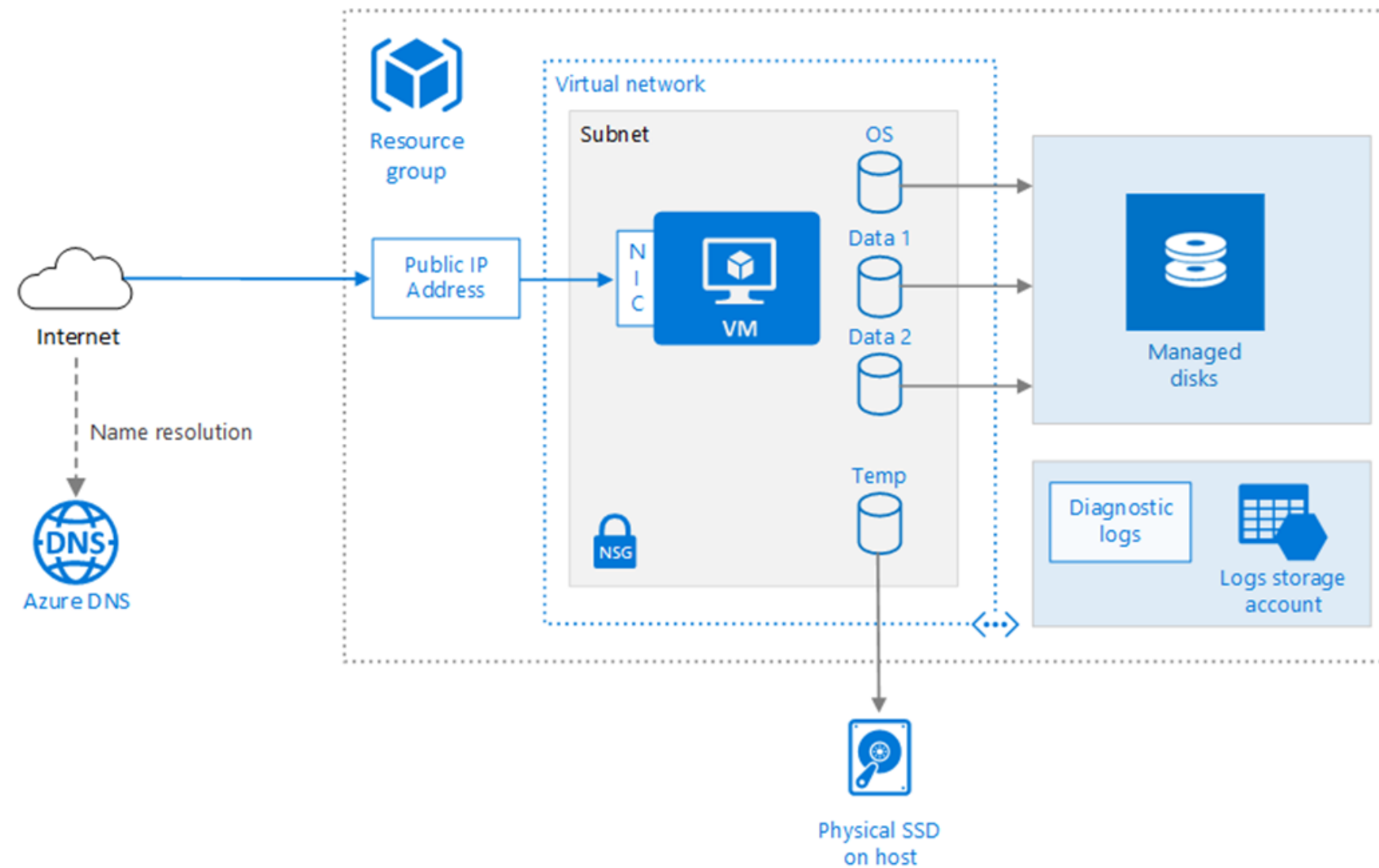
Virtual Machine High Availability

# Maintenance and Downtime

Unplanned Hardware Maintenance	Unexpected Downtime	Planned Maintenance

- When the platform foresees a malfunction, an unplanned hardware maintenance event is triggered.
  Action: Live migration

- When a virtual machine crashes unexpectedly, it is known as unexpected downtime.
  Action: Automatically migrate (heal)

- Periodic updates to the Azure platform are known as planned maintenance activities.
  Action: No action

Availability Sets

An availability set is a logical grouping of VMs within a data center.
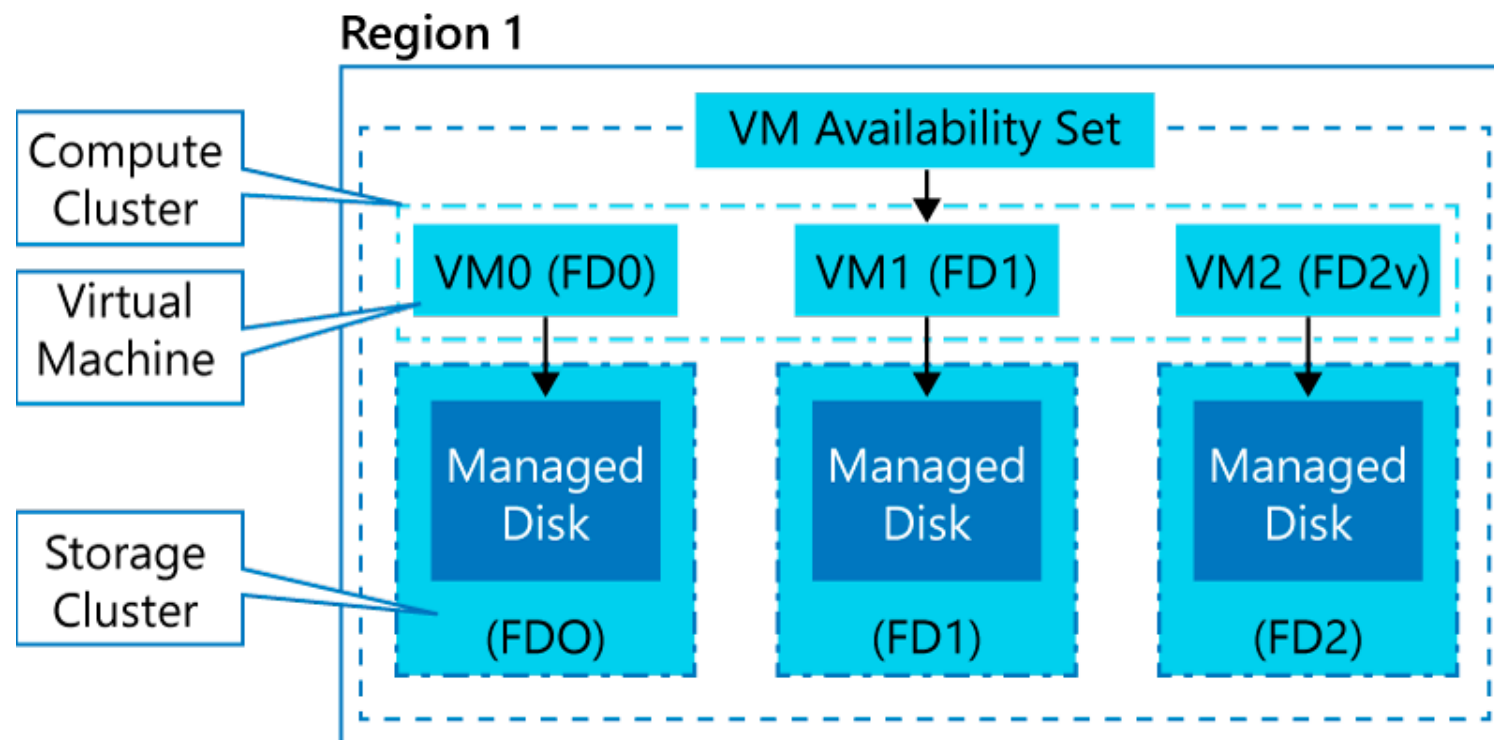
- On compute clusters, VMs are automatically distributed across fault and update domains.

- On storage clusters, it provides equal resiliency with managed disks.

- Provides a service level agreement (SLA) of 99.95 % availability (for 2 or more VMs).

image source: https://docs.microsoft.com/en-in/

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Update and Fault Domains

Update domains

- Azure can make incremental or rolling updates across a deployment using update domains.

- Only one update domain is rebooted at a time during scheduled maintenance.

- There are five update domains by default, but you can add up to 20 more.


image source: https://docs.microsoft.com/en-in/

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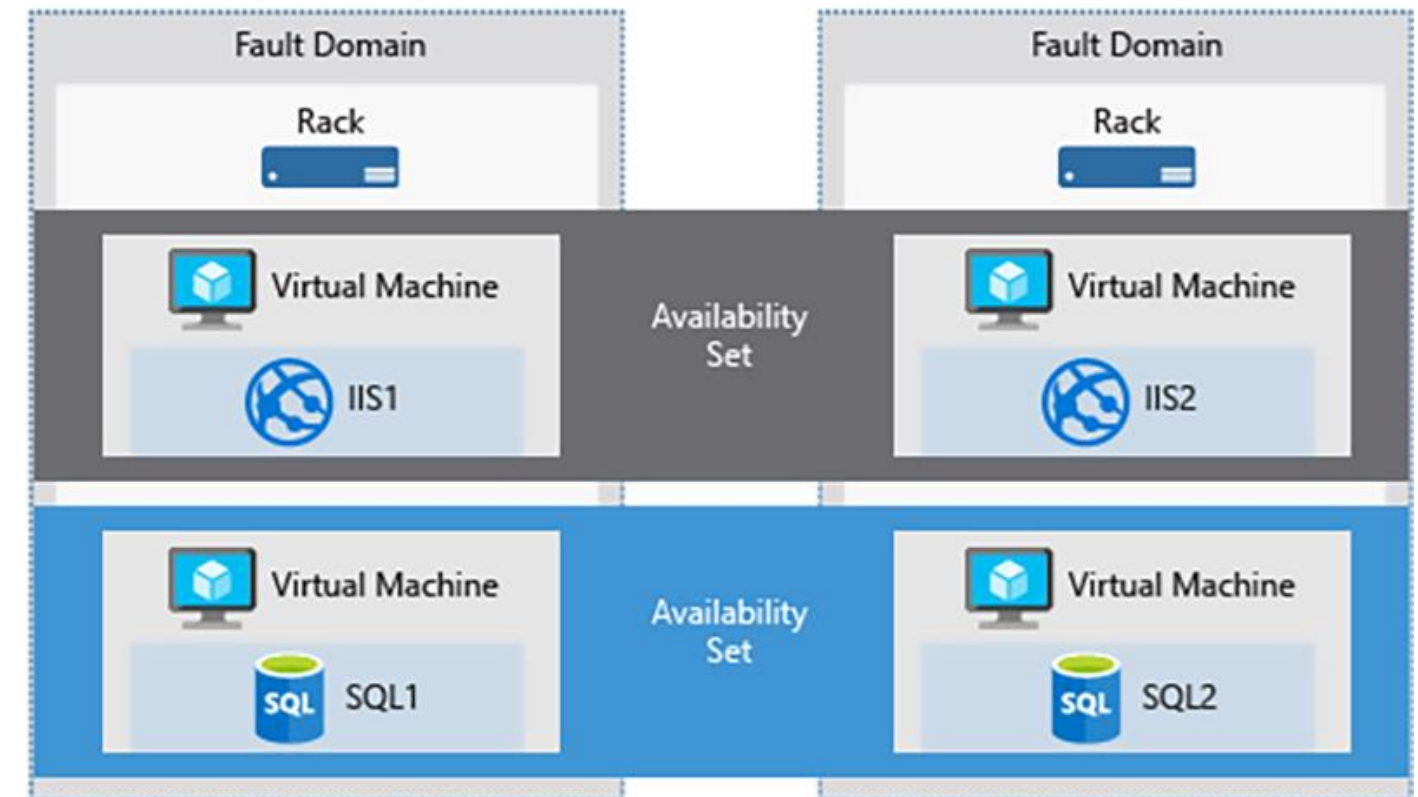
Update and Fault Domains

- These are a set of virtual machines that share a single point of failure and a similar set of hardware and switches.

- At least two fault domains are allocated to each VM in an availability set.

- Up to three fault domains can be configured.
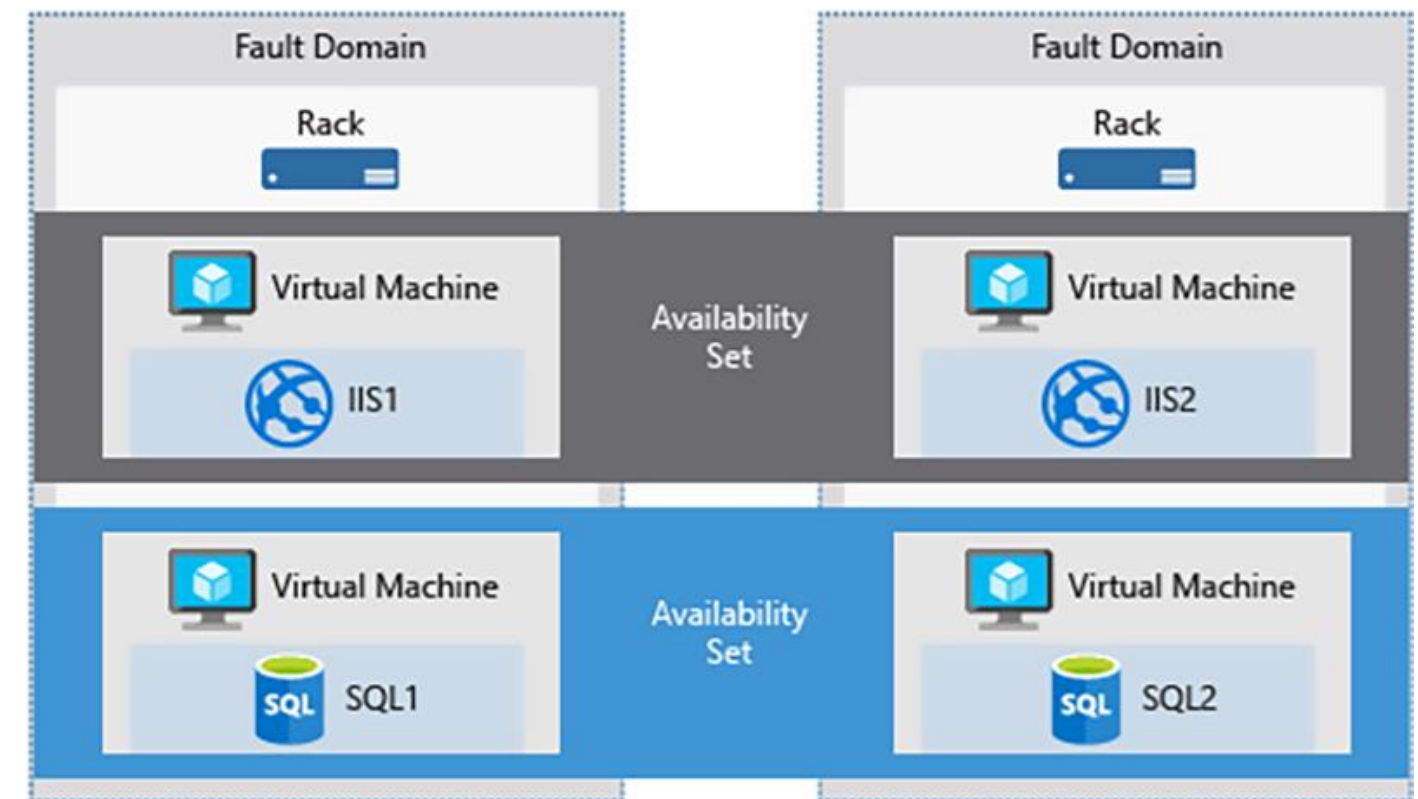
Availability Zones

Availability Zones is a high-availability service that safeguards the applications and data in the event of a data centre failure.

image source: https://docs.microsoft.com/en-in/
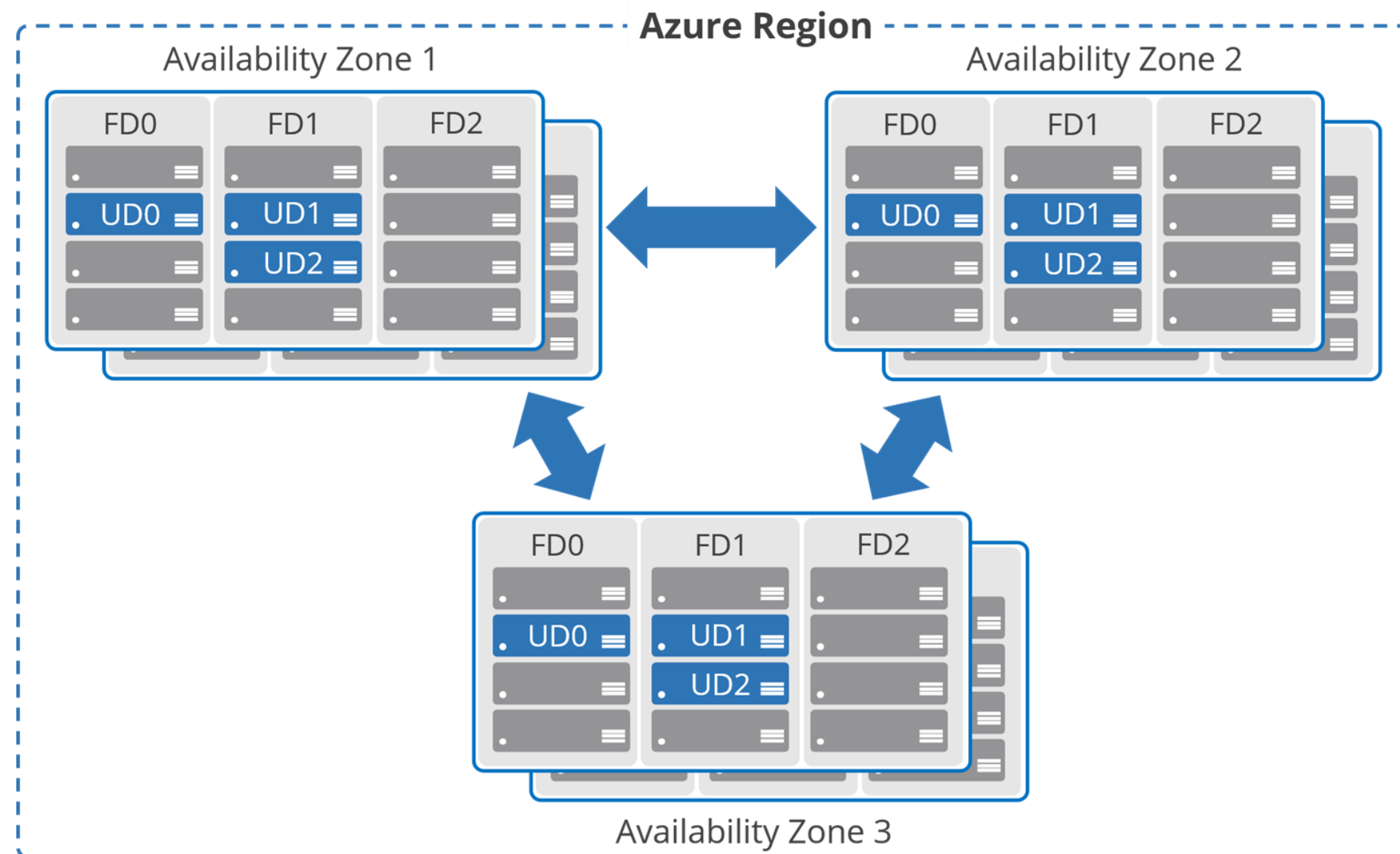
Service Level Agreements

- 99.99 % uptime guarantee for all virtual machines with two or more instances deployed in two or more Availability Zones.

- 99.95 % uptime guarantee for all virtual machines with two or more instances deployed in the same Availability Set.

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Service Level Agreements

- 99.90 % uptime guarantee on any single instance virtual machine that uses premium storage for all operating system disks and data disks.

- A VM can only be added to an availability set when it is created.

Assisted Practice

Virtual Machine Availability set and Machine Extension   **Duration: 10 Min.**

Problem Statement:

You are given a project to set up an availability set, which will allow Azure to understand how your application is constructed to provide redundancy and availability, as well as to add a machine extension, which will provide post-deployment setup and automated activities for a virtual machine.

Assisted Practice: Guidelines

Steps to set up availability set and machine extension for virtual machine:

1. Login to your azure portal
2. Configure availability set while creating a VM
3. Add an extension to VM

Azure Dedicated Hosts

Azure Dedicated Hosts

Azure Dedicated Host is a service that delivers physical servers, dedicated to a single Azure subscription and capable of hosting one or more virtual machines.

Host group
- Name
- Region
- Optional: Availability zone and fault domain count

Dedicated Host
- Name
- Asset ID
- Fault domain
- SKU

Virtual Machines
- Name
- ID
- Size
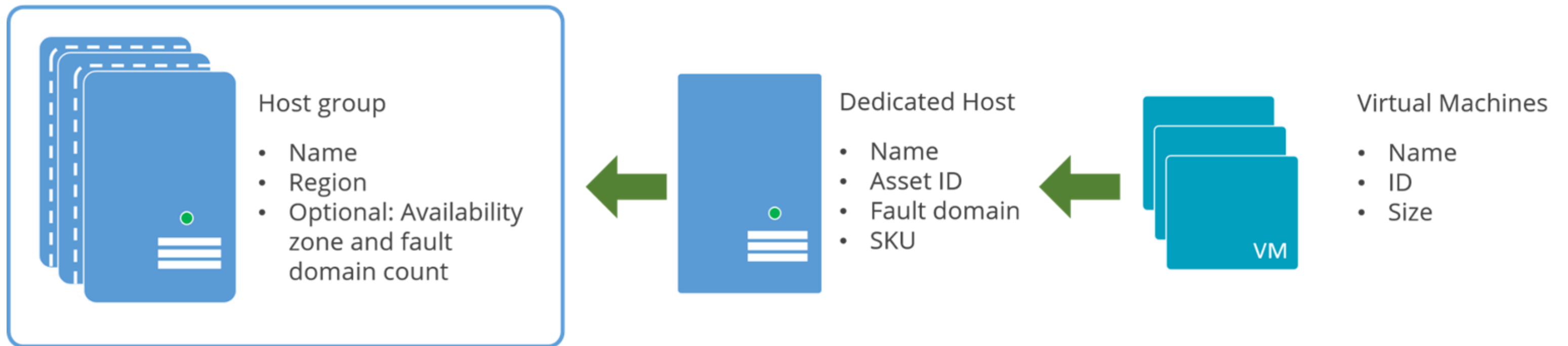
Dedicated hosts are physical servers that are used in data centers and are available as a resource.

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Azure Dedicated Hosts

Benefits of Azure dedicated hosts are given below:

03 — Control failovers

04 — Significant cost savings

02 — Compliance

05 — Licensing flexibility

01 — Physical isolation

Benefits
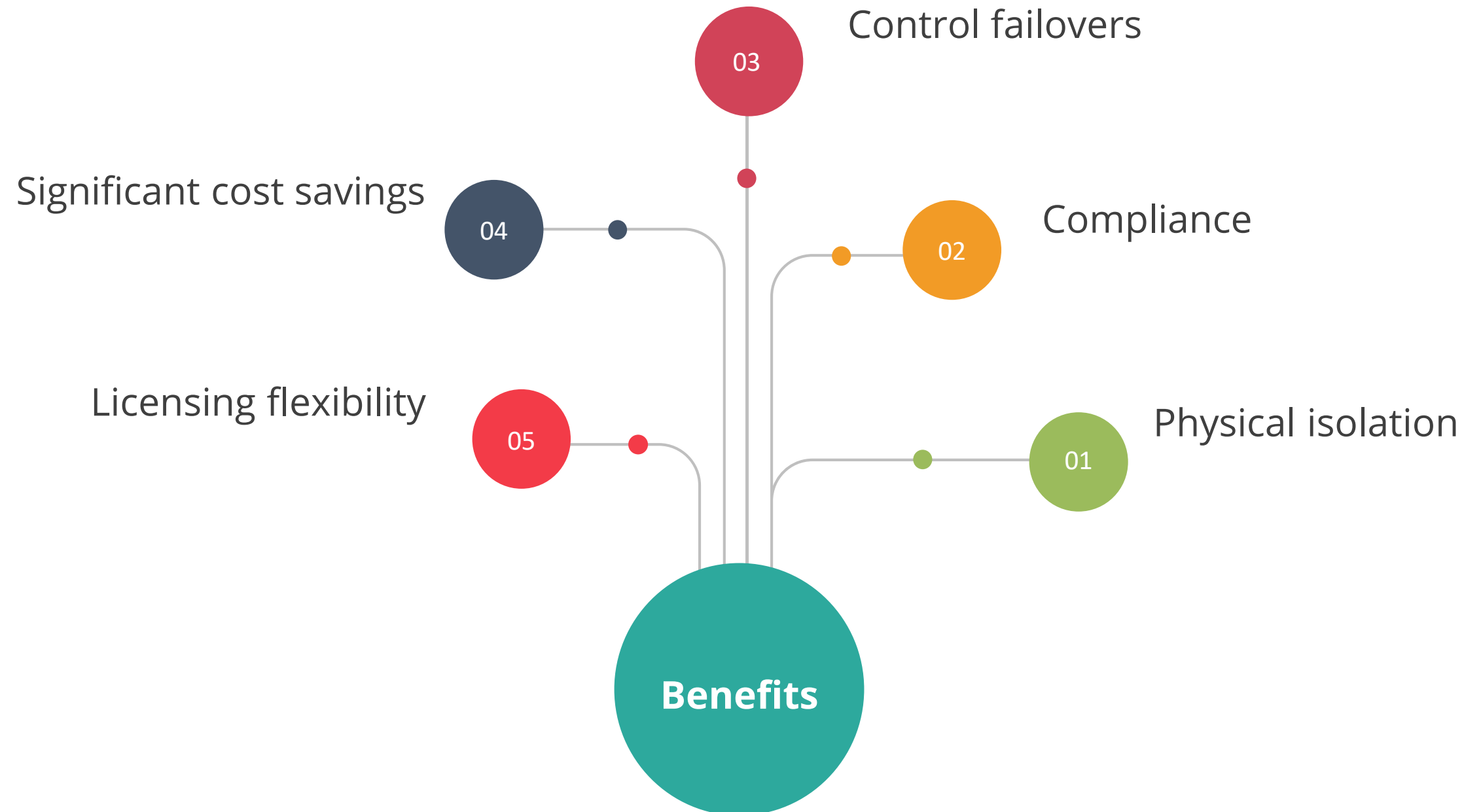
High Availability Considerations

The user should deploy many VMs across multiple hosts for maximum availability.

Use fault domains for
fault isolation

02

Use availability zones
for fault isolation

01

03

Use availability zones
and fault domains

**Options to design fault
isolation boundaries
using Azure Dedicated
Hosts**

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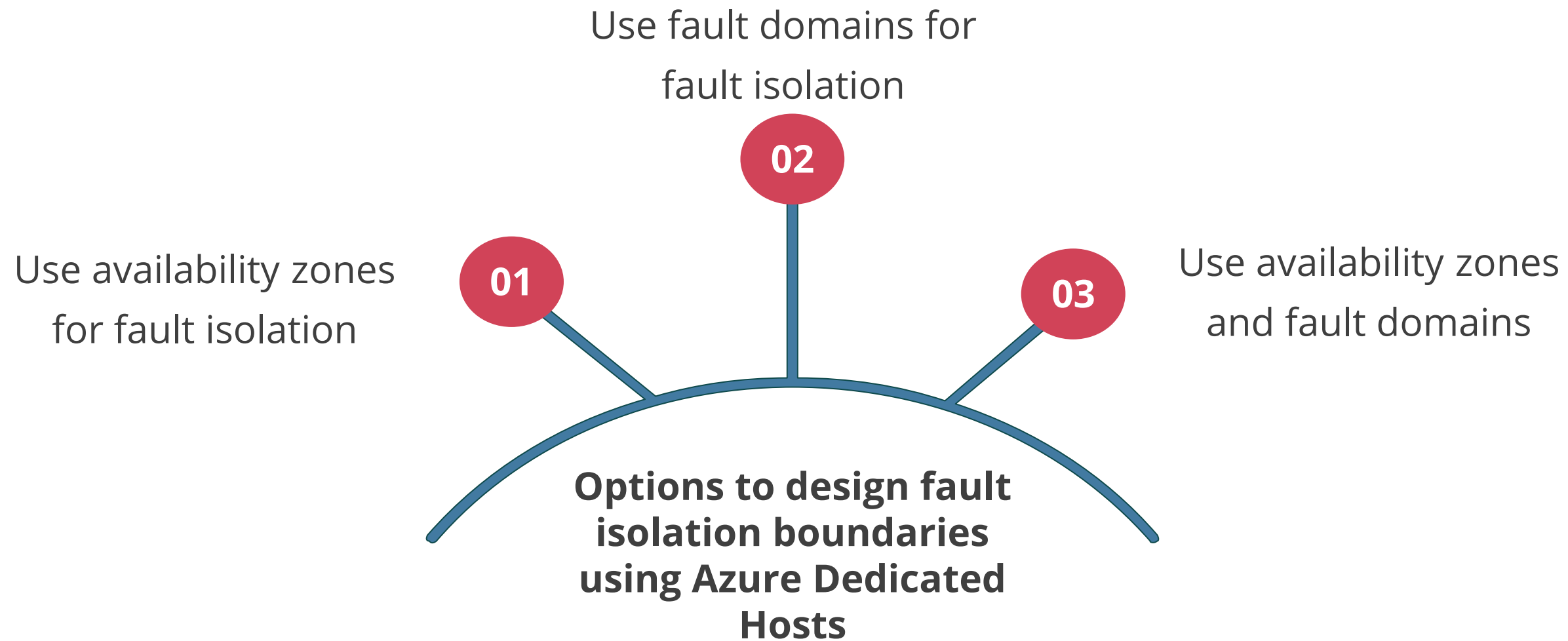
High Availability Considerations

Use availability zones for fault isolation

- A host group is created in a single availability zone.
- Once created, all hosts are placed within that zone.

Use fault domains for fault isolation

- A host can be created in a specific fault domain.
- When a user creates a host group, it is required to specify the fault domain count.

Use availability zones and fault domains

- The user can use both capabilities together to achieve more fault isolation.
- Each of the servers in the group should have a fault domain, and each of the VMs should have an availability zone.

Azure Dedicated Hosts Capacity

Azure assigns a dedicated host to a physical server after it is deployed. This ensures that the capacity will be available when the user needs to supply his VM.

These are the two capacity considerations:

Pricing

Quotas

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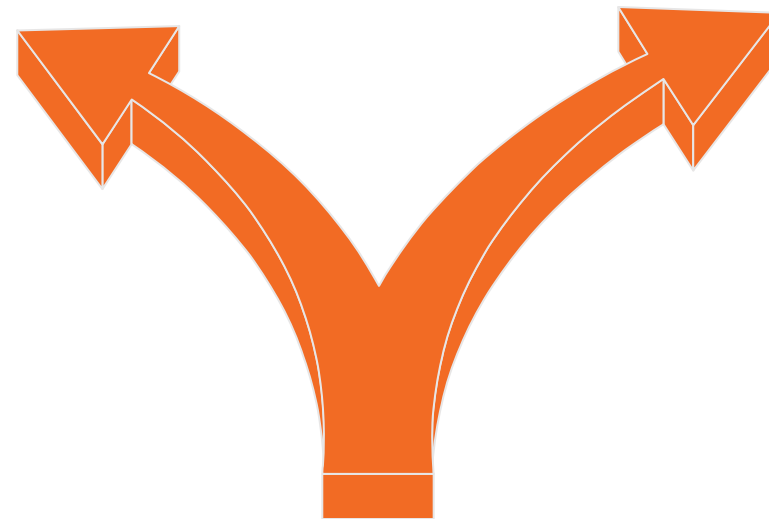
Azure Dedicated Hosts Capacity

Pricing

The host and VMs are invoiced separately for software licensing, storage, and network consumption.

The price of a host is determined by the VM family, kind (hardware size), and region.

Users are paid per dedicated host, regardless of how many VMs are deployed.
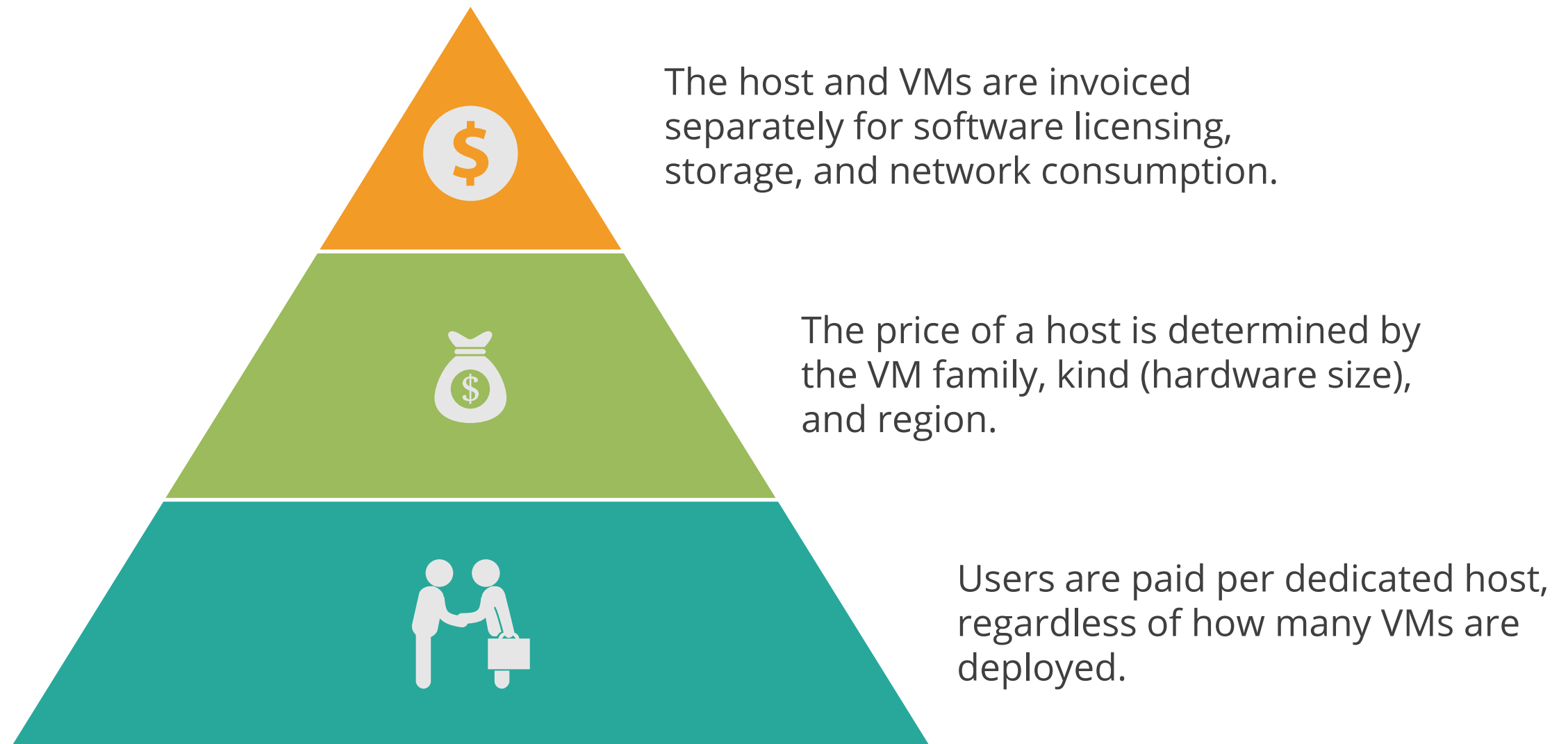
Azure Dedicated Hosts Capacity

Quotas
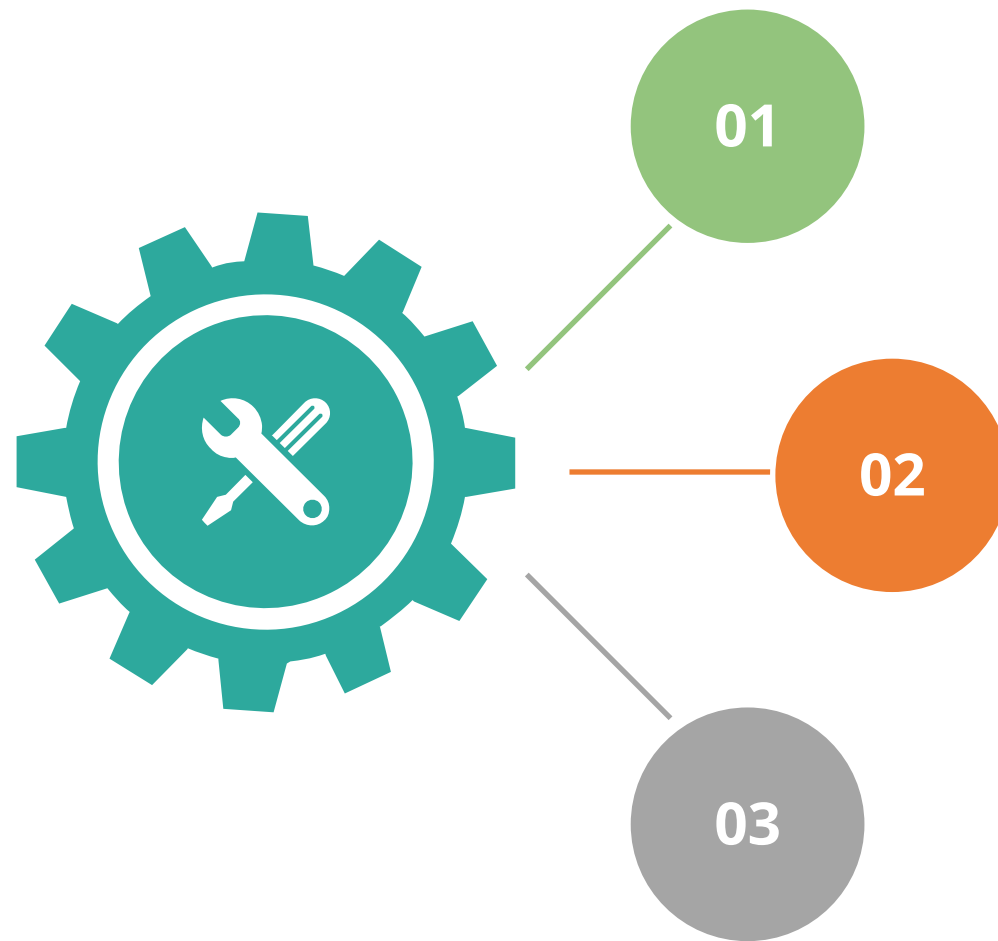
01 Two types of quota are consumed while deploying a dedicated host, dedicated host vCPU quota and VM size family quota.

02 The default quota limit per region is 3000 vCPUs.

03 Provisioning a dedicated host uses the dedicated host vCPU as well as the VM family vCPU quota, but not the regional vCPU.

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Deploy VMs to Dedicated Hosts

There are two limitations to deploy VMs to dedicated hosts:

Host

Optionally placing your virtual machine in a host   Learn more

Host group ⓘ   myHostGroup | Zone 1 | eastus ⌄

Host ⓘ   myHost ⌄

- On dedicated hosts, virtual machine scale sets are not presently supported.

- The sizes and types of dedicated hosts accessible vary by area.

Deploy VMs to Dedicated Hosts

These are the steps to deploy VMs to dedicated hosts:

01 Create a host group in portal
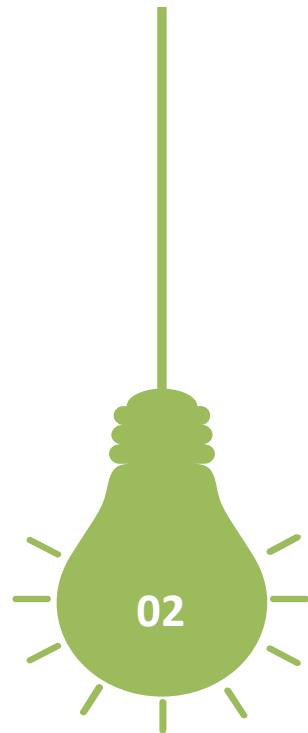
02 Create a dedicated host

03 Create a VM in portal

04 Add an existing VM

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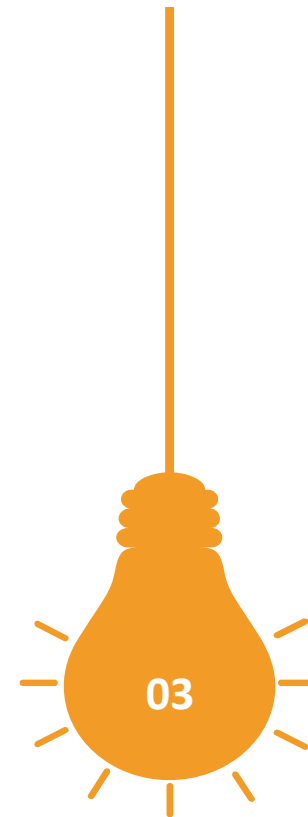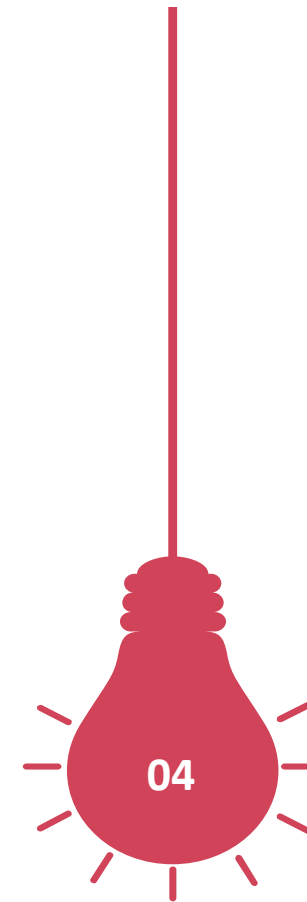
Azure Virtual Machine Scale Sets

Scale Sets

The user can create large-scale services for areas like computation, big data, and container workloads using virtual machine scale sets.
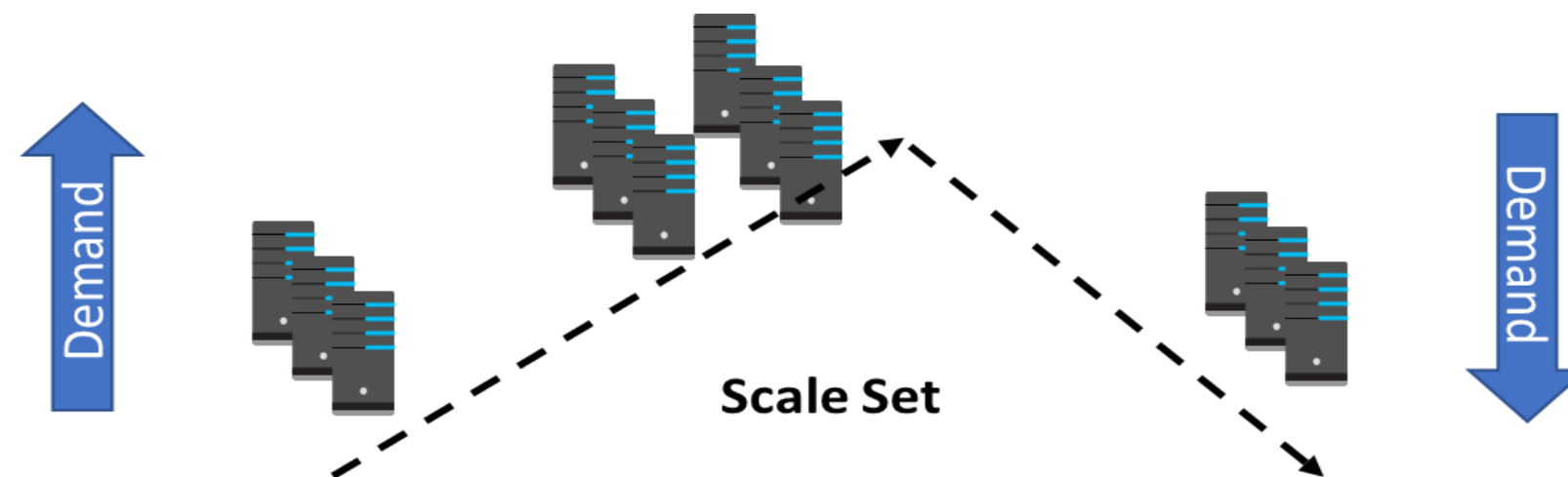
The user can construct and manage a group of load-balanced VMs using Azure virtual machine scale settings.

Scale Sets
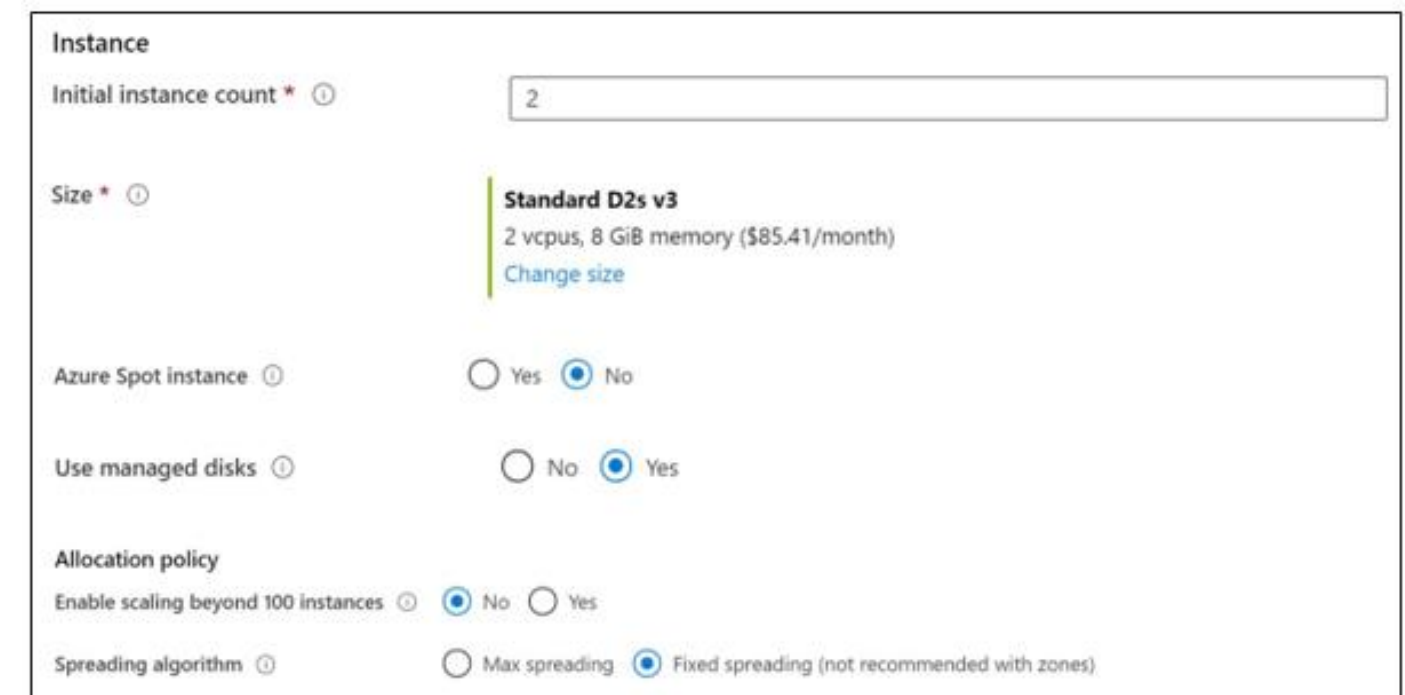
The benefits of scale sets are:

Multiple VMs are simple to set up and manage

Ensures application availability and resiliency

Large scale projects

Allows the application to automatically scale as demand changes

Scale Sets

Implementing Scale Sets

These are the following terms that the user should keep in mind while implementing scale sets:

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

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

- **Azure spot instance:** Can save up to 80%

- **Use managed disks**

- **Enable scaling beyond 100 instances**

Autoscale

Autoscale enables the user to run the appropriate number of resources to handle the load on application.

It allows users to add resources to manage increased load while also saving money by reducing idle resources.
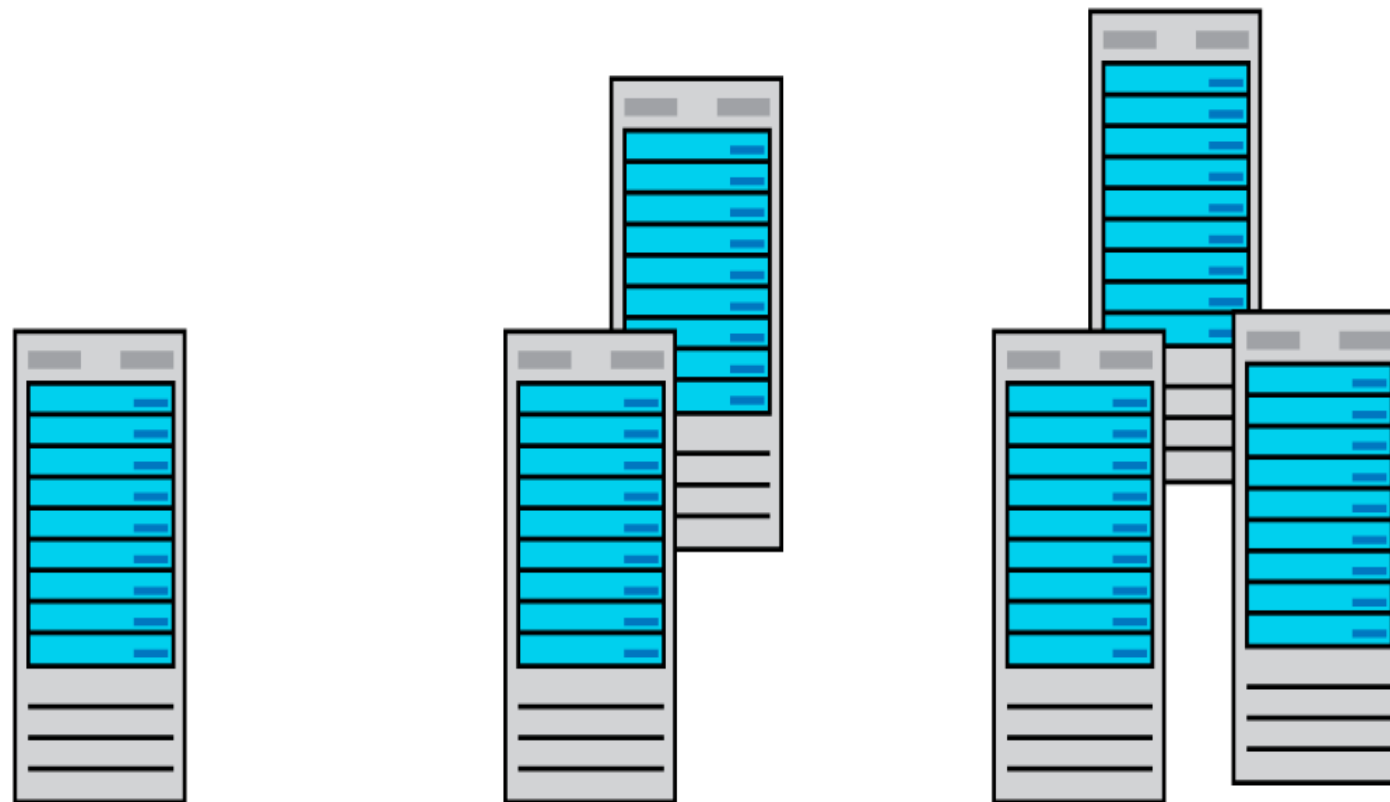
Autoscale

There are two main ways that an application can scale:

1 Horizontal Scaling
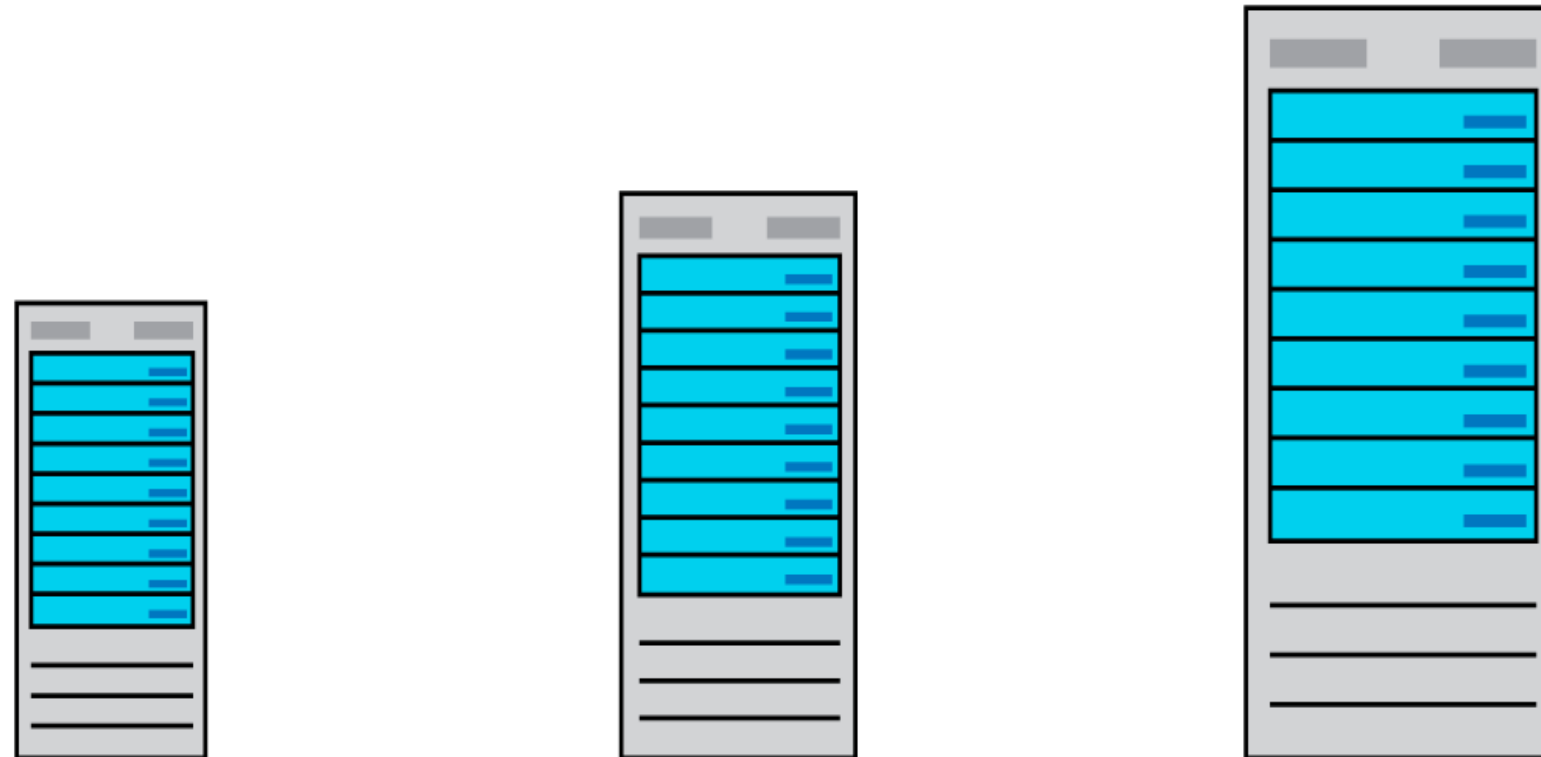
2 Vertical Scaling
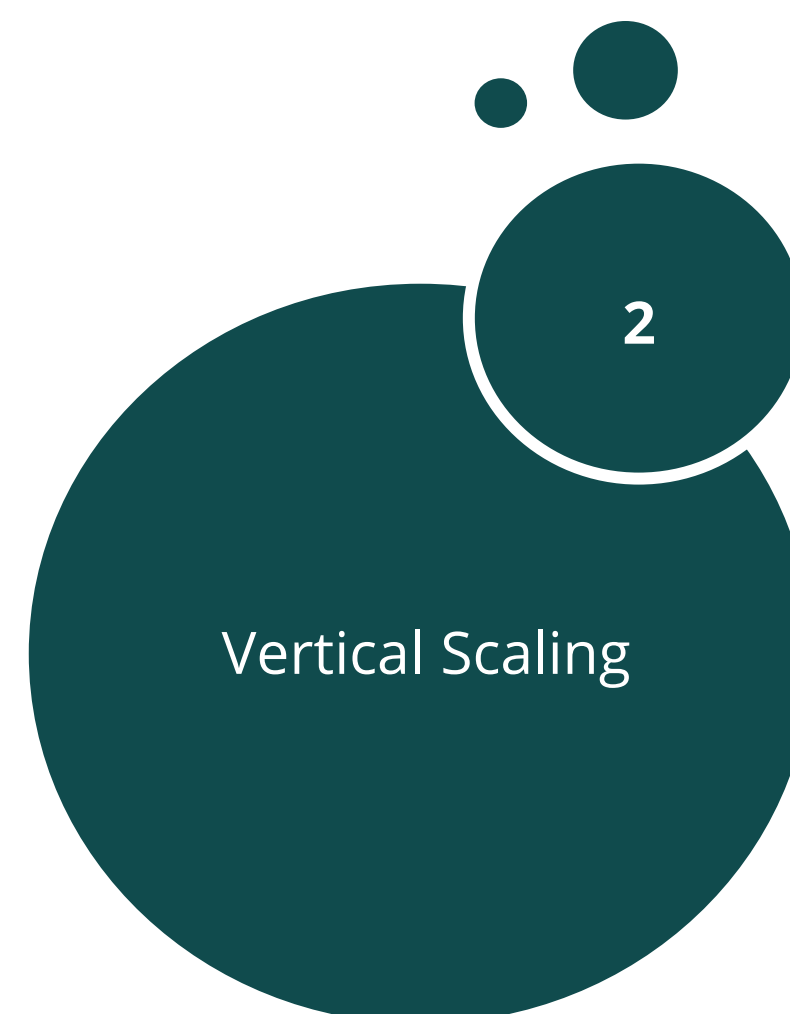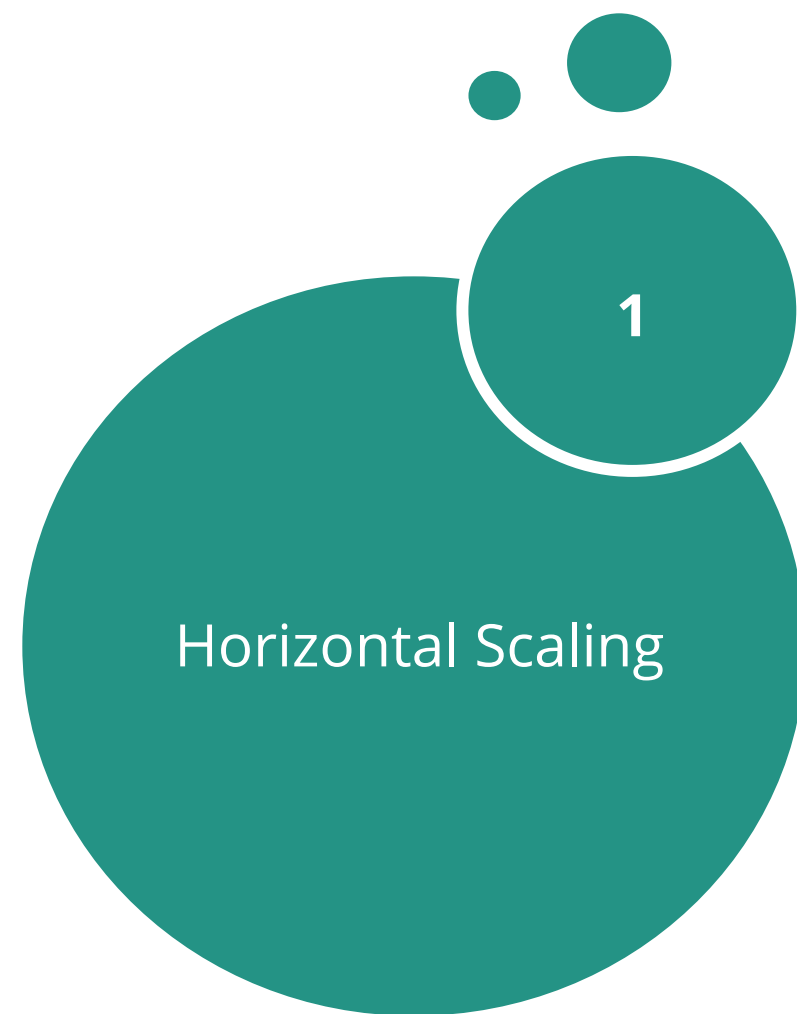
Horizontal Scaling

It is also called as scaling out and in.

- As fresh resources are deployed, the application continues to execute without interruption.

- The solution is deployed on these additional resources after the provisioning process is complete.

Vertical Scaling

It is also called as scaling up and down.

Vertical scaling often requires making the system temporarily unavailable, while it is being redeployed.

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Implementing Autoscale

Autoscale can be implemented by:

- Defining a minimum, maximum, and default number of VM instances
- Creating more advanced scale sets with scale out and scale in parameters

Create virtual machine scale set

AUTOSCALE

Autoscale ⓘ	Disabled Enabled
* Minimum number of VMs ⓘ	1
* Maximum number of VMs ⓘ	10

Scale out

* CPU threshold (%) ⓘ	75
* Number of VMs to increase by ⓘ	1

Scale in

* CPU threshold (%) ⓘ	25
* Number of VMs to decrease by ⓘ	1

Assisted Practice

Virtual machine scale set   **Duration: 10 Min.**

Problem Statement:

You've been assigned a project to construct a virtual machine scale set that will provide high availability for your applications while also allowing you to manage, configure, and update a large number of VMs from a central location.

Steps to create virtual machine scale set:

1. Login to your azure portal
2. Create a load balancer
3. Create a virtual machine scale set

Azure Disk Encryption for Virtual Machines

Azure Encryption Technologies

There are two main encryption-based disk protection methods for Azure VMs.

Storage Service Encryption (SSE)

- Performed in a data centre on a physical disk.
- All new and existing storage accounts have this feature enabled.
- It is not possible to disable it.

Azure Disk Encryption (ADE)

- VHDs of virtual machines are encrypted.
- The VM owner is in charge of it.
- On Windows VMs, BitLocker is used; on Linux VMs, DM-Crypt is used.
- Azure Key Vault is used to store encryption keys.

Deciding When to Use Encryption

Computer data is at risk when in transit (transmitted across the Internet or other networks), and at rest (saved to a storage device).

Azure provides the following additional disk encryption methods:

- SSE (Storage Service Encryption) is a feature of Azure (mandatory)
- ADE (Azure Disk Encryption) makes use of operating system tools (optional)
- When both are used together, you get defense-in-depth protection.

Encrypting an Existing VM Disk

Azure disk encryption prerequisites:

- An Azure key vault
- A key vault access policy that enables support for disk encryption
- ADE encryption keys stored in the key vault

To encrypt an existing VM disk, use:

- Azure PowerShell
- Azure CLI

Assisted Practice

Creating a Virtual Machine and Implement VM Disk Creation and VM Size   Duration: 10 Min.

Problem Statement:

You've been assigned a project to create a virtual machine by selecting the appropriate VM size for your apps and workloads, as well as implement VM disk formation.

Assisted Practice: Guidelines

Steps to create a virtual machine and implement VM disk creation and VM size:

1. Login to your azure portal
2. Create a virtual machine in the Azure portal
3. Create a VM disk
4. Manage VM size

Key Takeaways

- The Azure Virtual Machine service is a computing resource that lets a user create virtual machines in Azure.

- Azure uses VNets to provide secure communication between Azure Virtual Machines and other Azure services.

- Availability Zone is a high-availability service that safeguards the applications and data, in the event of a data centre failure.

- Azure Dedicated Host is a service that provides physical servers that can host one or more virtual machines.

- Azure provides additional disk encryption methods like Storage Service Encryption and Azure Disk Encryption.

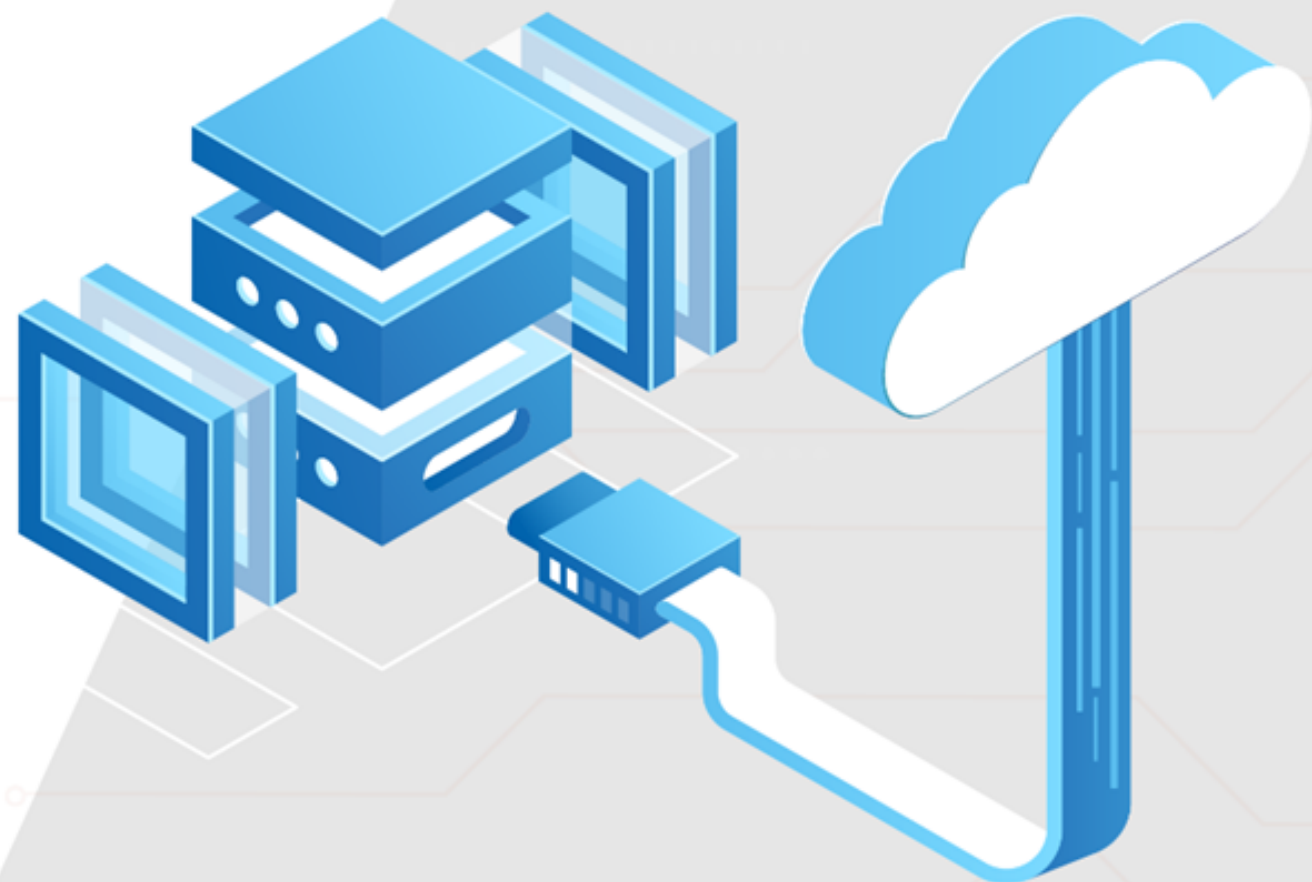## Connect and sign-in to an Azure Windows virtual machine

Duration: 25 Min.

Project agenda: To connect and sign-in to an Azure windows virtual machine

Description: You have been given a project to create a Virtual Machine (Windows). Ensure that you are able to RDP into the VM. Once the VM is created you need to spin up a web server on VM and ensure that it is reachable on Port 80. Also, to cater to additional data storage needs you need to add a data disk to the Virtual Machine.

Perform the following:

Create a windows virtual machine and connect to it using RDP.

Thank you