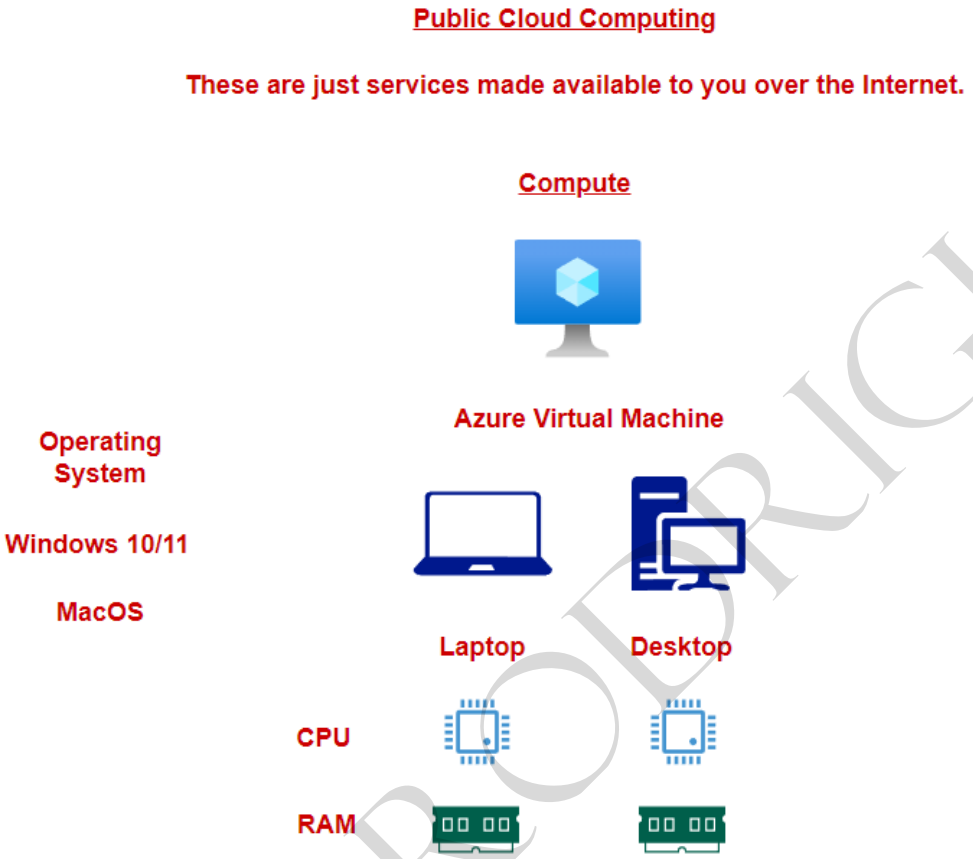
Introduction

Introduction to Cloud Computing



Server

Operating System

Windows Server 2022

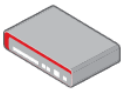
Ubuntu Server 22.04

Internet

Web Application

Server

Internet



Router

Server

Data store

All of the systems are part of a network

What is Microsoft Azure

This is a cloud platform

They make services available to you over the Internet

You can use this service to build, run and manage applications

Some key terms

Virtual Machine Service

Virtual Machine

Resource

Subscription

Billing Purposes

Resource Group

This is used to logically group your resources

Describe Azure architecture and services - Azure compute

Deploying a virtual machine

Virtual Machine Service

This service allows you to create a virtual machine on Azure

You don't need to manage physical servers

You can make use of On-demand pricing

You only pay based on how much you use

Buy servers

Costs money

Buy storage

Setup a network

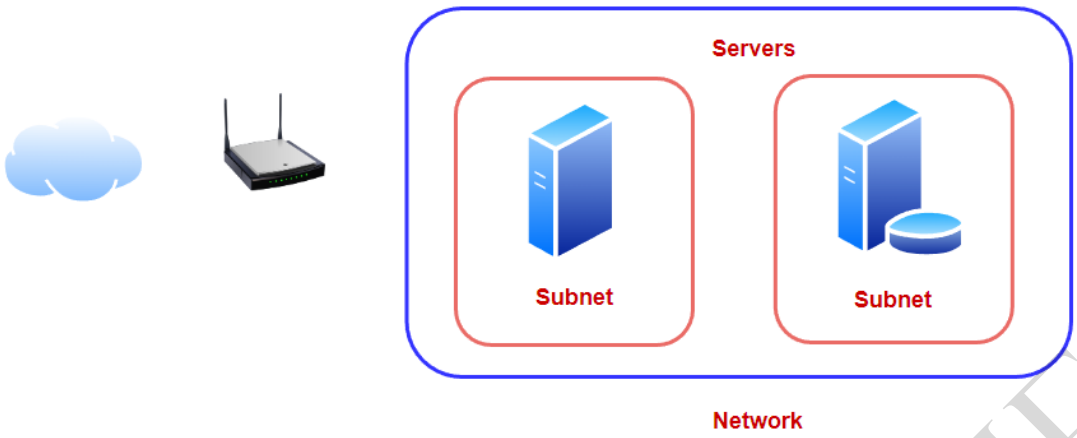
Machines are normally part of a network

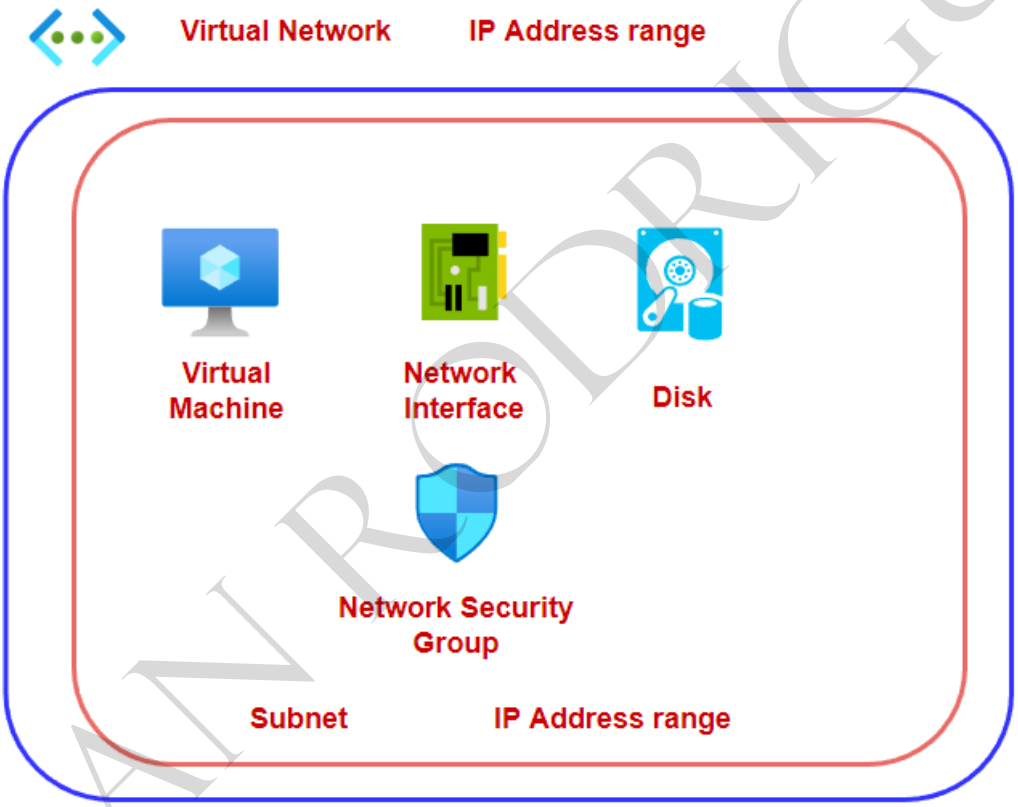
Wifi Router

All devices are part of the network managed by your Wifi Router

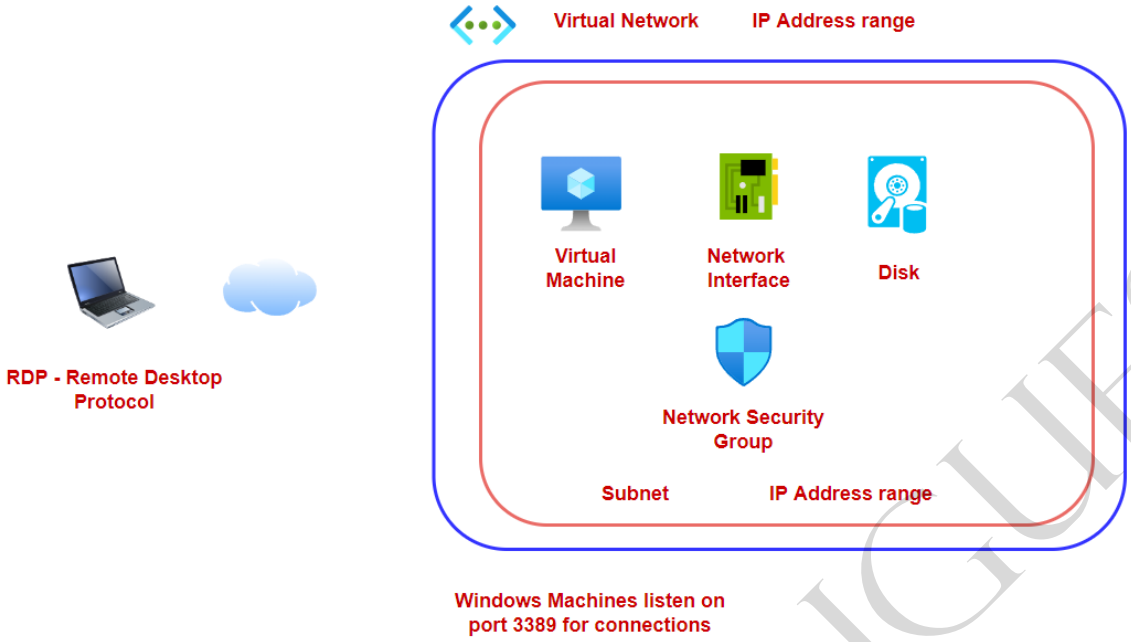
Each of your devices also gets assigned an IP address

This IP address helps to identify the devices on the network.

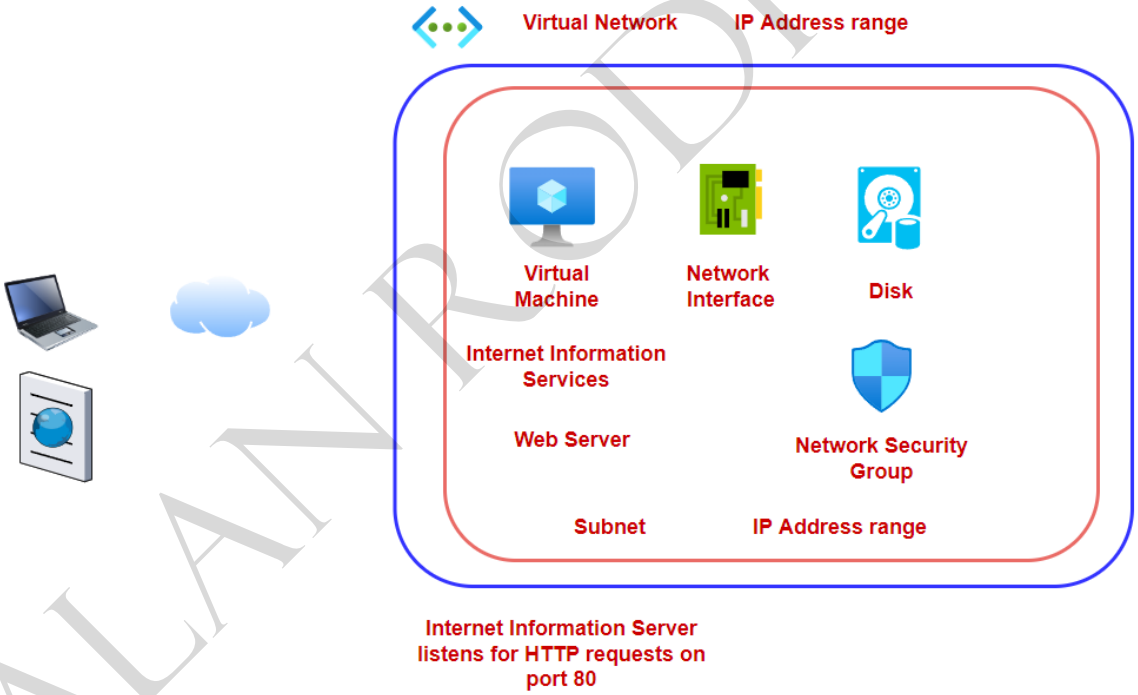




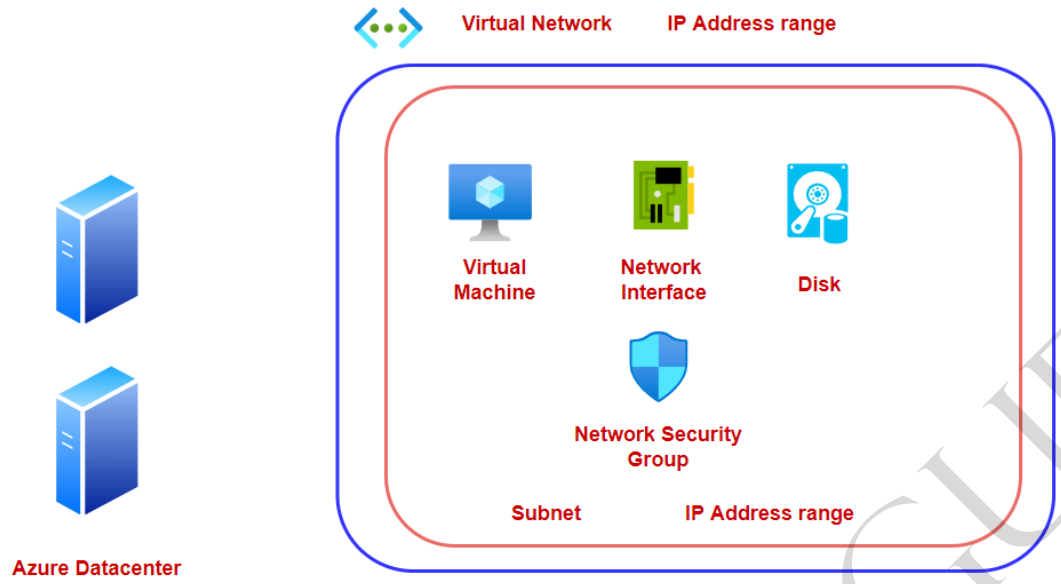
Connecting to an Azure Windows Virtual Machine



Lab - Installing Internet Information Services



Virtual Machines - OS and Temporary disk



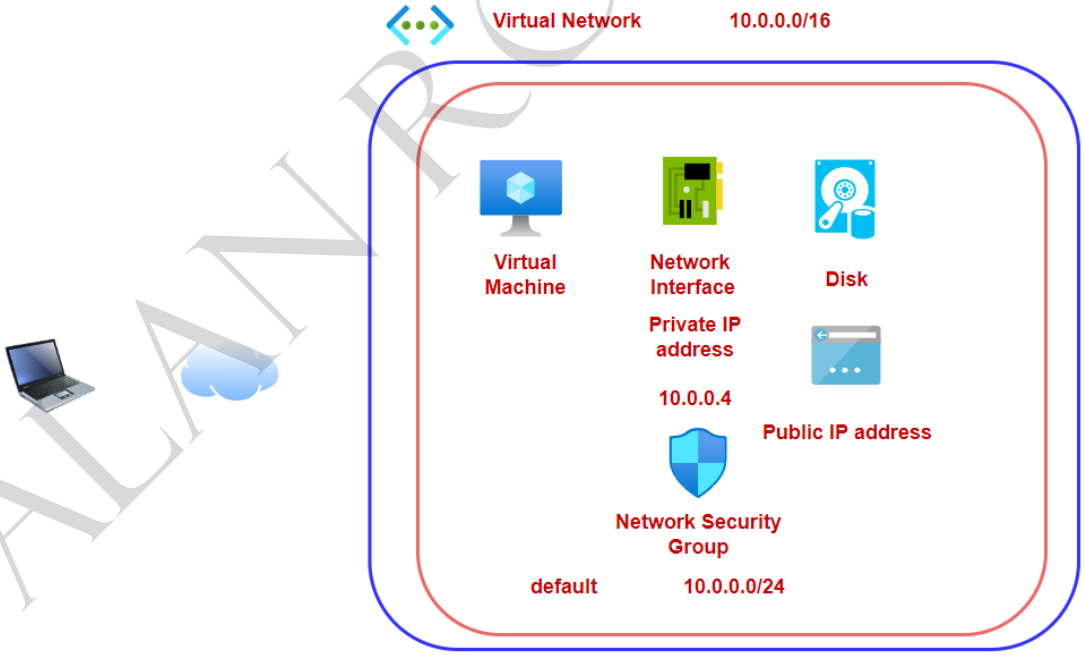
The Virtual Machine gets assigned an operating system disk

This is a managed disk - These are designed for high availability

Most VM's also get a temporary disk. This is not a managed disk.

The data on the temporary disk could get lost in the case of a maintenance event or when you redeploy the virtual machine.

Virtual Machine - IP addresses



The Public IP address allow Internet resources to communicate inbound to the Azure resources

Why do we choose a region

Virtual Machine Service

You don't need to manage physical servers

But the servers are still required to host the virtual machines.

It just that Azure is now managing the data centers that host these physical servers.

That is why you need to choose a region to deploy the Azure Virtual Machine

Depending on the region you choose, the Virtual Machine will be hosted on some physical server in that location.

There are some services that are available at the global level.

Which region should you choose

Make sure the service is available in that region.

Costing for that service in that region.

Maybe your company has a restriction that data should only be hosted in that region.

You might want to ensure that resources are closest to the users.

East US

Availability Sets

Availability Sets

The availability set is a logical grouping of VM's. It helps to improve the entire availability of your application.

Azure Virtual Machine

Physical server in a datacenter

What happens if there is a fault in the underlying physical server?

Or maybe Azure needs to apply an update on the physical server that requires a restart of the server.

Availability Sets can be used to manage these issues.

Fault Domain

Update Domain

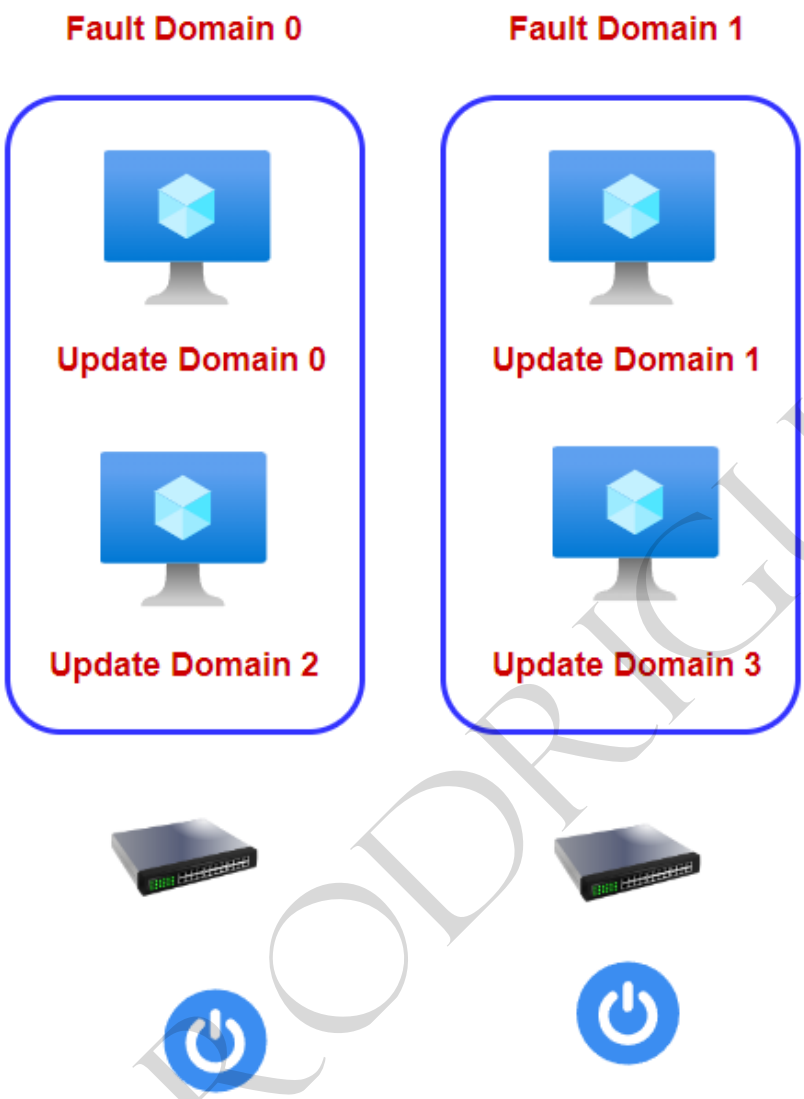
When you place your virtual machine as part of an Availability set, it gets assigned a fault and update domain.

Update domain

Here Azure will apply updates to the physical infrastructure one update domain at a time.

Fault domain

Here the virtual machines in the fault domain share a common power source and network switch.



Common questions

Is there a cost for using Availaibility sets?

No. You just need to pay for the underlying virtual machines.

Am I supposed to create multiple virtual machines? Or does the Availability set feature create duplicate copies of the VM?

You have to create the multiple VM's. The Availability set is just a feature for managing availability of your machines.

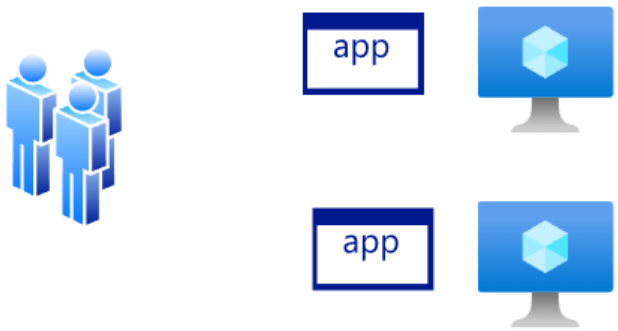
Does the Availability set replicate data across the VM's.

No. You manage all of these aspects. Remember the Availability set is just a feature for managing availability for your machines.

Availability Zones

Availability Zones

These are physical locations within an Azure region. These are made up of one or more datacenters. They have independent power, cooling and networking.



Azure Virtual Machine

In an Availability set, the machines might be located in a single datacenter

What happens if the datacenter goes down?

You can spread the deployment of your machines across datacenters by deploying them to different Availability zones

Common questions

Is there a cost for using Availaibility zones?

No. You just need to pay for the underlying virtual machines.

Then why not just make use of Availability zones instead of Availability sets?

This is because there is a charge of data transfer per GB between availability zones.

Does Availability zones replicate VM's or do data transfer?

No. Again this is all managed by you. Availability zones is just another availability feature from Azure.

Azure Dedicated Host

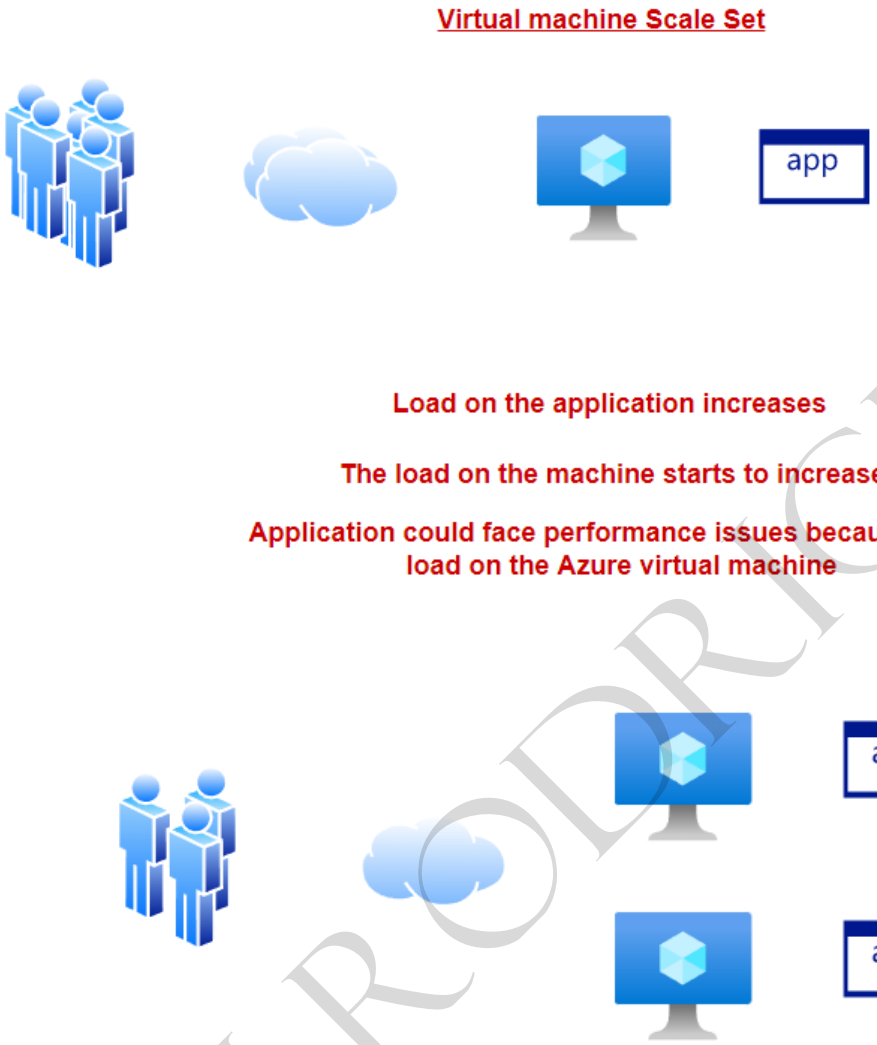
Azure Dedicated host

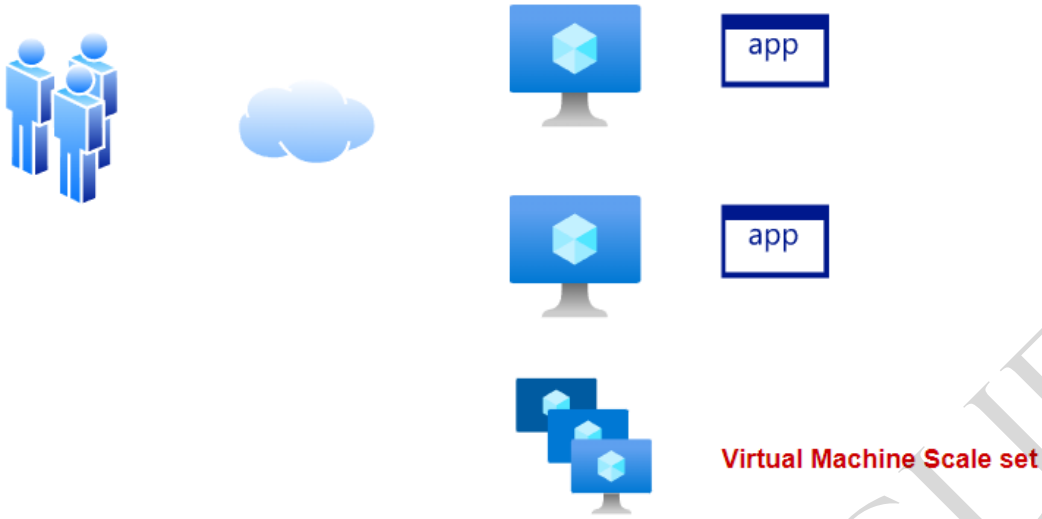
1. Hardware isolation - No other VM's will be placed on the host

2. You can control the maintenance events

Physical host

Virtual Machine Scale Set service





Virtual Machine Scale set is a group of virtual machines

Here the number of virtual machine instances can increase or decrease based on demand.

About Azure Web Apps

Here the physical server is managed by Azure

Azure virtual machine

You can log in as the administrator of the machine and install any application.

Azure Web Apps

They just want to host a web application on Azure.

This service has support for .NET, .NET Core, Java, Ruby, Node.js, PHP, Python.

This service can also scale up and scale down based on demand.

Here the physical server is managed by Azure

The virtual machine is also managed by Azure

If the company does not want the headache of managing the virtual machine.

About Azure Functions

Azure Functions

You can host your function code in Azure.

There is also an option to only pay based on your comsumption of the function.

There is support for C#, Java, JavaScript, PowerShell and Python.

Here again the compute infrastructure is managed for you.

Primer on containers

What is Docker

This is an open platform that is used for developing, shipping and running applications.

Docker has the ability to package and run an application in a loosely isolated environment called a container

Isolated and lightweight environment for hosting your application

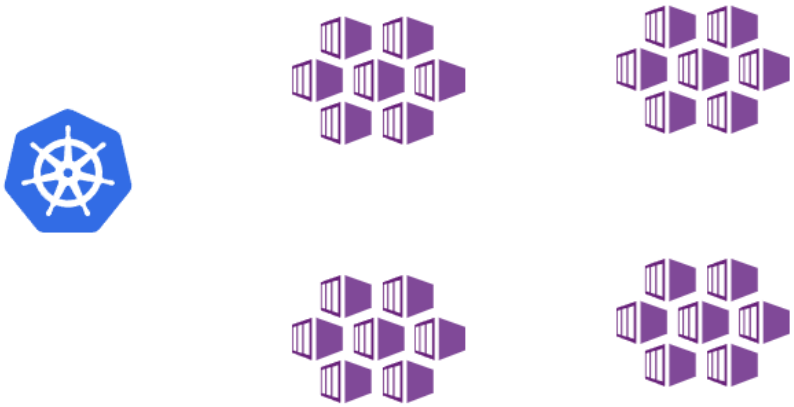
Docker host

CPU, Memory , Network

This is a read-only template with instructions that are required to create the Docker container

This is a runnable instance of an image

Kubernetes



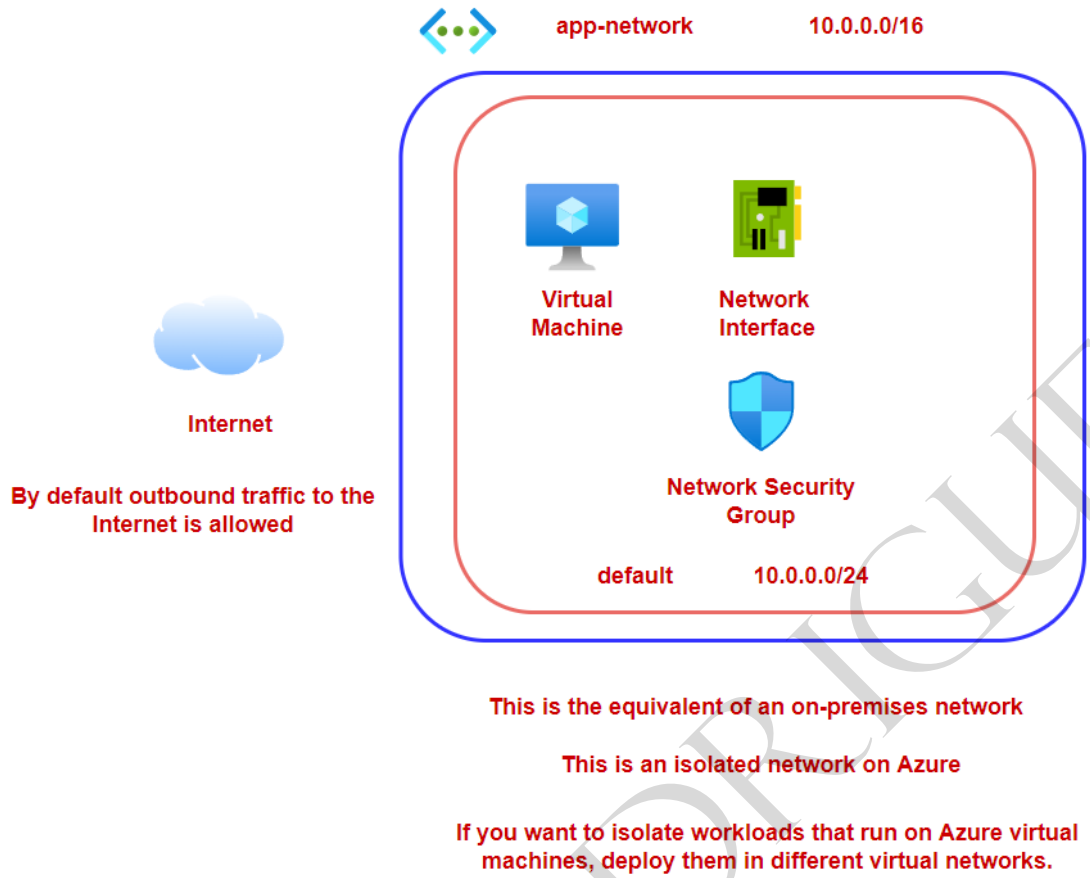
Managing containers at scale

Azure Kubernetes - Managed service for Kubernetes on Azure

Kubernetes is used to orchestrate your containers for hosting your applications

Describe Azure architecture and services - Networking

Azure Virtual Network

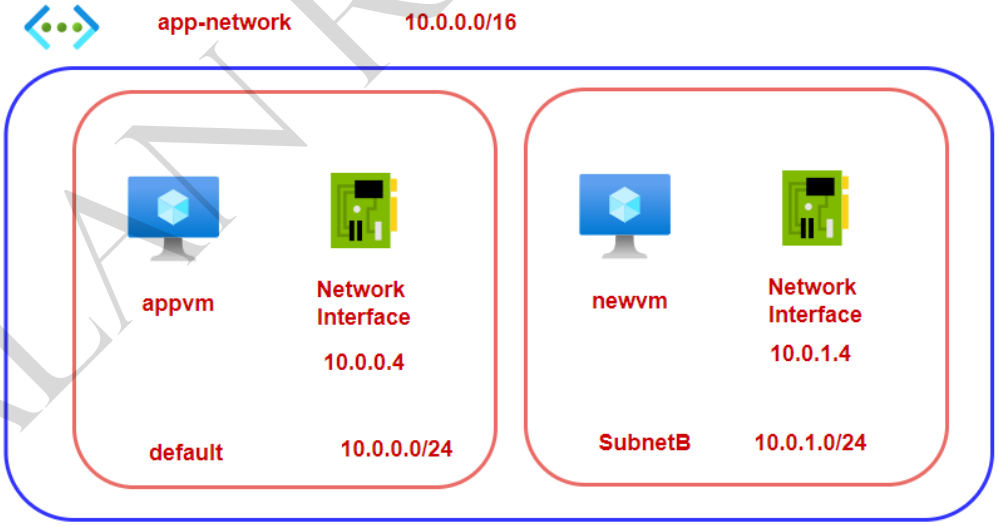


This is the equivalent of an on-premises network

This is an isolated network on Azure

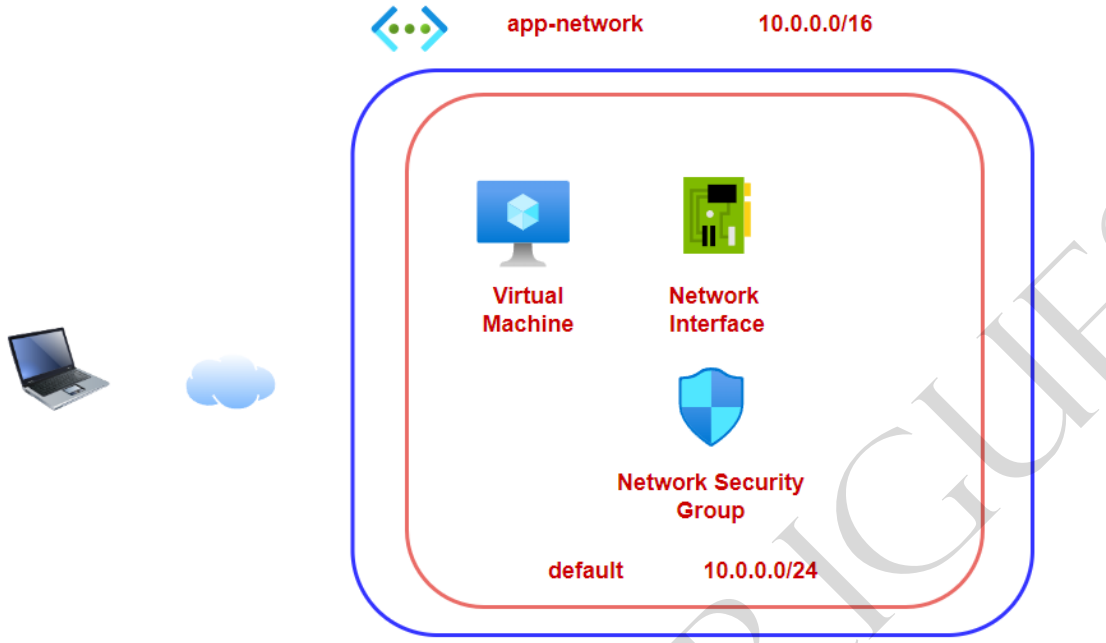
If you want to isolate workloads that run on Azure virtual machines, deploy them in different virtual networks.

Lab - Communication across virtual machines in a virtual network



By default communication between machines in different subnets is allowed.

Network Security Groups

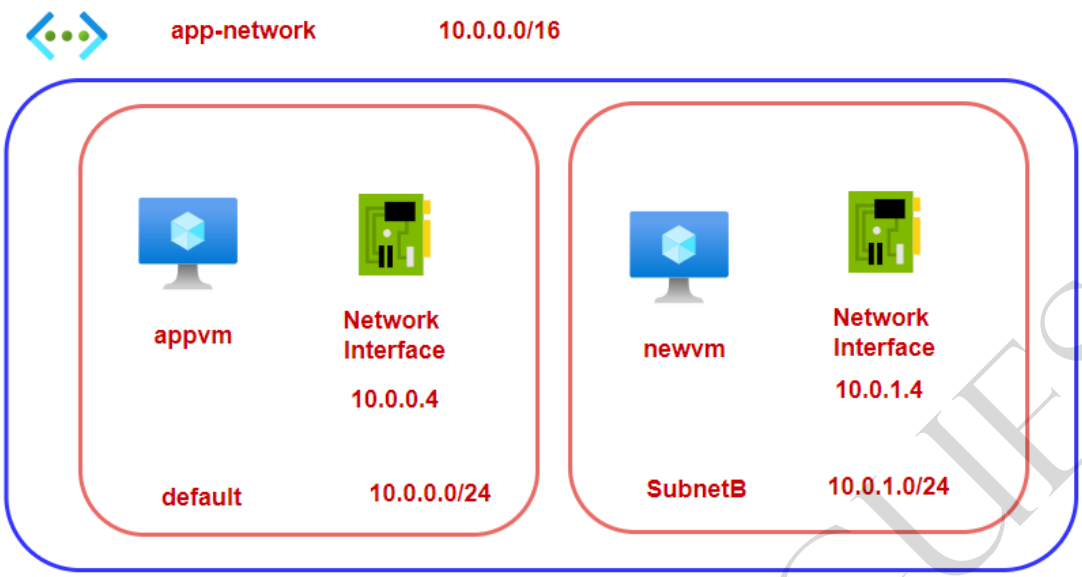


The Network Security Group is used to filter network traffic to and from Azure resources within an Azure virtual network

The group contains rules that are used to allow or deny inbound and outbound traffic.

Network Security Groups can be attached to a subnet or a network interface

Application Security Groups



Network Security Group

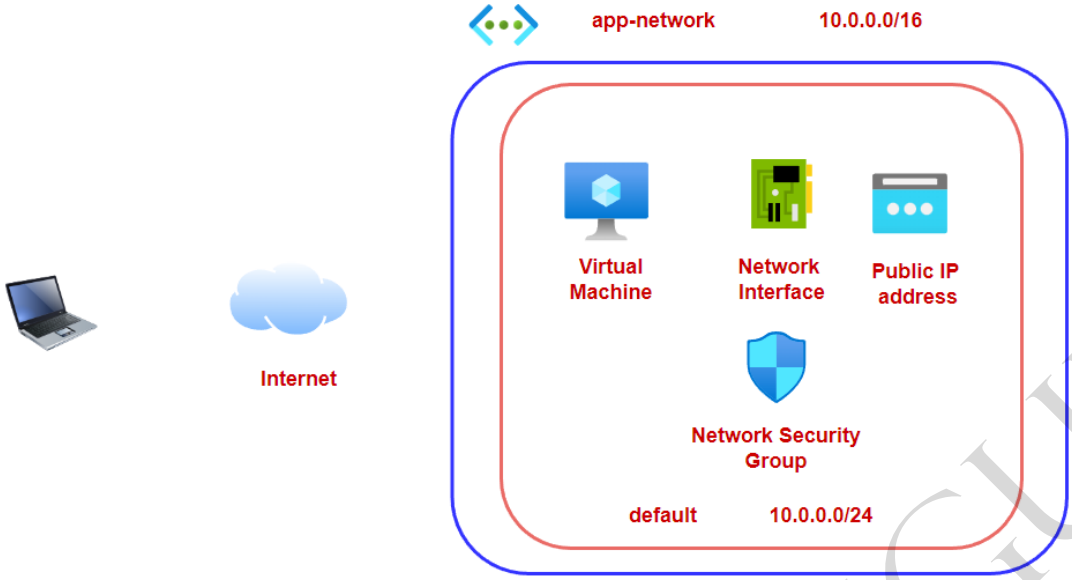
You can define one rule that allows Inbound traffic from 10.0.1.4 to 10.0.0.4

But here there is a depedency on the IP address

Instead you can make newvm part of an Application Security group - Let's say app-asg

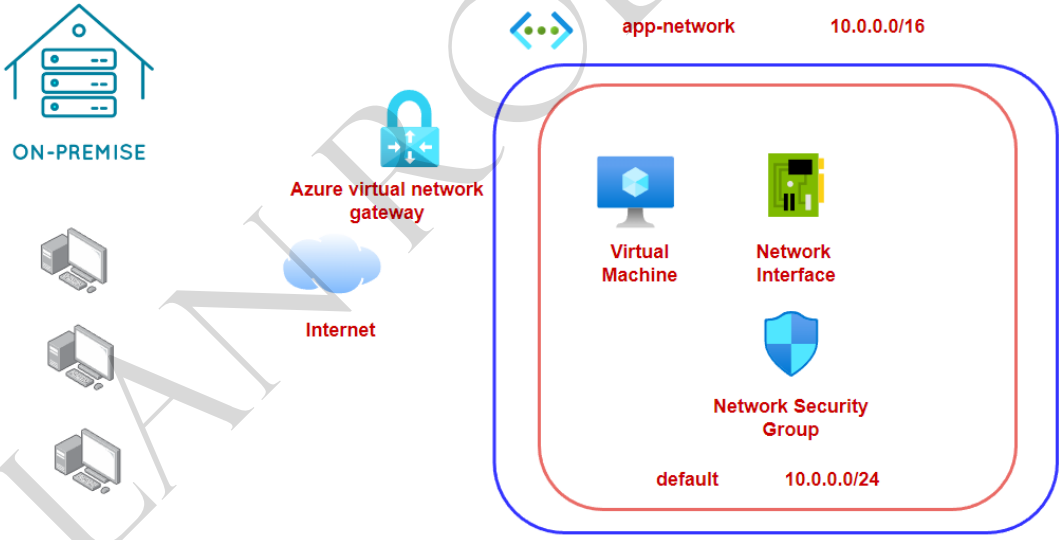
And then define the rule in the Network Security Group to allow traffic from app-asg to 10.0.0.4

Overview of VPN connections to Azure

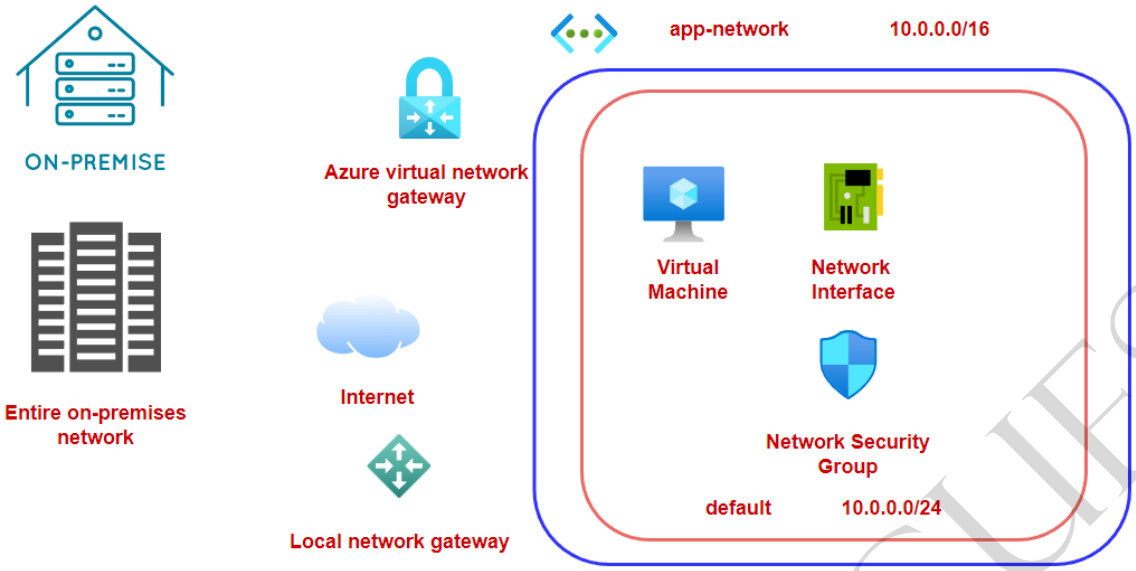


But there could be some Azure virtual machines in the Azure virtual network that don't require a public IP address.

Company could want machines in their on-premises environment to connect using the private IP address of the machine.



You can use a Point-to-Site VPN connection to connect each individual machine to the Azure virtual network



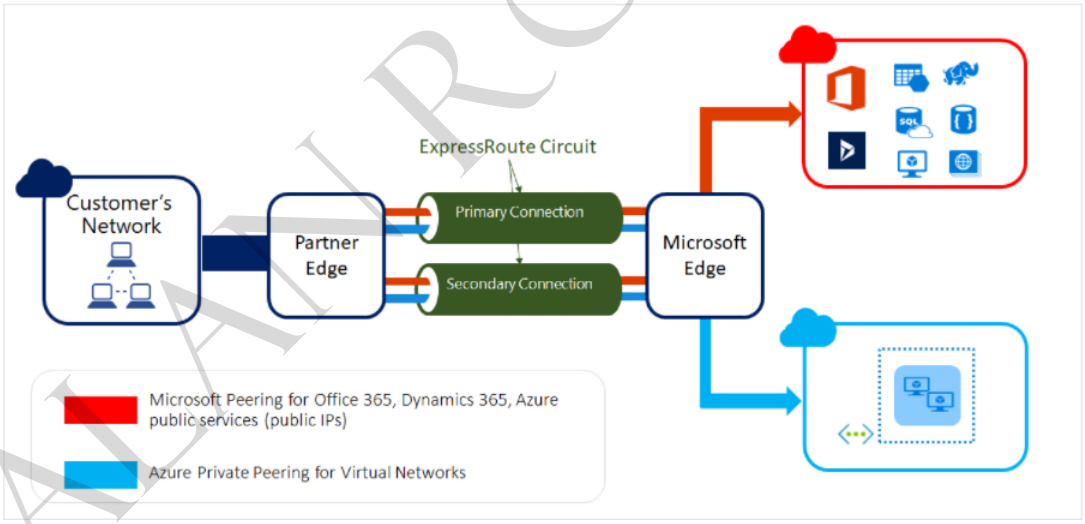
You can use a Site-to-Site VPN connection to connect an entire site to an Azure virtual network

Overview of Azure ExpressRoute

Azure ExpressRoute

Allows you to connect your on-premises networks to Microsoft cloud over the private connection

Here the connection is established with the help of a connectivity provider



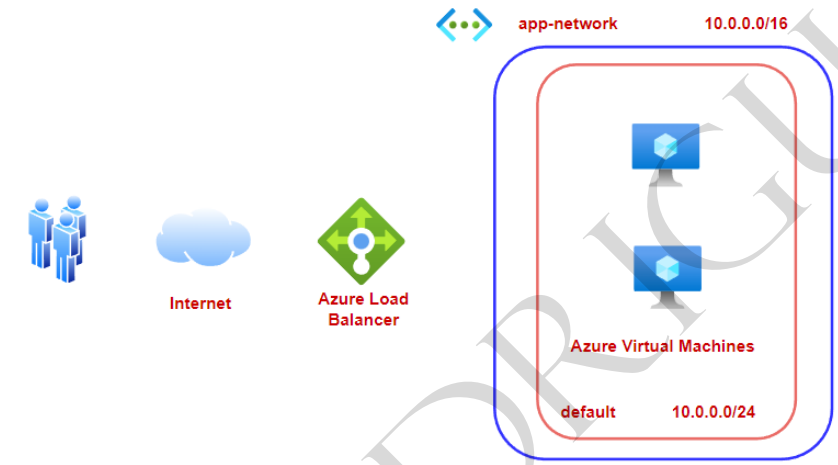
Reference - https://docs.microsoft.com/en-ca/azure/expressroute/expressroute-introduction

The ExpressRoute connection does not go over the public Internet

Your connections are more reliable, faster and you get less latency

You get two connections for each ExpressRoute circuit for redundancy

Azure Load Balancer



Configuration

Public IP address - If it is a public load balancer

Health probe - This is used to monitor the backend machines

Load Balancing rules - These are used to direct the requests coming into the Load Balancer to the backend virtual machines.

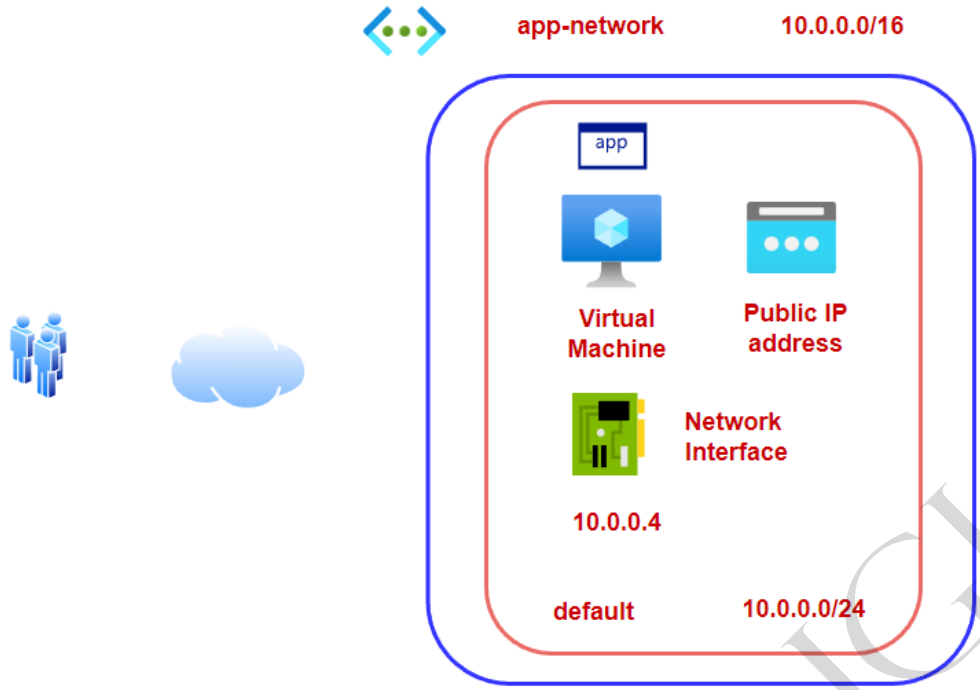
The Load Balancer is used to distribute incoming traffic and distribute to the backend Azure virtual machines.

There are two different SKU's for the Load Balancer - Basic and Standard

Basic Load Balancer - No charge - But there is no SLA and there are other features like no built-in high availability.

Standard Load Balancer has an hourly charge. But you get different features like high availability via the use of Availability zones.

Azure DNS

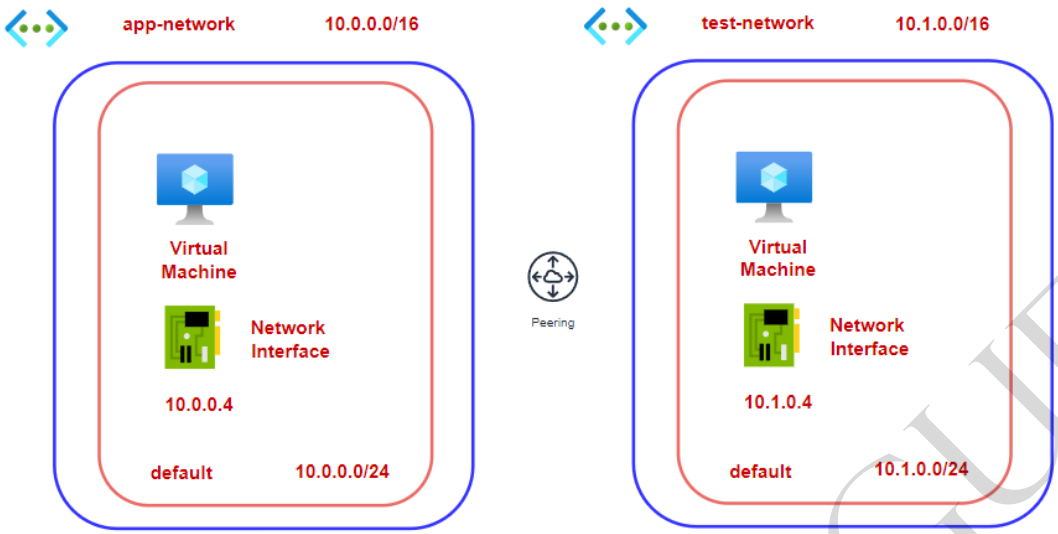


You could access the web application via the Public IP address or the DNS allocated by Azure.

You can route the user traffic to your application via your own domain name.

You can use the Azure DNS service when it comes to name resolution.

Lab - Azure virtual network peering



An Azure virtual network is an isolated network on the cloud

By default the Azure virtual machines cannot communicate across Azure virtual networks

For this you have to create an Azure virtual network peering connection

Describe Azure architecture and services – Storage

Introduction to Azure Storage

Azure Storage Accounts

This is storage on the cloud via the use of different services.

Azure Blob storage

This is an object storage service

This is great for storing unstructured data

Data Disk

Azure virtual machine

Ideal approach is to store the videos in an Azure storage account

Azure virtual machine

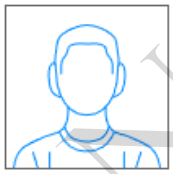
Azure Blob storage can grow automatically based on demand

Its great when you want to use it to store images, video, audio files.

Even good for storing backups.

Azure File shares

File Server

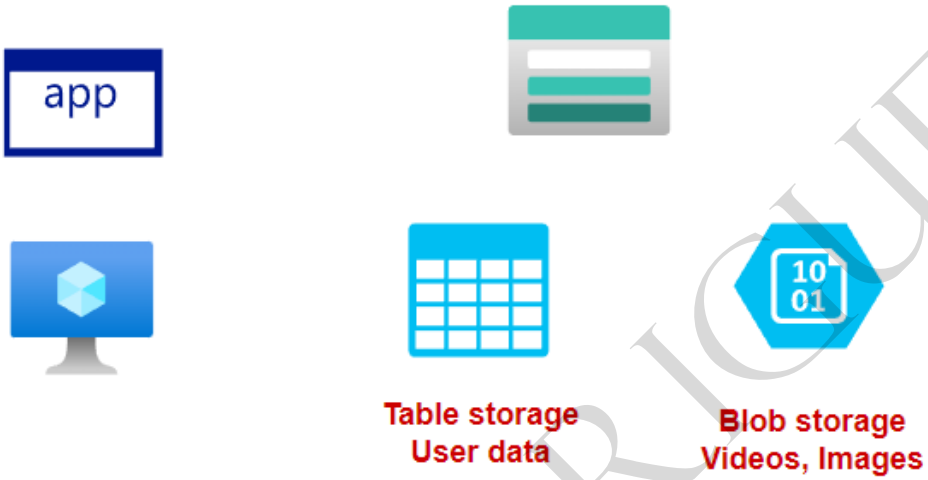


Azure Storage Account - File shares

Azure Table storage

This is great when you want to store non-relational structured data

This is when you data conforms to a schemaless design



Azure Queue storage

This is a messaging based service

Azure storage access tiers

Objects

There is a cost for storing objects

There is a cost for accessing objects

Companies might store millions of objects in a storage account

Use case - Initial there could be some objects that are accessed quite freqently. Then after some time, maybe a week or two , those objects are accessed less frequently.

Can a company save on costs when it comes to less frequently accessed objects.

An object can be set to a particular tier

Hot Access tier

This is optimized for objects accessed more frequently

Here you have high storage costs and lower access costs

Here the data needs to be stored for at least 30 days

Cool Access tier

This is optimized for objects accessed or modified infrequently

Here you have lower storage costs but higher access costs when compared with the Hot access tier.

This is optimized for objects that are rarely accessed

Here the data needs to be stored for at least 180 days

Archive Access tier

Here you have lower storage costs but higher access costs when compared with the Cool access tier.

Good for long-term backups.

You can set the Hot and the Cool access tier at the storage account level.

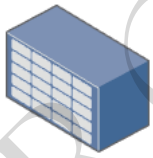
You can set the Hot ,Cool and Archive access tier at the blob level.

Azure Storage Accounts - Data Redundancy

Azure Storage account - Redundancy

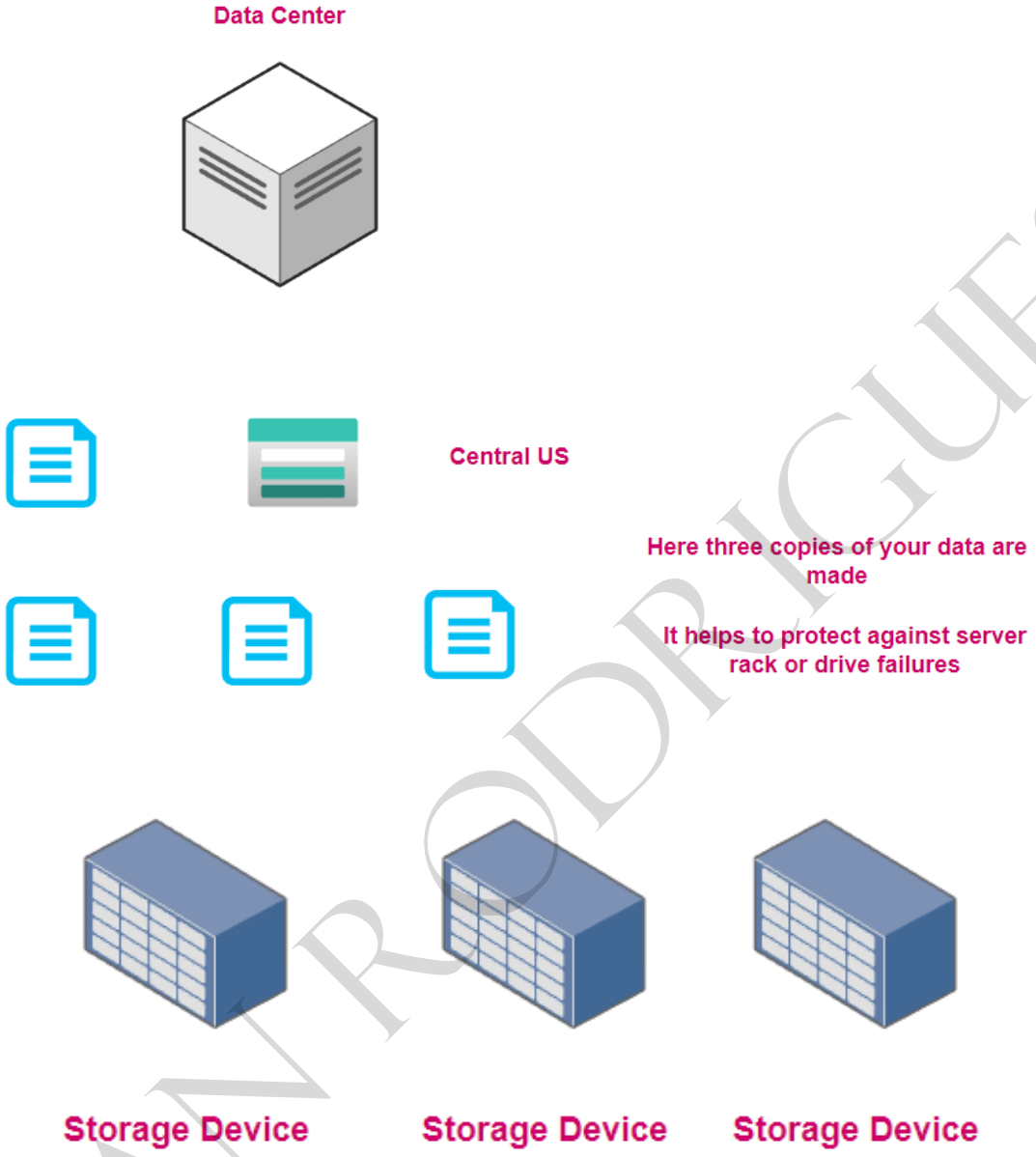
Multiple copies of your data are stored

This helps to protect against planned and unplanned events - transient hardware failures, network or power outages.



Storage Device

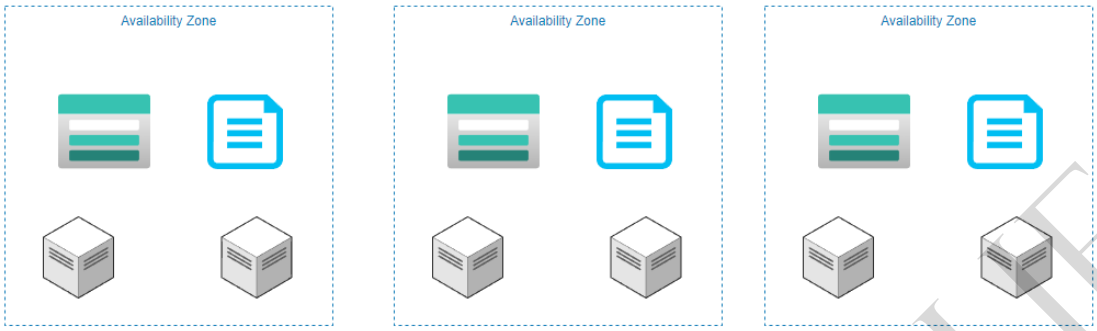
Locally-redundant storage



Zone-redundant storage

This helps to protect against data center level failures

Here data is replicated synchronously across three Azure availability zones

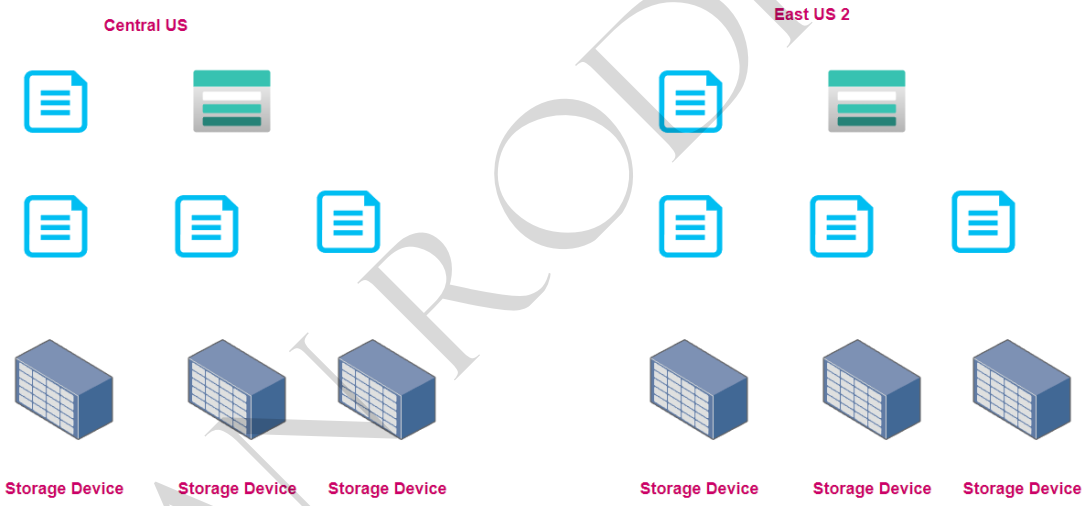


Central US

Each availability zone is a seperate physical location with independent power, cooling and networking

Geo-redundant storage

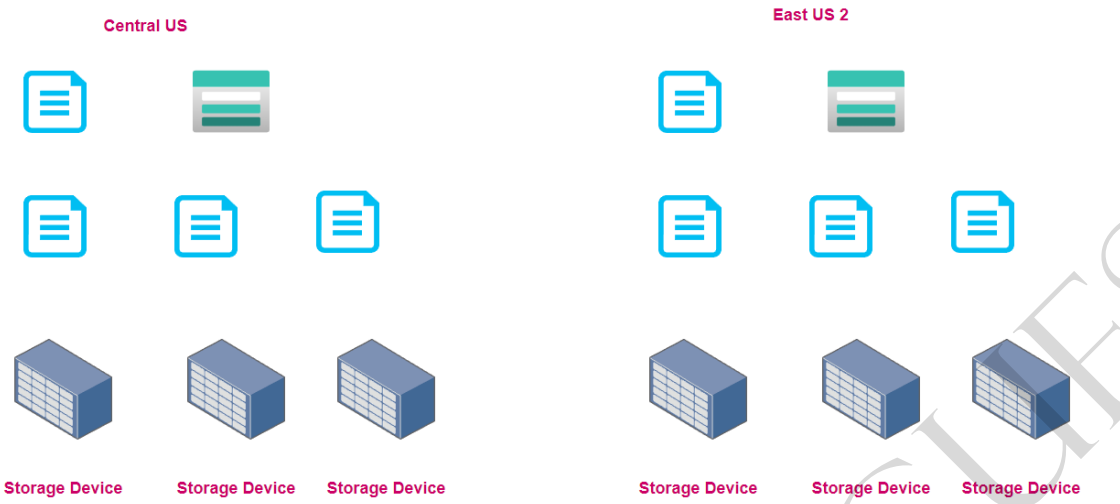
Here data is replicated to another region



Data is copied three times in the primary region using LRS

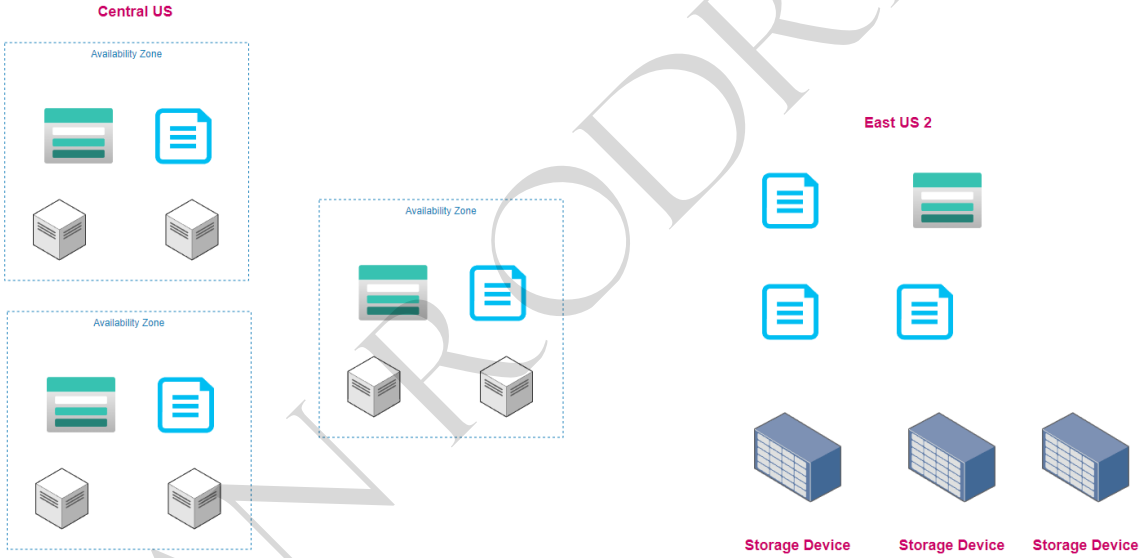
Data is copied three times in the secondary region using LRS

Read-access geo-redundant storage



Geo-zone-redundant storage

Read Access geo-zone-redundant storage



Note - Azure File Sync service

Azure File Sync

File shares

Azure Storage Account - File shares

Windows Server can be used to cache frequently used files.

You can achieve this with the Azure File Sync service

Here one of the steps is to download and install the Azure File Sync agent on the Windows server

Azure Premium Storage accounts

Premium storage accounts

Premium block blobs

This is used when you need high performance when it comes to storage and access to data.

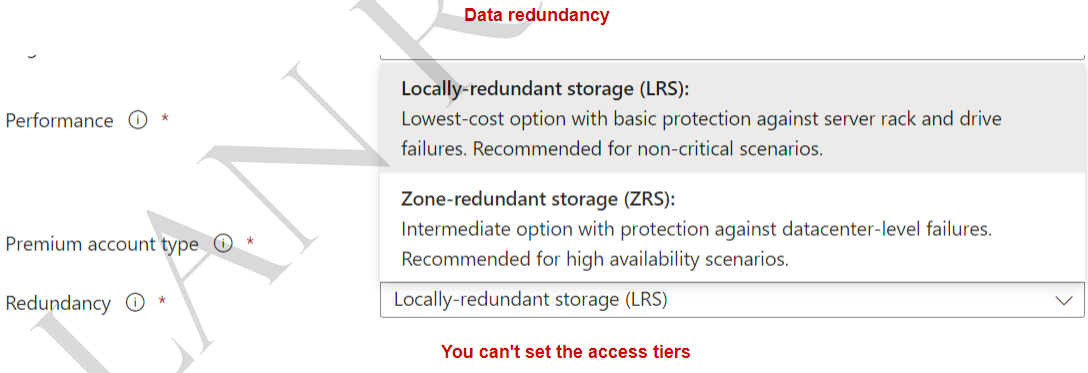
Here the data in the background is stored on solid-state drives. These are optimized for low latency.

Here the file transfer is also much faster.

Workloads - Streaming , Machine Learning

You have higher storage costs but lower transaction costs

Data redundancy

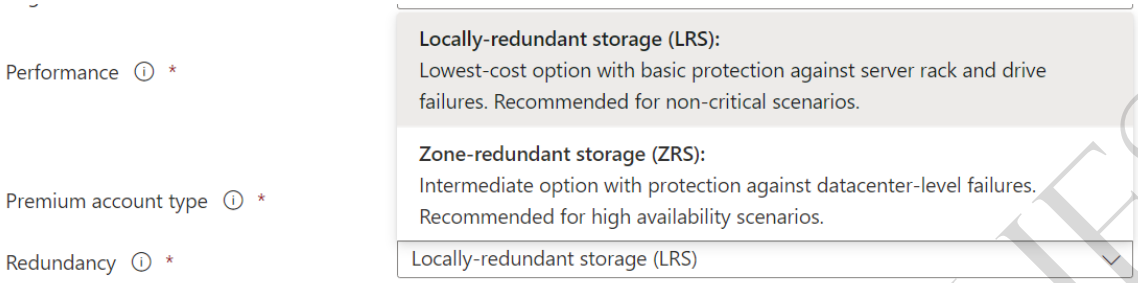


Premium file shares

Here again you get high performance and low latency

Backed by solid-state drives for storage

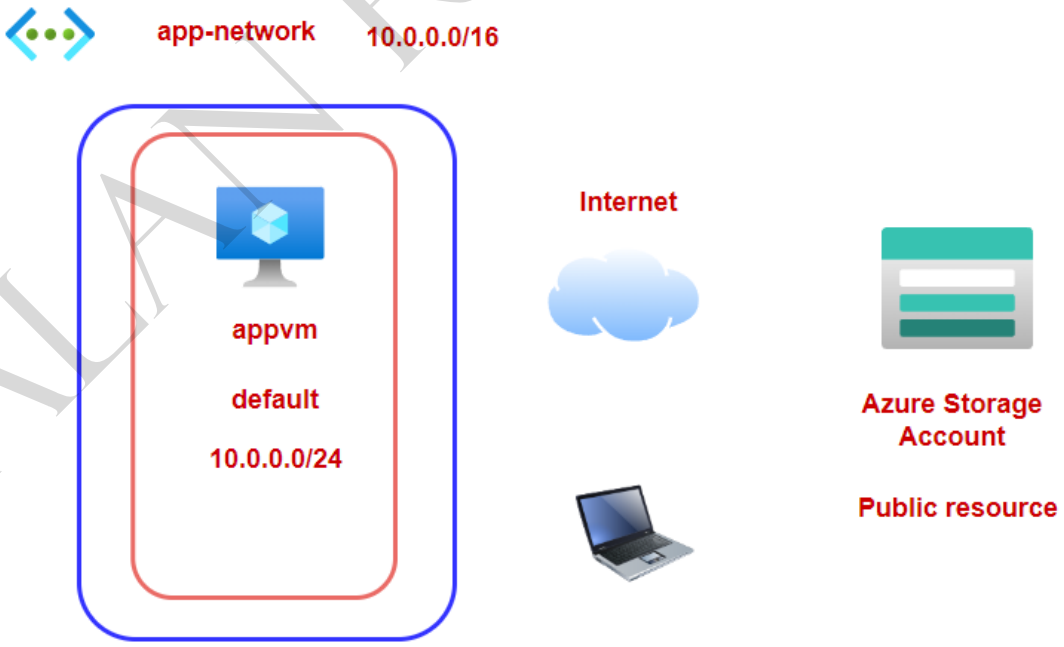
Data redundancy



Virtual Network Service Endpoints

Virtual Network Service Endpoints

This provides secure and direct connectivity to Azure services over the Azure backbone network



Describe Azure architecture and services – Databases

Azure SQL Database service

Virtual Machine

IaaS

Install Microsoft SQL Server

Configure the server

Configure high availability

Configure backups

Azure SQL database

PaaS

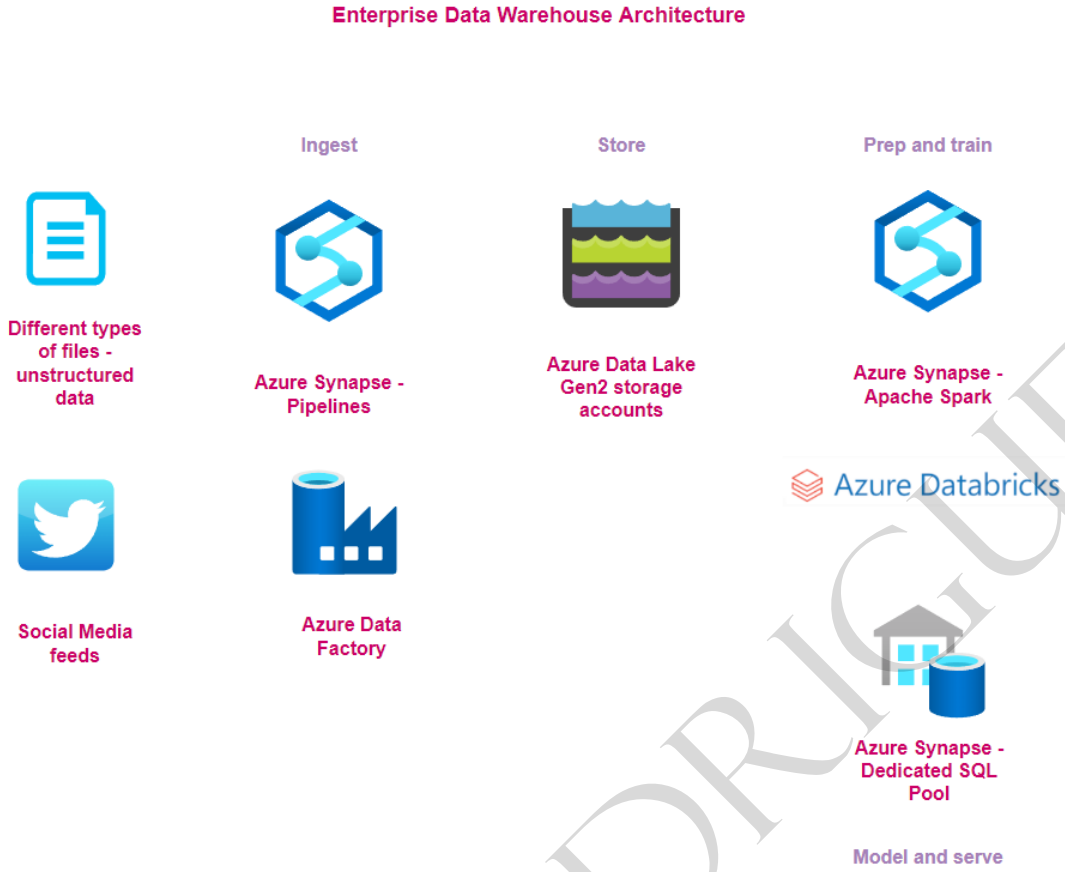
Here the infrastructure is managed for you

Backups are managed for you

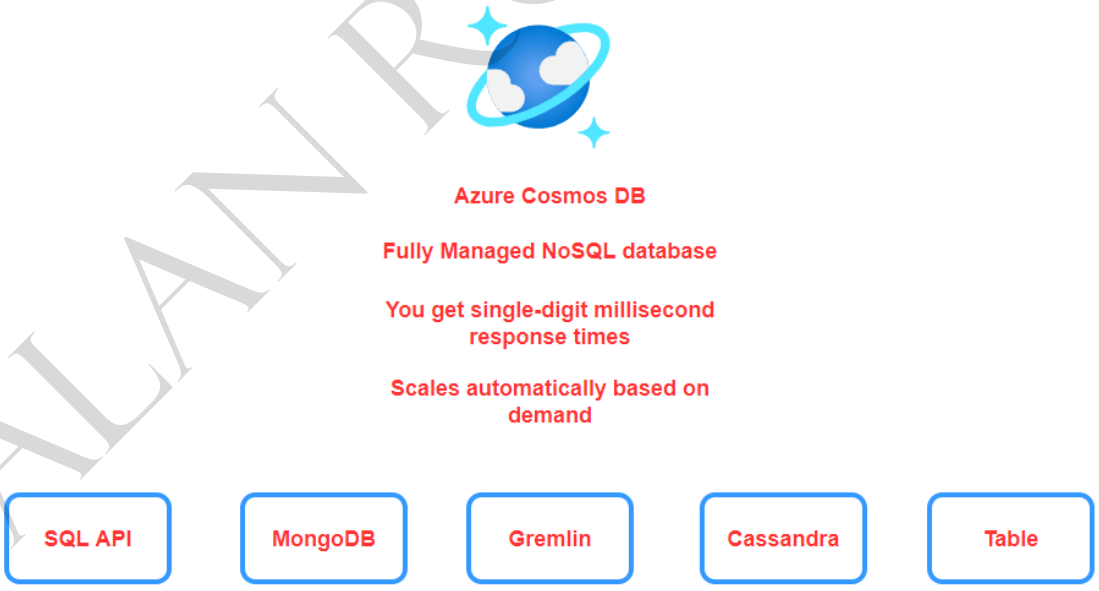
You get built-in high availability

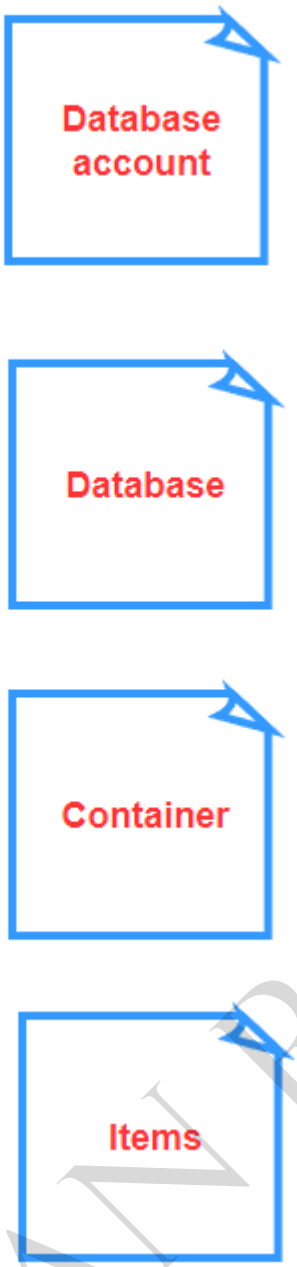
Virtual Machine

Enterprise Data warehouse architecture



About Azure Cosmos DB





Azure SQL Database vs Cosmos DB

Azure SQL Database

When you need to have relationships between tables

When you want to have constraints like foreign key constraints

Azure Cosmos DB

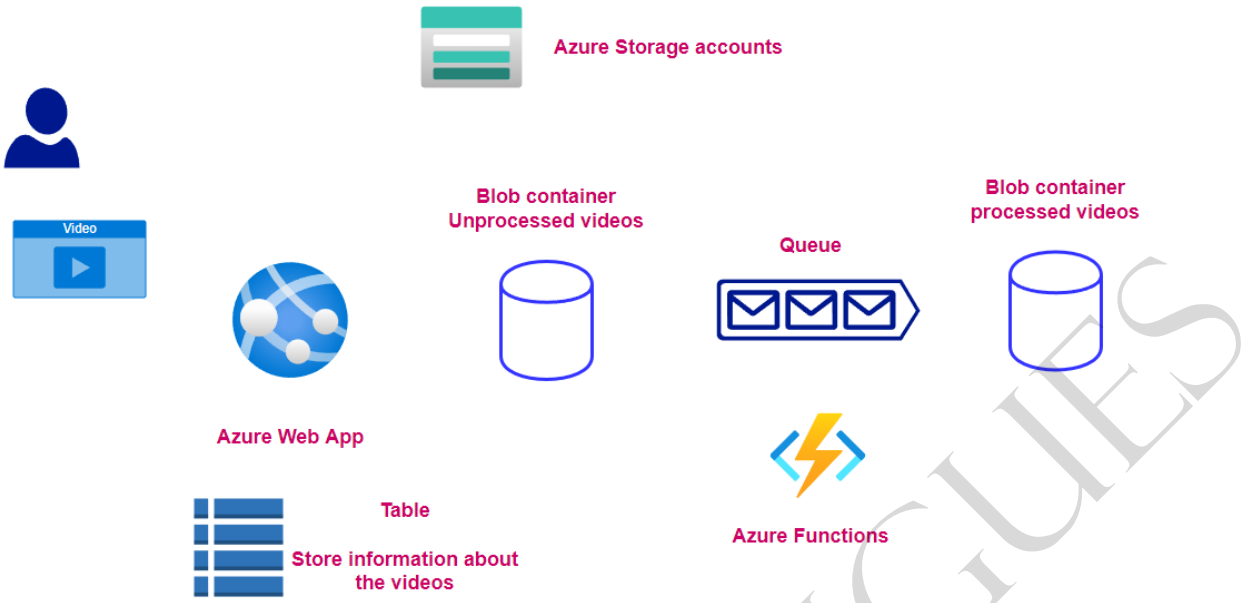
NoSQL data store

Flexible schemas

No need of joins between data structures

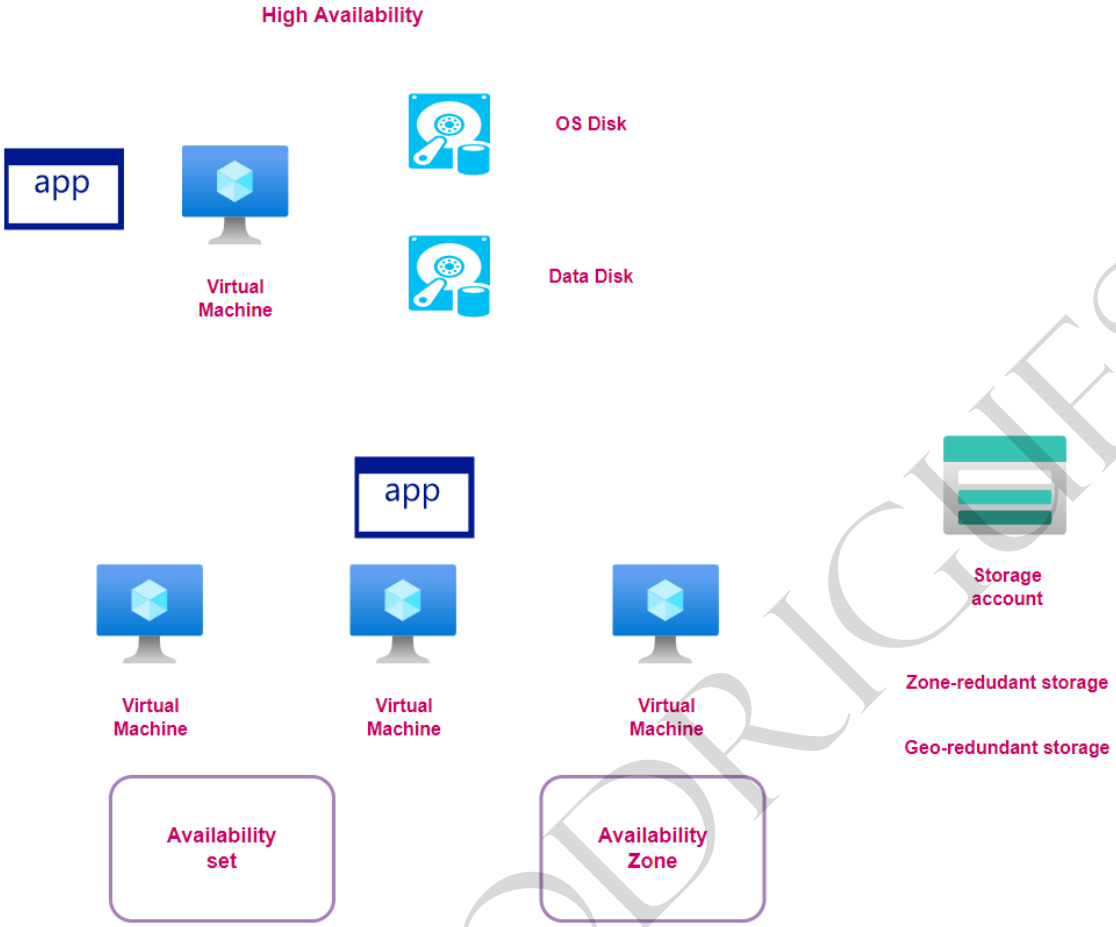
A sample architecture - use case 1

A sample architecture - use case 2

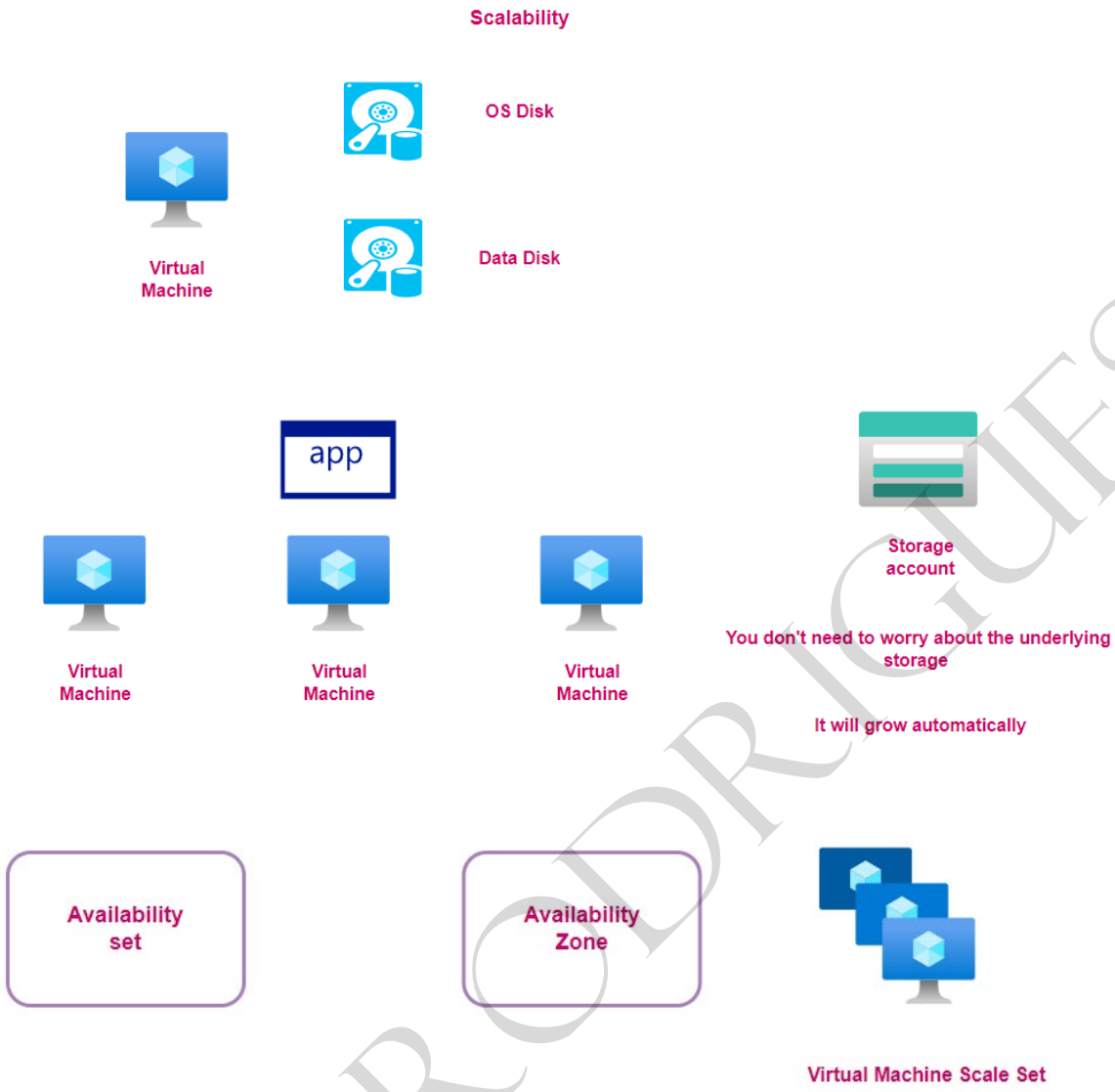


Describe cloud concepts

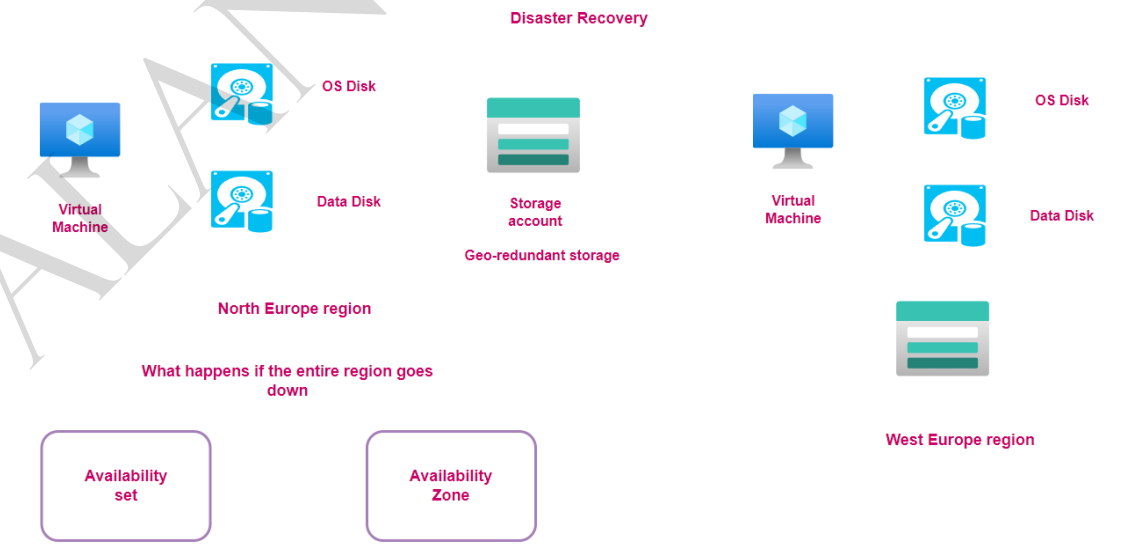
Benefits of the cloud - High Availability



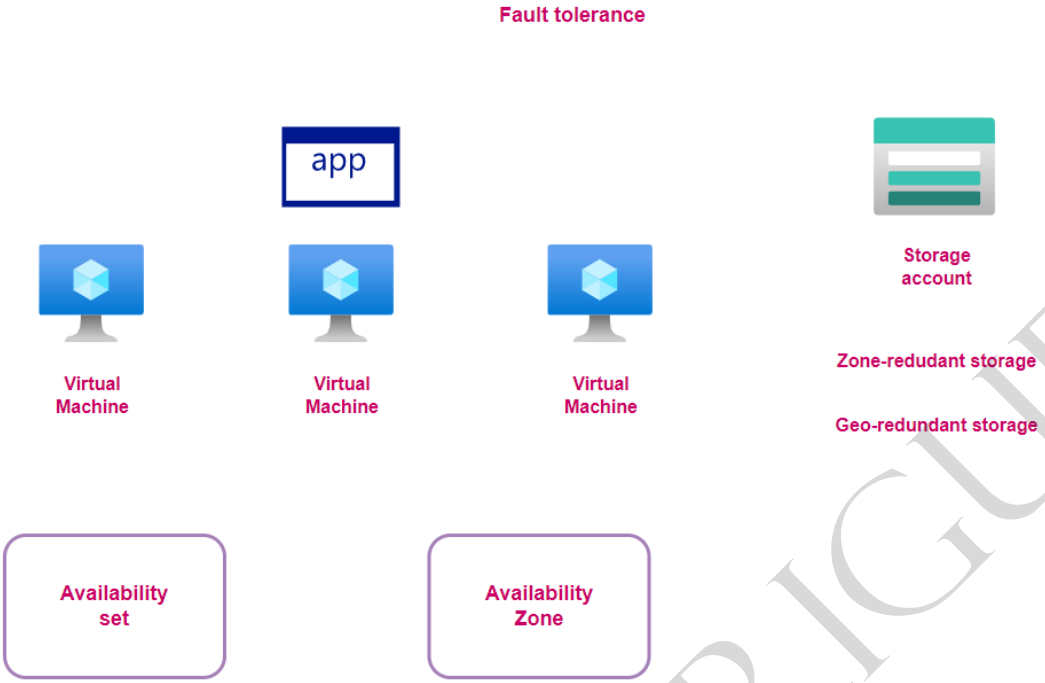
Benefits of the cloud – Scalability



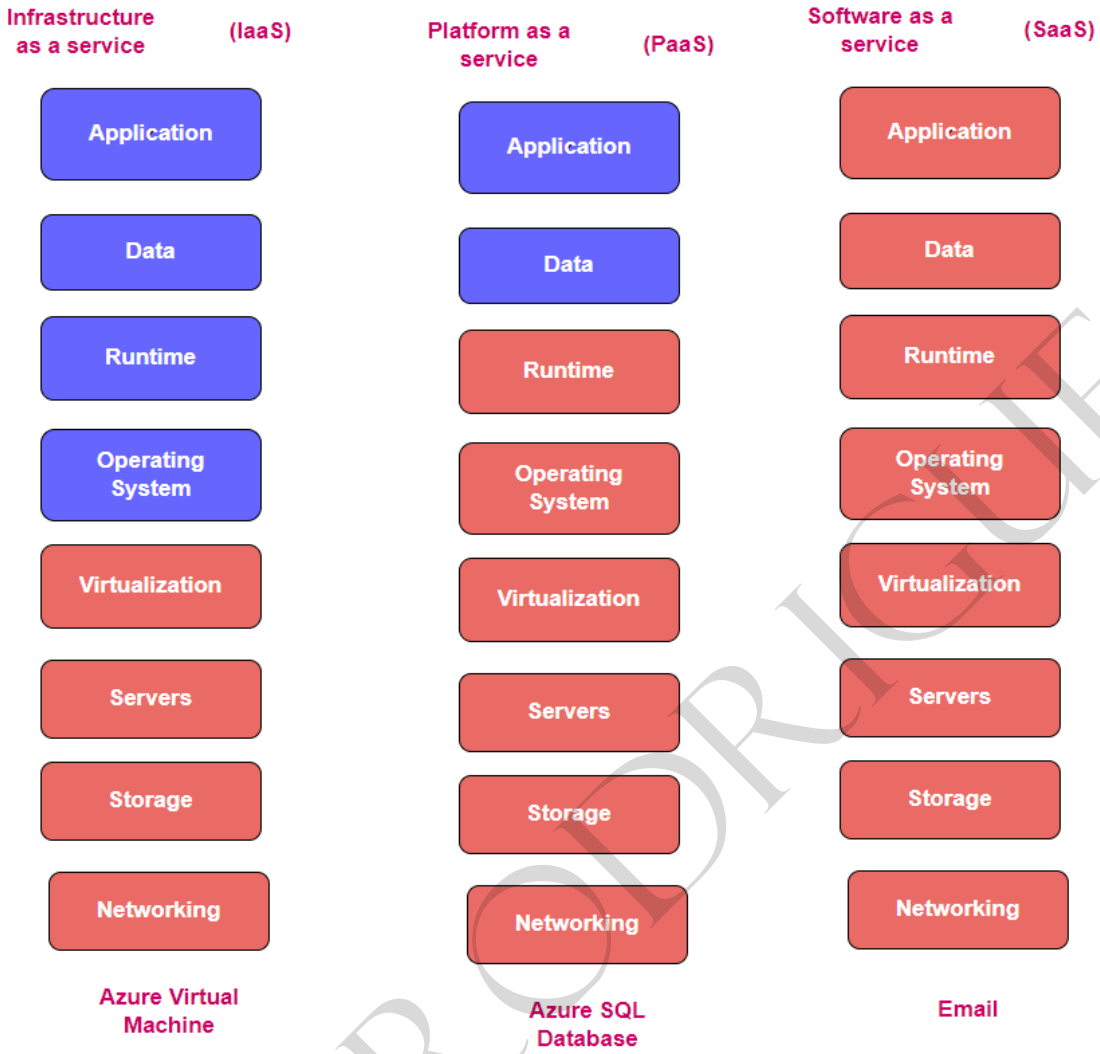
Benefits of the cloud - Disaster recovery



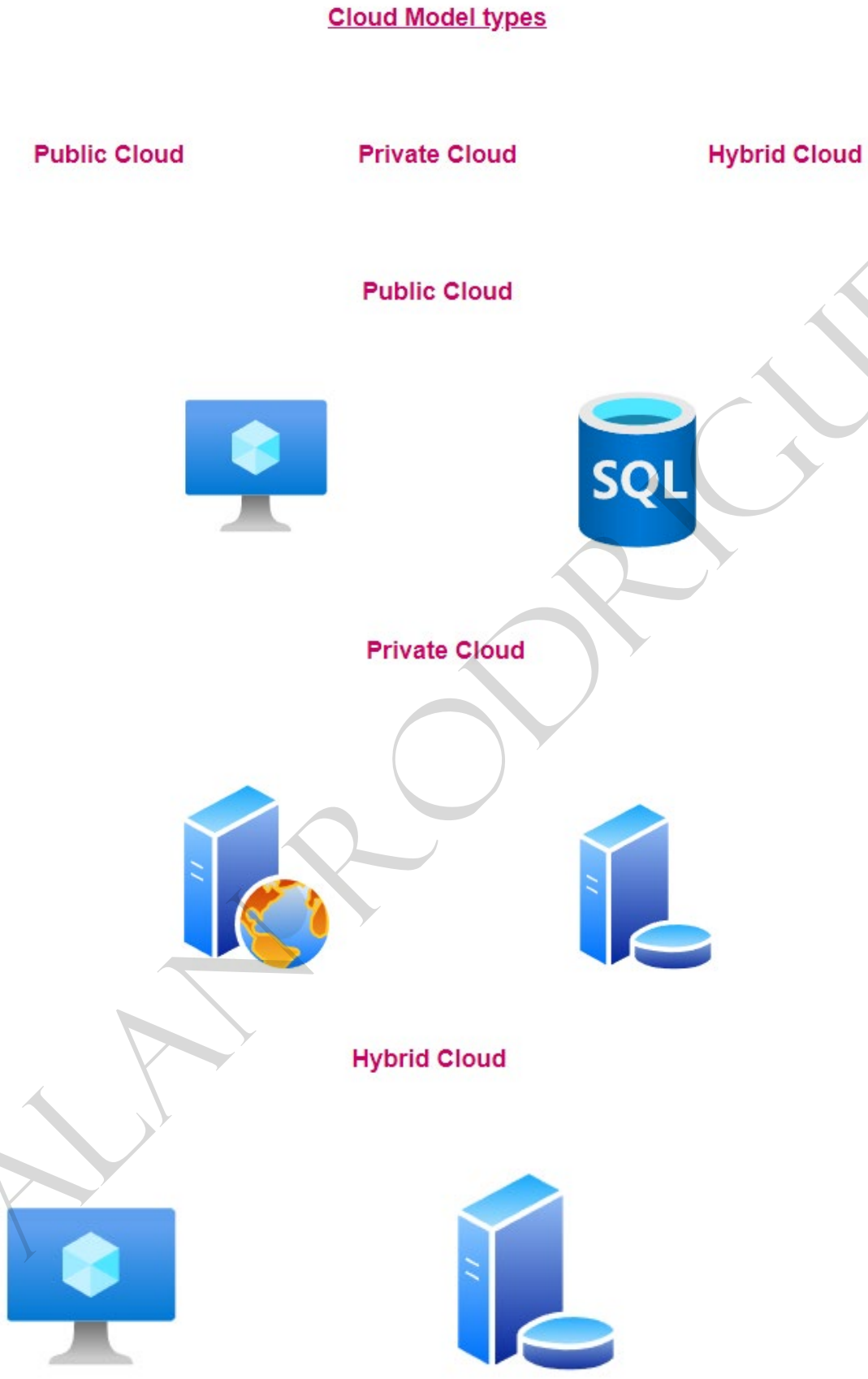
Benefits of the cloud - Fault tolerance



Cloud service model



Cloud model types



Describe Azure architecture and services - Other services

Azure Traffic Manager

Azure Content Delivery Network

Azure CDN

Content Delivery Network

Helps to deliver content to users across the globe by placing content on physical nodes placed across the world

East US

North Europe

Web Application

Central US

East US

CDN Profile

Global level

Endpoint

Web Application

Central US

Source

1. The user in the East US location makes a request to the CDN endpoint

2. The CDN checks whether the Point of presence location closest to the user has the requested file.

3. If not a request is made to the source to get the required file.

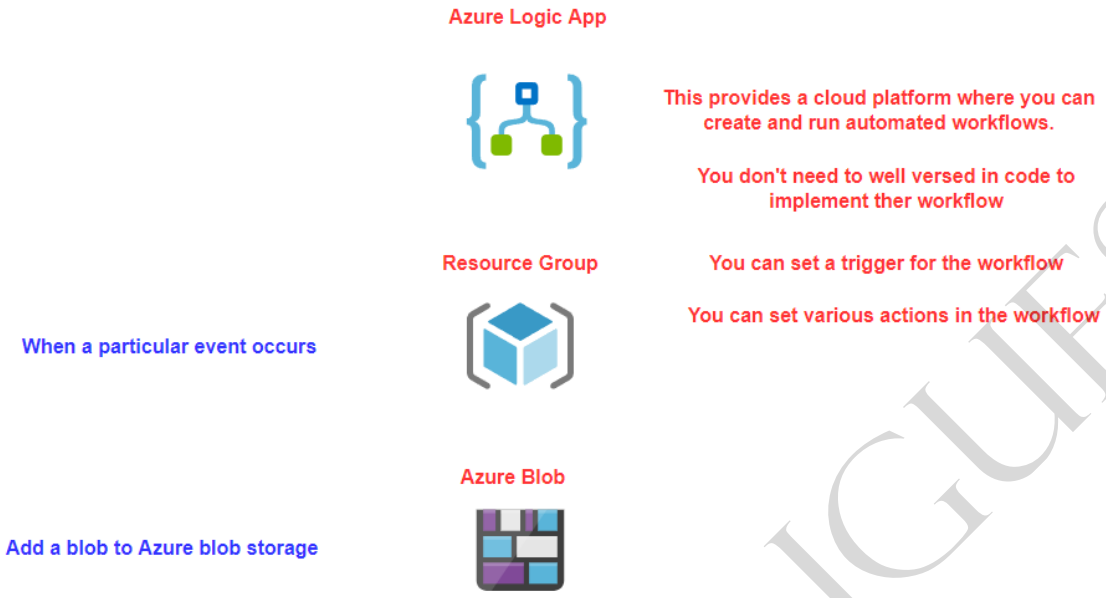
4. A server in the Point of presence location will then cache the required file.

5. The server will also send the file to the user.

6. Subsequent users from the same location will now be served the file from the server in the point of presence location.

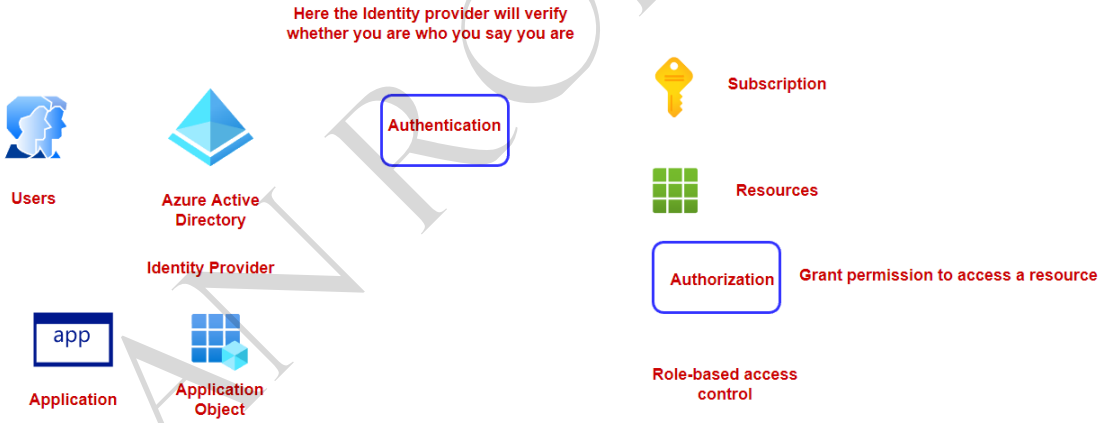
Lab - Azure Key Vault

Azure Logic Apps

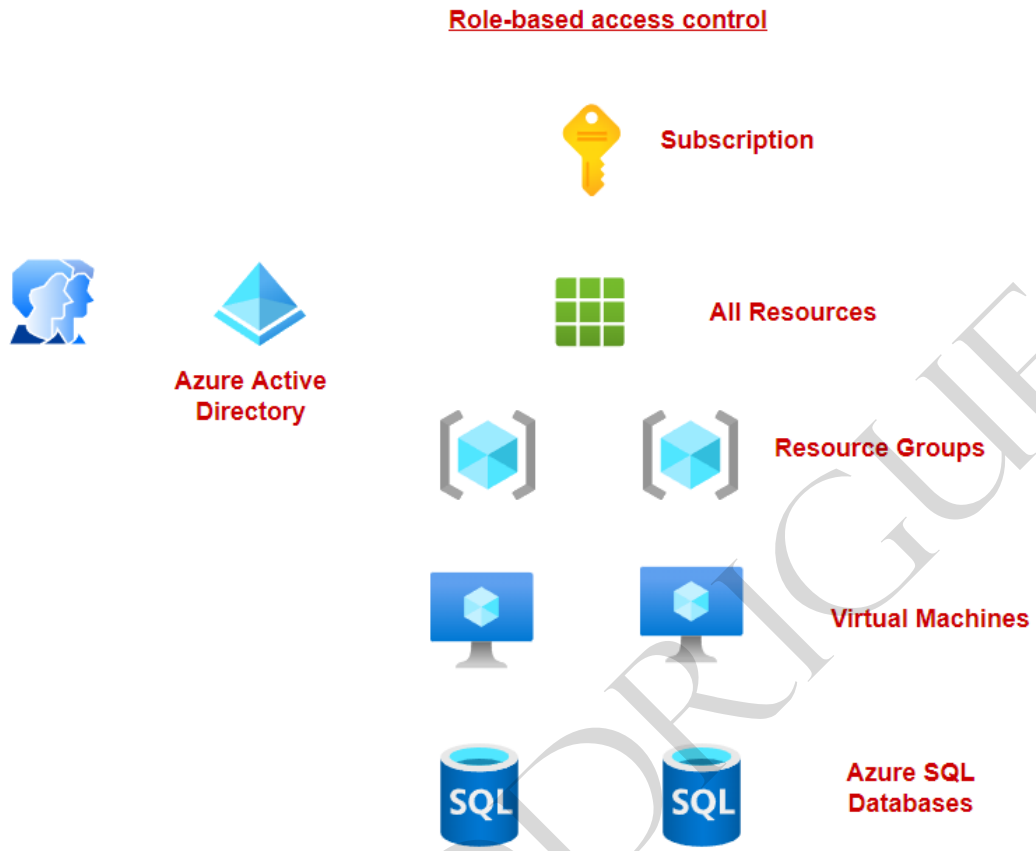


Describe Azure architecture and services - Identity and Access

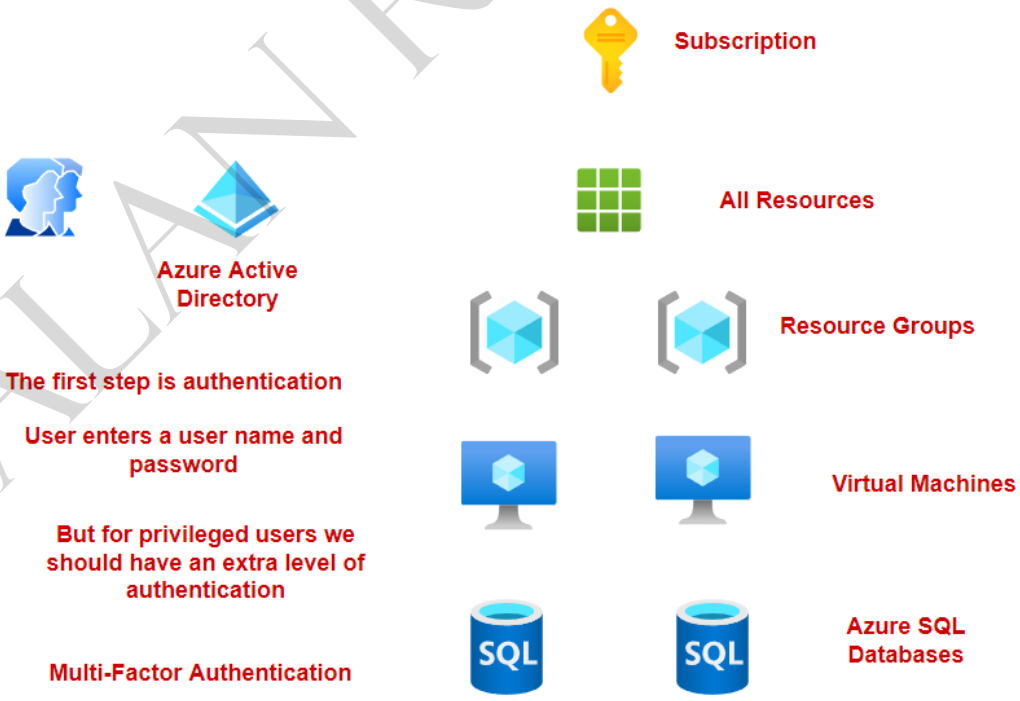
Azure Active Directory



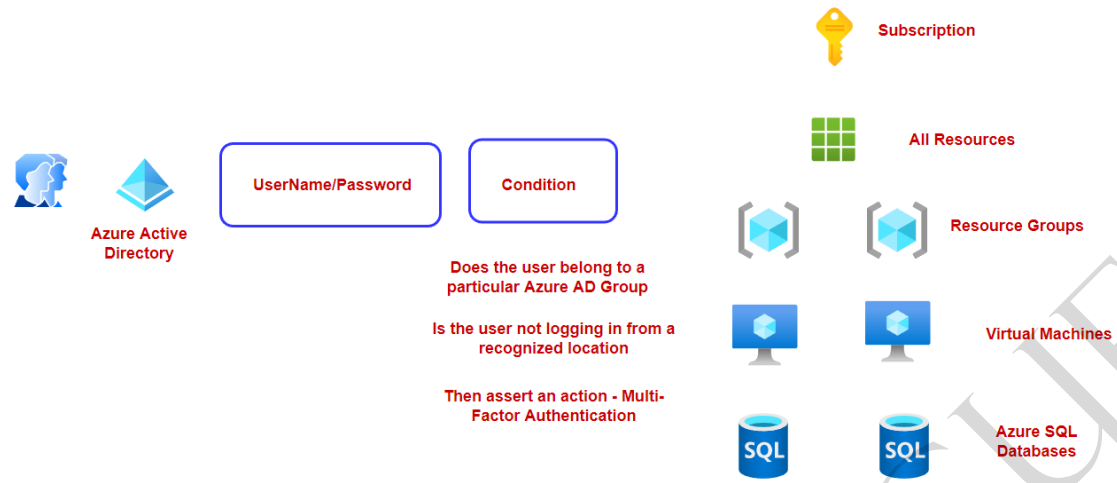
Role Based Access Control



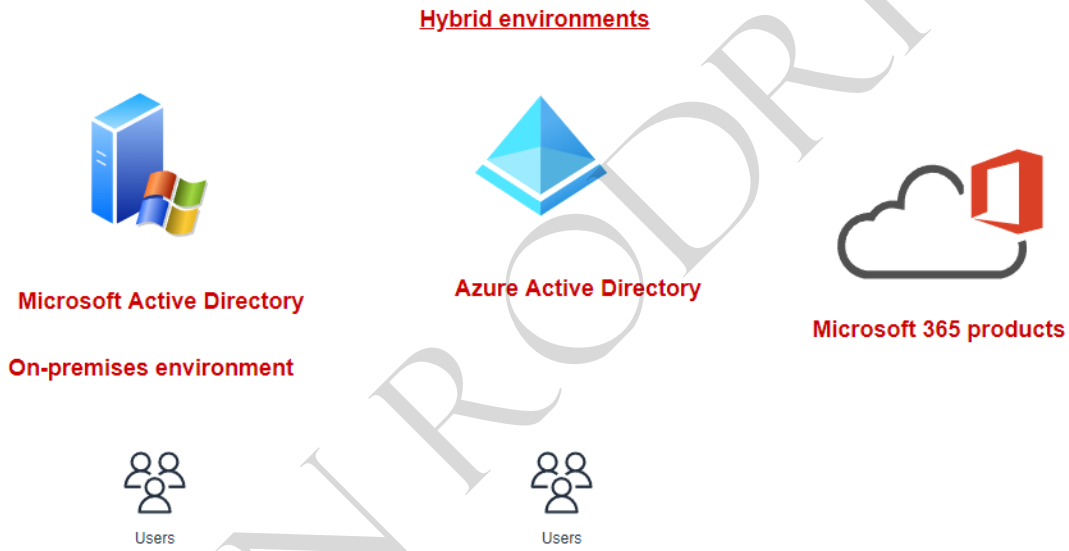
Lab - Multi-Factor Authentication



Conditional Access Policies



Hybrid environments – Identities



Microsoft Active Directory

On-premises environment

Users

Azure AD Connect

Azure Active Directory

Users

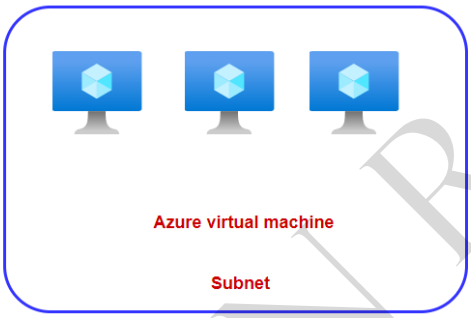
Azure AD Domain Services

This gives you the option of hosting the full version of Microsoft Active Directory as a managed software on the cloud.

You get the options of domain join, group policy, lightweight directory access protocol and Kerberos/NTLM authentication.

Microsoft Sentinel

Azure virtual network



Azure virtual machine

Subnet

Log Analytics workspace

Microsoft Sentinel

Security Information and Event Management

Security Orchestration , automation and response

1. Collect data

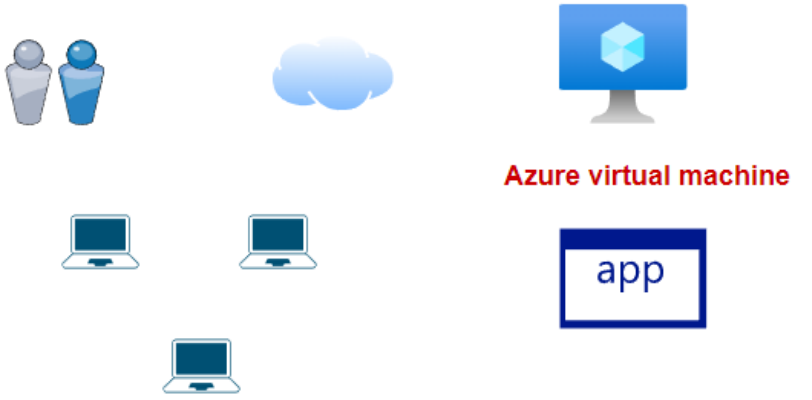
2. Detect threats

3. Respond and investigate threats

Azure Activity Log

Azure Active Directory sign-ins

Azure DDoS protection



DDoS attack

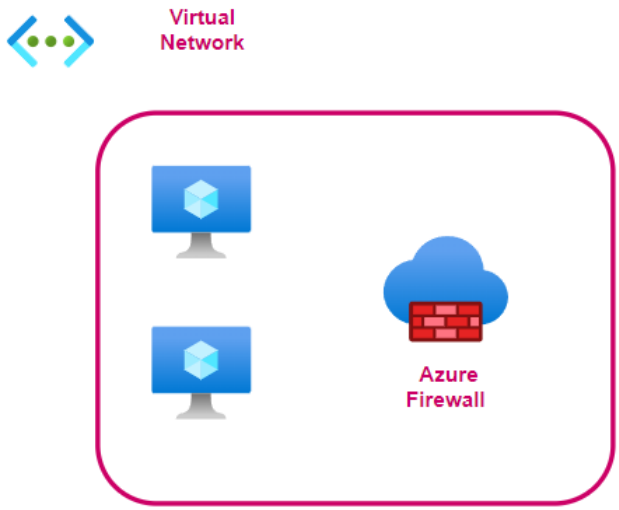
Distributed Denial of Service

Here the systems are trying to flood the target with traffic

Azure DDoS protection

Service helps to protect resources in an Azure virtual network against DDoS attacks

Azure Firewall



1. Has built-in high availability

2. Can deploy the Azure Firewall Instance across two or more Availability zones - 99.99% SLA

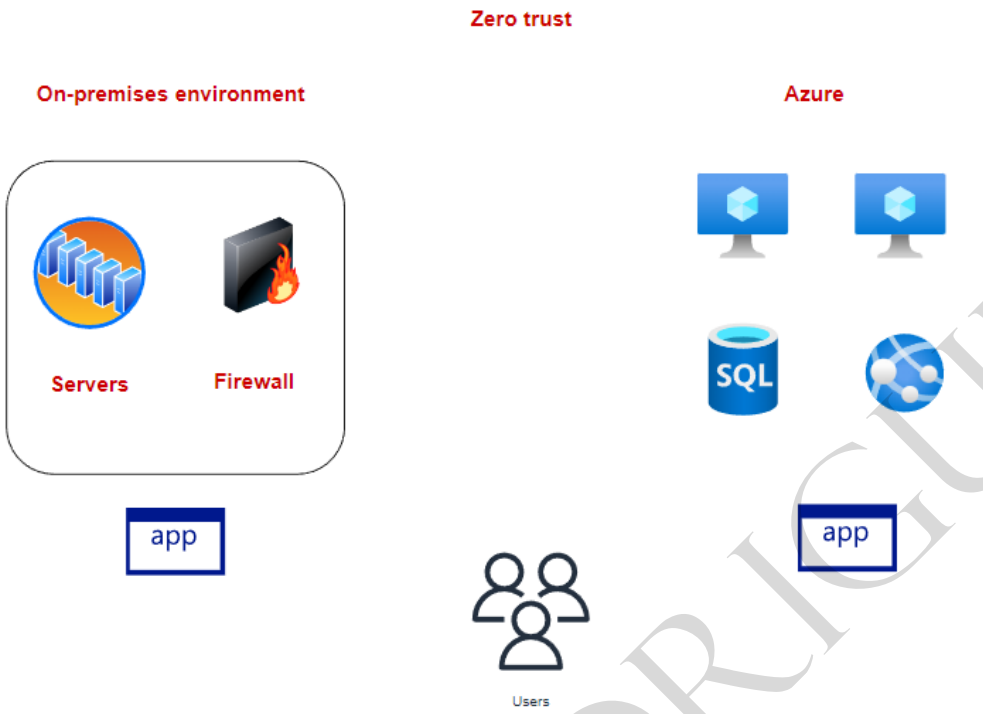
3. You can filter traffic based on fully-qualified domain names

4. You can also create network filtering rules - Based on source and destination IP address, port and protocol

5. It is stateful in nature, so it understands what packets of data to allow

6. It has built-in Threat Intelligence - Here you can get alerts or deny traffic from/to malicious IP addresses and domains

Concept of Zero Trust



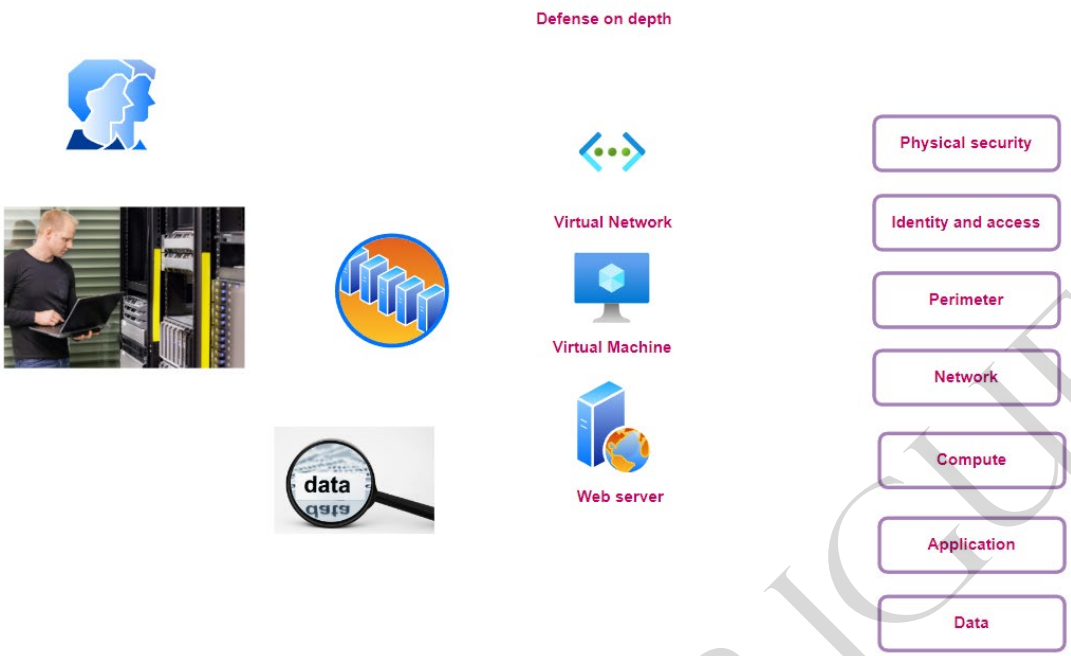
Foundation principles

1. Verify explicitly - Ensure to always authenticate and authorize users

2. Use least access privileges wherever possible

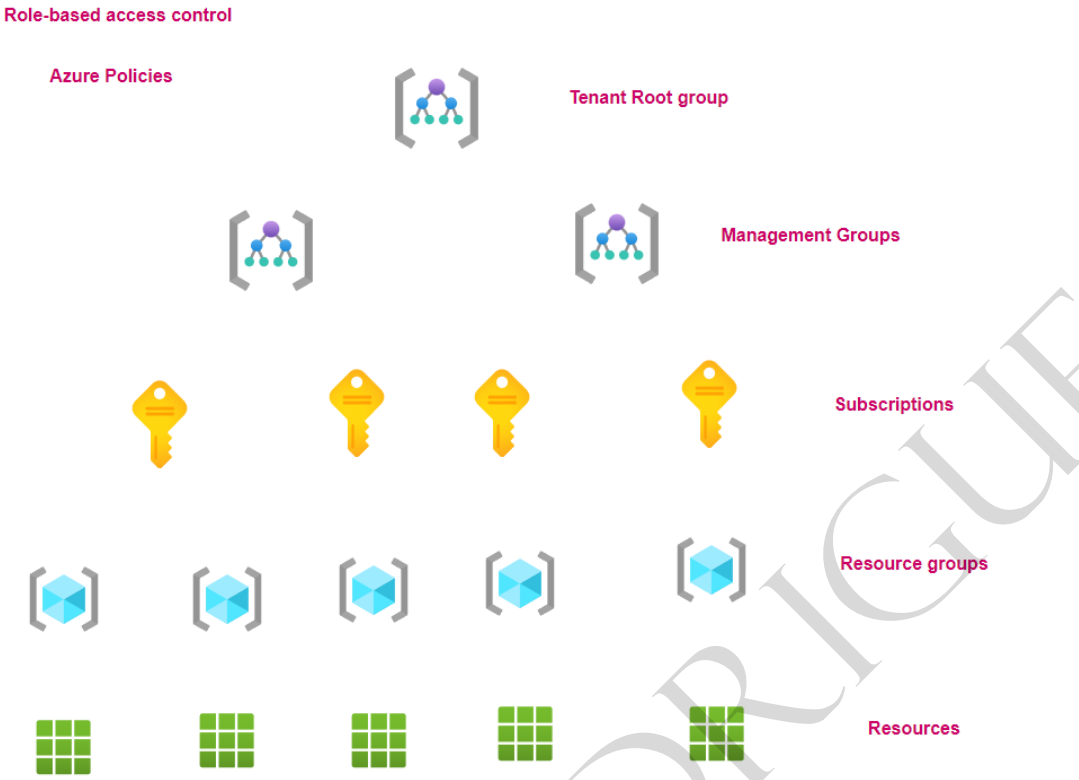
3. Assume breach - Understand your surface area when it comes to threats , look at threat intelligence.

Defense on Depth



Describe Azure management and governance

Management Groups



Azure Blueprints

Lab - ARM templates

Azure virtual network

Azure virtual machine

Azure SQL database

Azure virtual machine

Azure Web App

You define your infrastruture as code

Create an Azure Resource Manager template

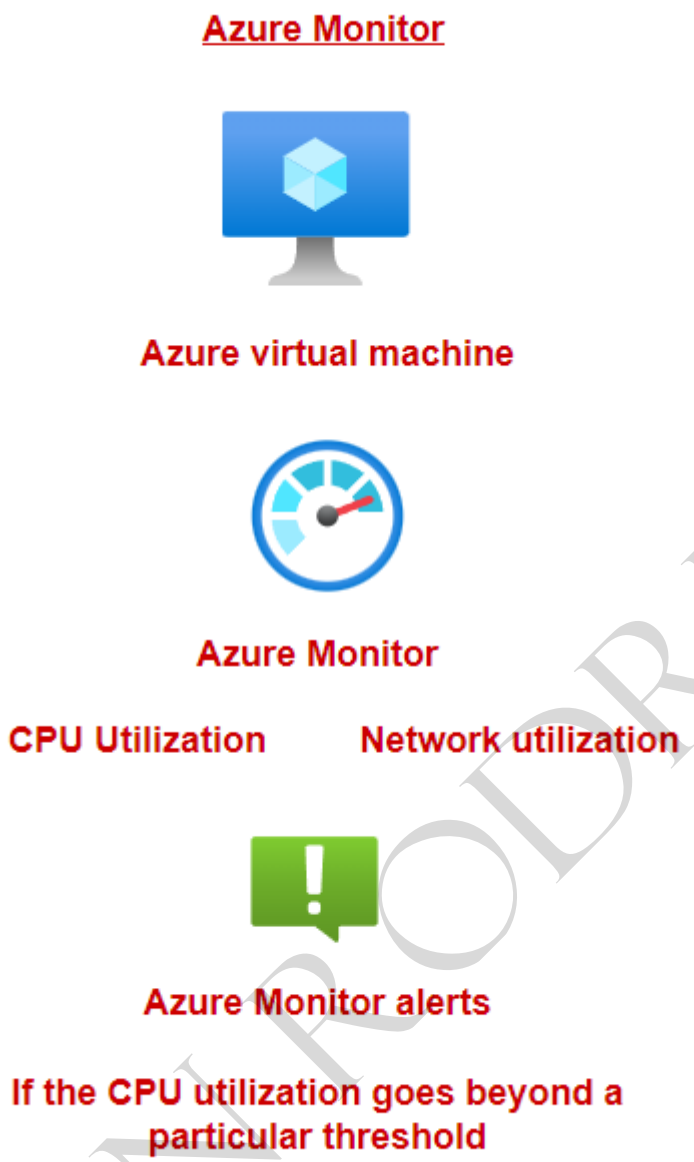
This is a JavaScript Object Notation file that actually contains the definition of the infrastructure

You can store the ARM templates in your source code repository along with your application code

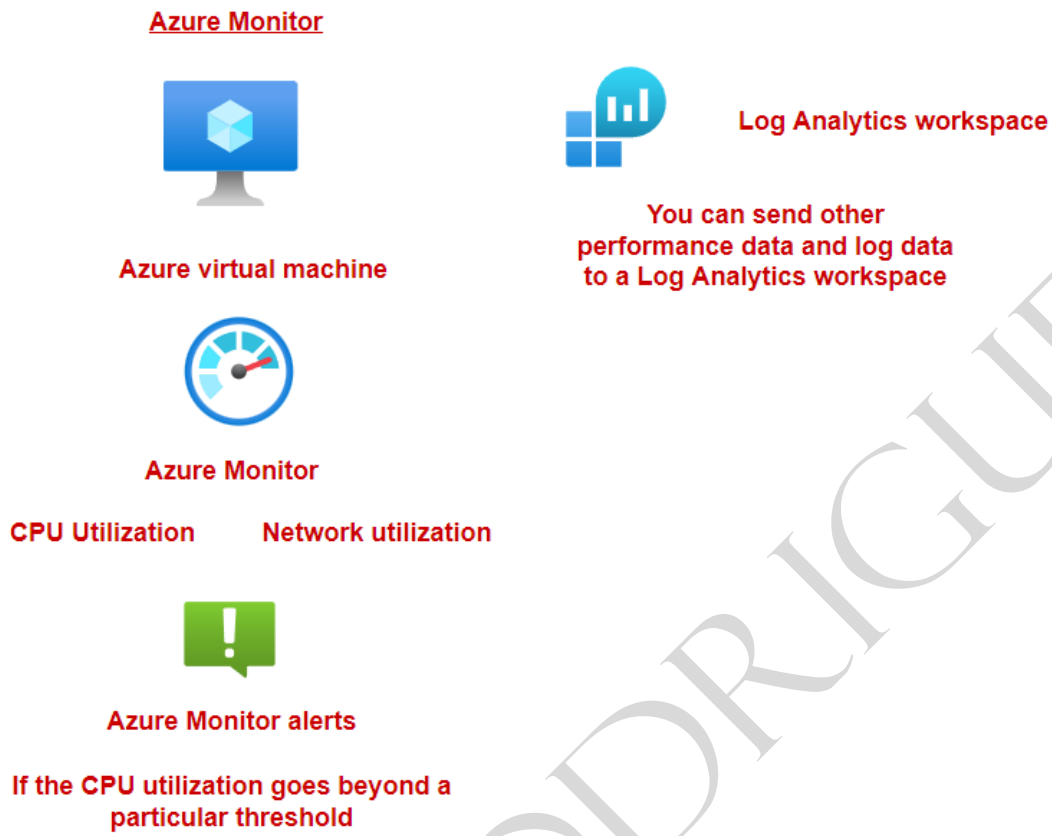
Microsoft has also release a new language called Bicep that has the same capabilities as ARM templates.

Bicep just uses a syntax that is easier to use.

Azure Monitor service

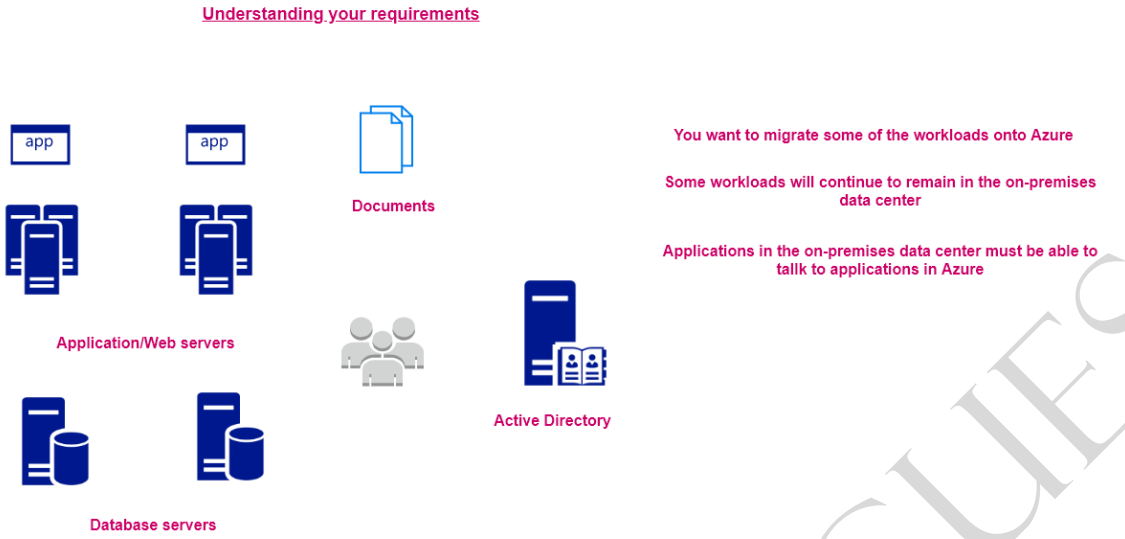


Lab - Log Analytics

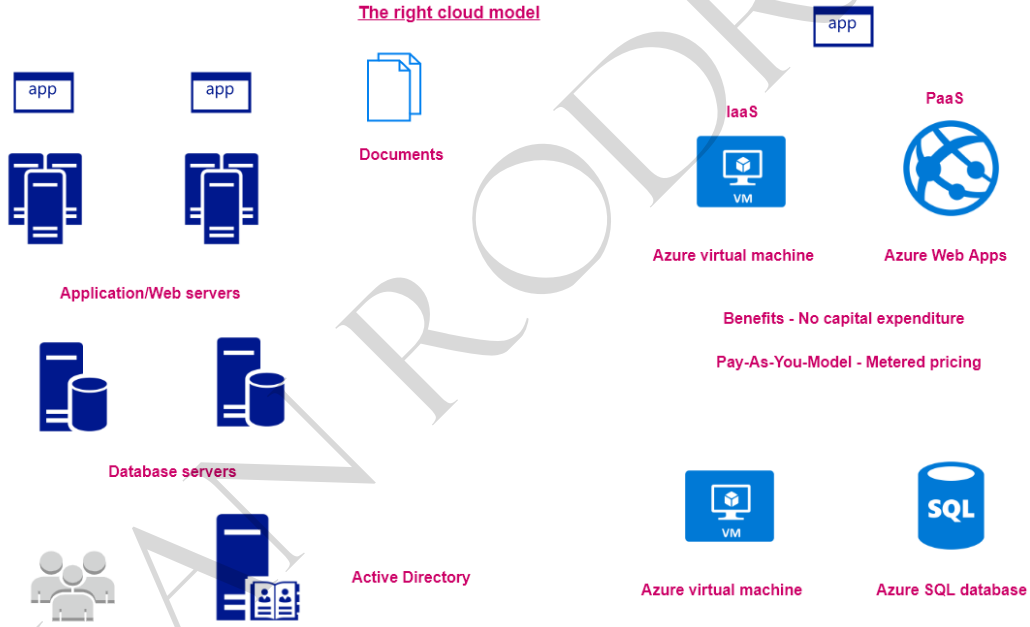


Putting everything together

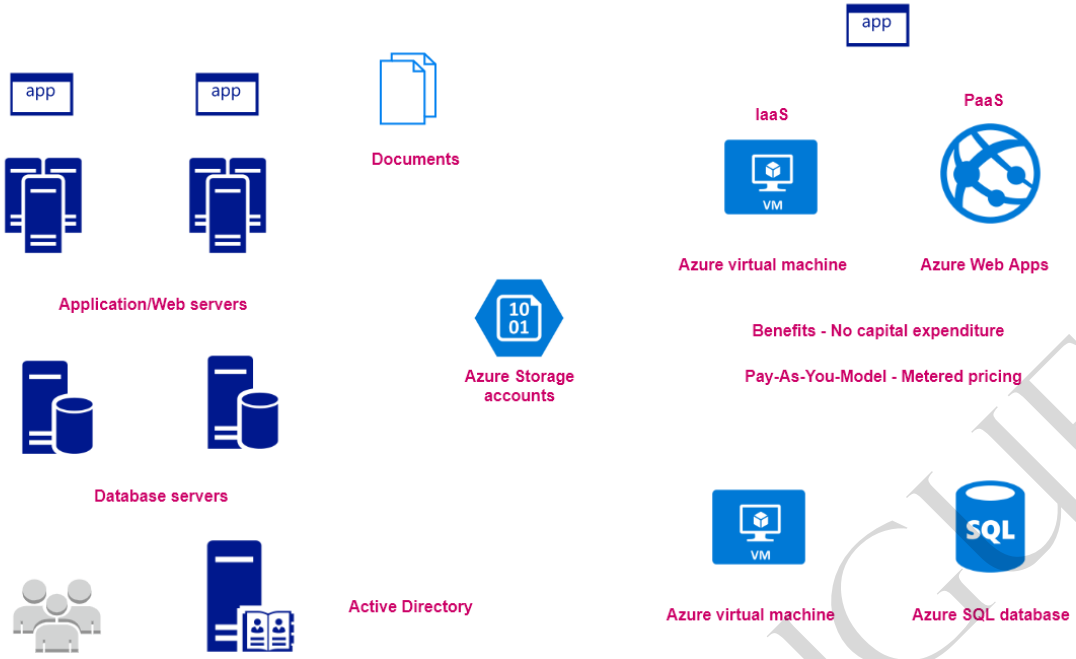
Understanding your requirements



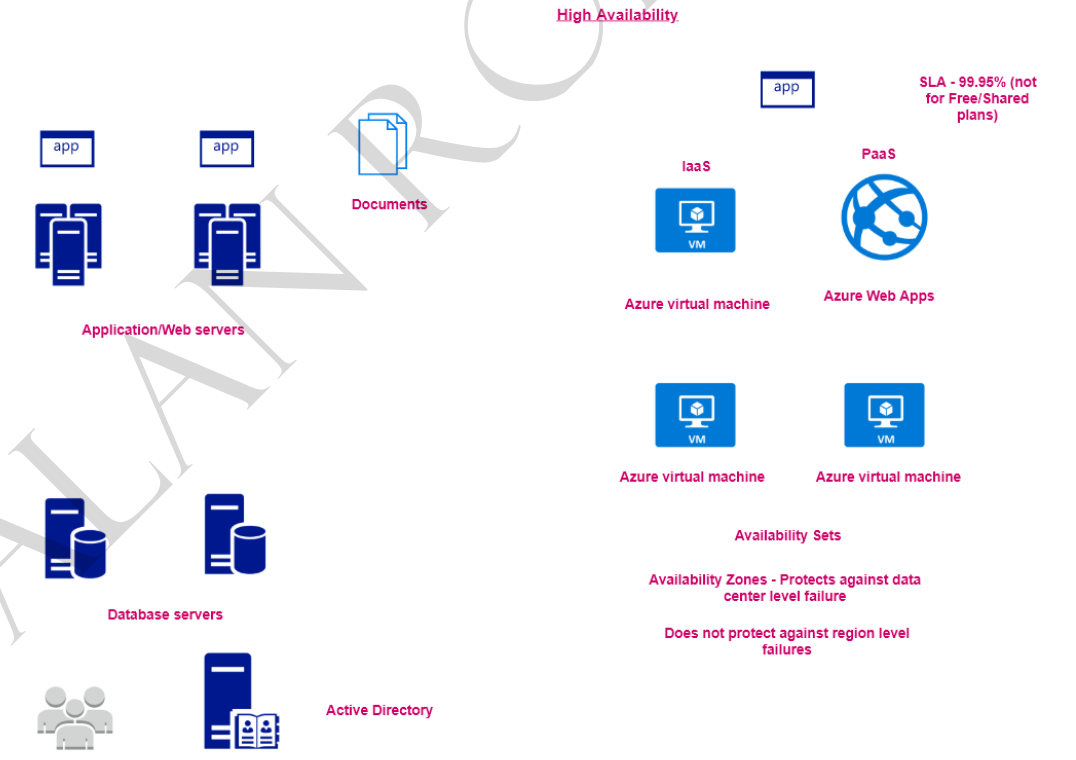
Choosing the right cloud model



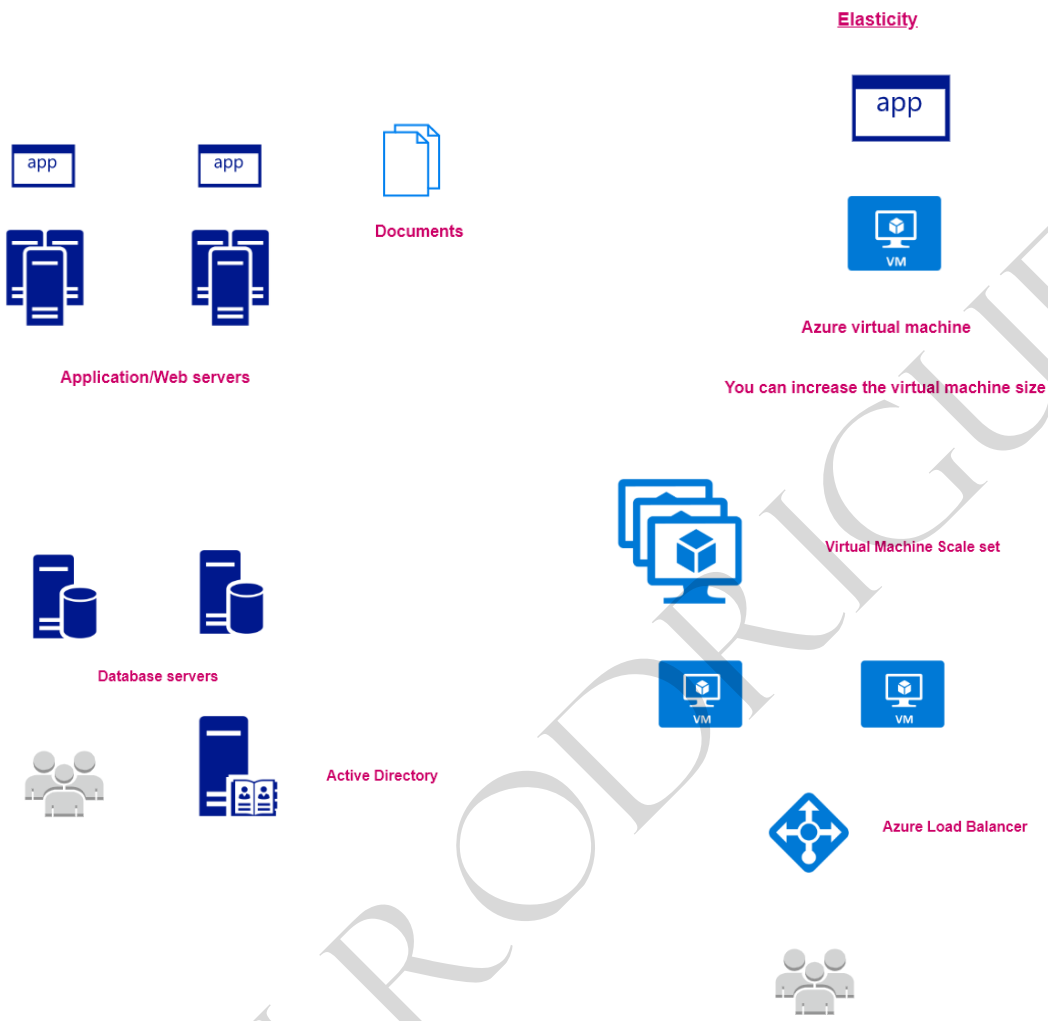
Storing user documents



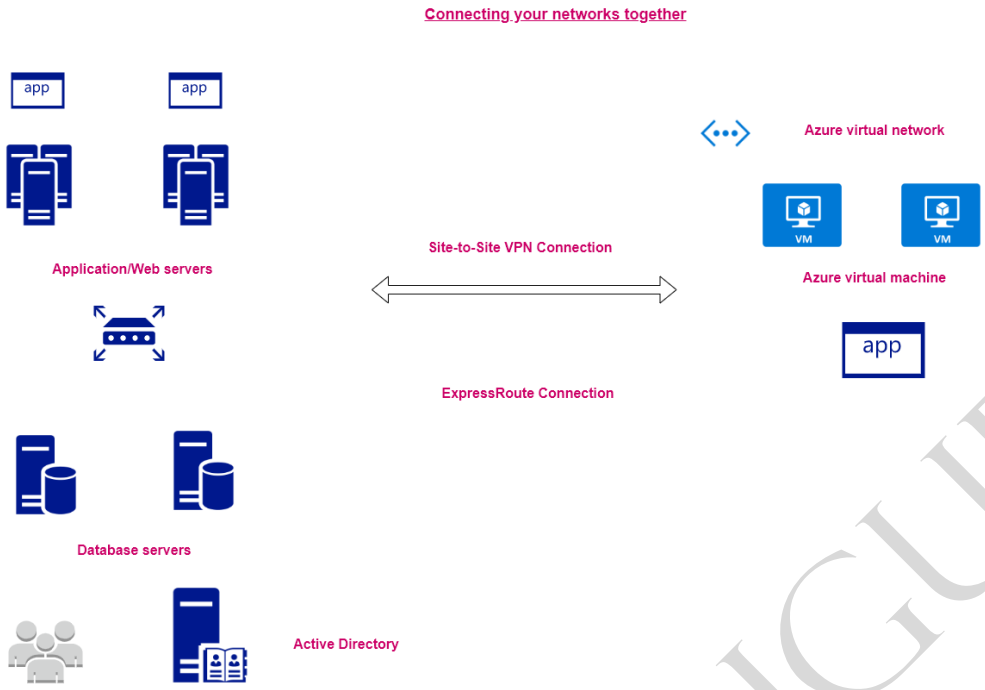
High Availability



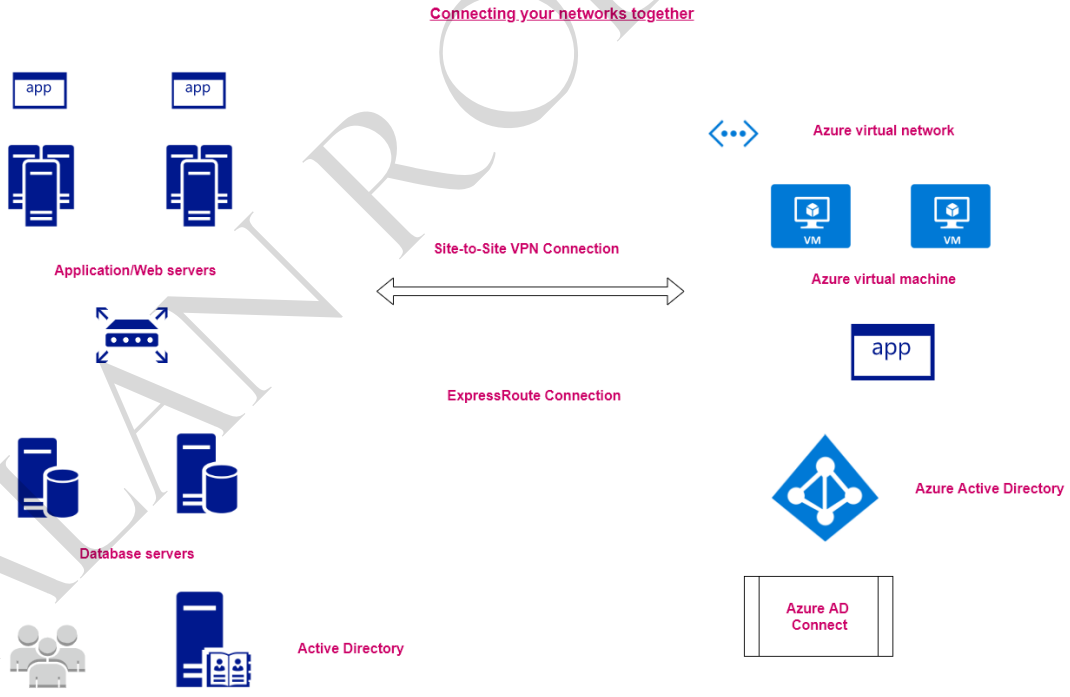
Elasticity



Connecting data center to Azure



The user identities



Monitoring your infrastructure

Monitoring your infrastructure