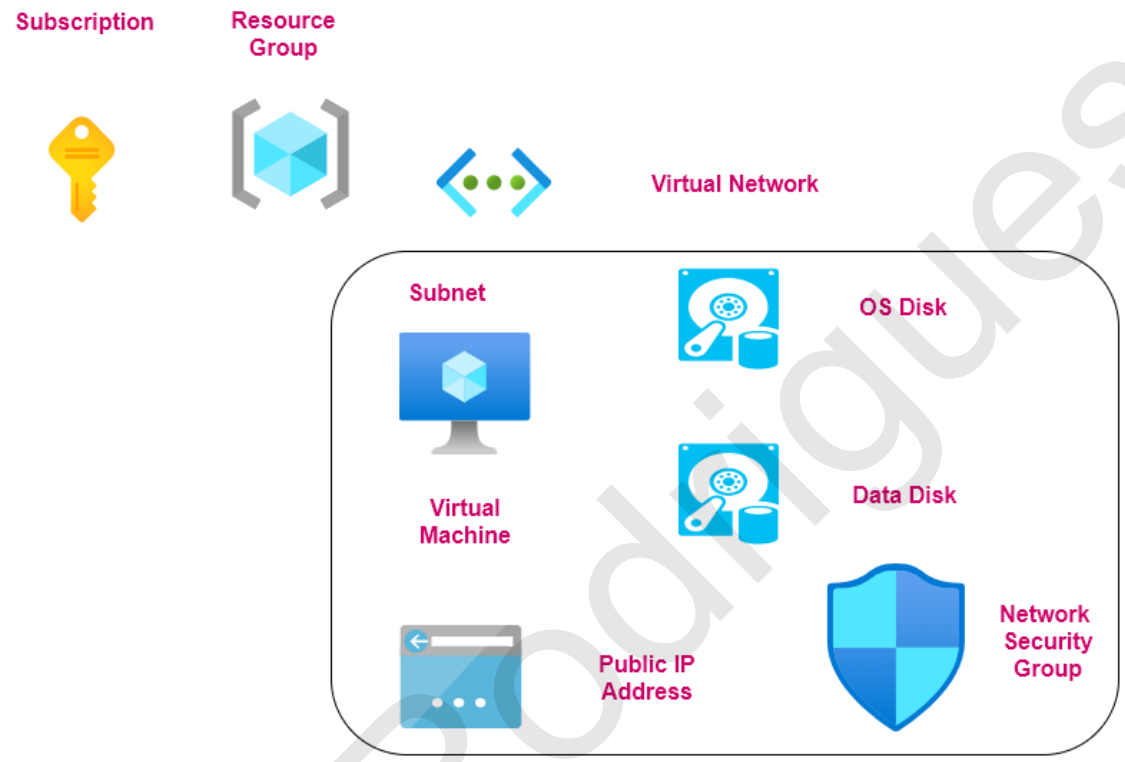
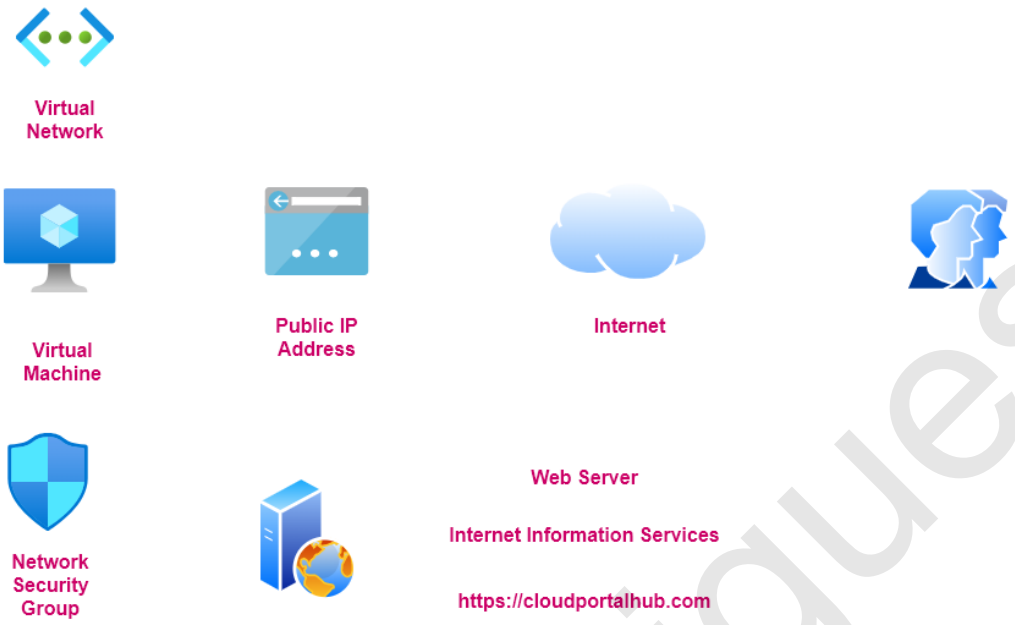
# Develop Azure compute solutions - Azure Virtual Machines

## What goes into the deployment of a virtual machine




## Lab - Installing Internet Information Services




# Lab - Deploying a .Net Core app on Windows Server

Windows Server virtual machine

Internet Information Services

Step 1 : Assign a DNS name to the VM

Step 2 : Add a rule for port 8172 to the Network Security Group

Step 3 : Add the role of the Management service on the VM

Step 4 : Check the configuration of the Management service in IIS

Step 5 : Install the .Net Core Hosting Bundle. This allows .Net applications to be hosted on IIS

Step 6 : Install the Web Deploy v3.6 tool

## Using NGINX on the Linux VM

**Linux Server virtual machine**

**Kestrel Web server**

**Publish to a folder**

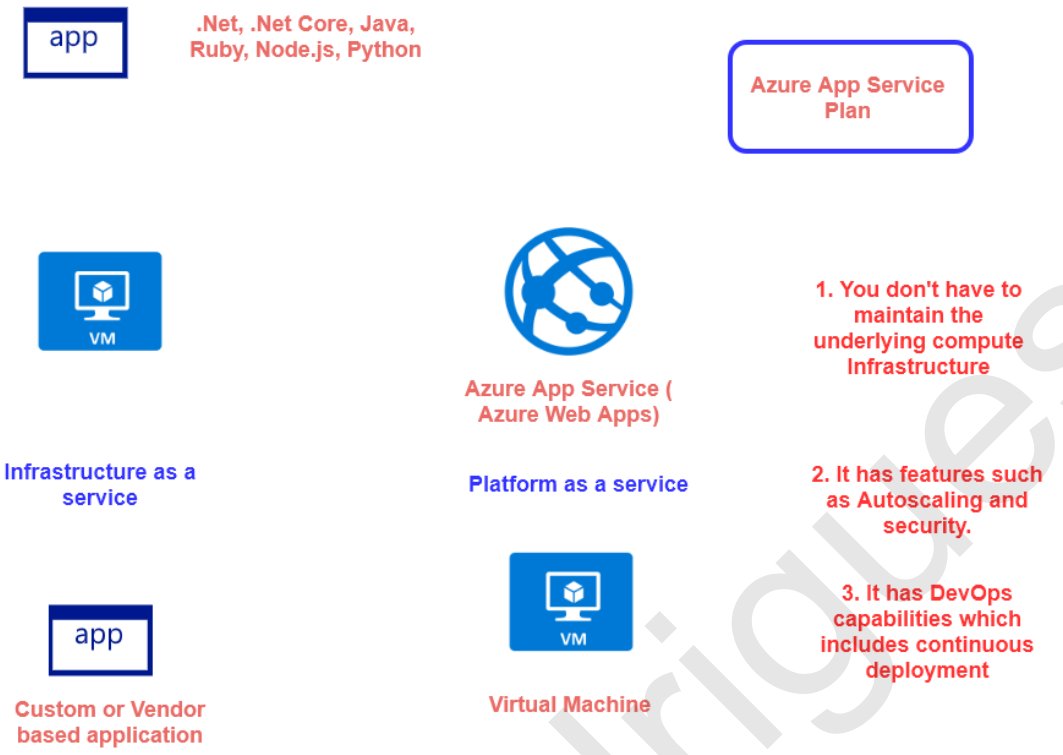
**Copy the folder to the server**

**Install ASP.Net 6.0**

**NGINX Web server**

# Develop Azure compute solutions - Azure Web Apps

## Introduction onto Azure Web Apps




## Lab - Azure SQL Database

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

## Azure Web Apps – Autoscaling


## Deployment Slots

Deployment Slots

Staging Environments for App Service Plans


Version 1

Version 2

Production Slot

Staging slot

Standard , Premium and Isolated App Service Plan

Applications in deployment slots have their own host names

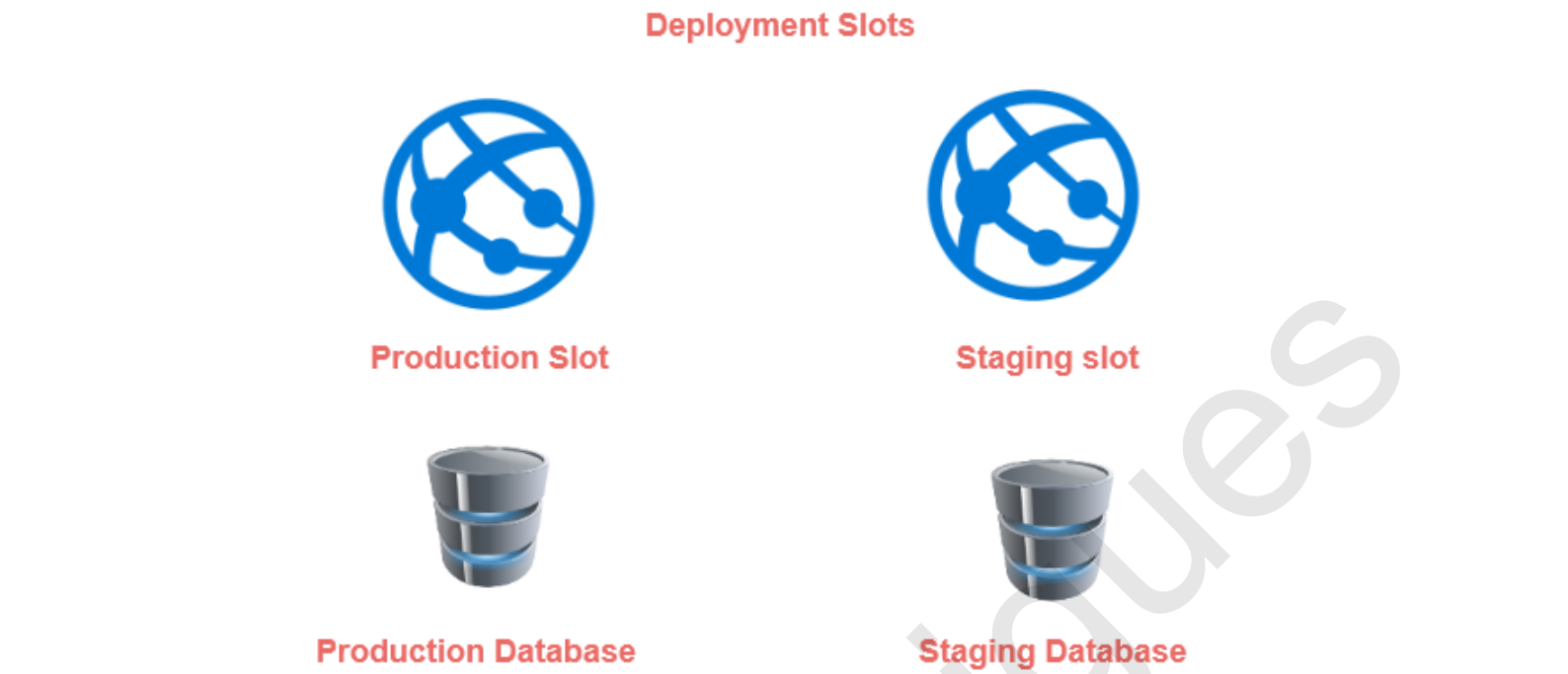
1. You have the chance to validate all application changes in the staging deployment slot

2. You can then swap the staging slot with the production slot

3. This helps eliminate the downtime for your application when new changes are deployed

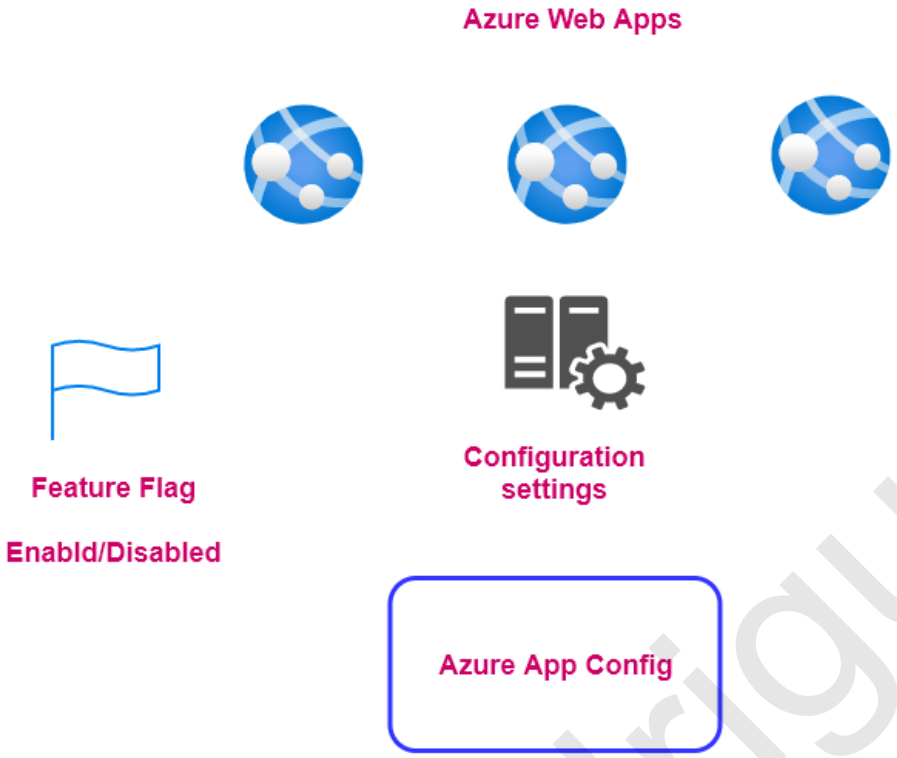
4. You can also easily roll back the changes

## Deployment slots with databases



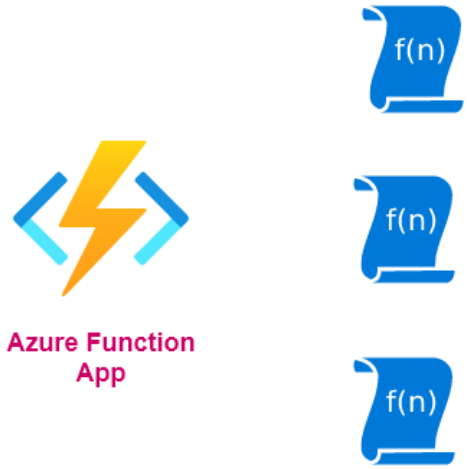

1. First create a script for the database changes in production
2. Define an outage time slot
3. Ensure production database backups are in place
4. Apply the scripts in the production database
5. Perform a swap of the staging and production slots

## Azure App Configuration




Develop Azure compute solutions - Azure Functions

## What are Azure Function Apps




You can then define different functions in the Function App

You are charged based on how much you consume


## Inspecting a HTTP Trigger-based function

Azure Function App


Function

HTTP Trigger

Internet

Web Site

www.google.com

HTTP/HTTPS request

HTTP/HTTPS response

Query String parameter

**GET Method**

https://cloudportalhub.com/customer?id=1

**POST Method**

This is used when you want to submit some data to the site

## Develop Azure compute solutions - Containers

### What is the need for containers

Isolation


App dependencies

Third-party libraries


App dependencies

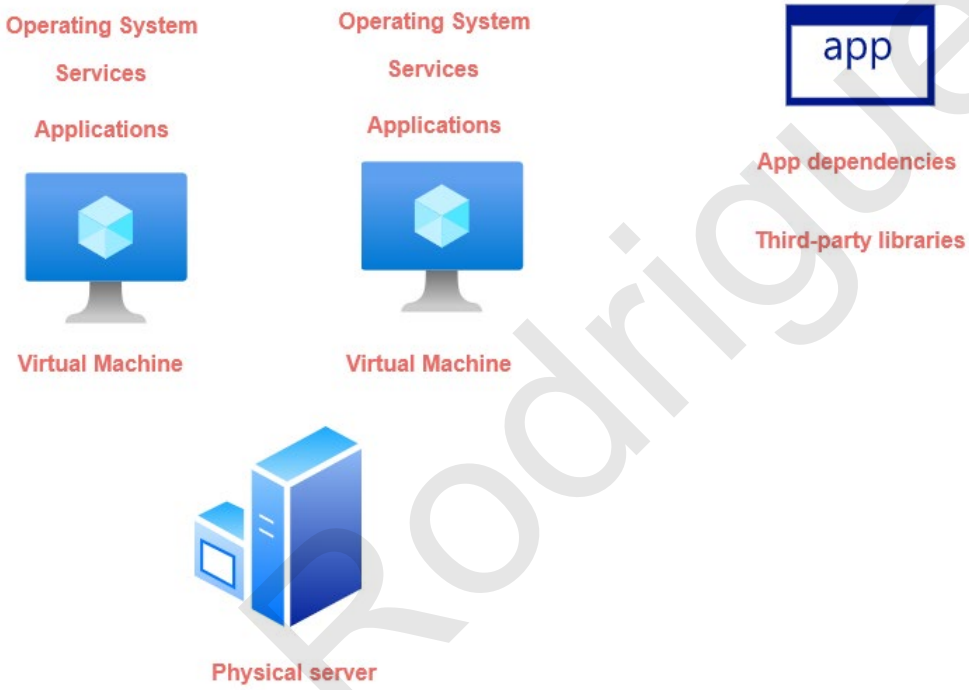
Third-party libraries

App dependencies

Third-party libraries

Containers helps to package the application along with libraries , frameworks and dependencies that are required.

Portability




## What is Docker

## 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

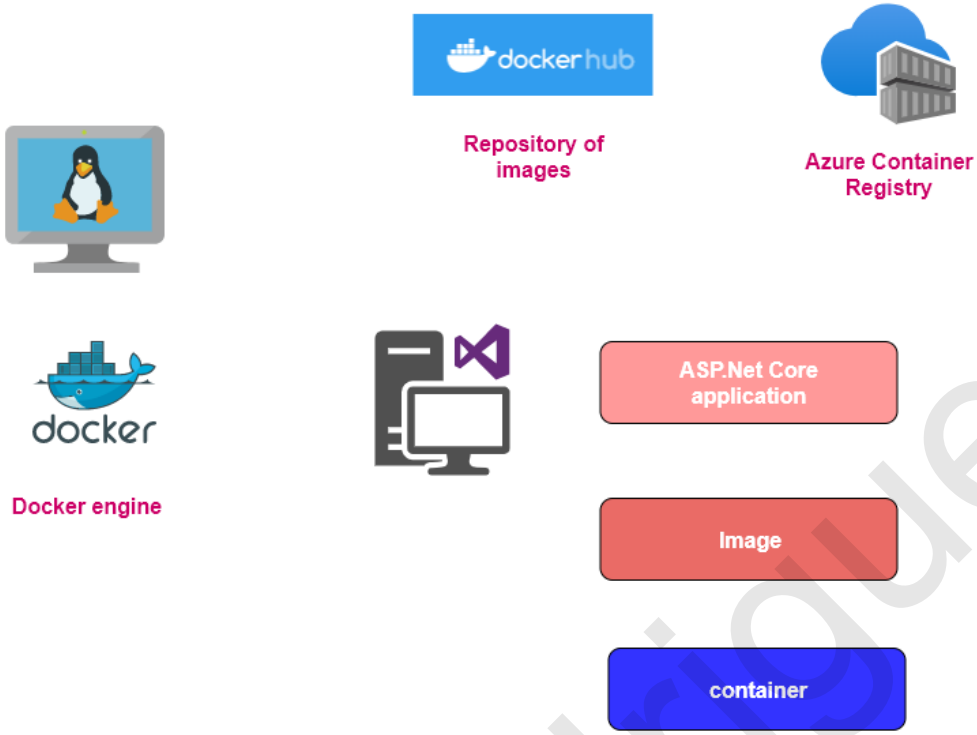

Docker host

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**

## The need for a registry




Setting up our application against MySQL database

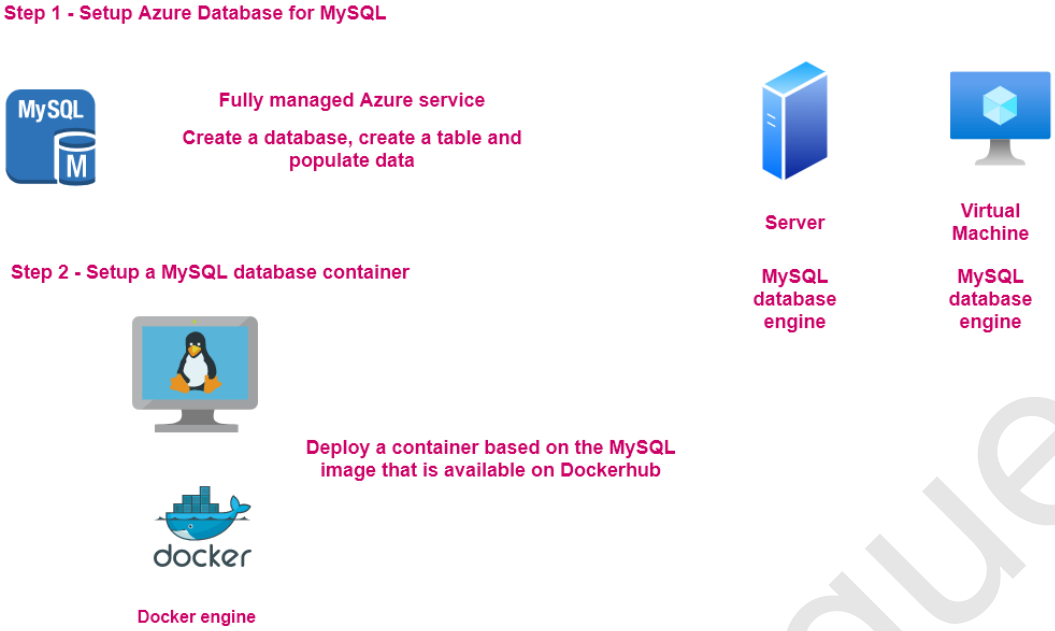

Application


MySQL database

Container

Container

Azure Container Group

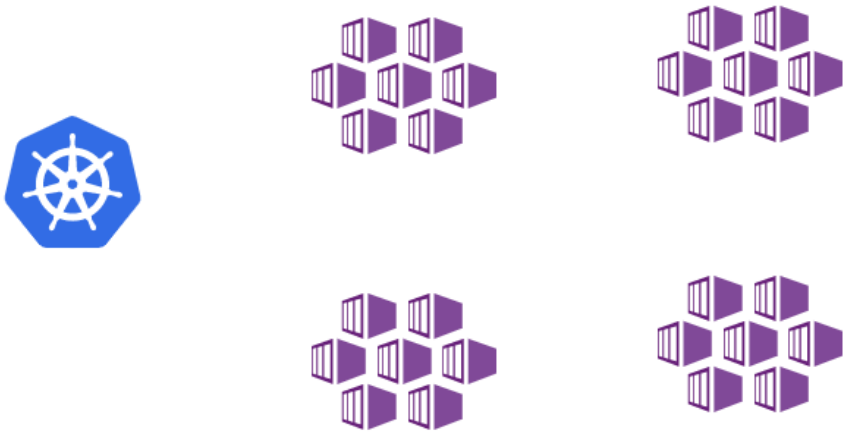



**Step 3 - Customize the MySQL image**

**We want to ensure that the database and tables are already deployed to the container**

## What is Azure Kubernetes

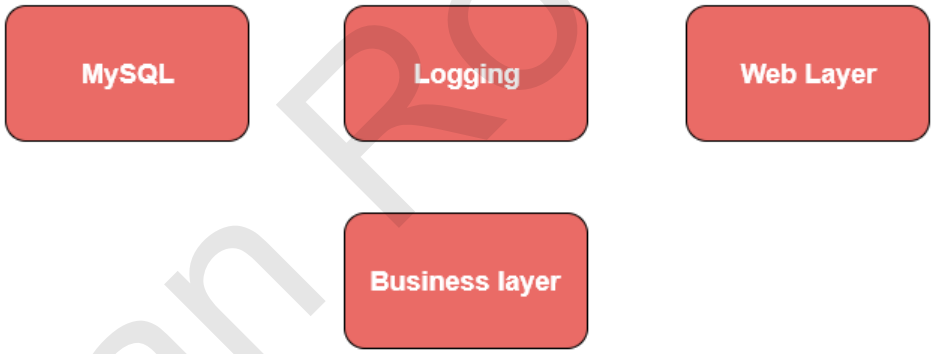
Kubernetes



Managing containers at scale

Azure Kubernetes - Managed service for Kubernetes on Azure

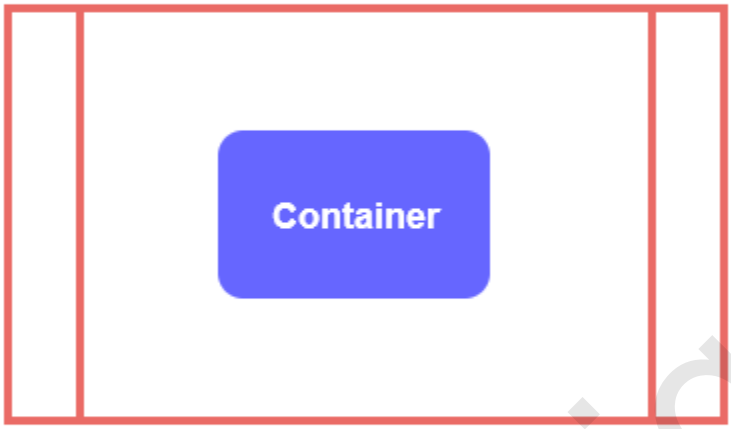
Kubernetes is used to orchestrate your containers for hosting your applications




Kubernetes cluster

## Deployment of containers

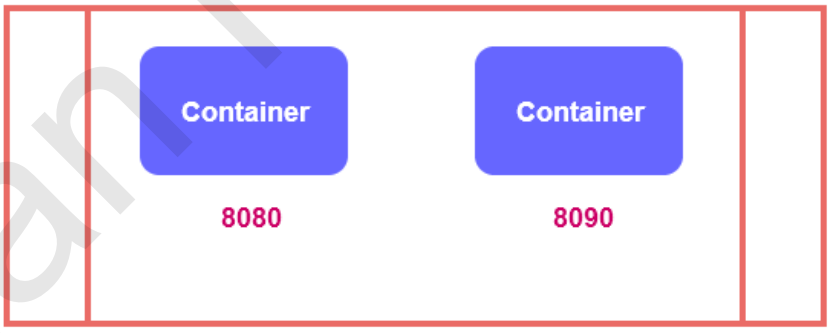
### Pod




A Pod is used to group one or more containers.

The pod gets shared storage and network resources

Pod

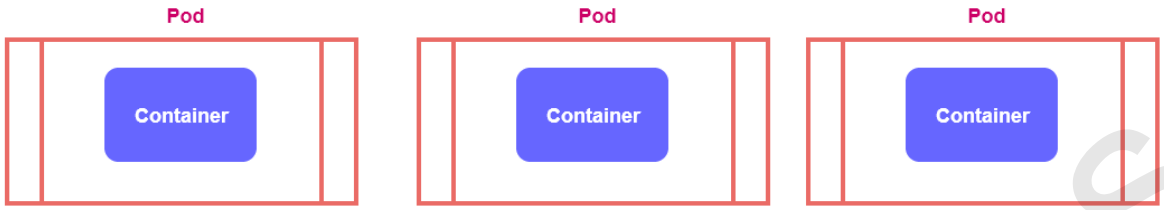



10.0.0.16

Deployment

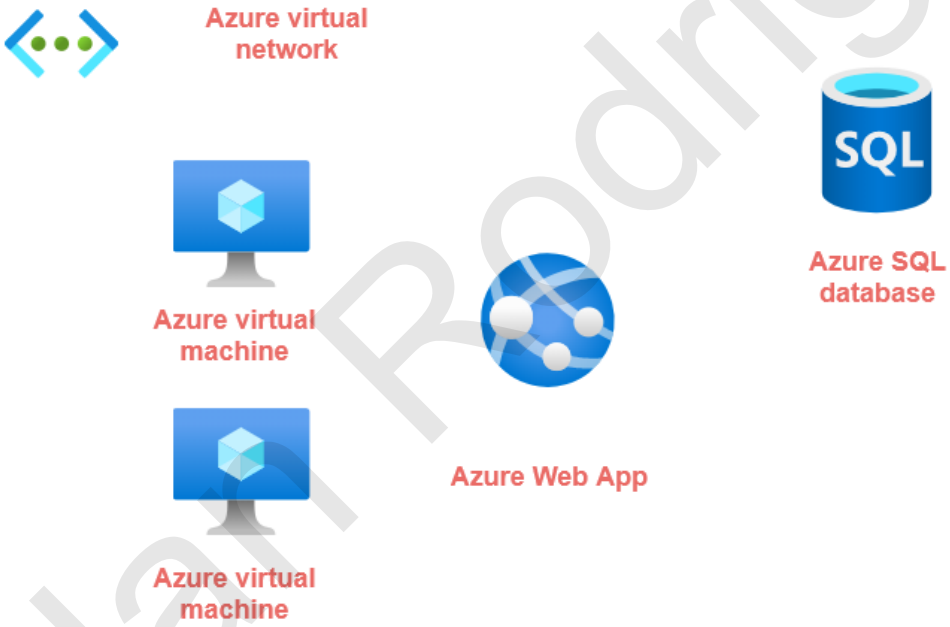
This is a declarative way to describe the state of the Pods and ReplicaSets

The deployment controller is used to ensure the desired state of the environment is always met




# Develop Azure compute solutions - Other tools and Review

## What are ARM templates




You define your infrastruture as code

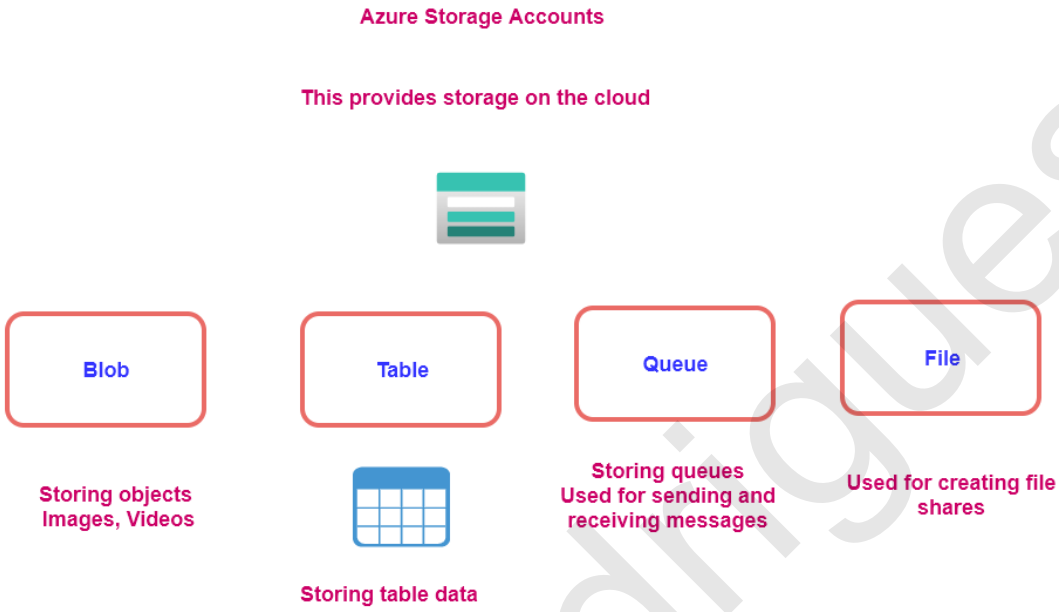
Create an Azure Resource Manager template

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

# Develop for Azure Storage - Azure Storage Accounts

## What are storage accounts




## Azure Blob service

Its optimized for storing large amounts of unstructured data

Azure Storage Account


Azure virtual machine

Blob service

Container

Files

Unique URL

Images


Videos

**Block blobs**

This is made up of blocks of data that can managed individually

**Append blobs**

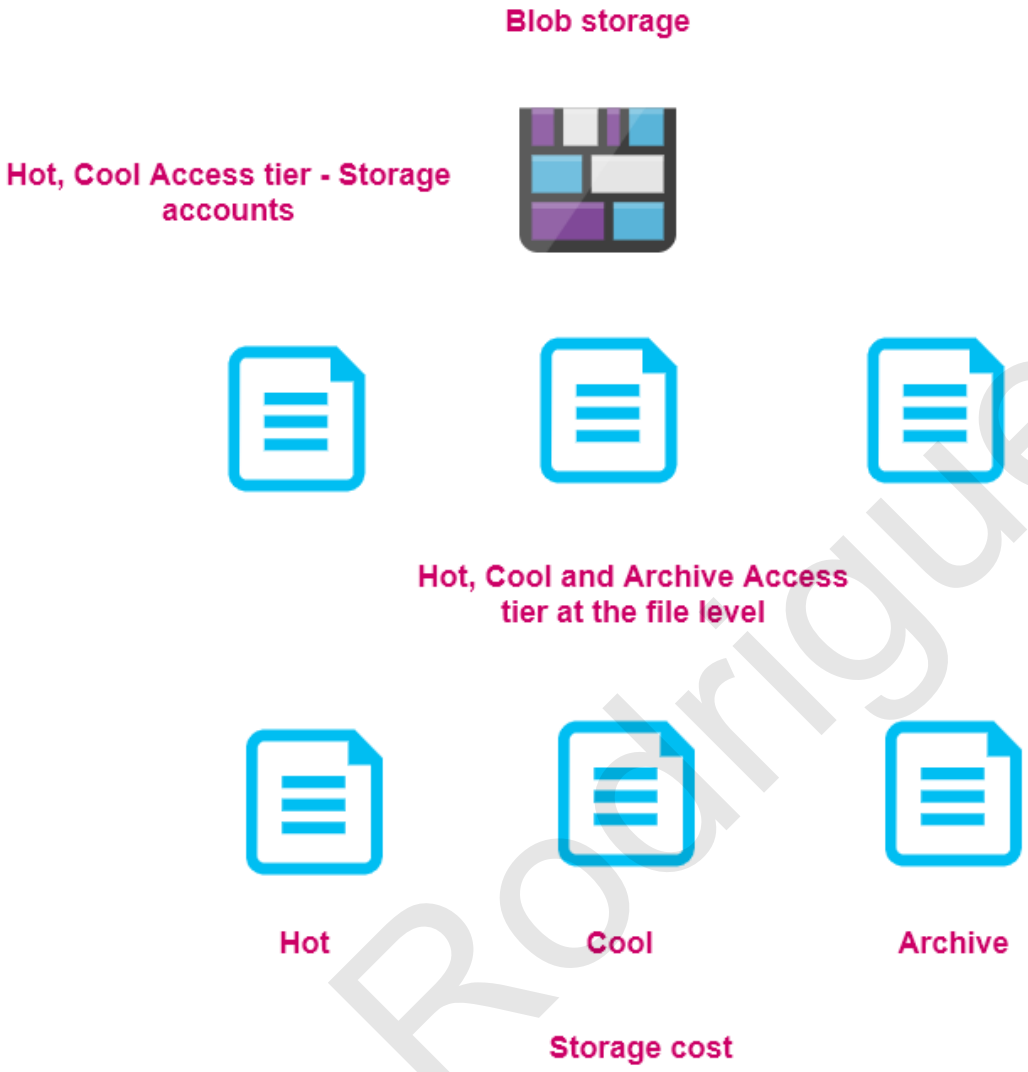
These are block blobsthat are optimized for append operations - Good for logging

**Page blobs**

This is used for virtual hard drive files for Azure virtual machines

# Azure Storage Accounts - Different authorization techniques

## Storage Accounts - Access Tiers



Early deletion fees

Cool

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

Archive

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

To read an object in the Archive tier

Cool

Archive

Rehydration

Hot

## What is Azure Table Storage

## Azure Table Storage

This is a service that is used to store non-relational structured data

Based on structured NoSQL data

Here you follow a key/attribute store with a schemaless design

SQL database

Products Table

Orders Table

Customers Table

There are relationships between the tables

Becomes easier to fetch related data

But not all applications need to have such complicated design when it comes to data storage

## Elements of Azure Table Storage

**A table is a collection of entities**

**The entities don't abide by any schema**

**Each entity can have a different set of properties**

**An entity is made up of properties**

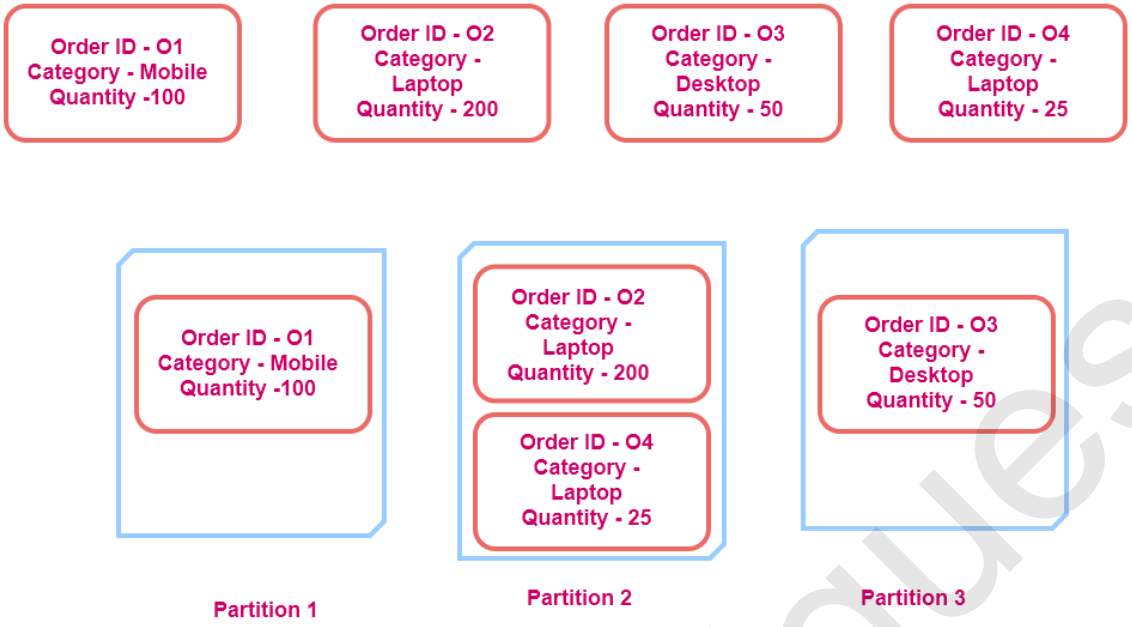
**Each property is a name-value pair**

**Entity**

**Partition Key - This is a string value. This identifies the partition that the entity belongs to**

**Row Key - This is a string value. This uniquely identifies each entity within the partition**

**The Partition key along with the Row key helps to uniquely identity the entity within the table.**




# Develop for Azure Storage - Azure Cosmos DB

## What is Azure Cosmos DB

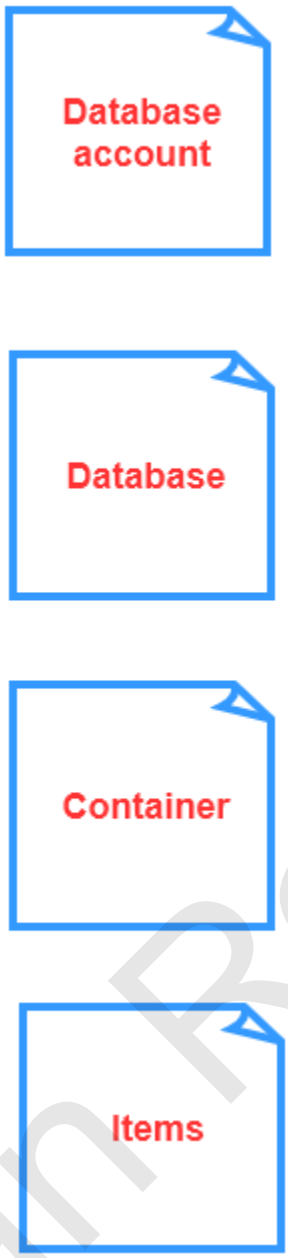
**Azure Cosmos DB**

**Fully Managed NoSQL database**

**You get single-digit millisecond response times**

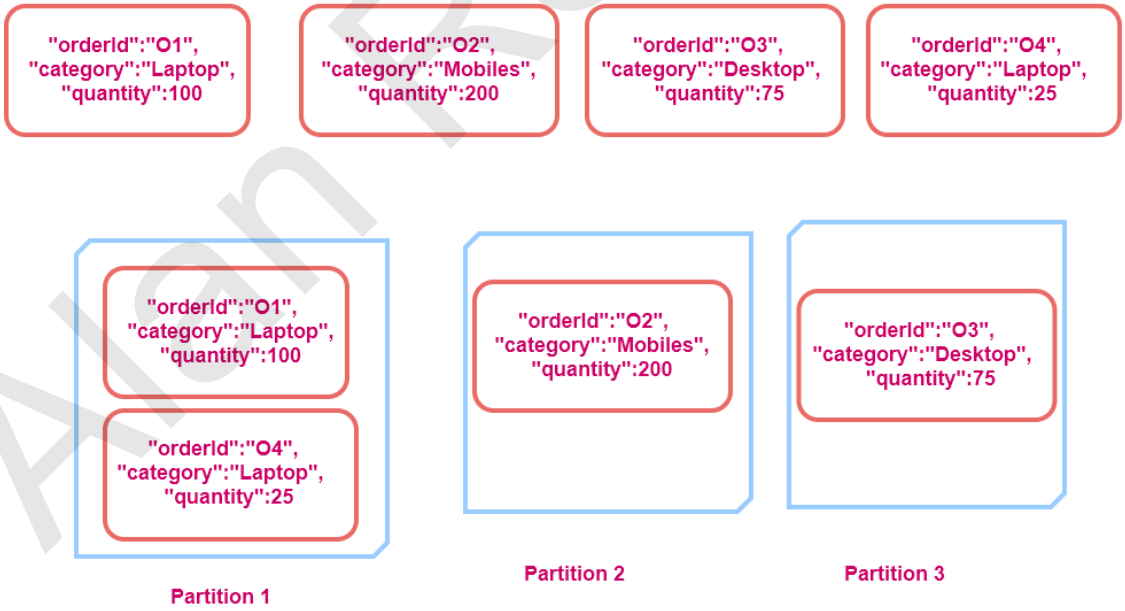
**Scales automatically based on demand**

**SQL API** | **MongoDB** | **Gremlin** | **Cassandra** | **Table**



| | Database Term | Container Term | Item Term |
|---|---|---|---|
| SQL API | Database | Container | Item |
| MongoDB | Database | Collection | Document |
| Gremlin | Database | Graph | Node/Edge |
| Cassandra | Keyspace | Table | Row |
| Table | NA | Table | Item |

## More on Partition Keys




## When to choose what API

SQL API

Data that can be queried via SQL

Data that is related to some nature

Table API

MongoDB API

Some similarities to the SQL API

Cassandra API

Column-friendly database

Does not support joins or subqueries

Gremlin API

## Consistency


**Consistency** **Latency** **Throughput**

**Strong**

Here the reads are guaranteed to return the most recent committed version of an item

West US

West US 3

West Central US




**Bounded staleness**

Here the reads might lag behind writes by at most "K" versions of an item or "T" time interval

West US

West US 3

West Central US

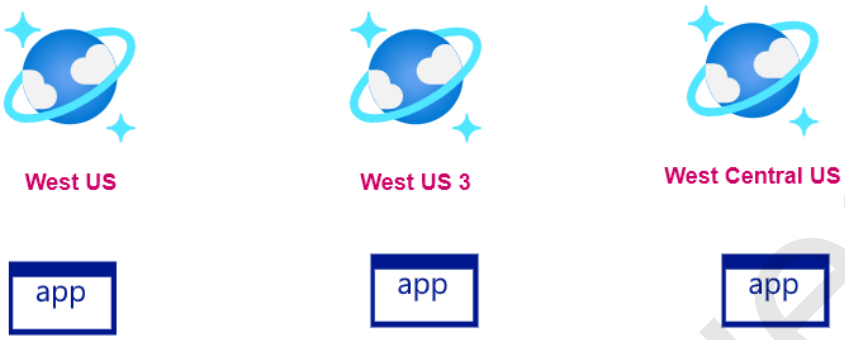



**Session**

Here within a single client session, the reads are guaranteed to honor the consistent-prefix, monotonic reads and writes, read-your-writes and write-follows-read guarantees

**Consistent prefix**

**Here the client will not see out of order writes**




{ "orderId":"O1", "category":"Laptop", "quantity":100}

{ "orderId":"O1", "category":"Laptop", "quantity":200}

{ "orderId":"O1", "category":"Laptop", "quantity":300}

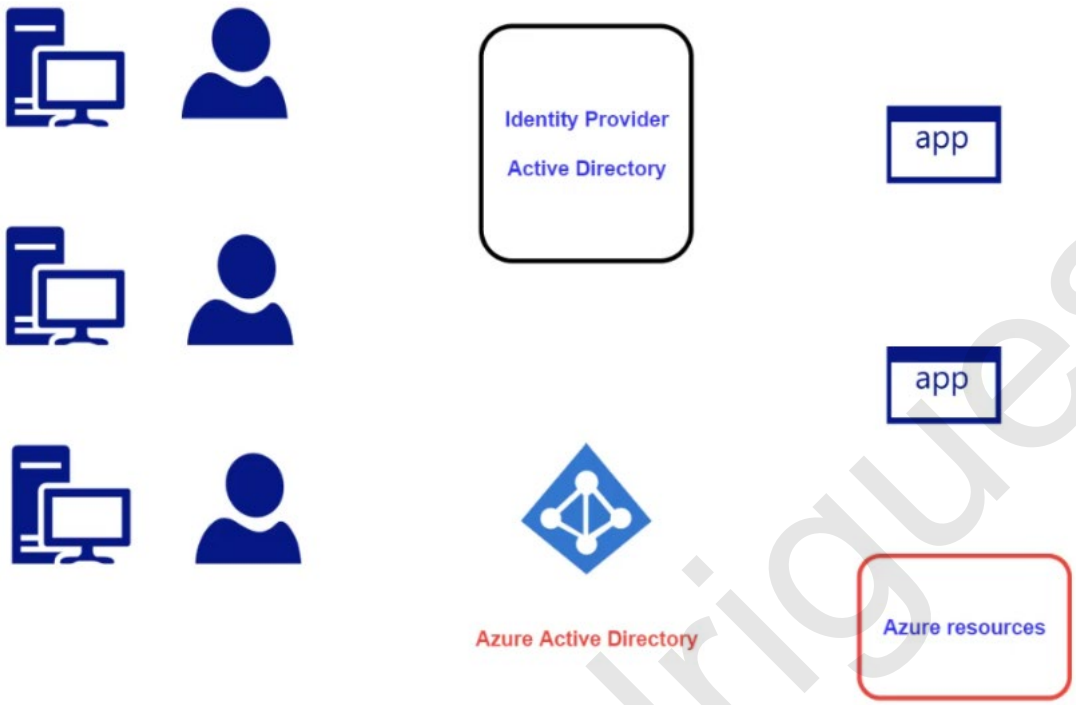
{ "orderId":"O1", "category":"Laptop", "quantity":400}

**Eventual**

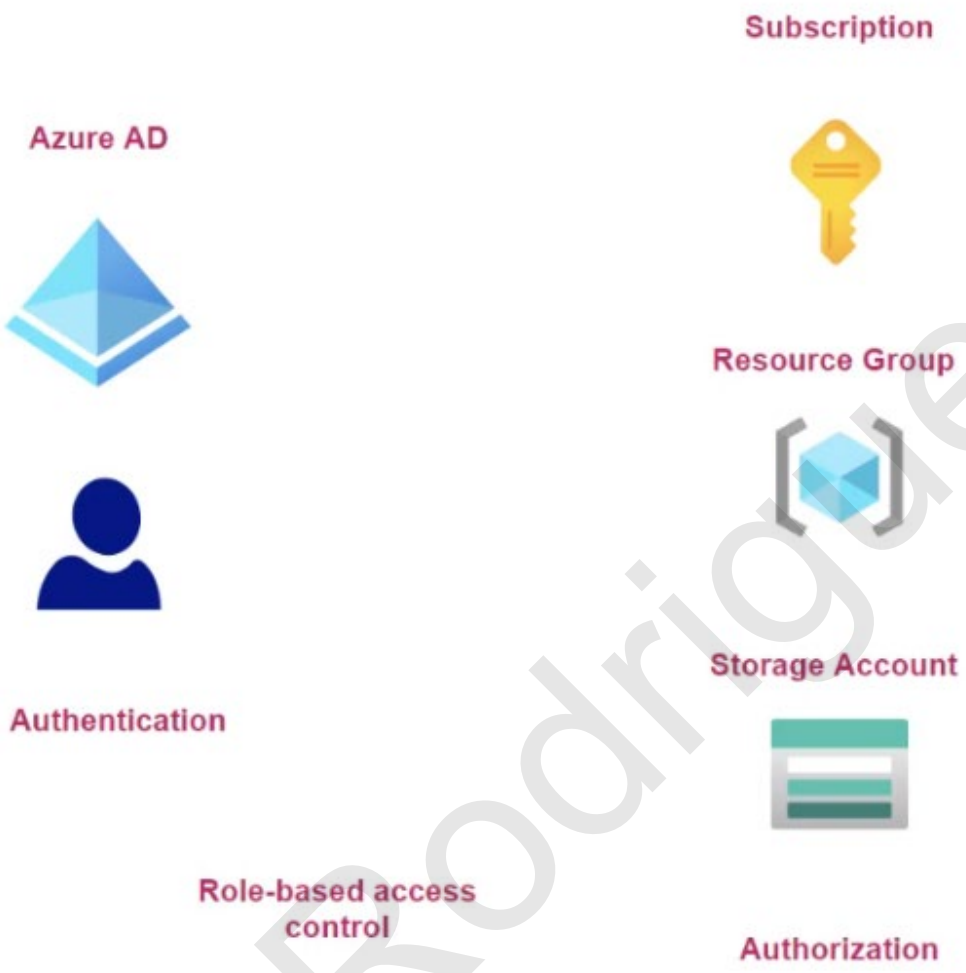
**Eventually the data will be consistent. But there is no order gurantee for the reads.**

## Implement Azure security

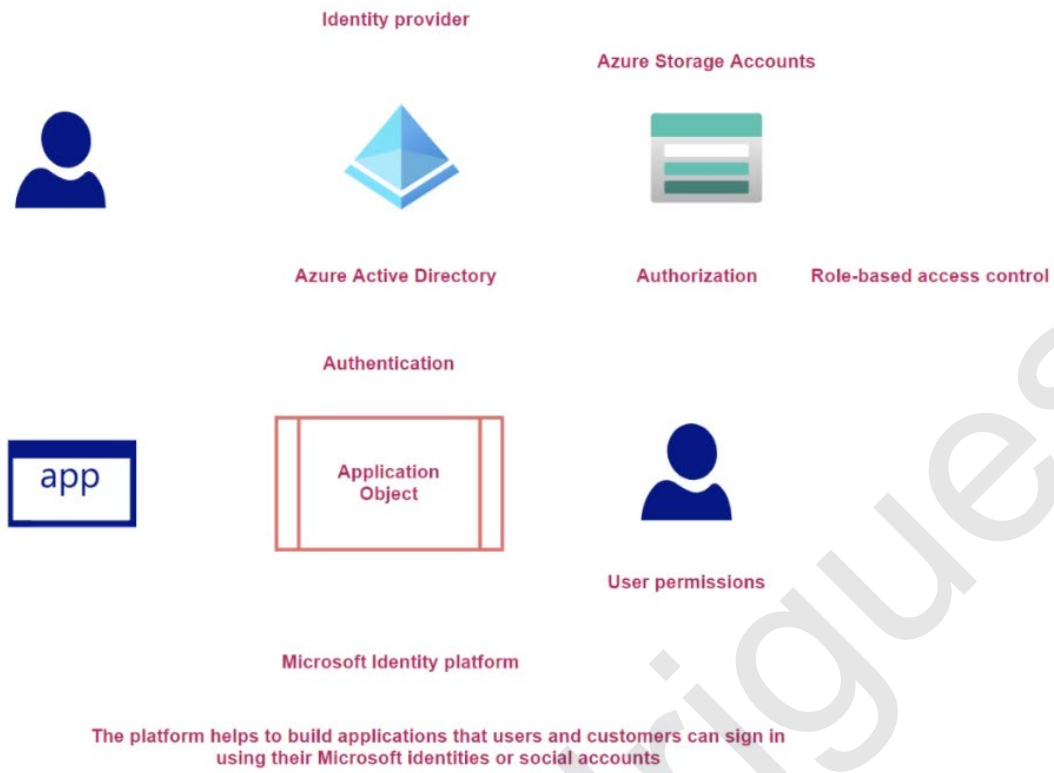
## What is Azure Active Directory



So what is Role-based access control




Introduction to Application Objects

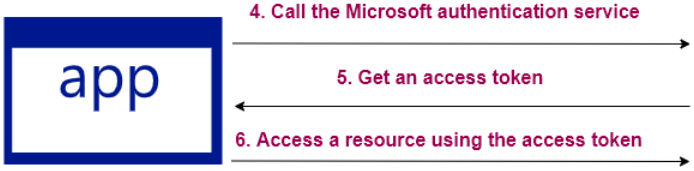



Lab - Application Object - Blob objects


Lab - Getting user and group information

API call


Azure AD




Postman

1. Register an application in Azure AD

2. Provide permissions

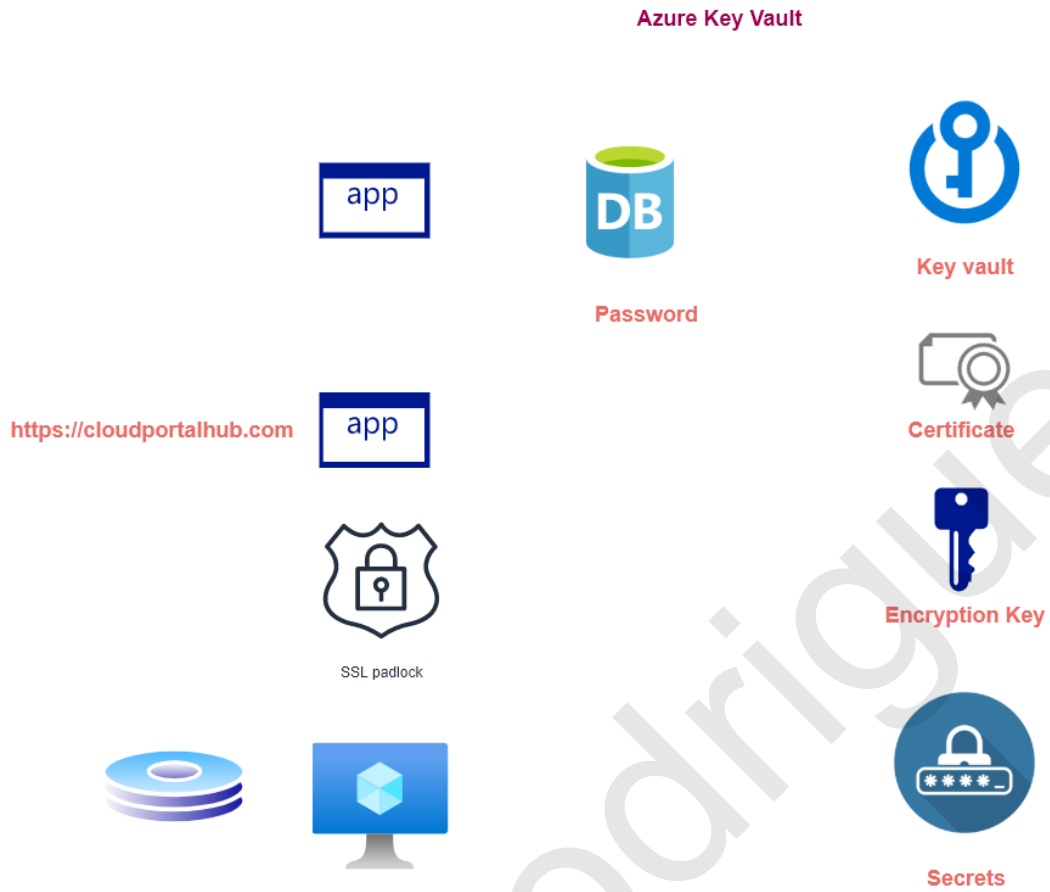
Delegated permissions — Runs on behalf of the user

Application permissions — Runs on behalf of the application

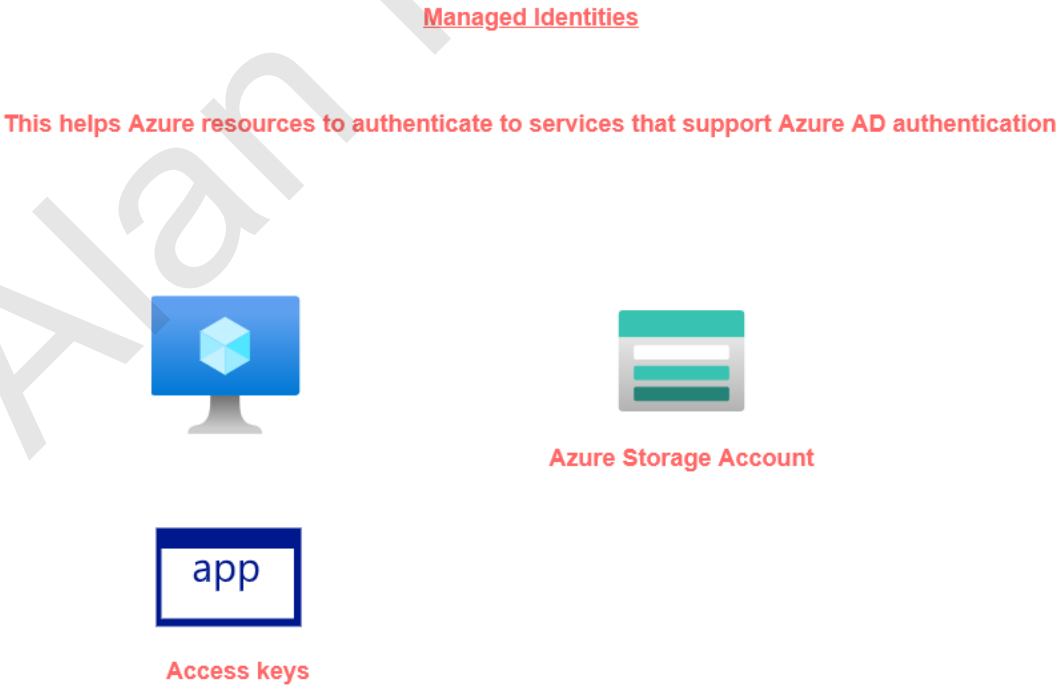
3. Provide admin consent

7. Finally call the GRAPH API

## Azure Key Vault




## Managed Identities




# Implement Azure security - Authentication and Authorization

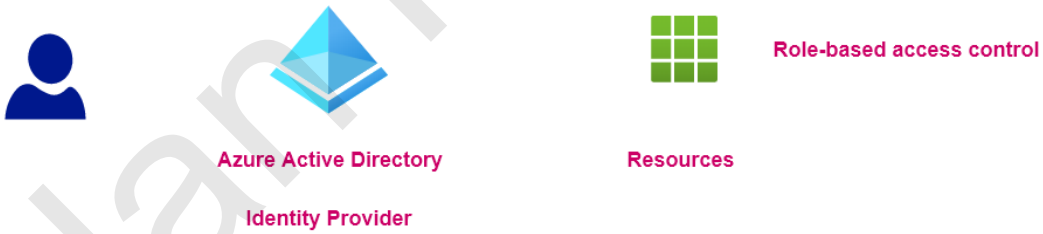
## Authentication and Authorization

**Authentication**

This is the process wherein you prove that you are who you say you are

**Authorization**

This is the process of granting access to perform an action



Old era of authentication


Database of user names and passwords

**Problems**

1. You have to maintain the database of user names and passwords

2. You need to maintain the security of the database

3. You need to implement newer methods of authentication - Multi-Factor Authentication

4. The application itself is responsible for authenticating the user

## API's and Authorization

**Modernize the authentication**


Azure Active Directory

Identity Provider

Resources

**Benefits**

1. You are delegating the task of authentication to an external identity provider

2. The provider can take care of additional authentication mechanisms such as Multi-Factor Authentication


API — Get information of customer

API — Get information of order

API — Get information of product

Application programming Interface


API — Get information about Azure virtual machines

API — Create an Azure virtual machine

API — Custom App on Azure

Application programming Interface


API — Get information of customer

Authentication

Authorization

Identity provider

Access Token

**Benefits**

Better security

Life time - last between 60-90 minutes

The API can validate the token based on the aud claim - This matches the application

**ID token**

**This is an extension of the OpenID Connect protocol**

**This is JSON web token**

**The token payload contains information about the user that is requested by the client**

## Using Microsoft libraries


**Azure Active Directory**

**Identity Provider**

**User names and passwords**

**Other identity providers**

**Microsoft Identity Platform**

**Helps to build applications that users can connect to using a wide variety of identity providers**

**Users can have Microsoft identities or social accounts**

**Compliant with OAuth 2.0 and OpenID Connect standards**

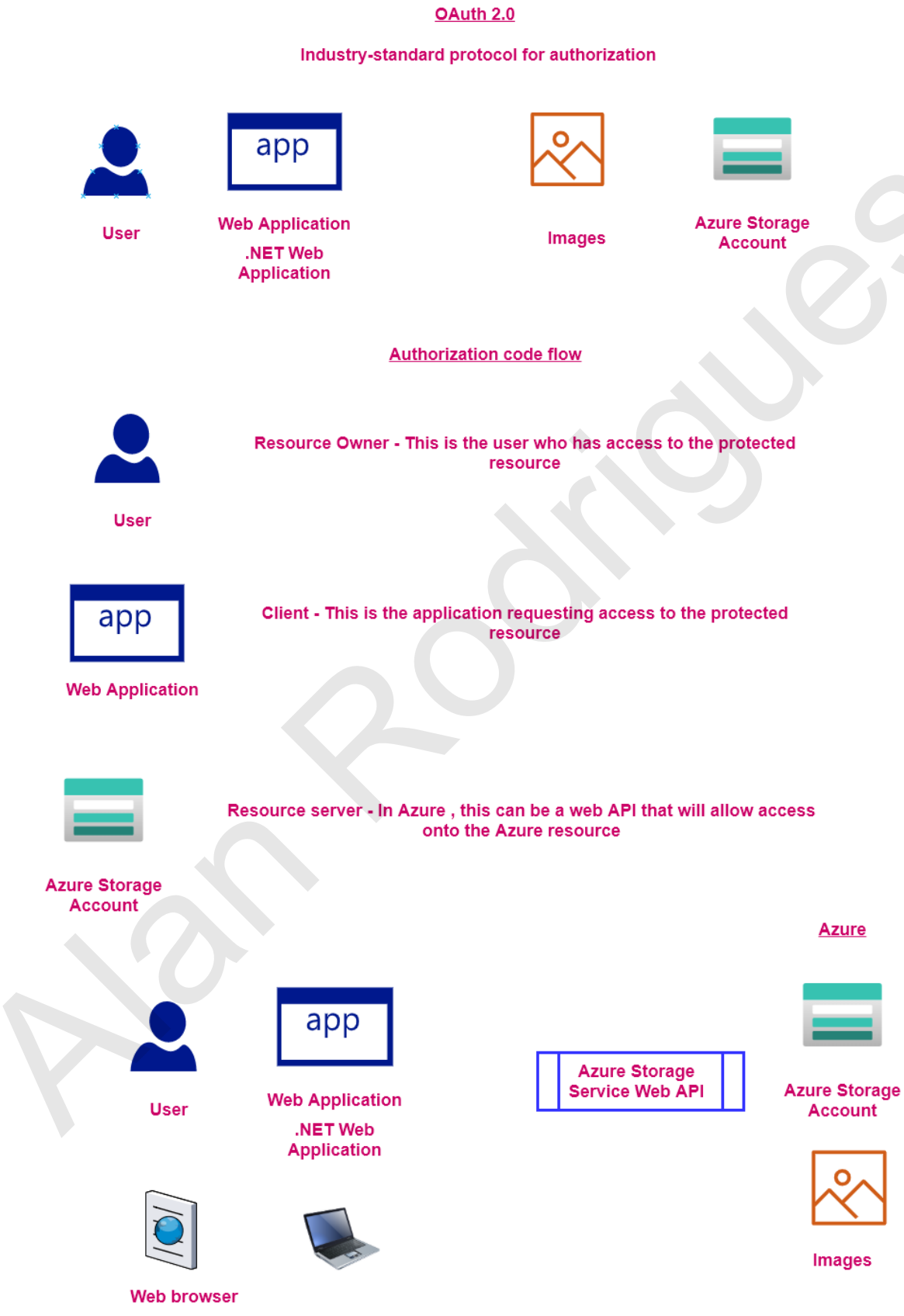
**Microsoft Authentication Library**

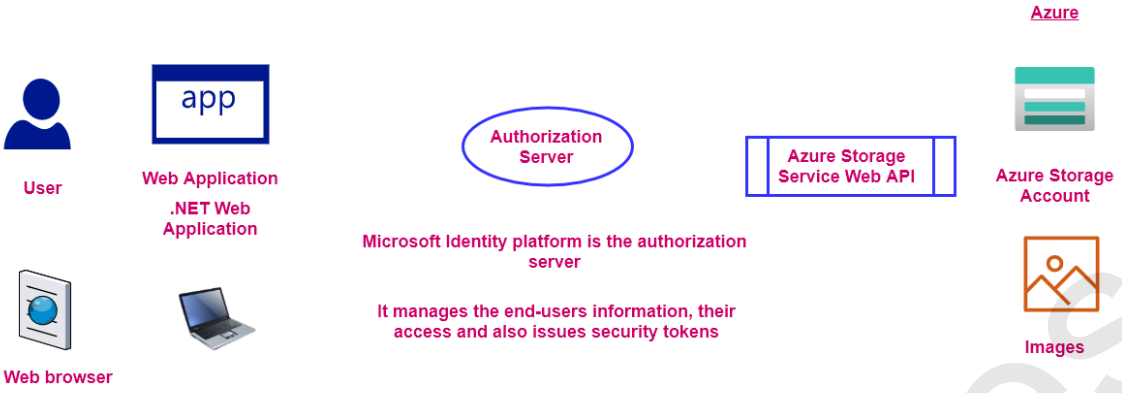
**Enables developers to acquire access tokens from the Microsoft Identity platform**

**This can be used to authenticate users and allow secure access to API's**

**It also maintains the token cache and refresh tokens when they are about to expire**

# OAuth2 - Authorization Code Grant






## So how does Authorization code flow work?


Client Application

Redirect URI
http://cloudportalhub.com/callback

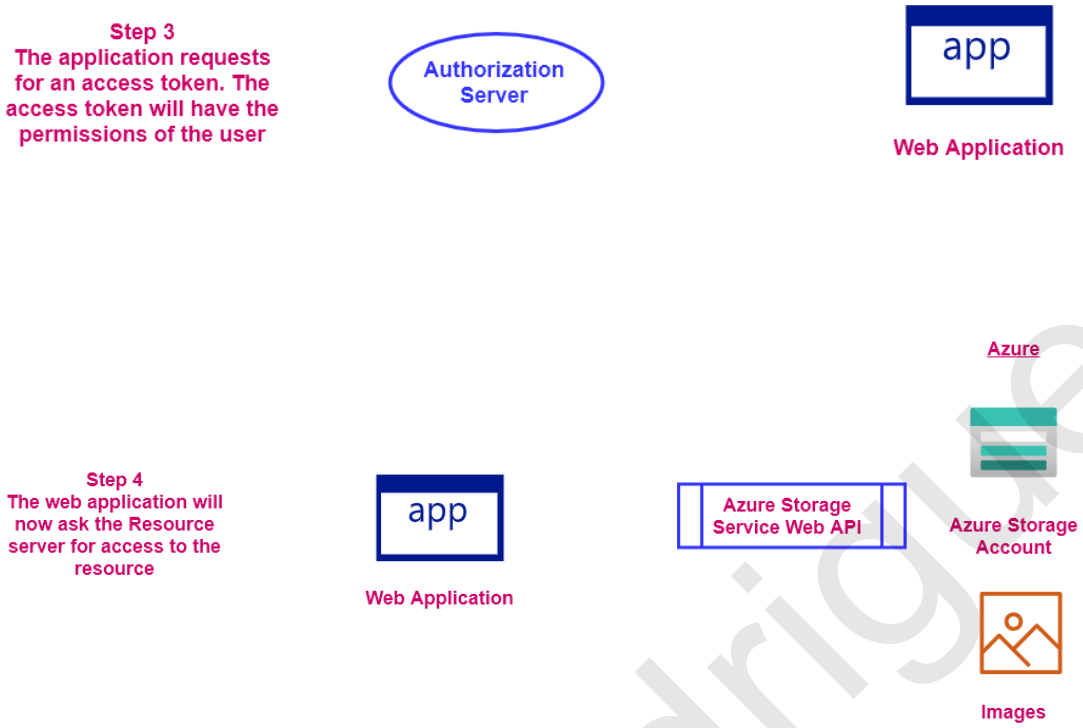
Response type:code


The authorization code is just the inital step in the process
The application can't do much with this code

The application then needs to use the authorization code to get an access token

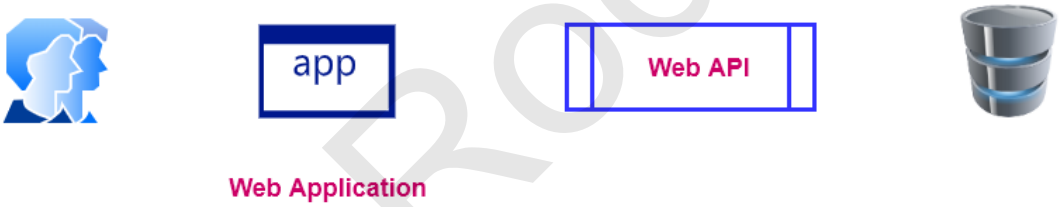
The authorization code is viewable in the browser

But the later on process of getting the access token with the use of the authorization code is done by the application in the backend.



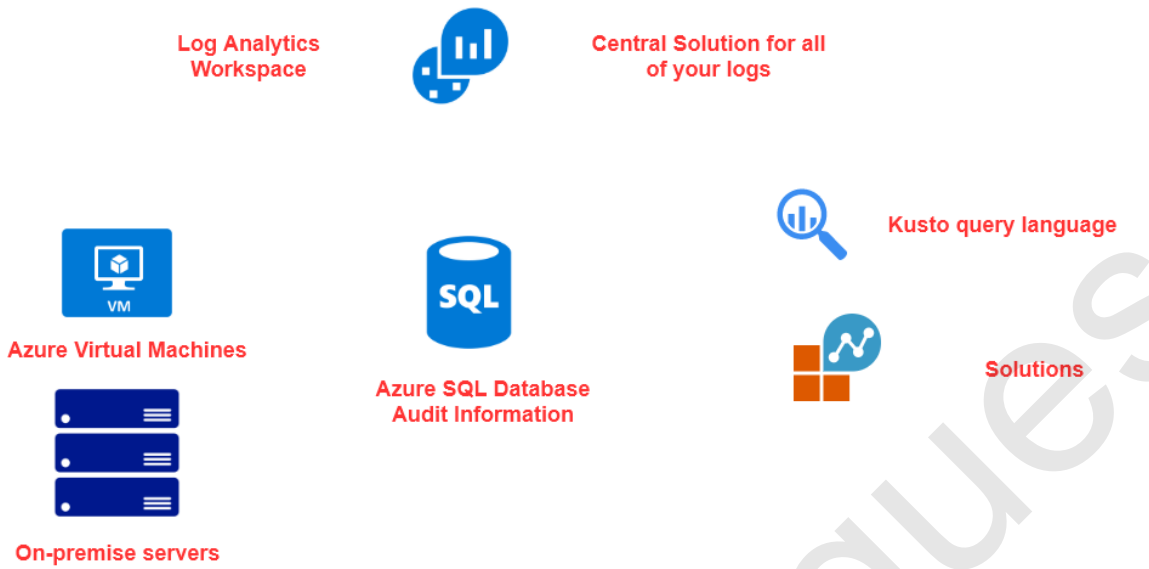

## Lab - Getting an access token


Lab - Creating our Web API

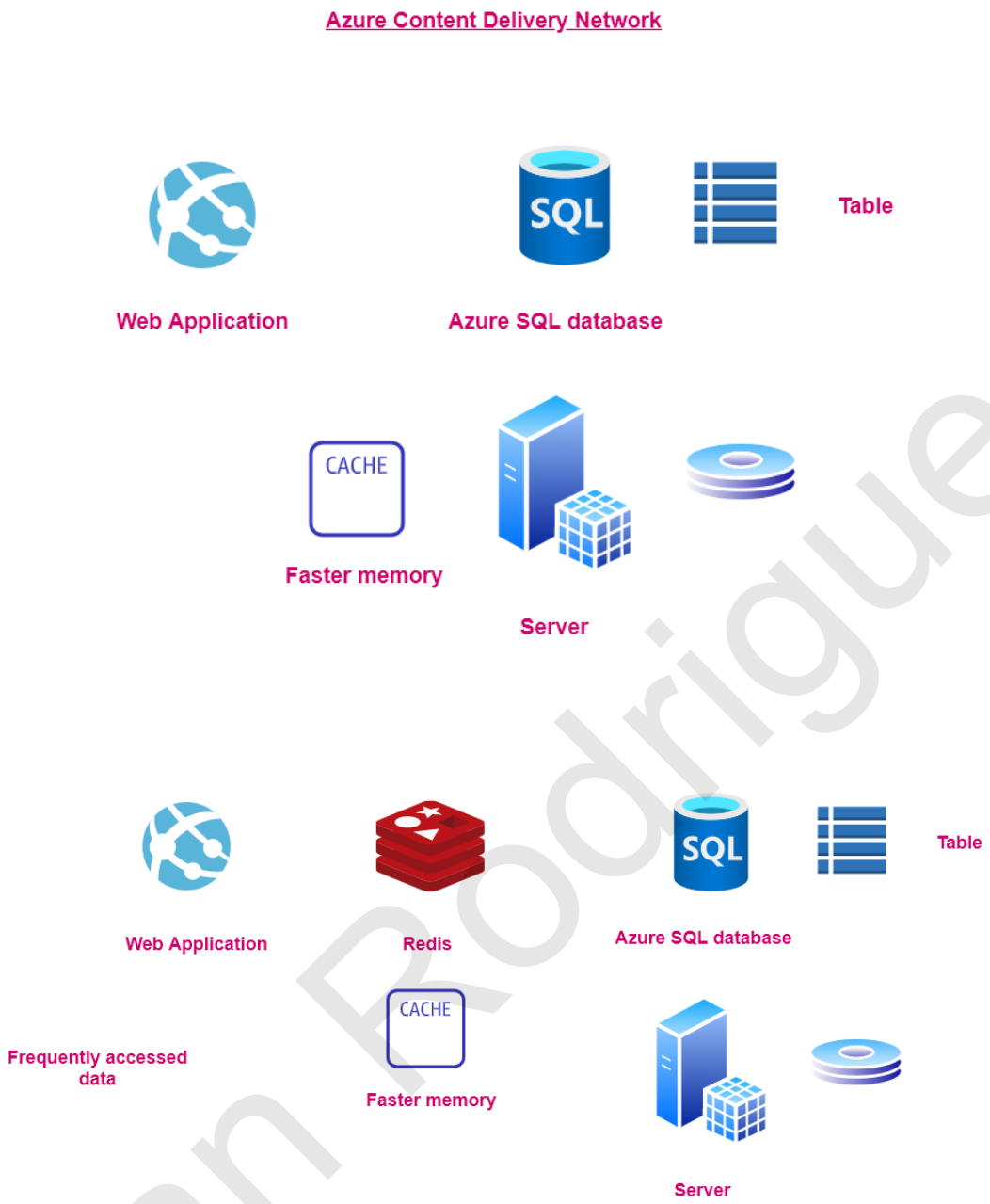



## Monitor, troubleshoot, and optimize Azure solutions

## What is a Log Analytics Workspace




## Optimizing Content Delivery






# What is Azure Cache for Redis

## 1. Data Cache

Web Application

Azure Cache for Redis


Azure SQL database


Faster memory

Top 10 courses for the day

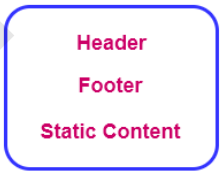
The application would first calculate the top 10 courses based on the data in the database

Then the application would store the top 10 courses along with any supporting data to Azure Cache for Redis

The application would then fetch this data for users from Azure Cache for Redis

The application would then update the data in Azure Cache for Redis on a daily basis

## 2. Content Cache

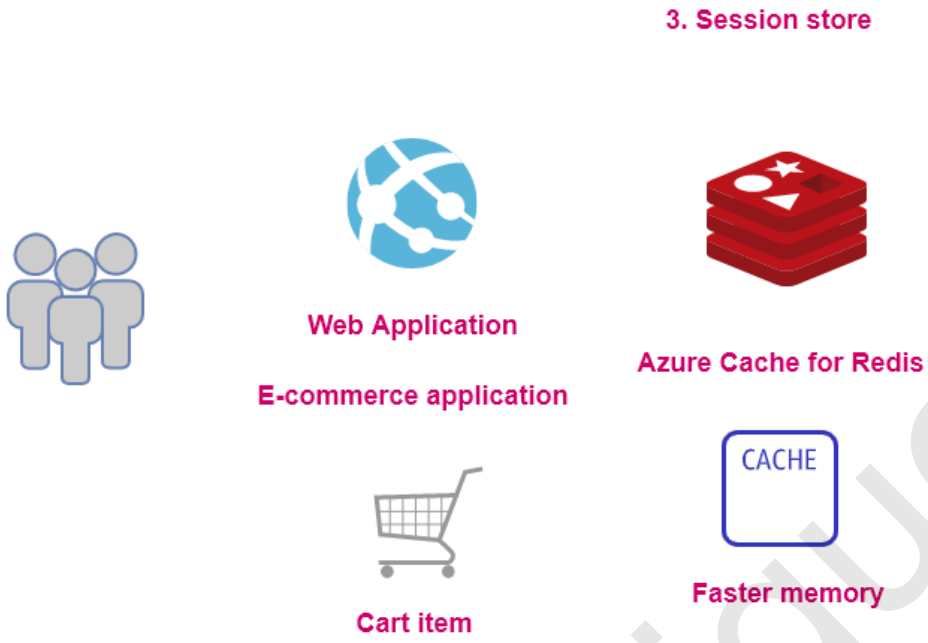



Web page

Azure Cache for Redis

Web Application


Faster memory




## What is 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.

## Azure Content Delivery Network Caching

CDN Profile

Global level

Endpoint

Web Application

Central US

Source

Cache can be set by the application for responses to requests.

**Bypass cache** - Do not cache and ignore if there are any cache header specific values provided by the origin.

**Override** - Ignore any cache header values provided by the origin , but specify the values provided here.

**Set if missing** - If the headers are not set by the origin, only then set the values specified here.

There are also specific settings for query string parameters

https://sqlapp.azureedge.net&id=1

**Ignore query strings** - Just ignore the query strings

**Bypass caching for query strings** - Here the CDN will go to the origin server for each request that has a query string parameter

**Cache every unique url**

https://sqlapp.azureedge.net&id=1 will be cached as a seperate asset

https://sqlapp.azureedge.net&id=2 will be cached as a seperate asset

## Connect to and consume Azure services and third-party services

### Using a messaging service

Messaging service

Azure Storage queues

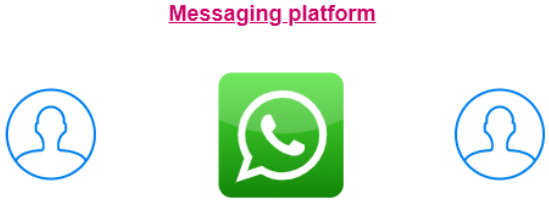
Azure Service Bus

Component

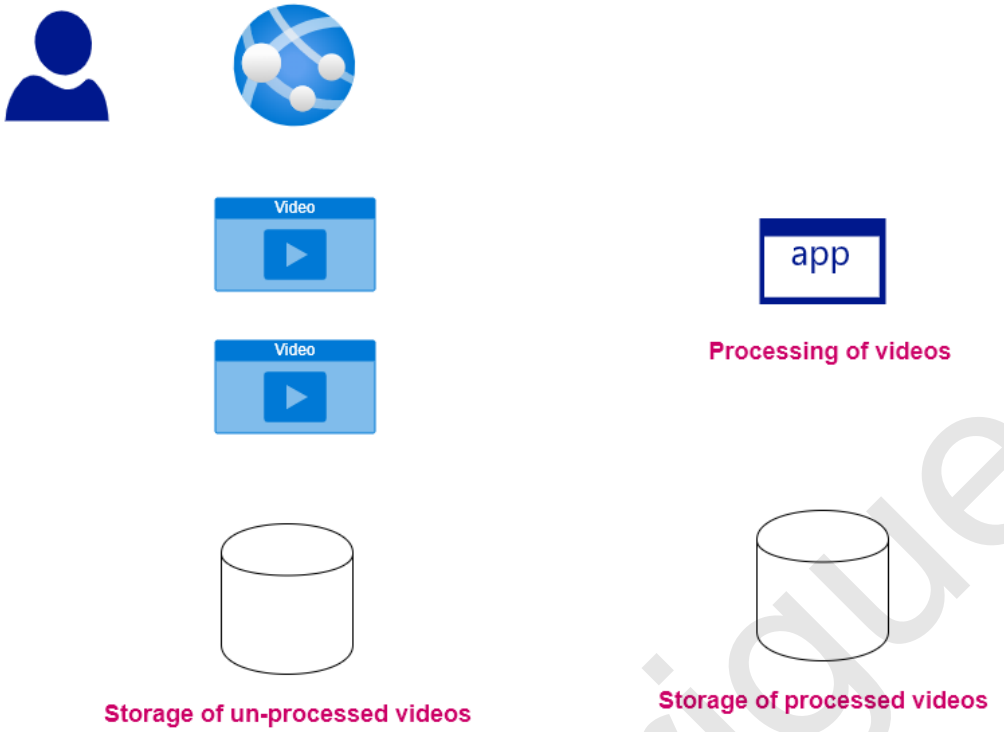
Component

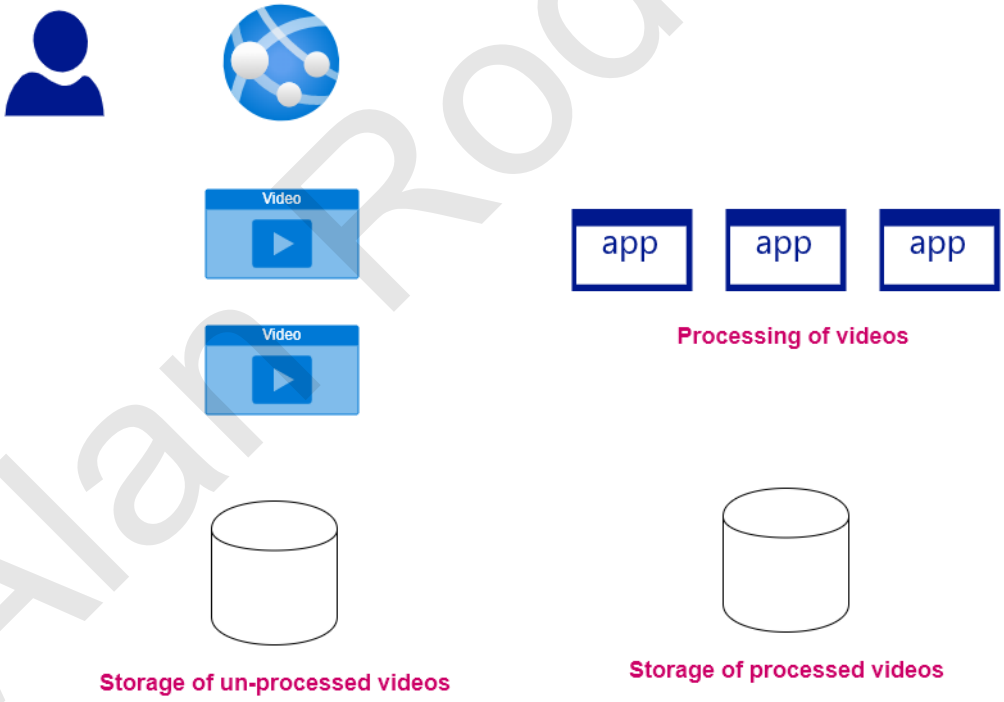
System

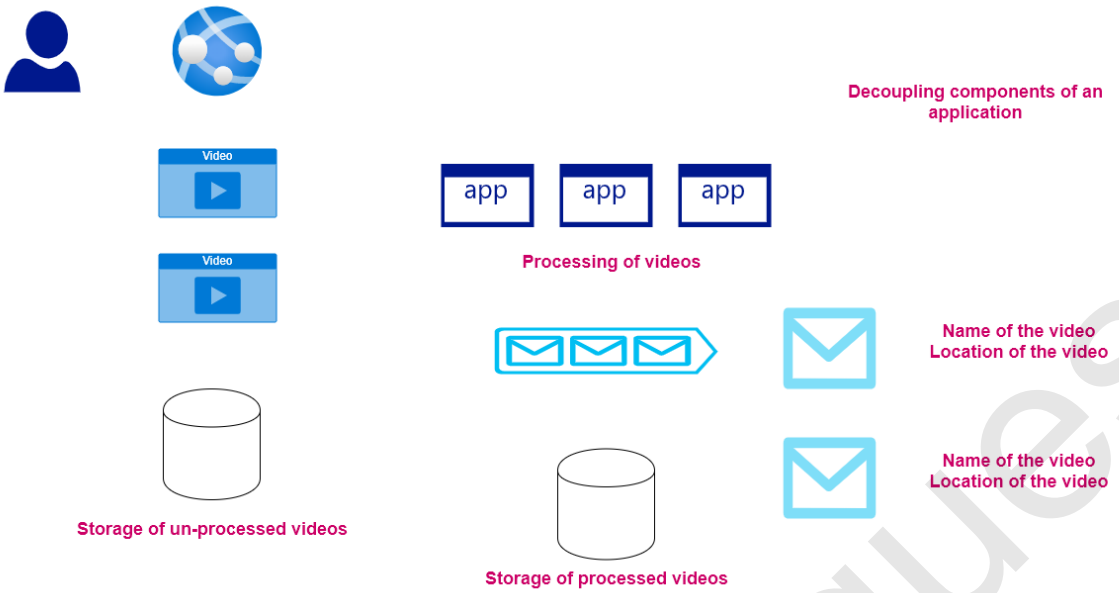




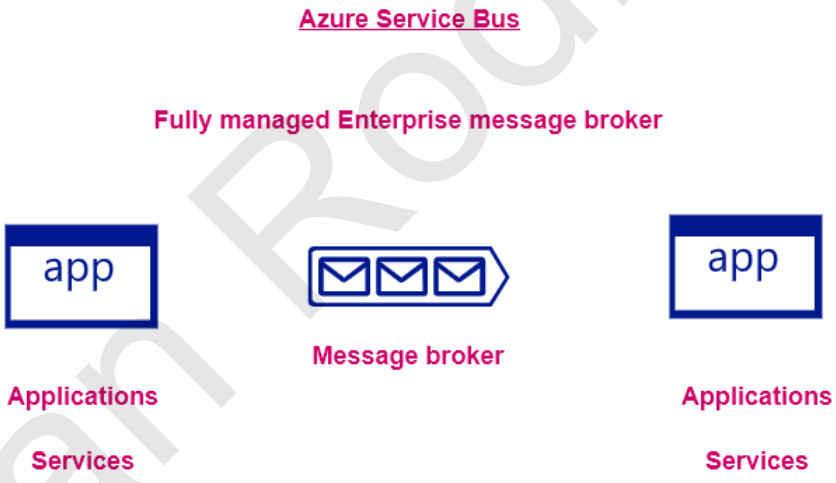

## The purpose of the queue service






## What is Azure Service Bus



## Queues


Sender

Receiver

The messages in the queue are ordered

The messages are held in triple-redundant storage

The data is available across availability zones if enabled

The messages can then be retrieved via the pull mode

## Topics

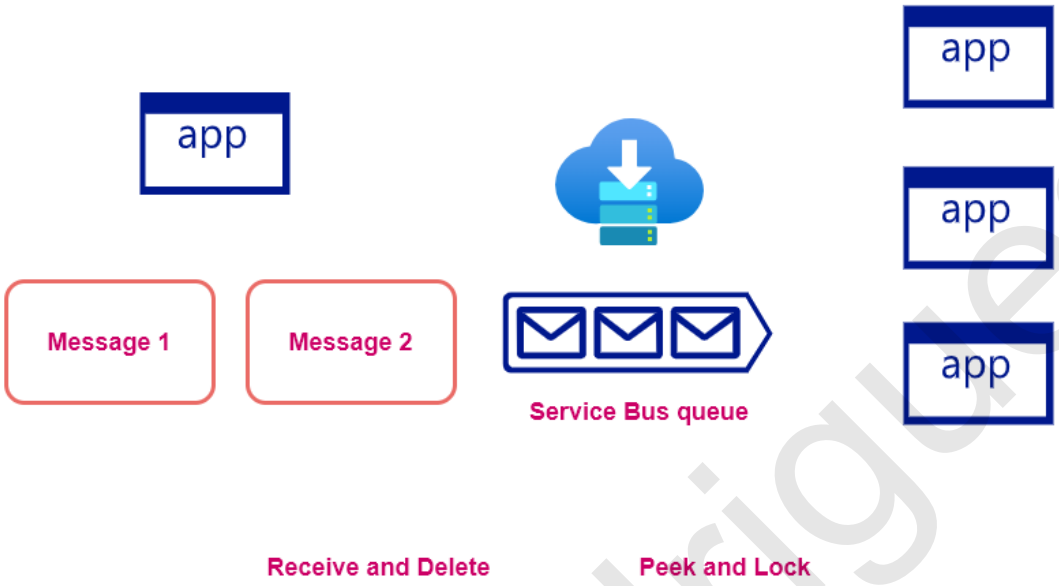

Sender

Receiver

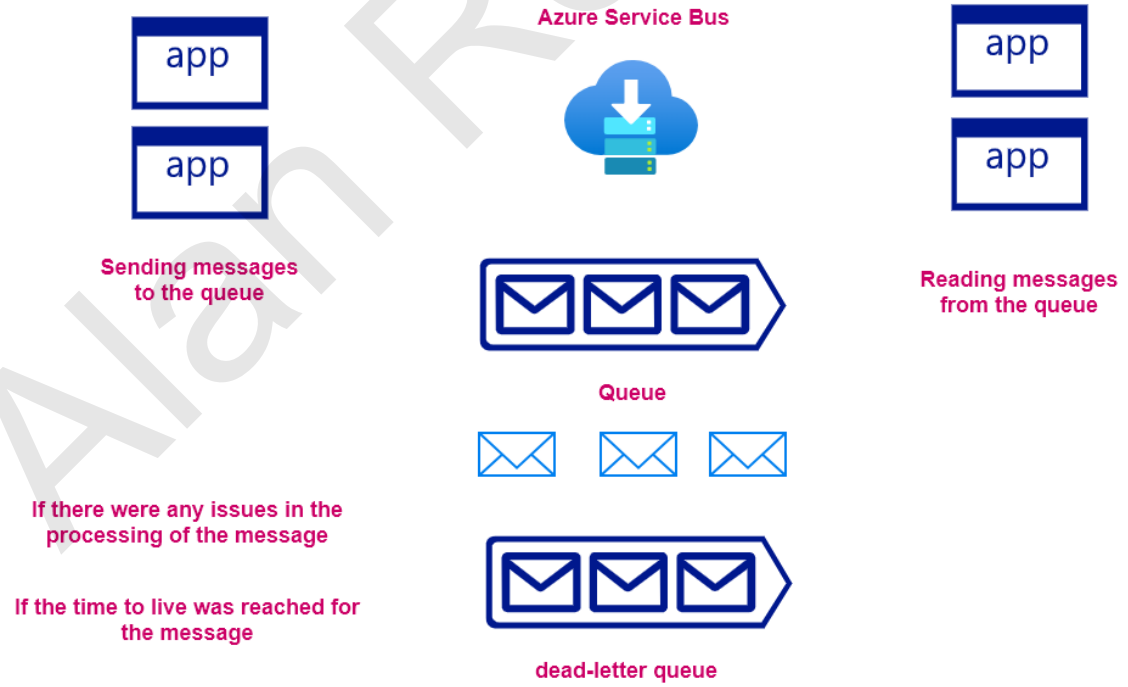
The subscriber to the topic will receive a copy of the message sent to the topic

You can define rules which contain filters on each subscription. The filter will decide which messages are received by the subscription

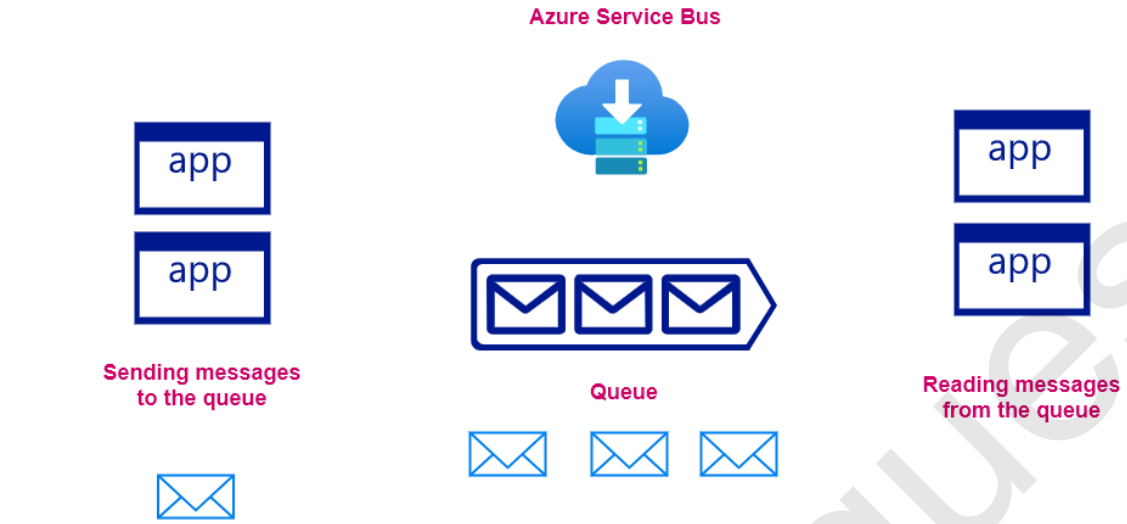
## Azure Service Bus queue - Message lock duration




## Lab - Azure Service Bus queue - Dead letter queue



## Lab - Azure Service Bus queue - Duplicate message detection




What happens if the sender sends a message

Then the sender crashes

It might send the same message again

## What are Azure Event Hubs

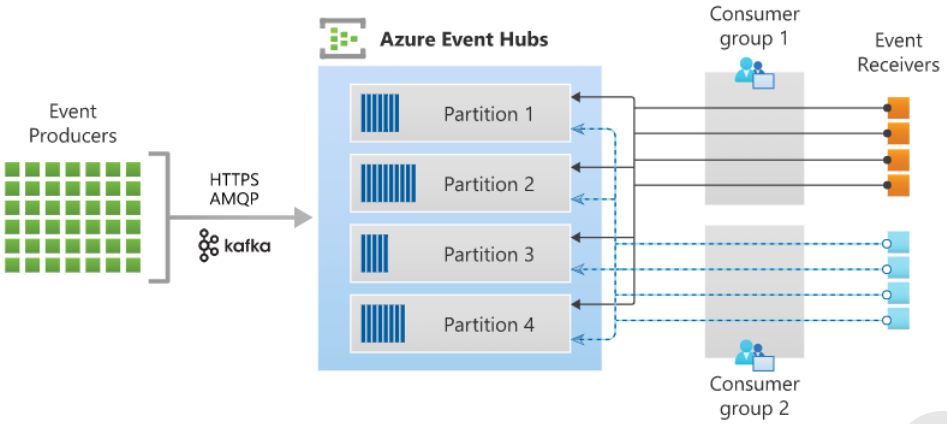
Companies want to perform analysis of data in real time


What are Azure Event Hubs

This is a big data streaming platform

This service can receive and process millions of events per second

You can stream log data , telemetry data, any sort of events to Azure Event Hubs




https://docs.microsoft.com/en-us/azure/event-hubs/event-hubs-features

**The different components**

**Event producers - This is an entity that sends data to an event hub. The events can be published using the protocols - HTTPS, AMQP, Apache Kafka**

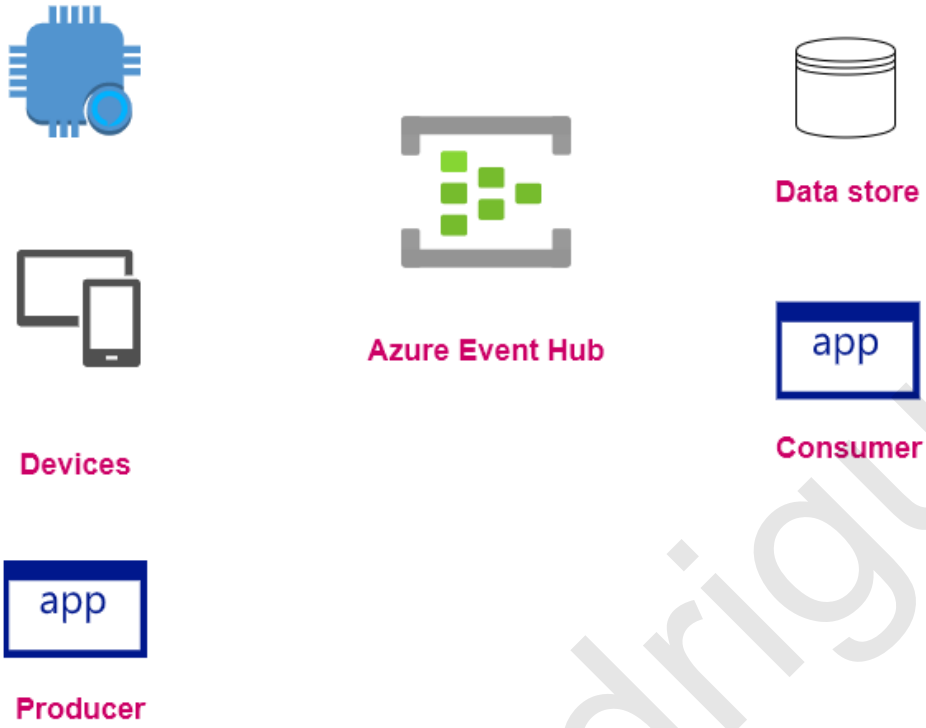
**Partitions - The data is split across partitions. This allows for better throughput of your data onto Azure Event Hubs**

**Consumer groups - This is a view (state,position or offset) of an entire event hub**

**Throughput - This controls the throughput capacity of Event Hubs**

**Event Receivers - This is an entity that reads event data**

## Lab - Creating an Azure Event Hub




So let's understand some concepts


The consumer application needs to keep on running to process events in real time from the Event Hub

After consuming the events do the events get deleted?

Well No. Because Azure Event Hubs serves a different purpose

Maybe another type of consumer needs to read the events again for another requirement.

Does that mean Azure Event Hubs will keep the messages indefinitely?

Again No. There is a message retention. This means this is not treated as a permenant data store.


Did you notice that after running the consumer program again, it is reading all of the events again from the beginning.

Your program needs to keep track of events being read.

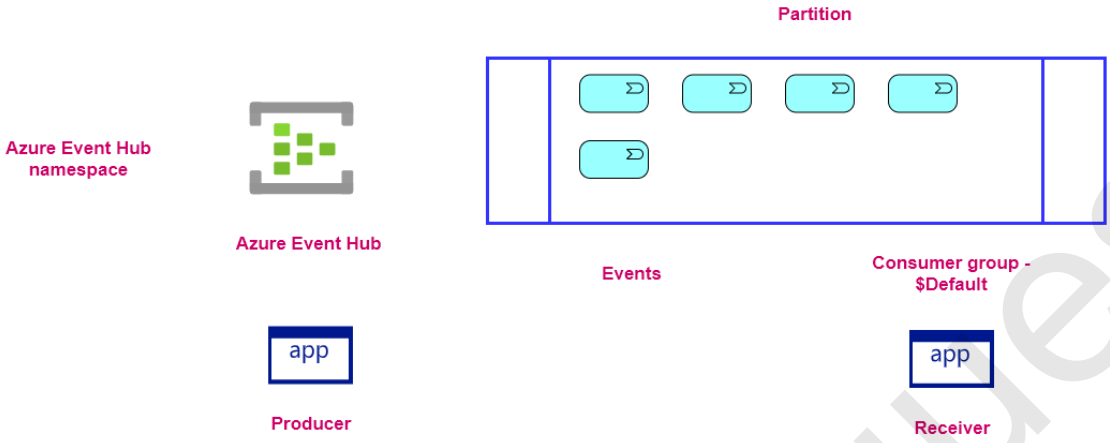


## Azure Event Hubs - Other concepts

## Throughput capacity

Ingress - Up to 1 MB per second or 1000 events per second

Egress - Up to 2 MB per second or 4096 events per second




You might start getting ServerBusyExceptions when the ingress traffic goes beyond the limit

You might start getting ServerBusyExceptions when the ingress traffic goes beyond the limit

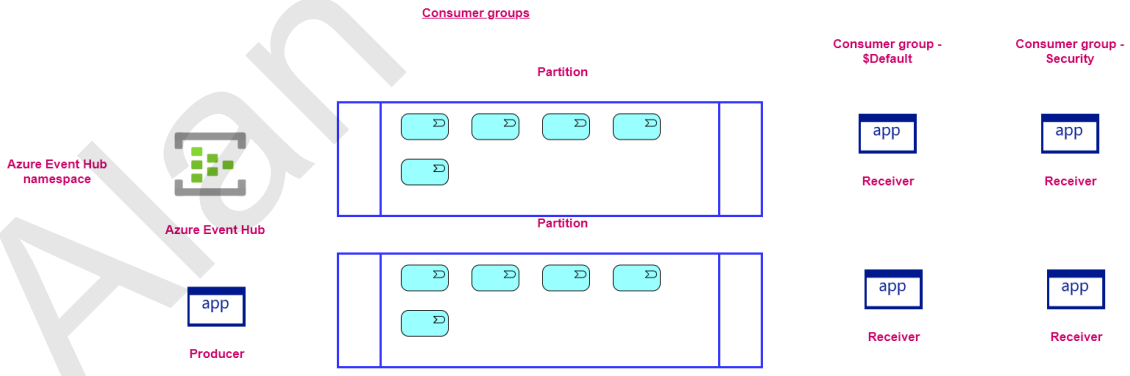
## Partitions

You cannot change the number of partitions after the hub is created , except for the dedicated cluster and premium tier offering.

Recommended throughput of 1 MB/s per partition

You can also mention which property in your data can be the partition key.

Azure Event Hub will hash the value and map the event to the relevant partition.

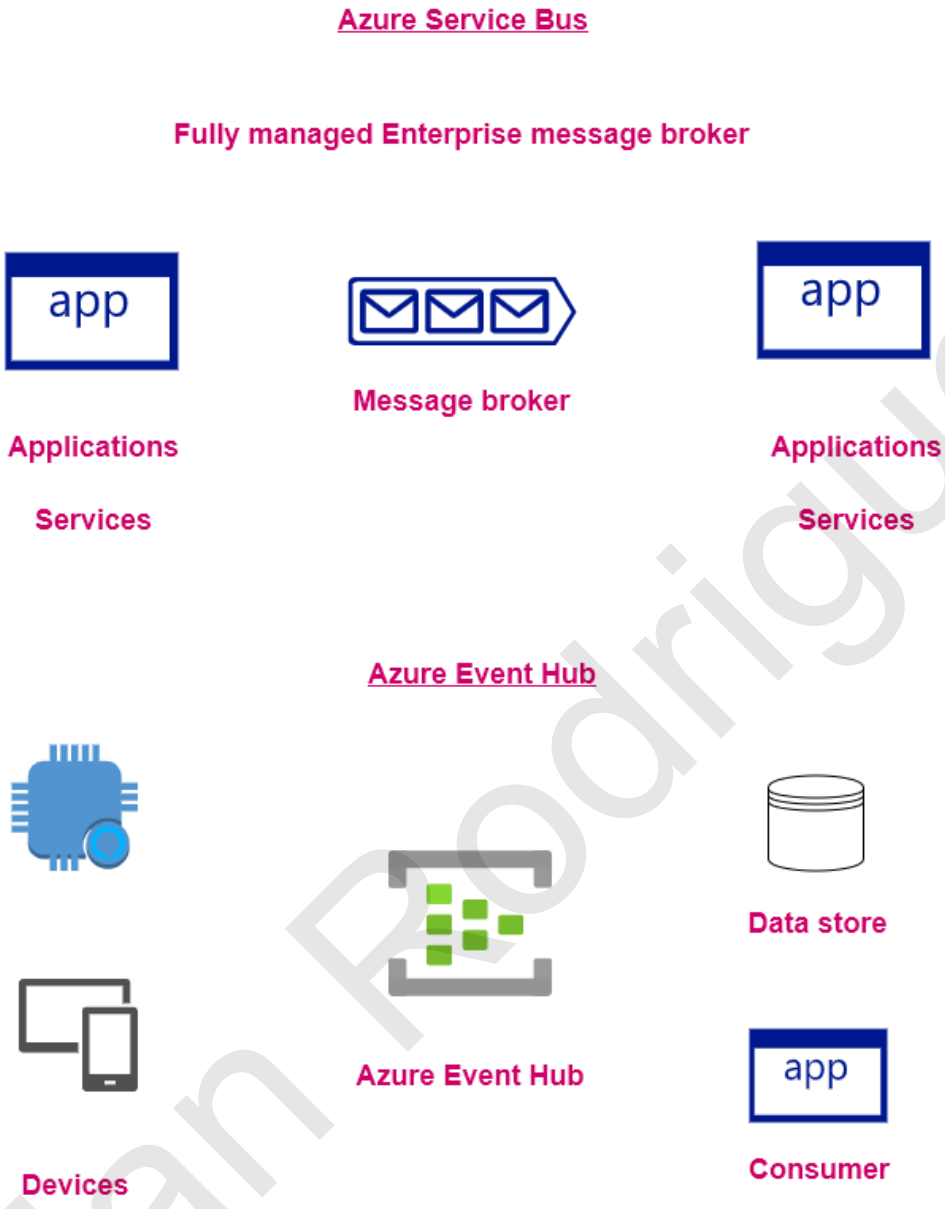



The recommendation is to have one receiver per partition

You can have up to 5 concurrent readers per partition per consumer group

But you have to be careful not to duplicate the process of reading the same messages

## Comparison with Azure Service Bus






## Lab - Azure Functions - Azure Blob Storage

Azure Storage Account

Azure Event Grid

Azure Event Subscription

Azure Function

Source of the events

What are the events you want to send to the topic

Topic

So which one should we use

Azure Storage Account

Azure Function

Based on the Blob trigger

If your Azure Function is based on the Comsumption Plan, there can be a latency in processing new blobs, then consider two options

1. Change to an App Service Plan and put the Always On enabled option

2. Use the Event Grid trigger

Use the Event Grid trigger in high-scale events like processing more than 100,000 blobs or 100 blob updates per second.

Another option for faster and reliable processing of blobs

1. Consider creating a queue message when creating the blob

2. Use the queue trigger and then process the blob

## Debugging Azure Event Grid locally

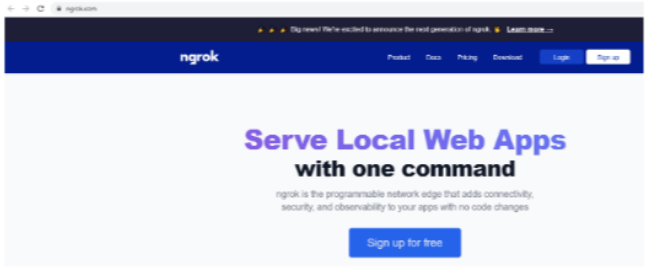
Developing Azure Function with Event Grid locally

Azure Storage Account

Azure Event Grid

Azure Event Subscription

Azure Function




Local Machine

ngrok

## Connecting to an HTTP endpoint

Azure Storage Account

Source of the event

The event will have common information that is similar for events

It will also have information which is specific for that type of event

Azure Event Grid

Publish to a system topic

This topic is specific for Azure storage accounts

Handshake

ValidationCode
ValidationURL

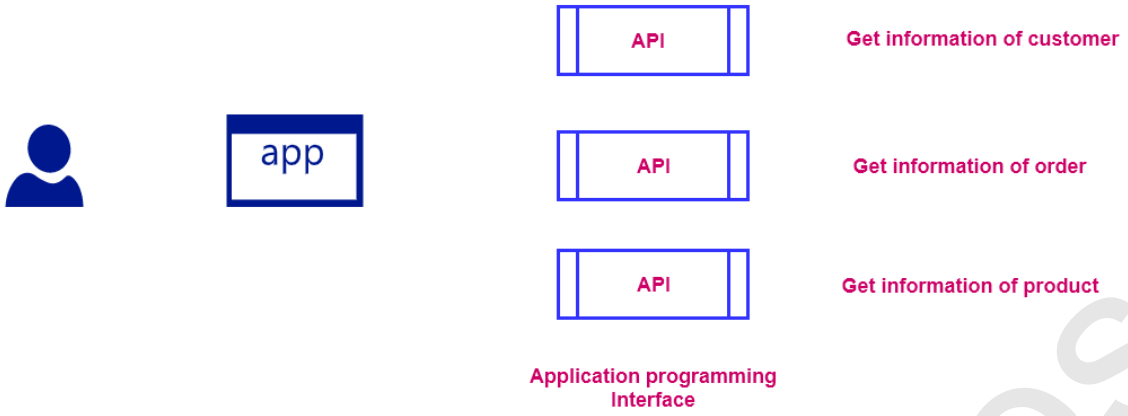
Azure Functions Visual Studio

http://localhost:7071/runtime/webhooks/EventGrid?functionName={functionname}

ngrok

The function is based on the HTTP/HTTPS trigger. Its based on a Web hook

## What is the API Management service




API Management service

1. Better security
2. Define policies
3. Built-in cache

## API management policy – Cache

Cache

Azure Web App

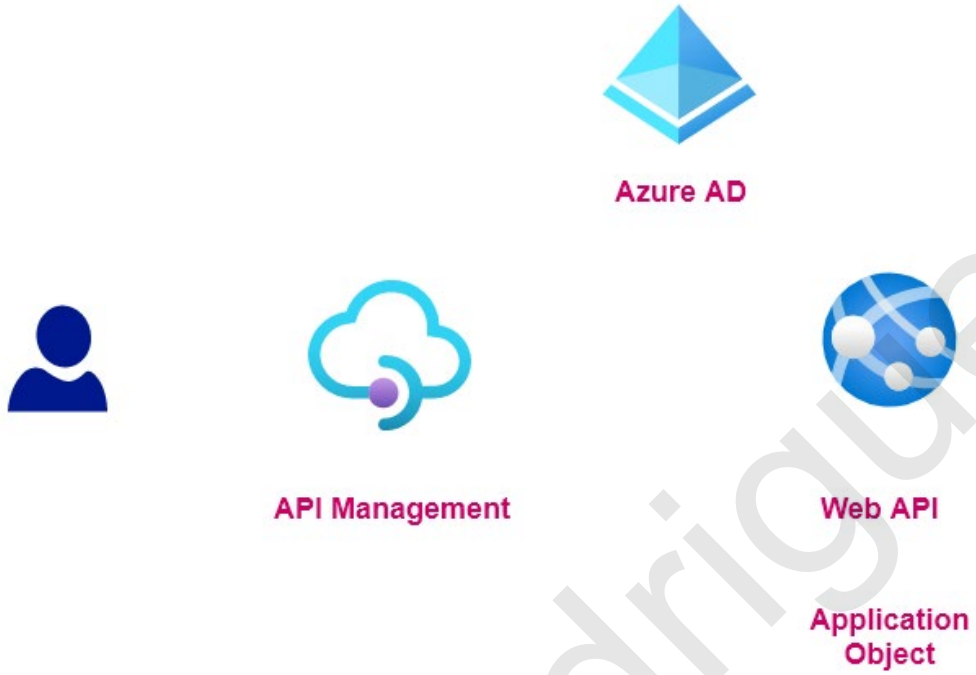


API Management

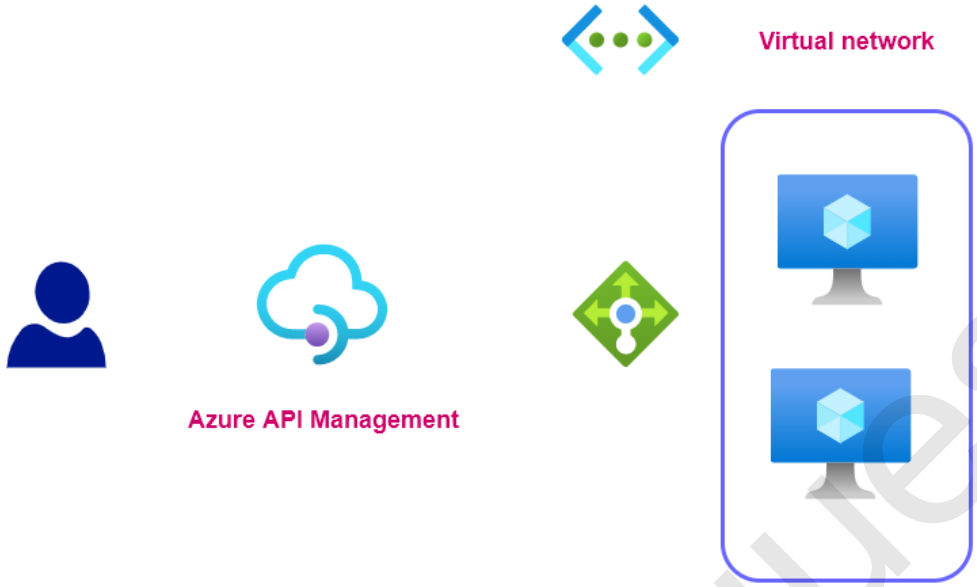
Azure SQL database

Redis Cache

## API management policy – OAuth




## API management - Virtual Network




External - Here the gateway is accessible from the public internet via an external load balancer

Internal - Here the gateway is only accessible from the virtual network via an internal load balancer

## Lab - API management - Virtual Network