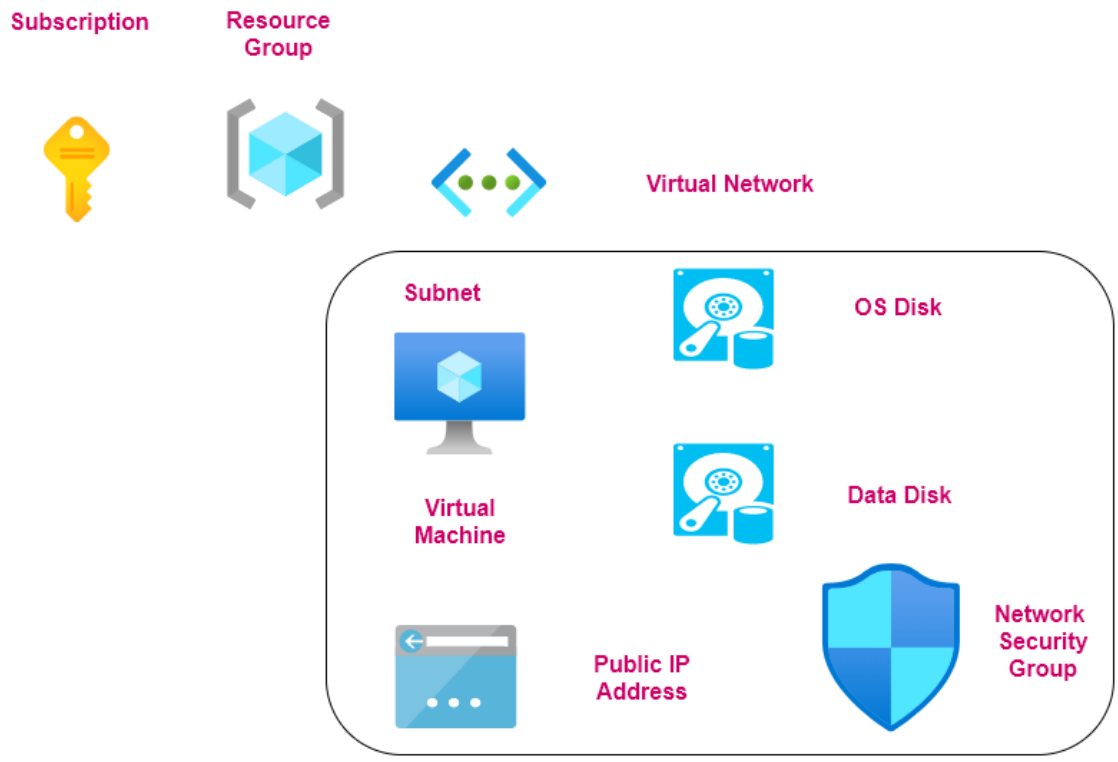
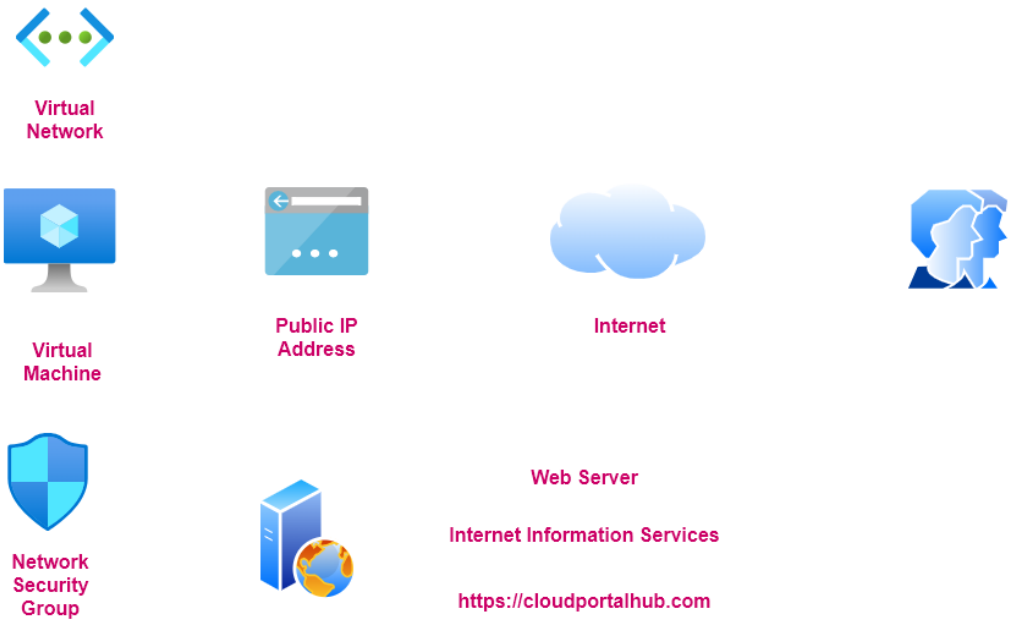
Develop Azure compute solutions - Azure Virtual Machines

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

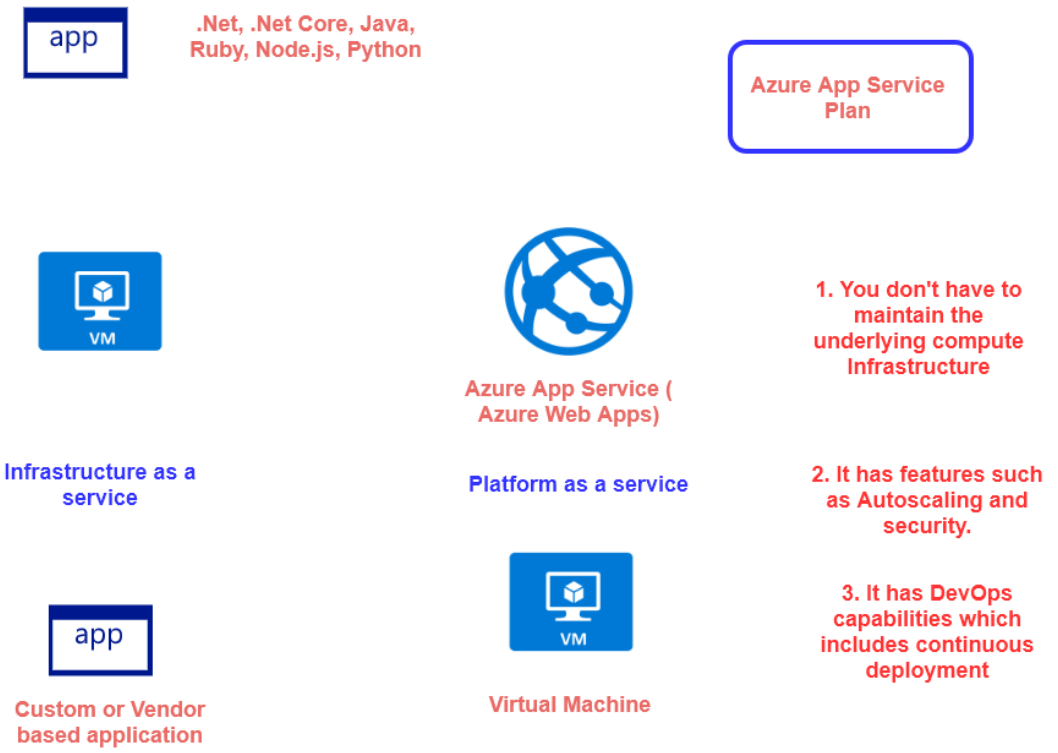
Copy the folder to the server

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

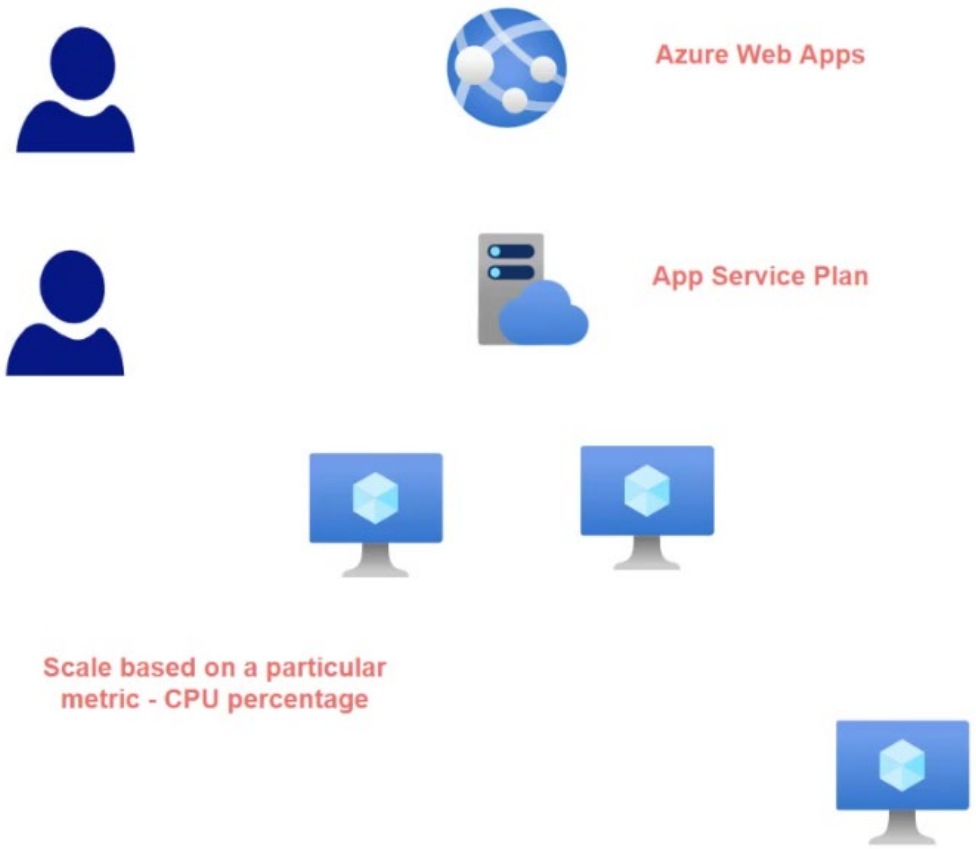
PaaS

Here the infrastructure is managed for you

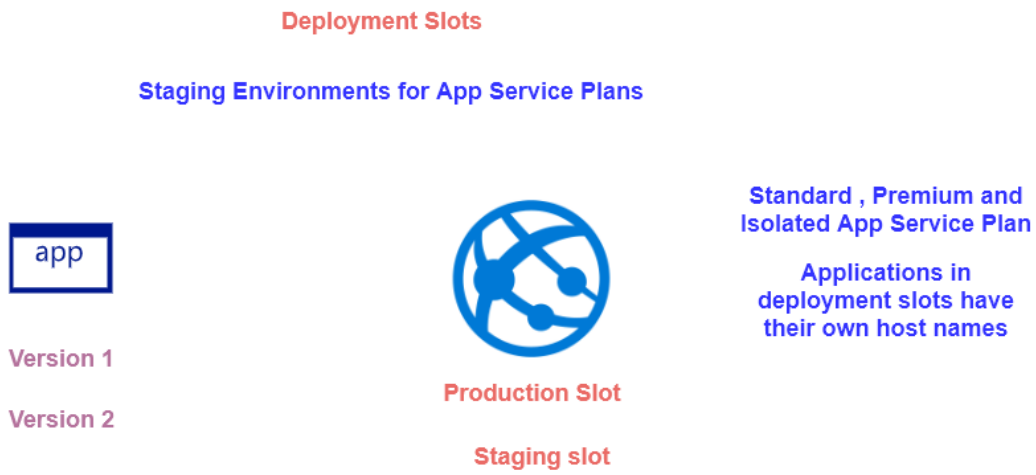
Backups are managed for you

You get built-in high availability

Azure Web Apps – Autoscaling

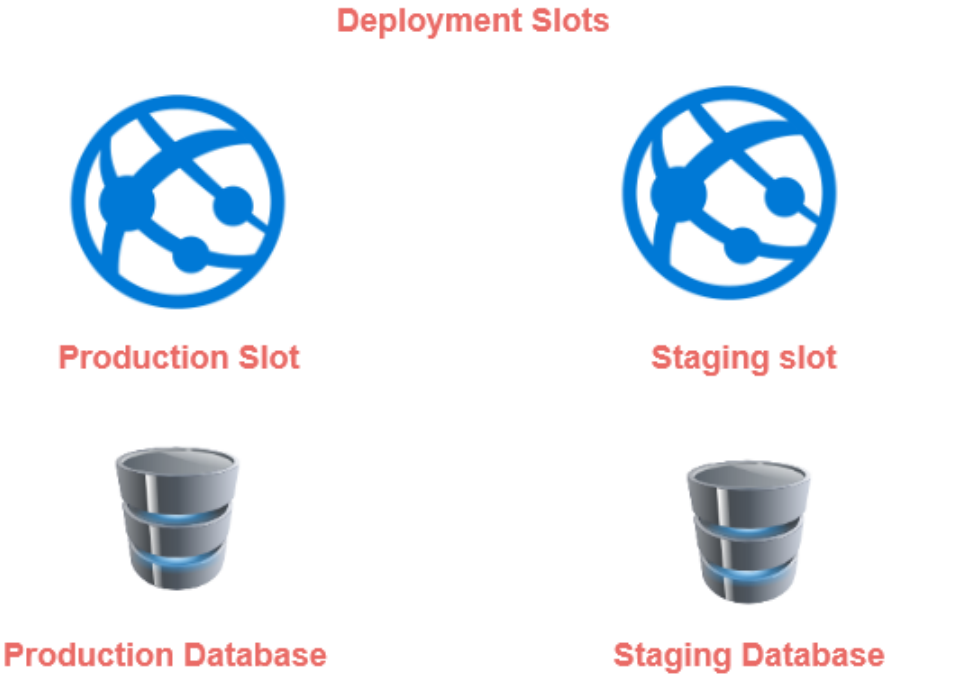


Deployment Slots



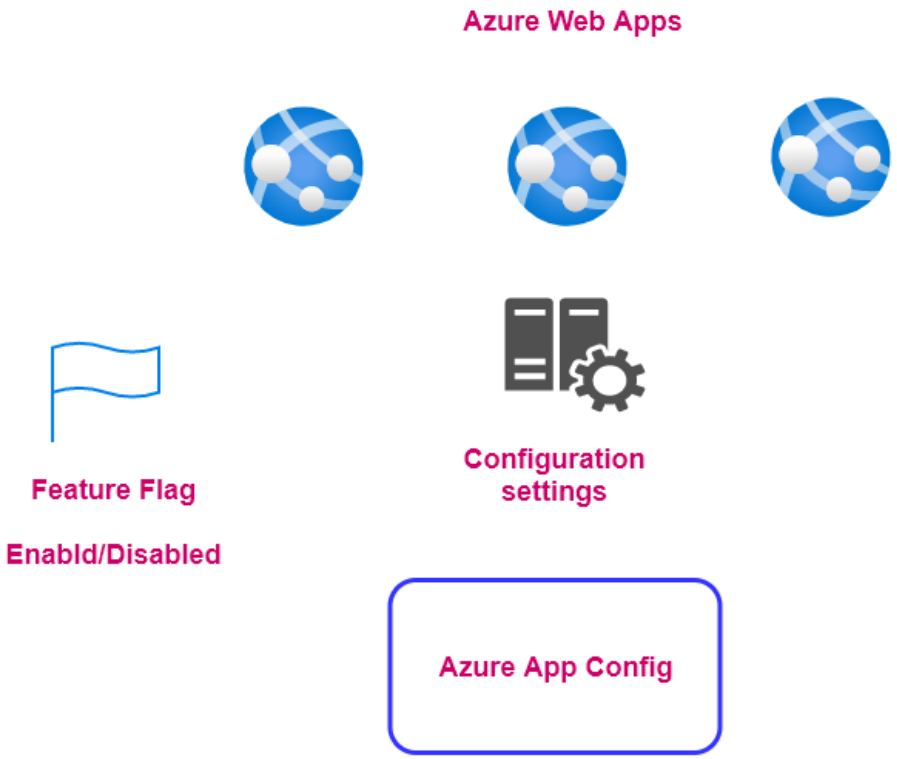
1. You have the chance to validate all application changes in the staging deployment slot
2. You can then swap the staging slot with the production slot
3. This helps eliminate the downtime for your application when new changes are deployed
4. You can also easily roll back the changes

Deployment slots with databases



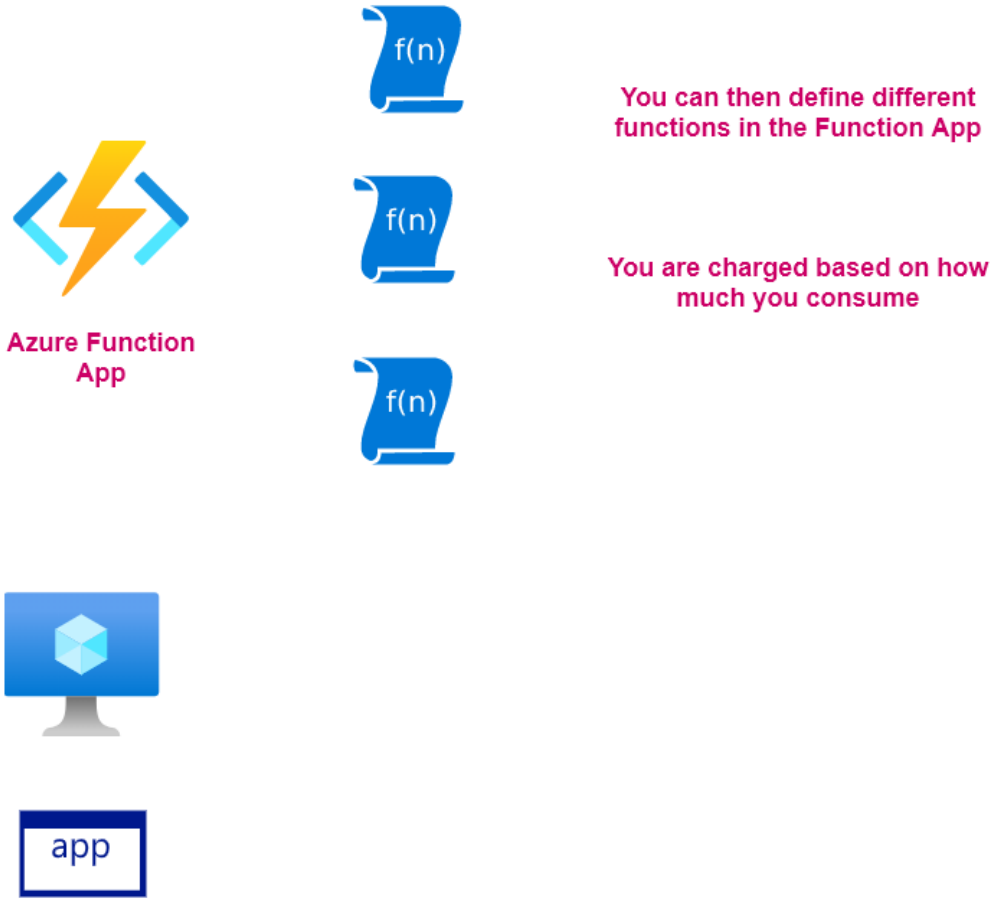
1. First create a script for the database changes in production
2. Define an outage time slot
3. Ensure production database backups are in place
4. Apply the scripts in the production database
5. Perform a swap of the staging and production slots

Azure App Configuration



Develop Azure compute solutions - Azure Functions

What are Azure Function Apps



Inspecting a HTTP Trigger-based function

Azure Function App

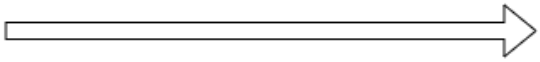
Function

HTTP Trigger

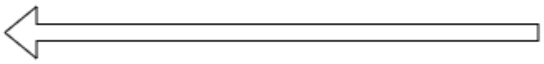
Internet

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

app

App dependencies

Third-party libraries

app

app

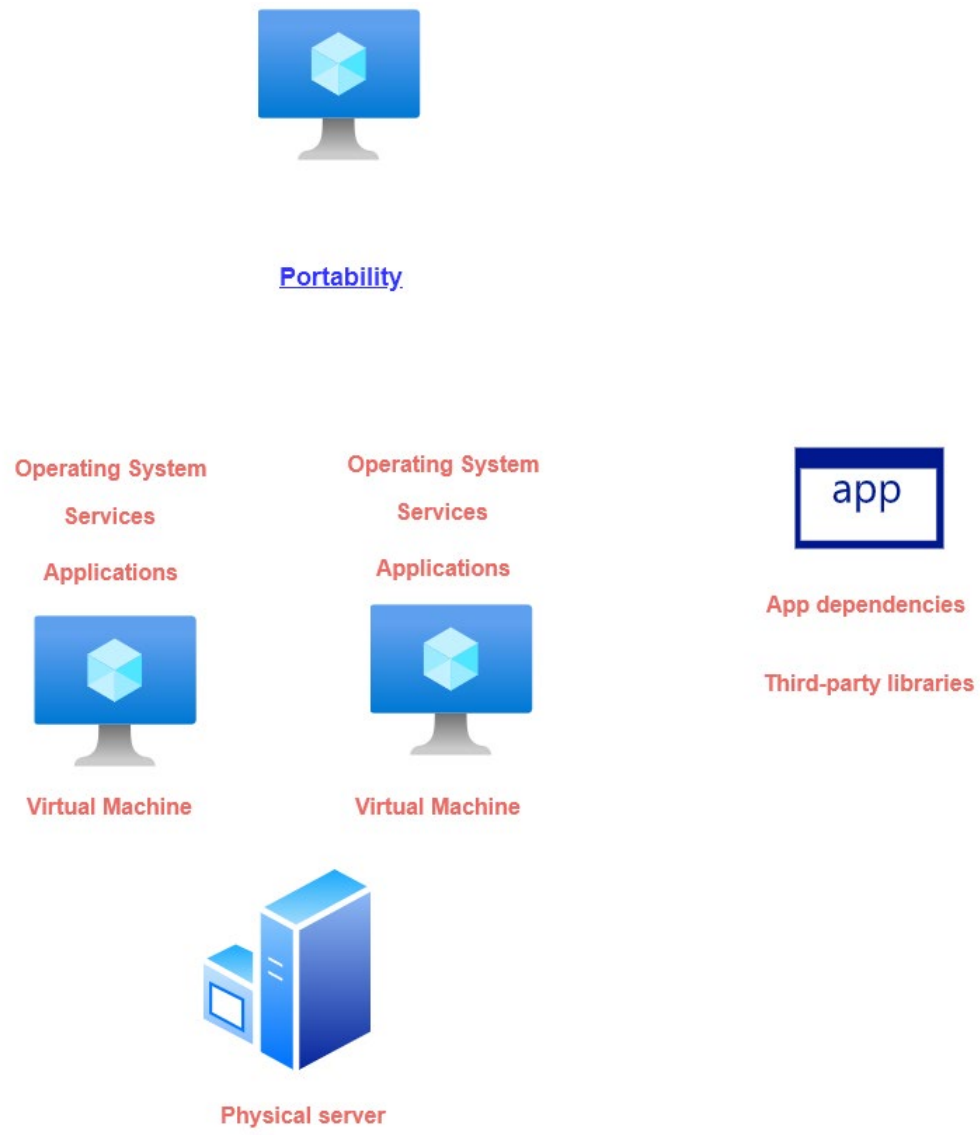
App dependencies

Third-party libraries

App dependencies

Third-party libraries

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

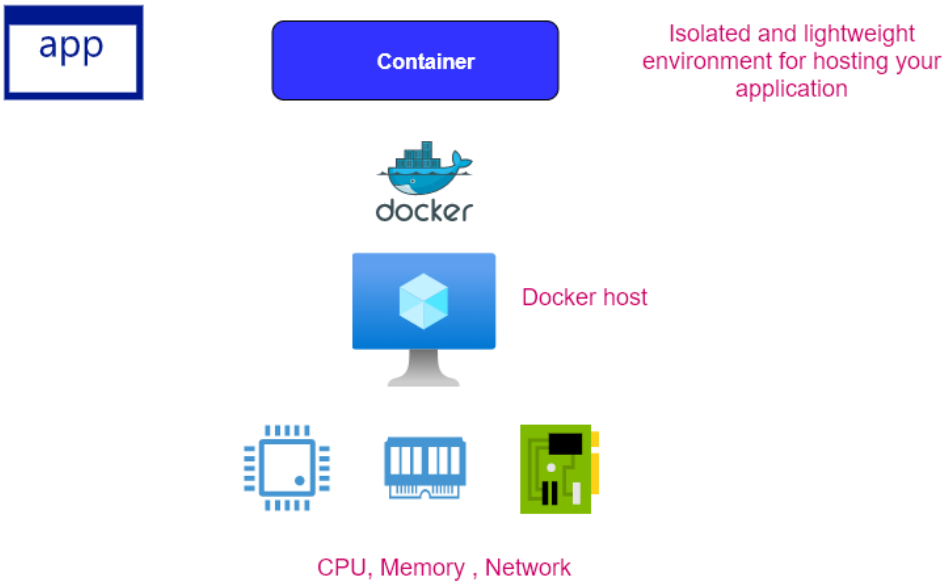


What is Docker

What is Docker

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

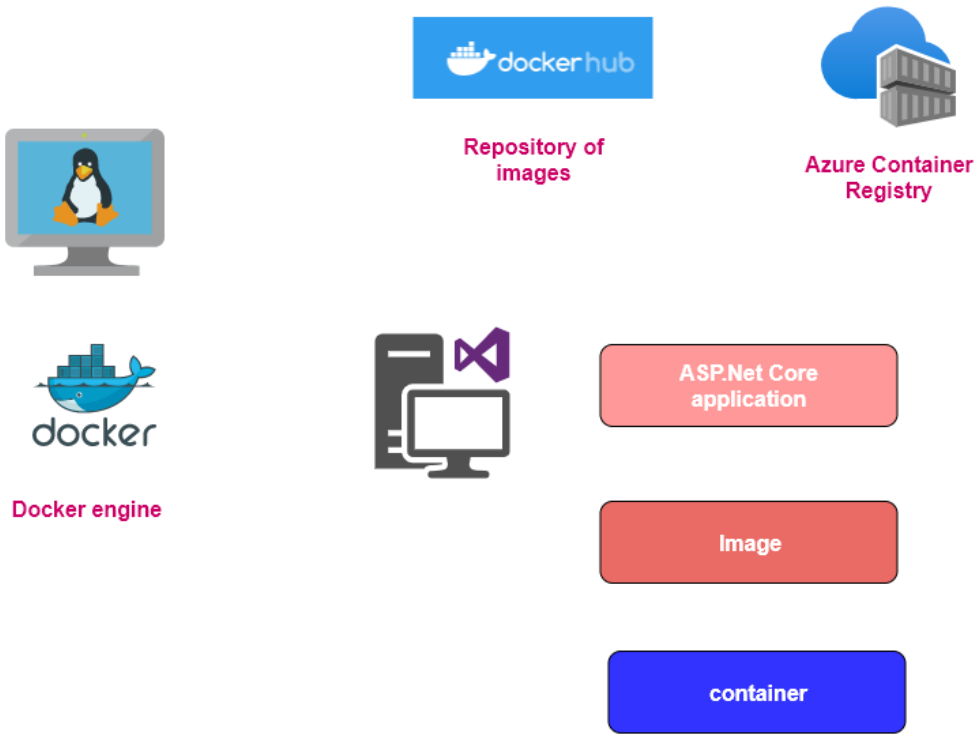
Docker has the ability to package and run an application in a loosely isolated environment called a container



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

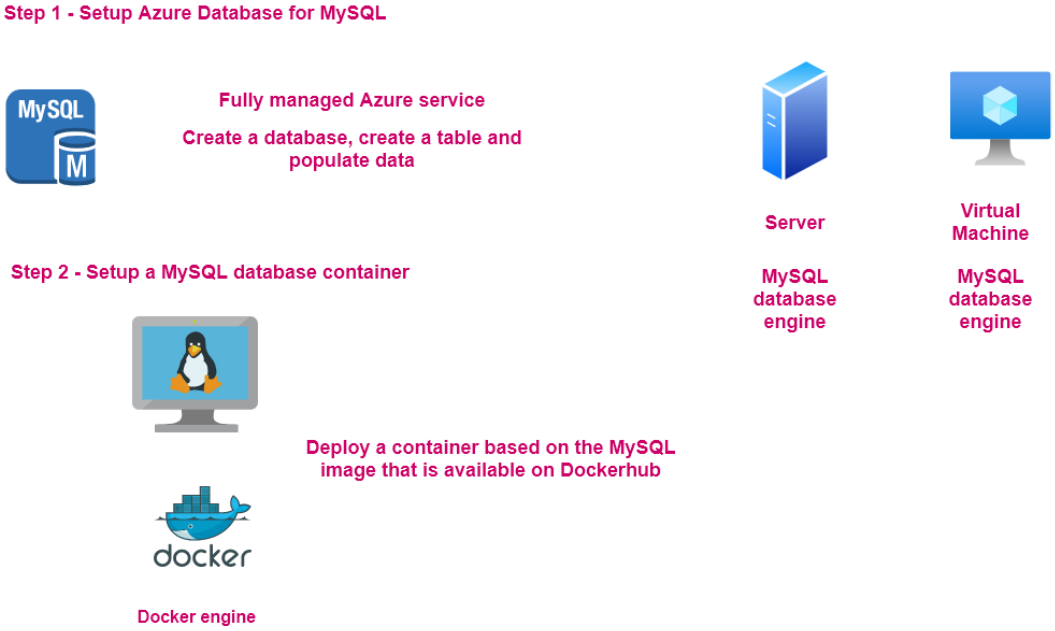
Application

MySQL database

Container

Container

Azure Container Group

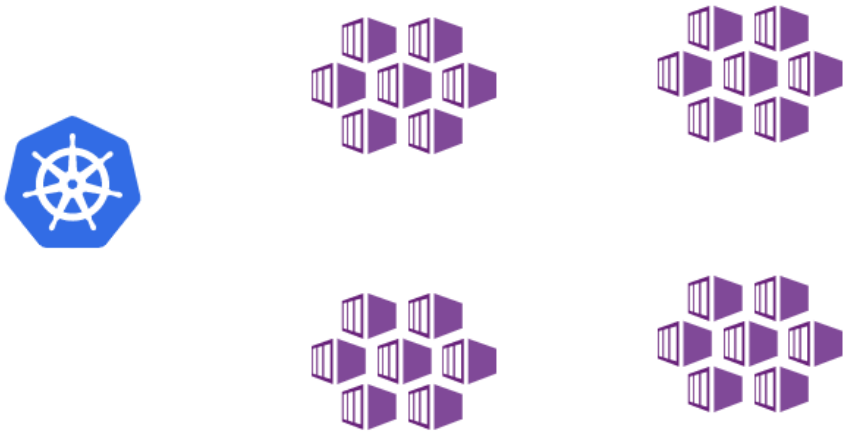


Step 3 - Customize the MySQL image

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

What is Azure Kubernetes

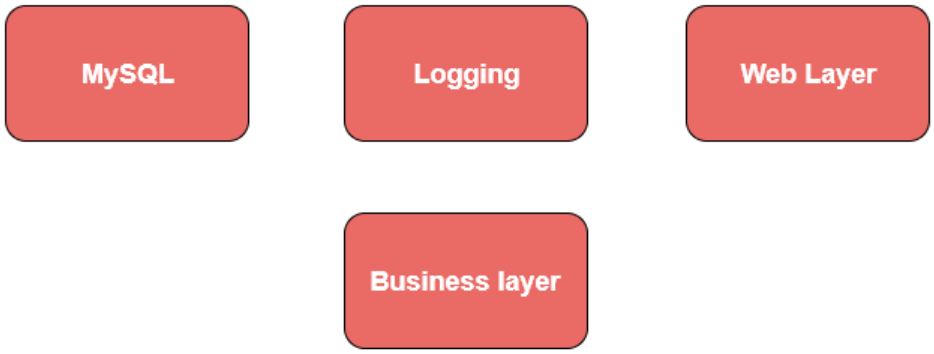
Kubernetes



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

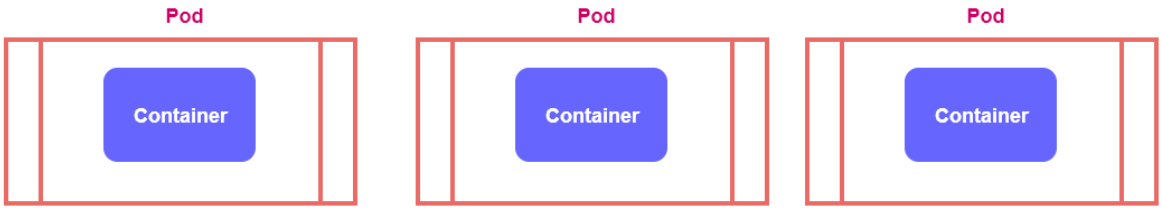
Pod

10.0.0.16

Deployment

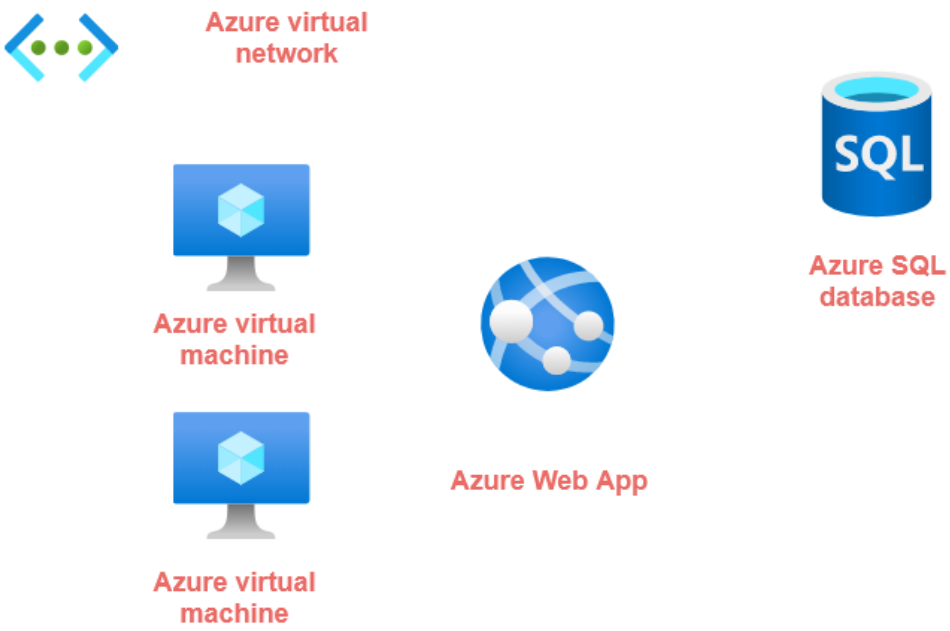
This is a declarative way to describe the state of the Pods and ReplicaSets

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

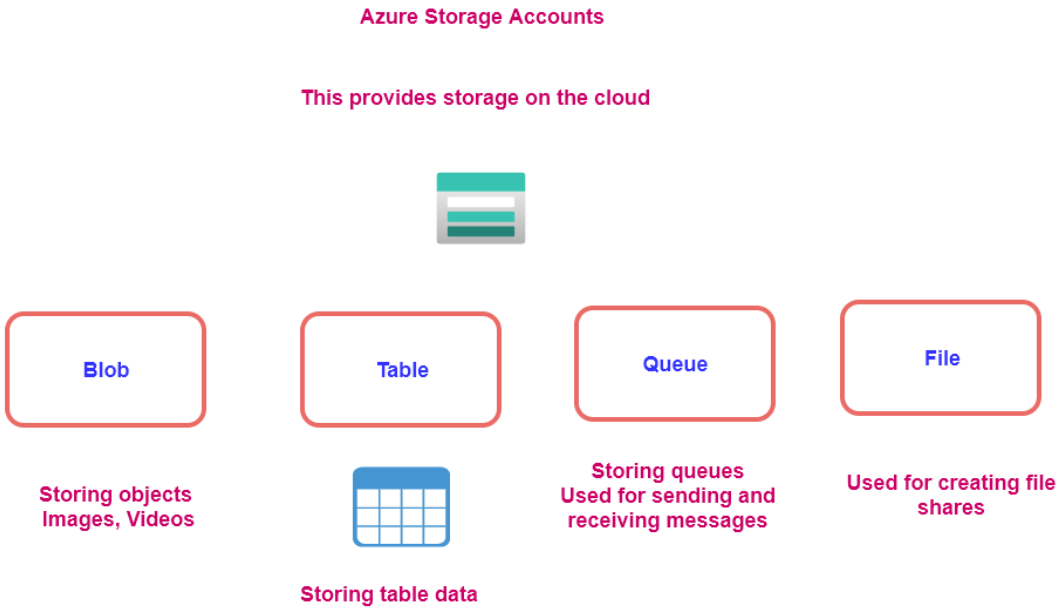
Create an Azure Resource Manager template

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

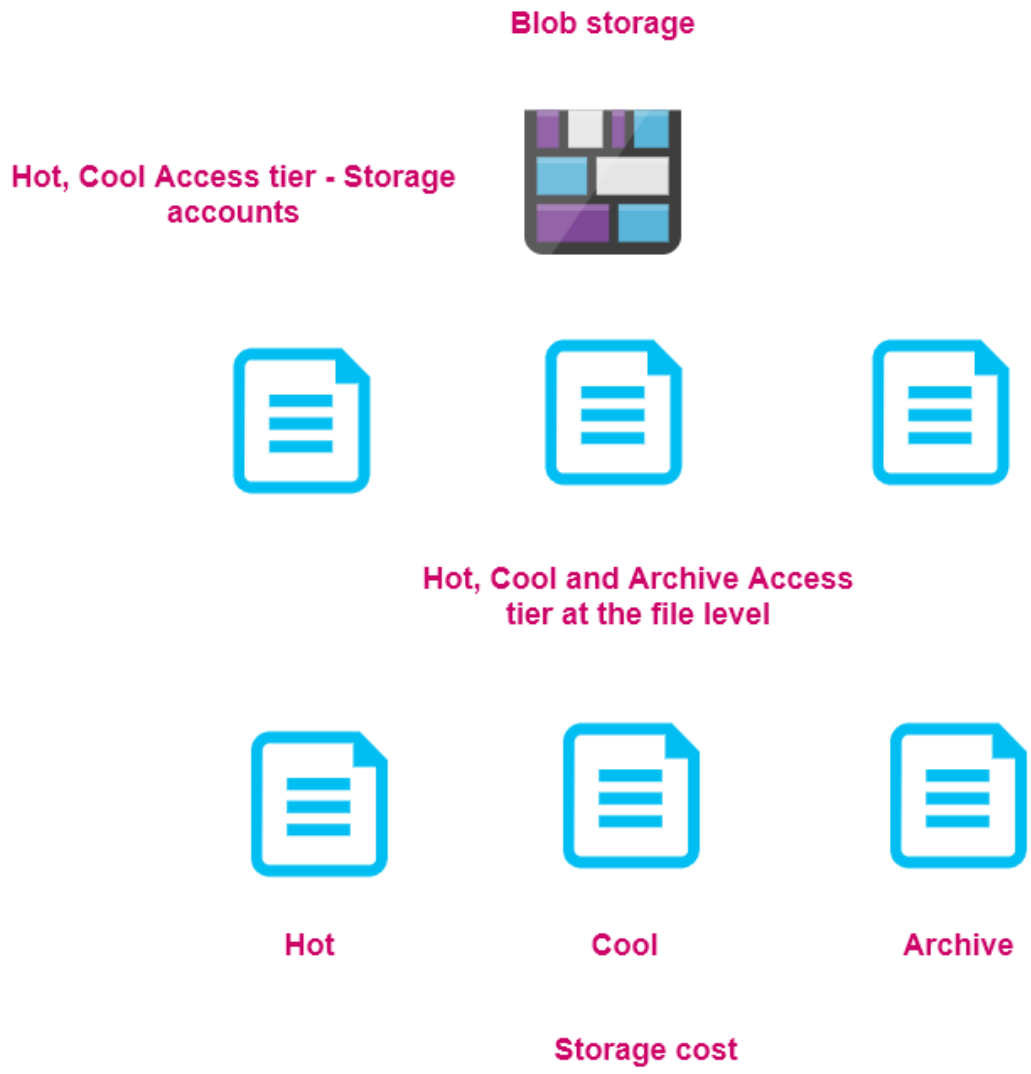
These are block blobsthat are optimized for append operations - Good for logging

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

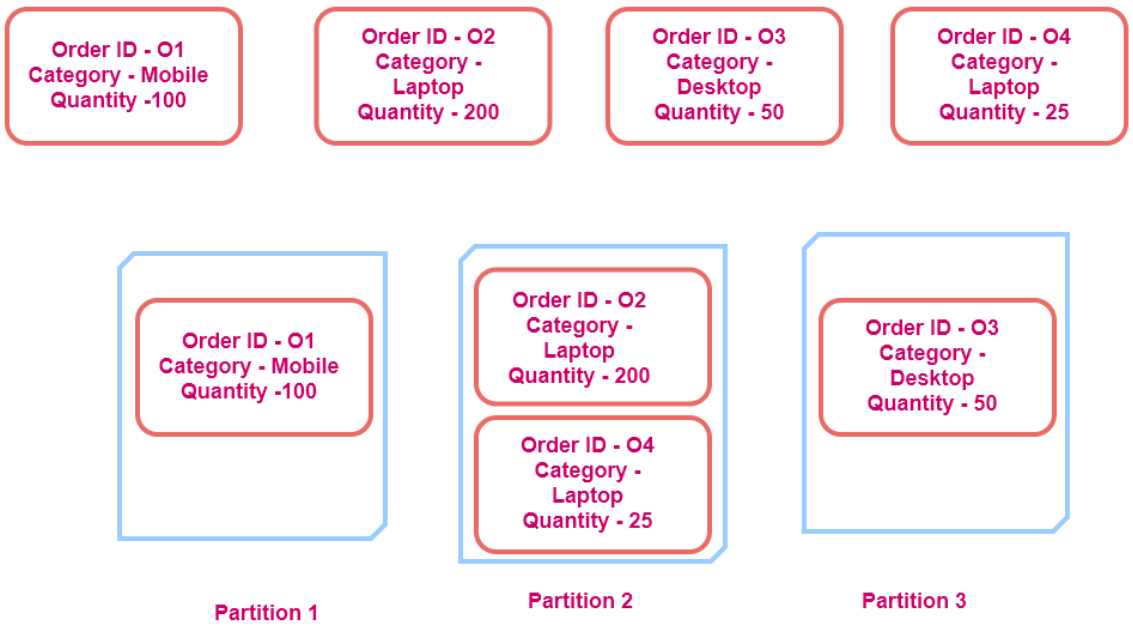
Each property is a name-value pair

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

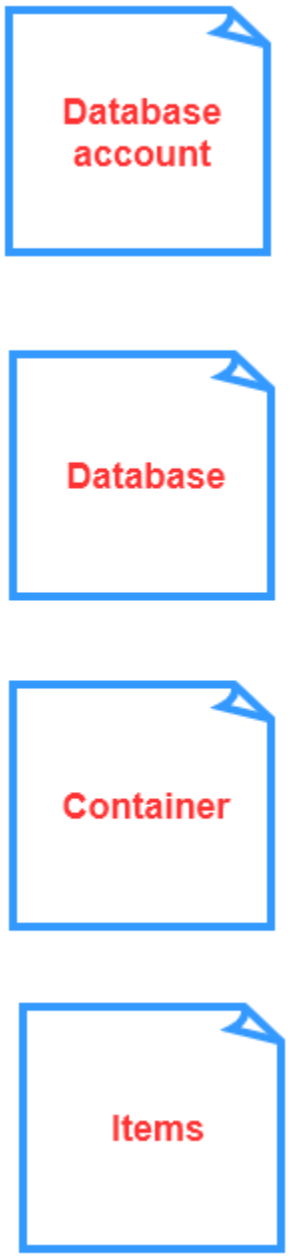
Azure Cosmos DB

Fully Managed NoSQL database

You get single-digit millisecond response times

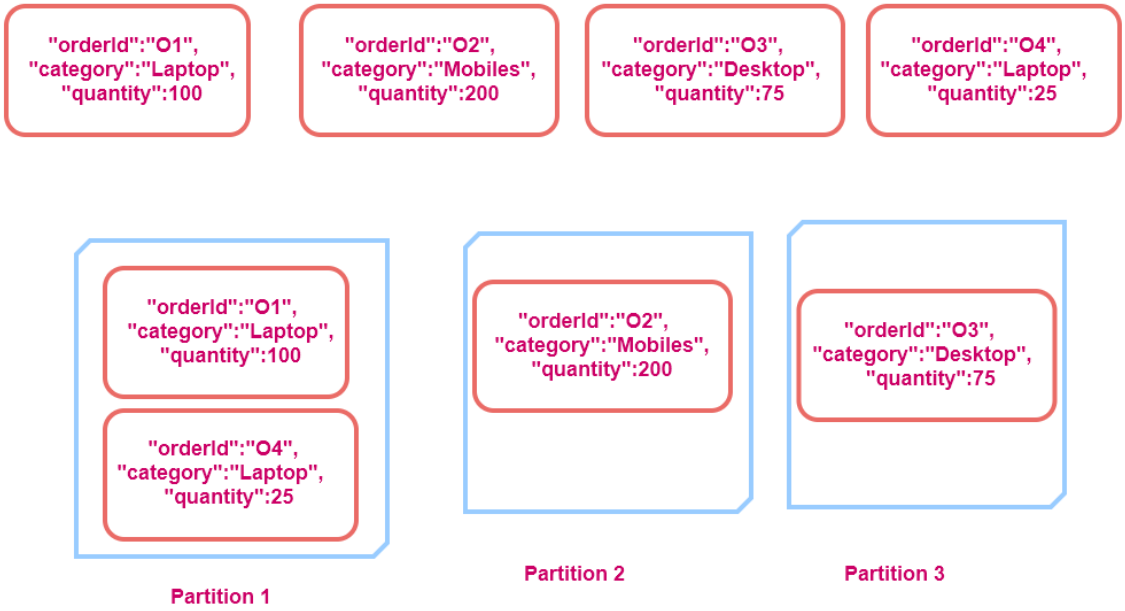
Scales automatically based on demand

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


Database account
Database
Container
Items

	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

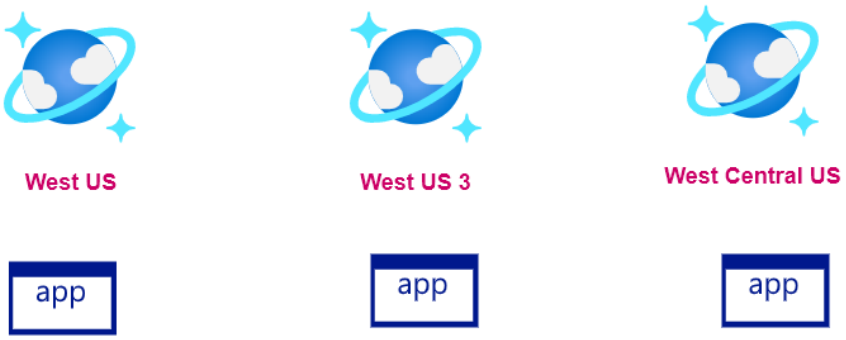
West Central US

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}

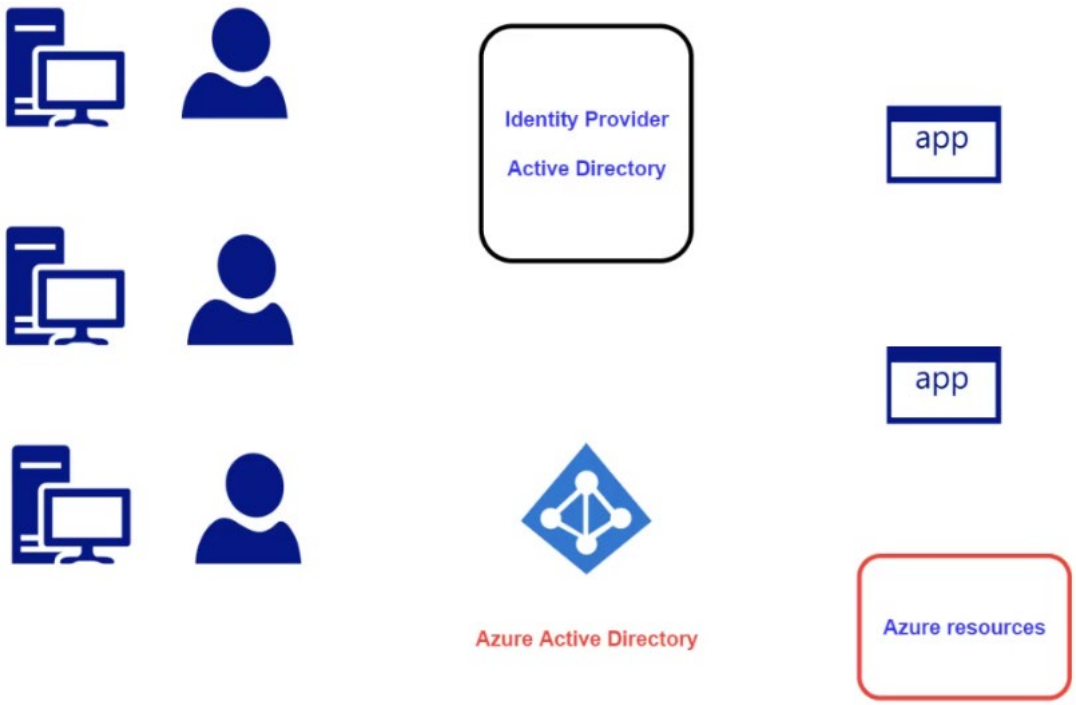
{ "orderId":"O1", "category":"Laptop", "quantity":400}

Eventual

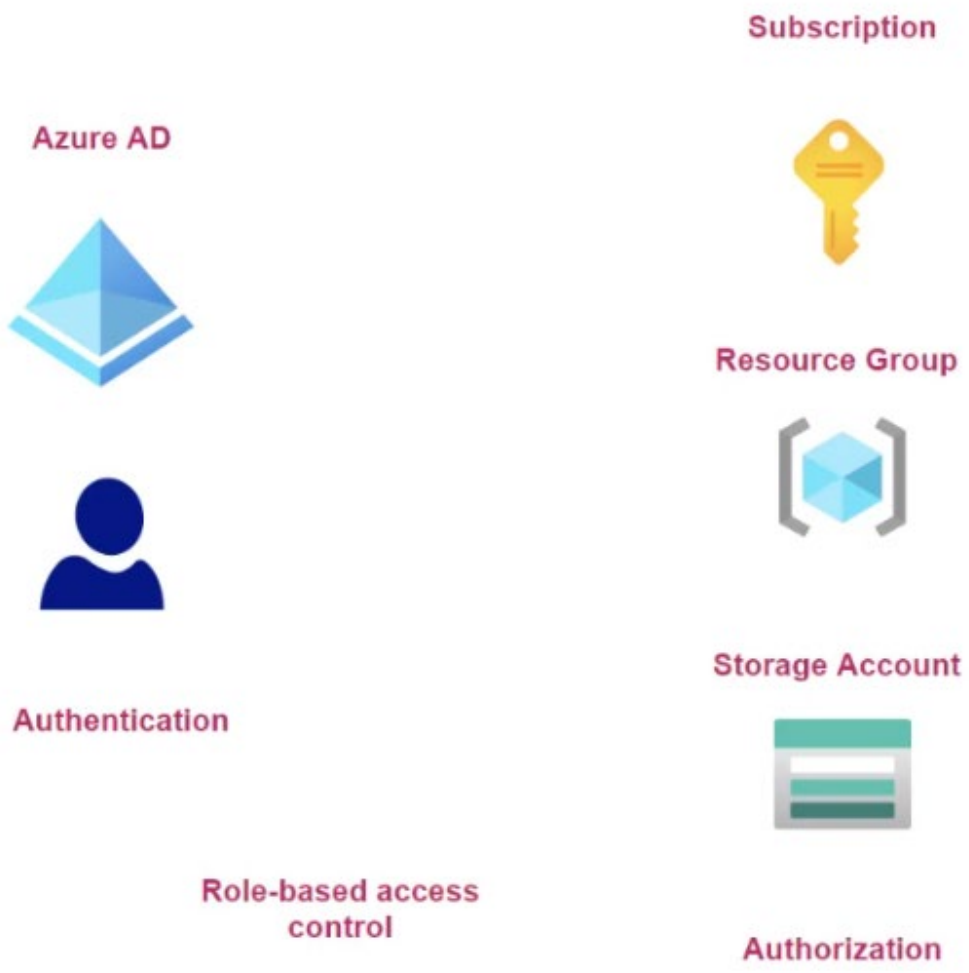
Eventually the data will be consistent. But there is no order gurantee for the reads.

Implement Azure security

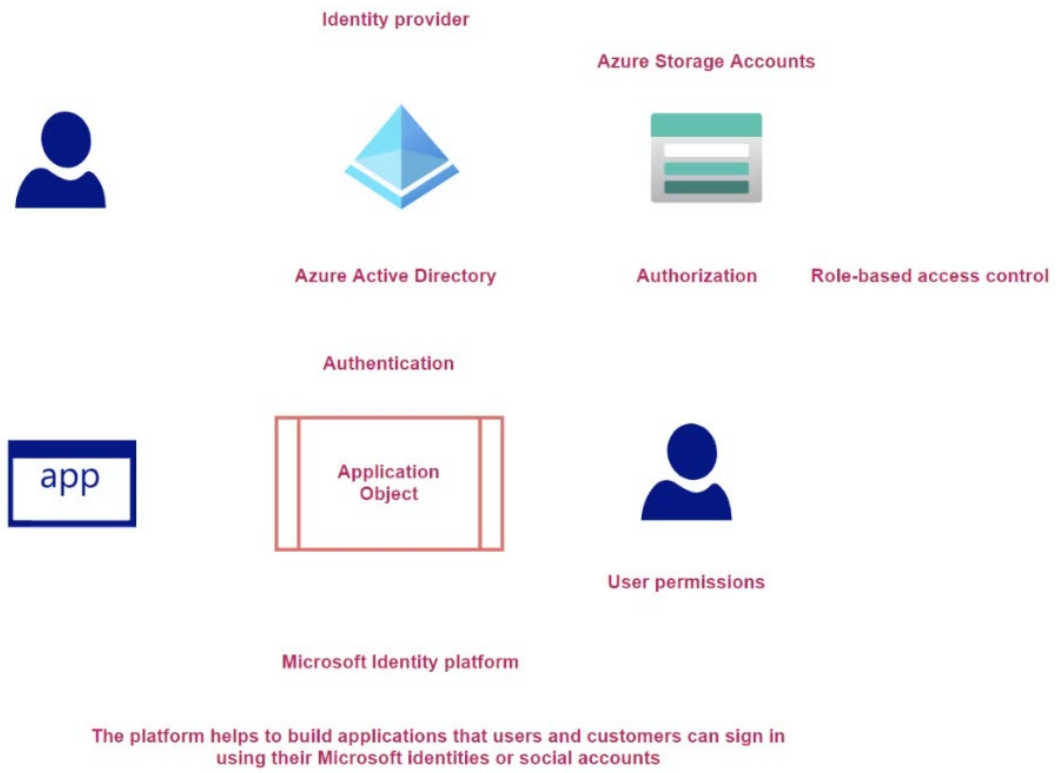
What is Azure Active Directory



So what is Role-based access control



Introduction to Application Objects

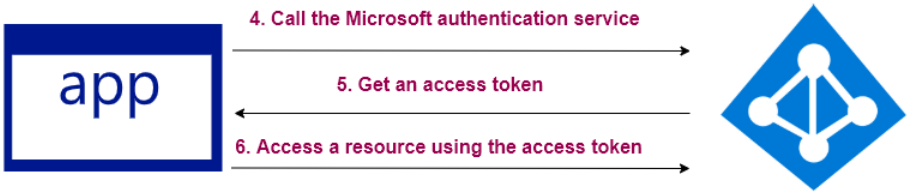


Lab - Application Object - Blob objects

Lab - Getting user and group information

API call

Azure AD



Postman

1. Register an application in Azure AD

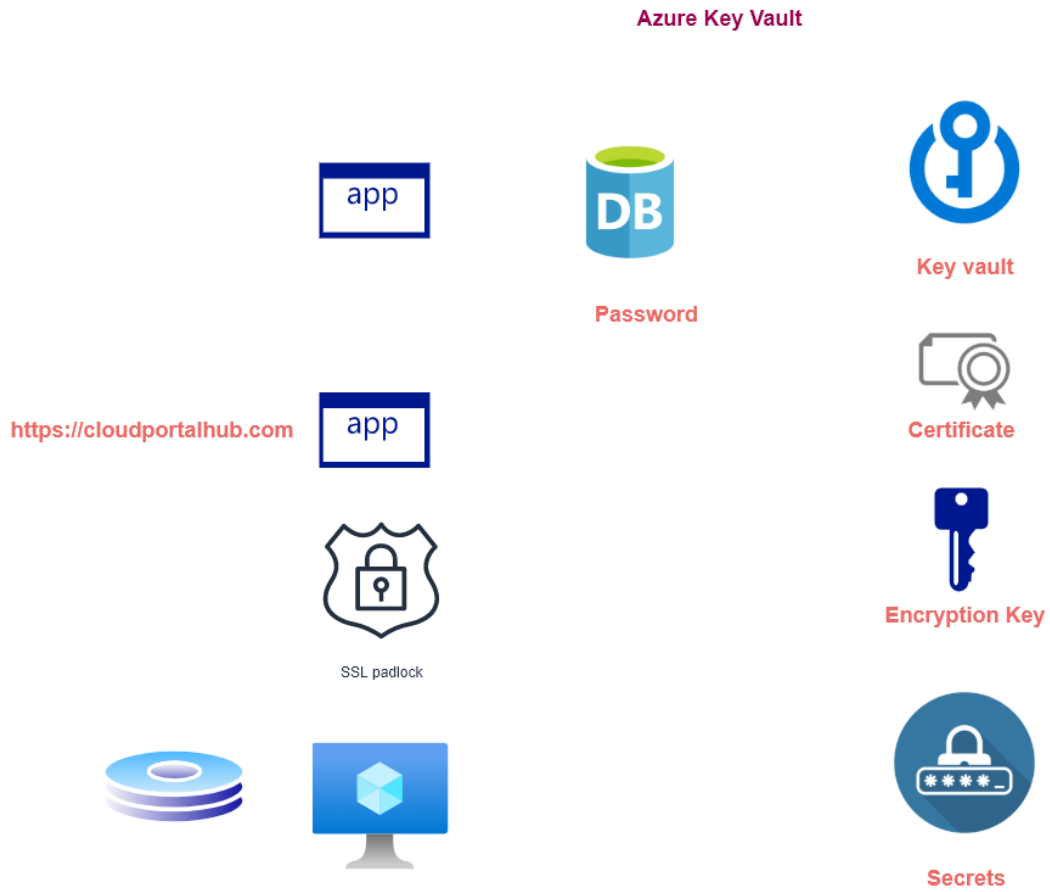
2. Provide permissions

Delegated permissions	Application permissions
Runs on behalf of the user	Runs on behalf of the application

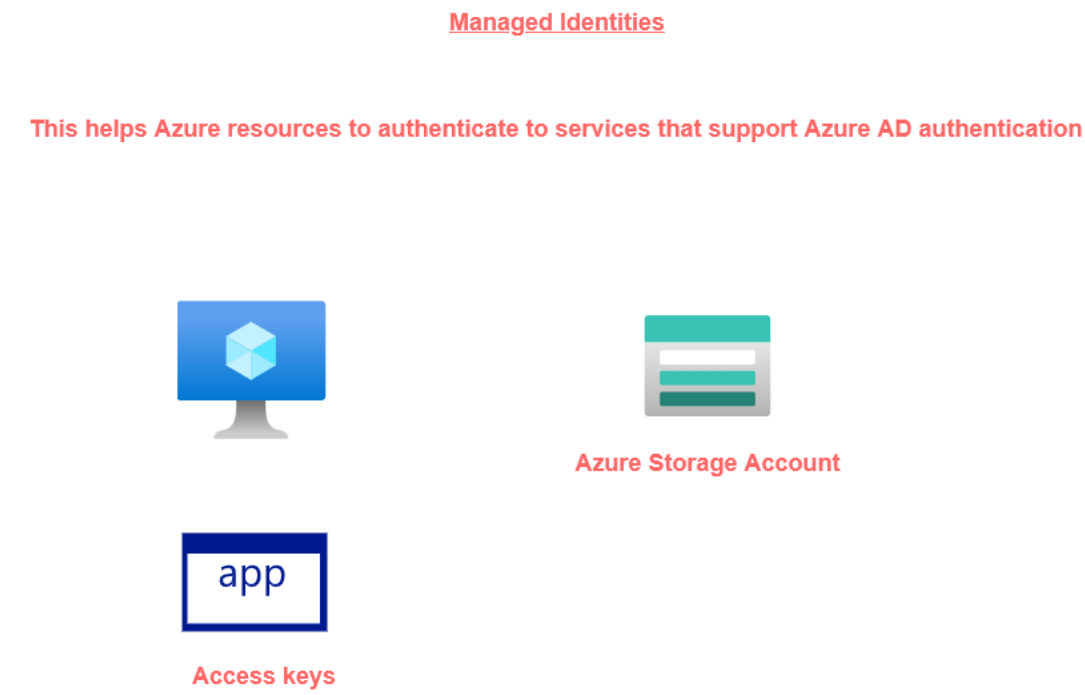
3. Provide admin consent

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

Get information of customer

Get information of order

Get information of product

Application programming Interface

Get information about Azure virtual machines

Create an Azure virtual machine

Custom App on Azure

Application programming Interface

Get information of customer

Authentication

Authorization

Identity provider

Access Token

<u>Benefits</u>

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

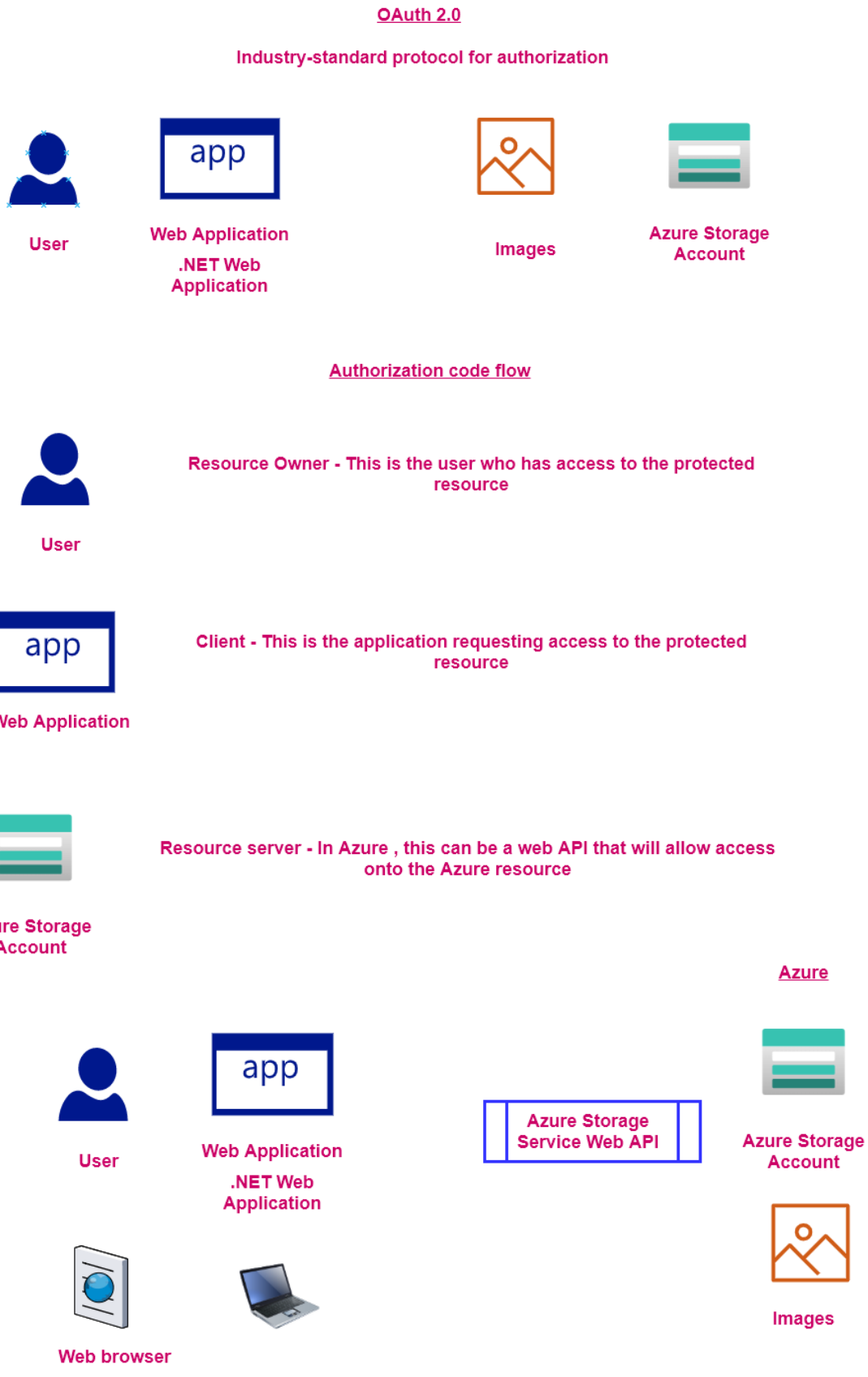
Microsoft Authentication Library

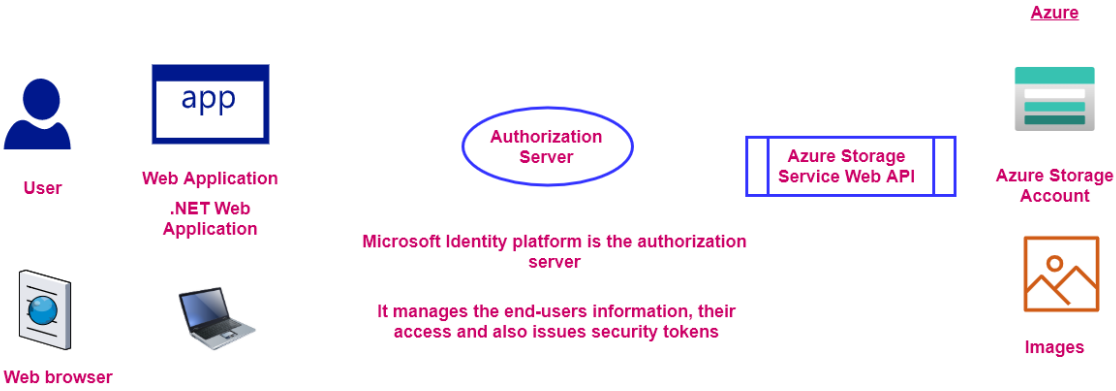
Enables developers to acquire access tokens from the Microsoft Identity platform

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?

Step 1
The application makes a call to the authorization server

Client Application

Redirect URI
http://cloudportalhub.com/callback

Response type:code

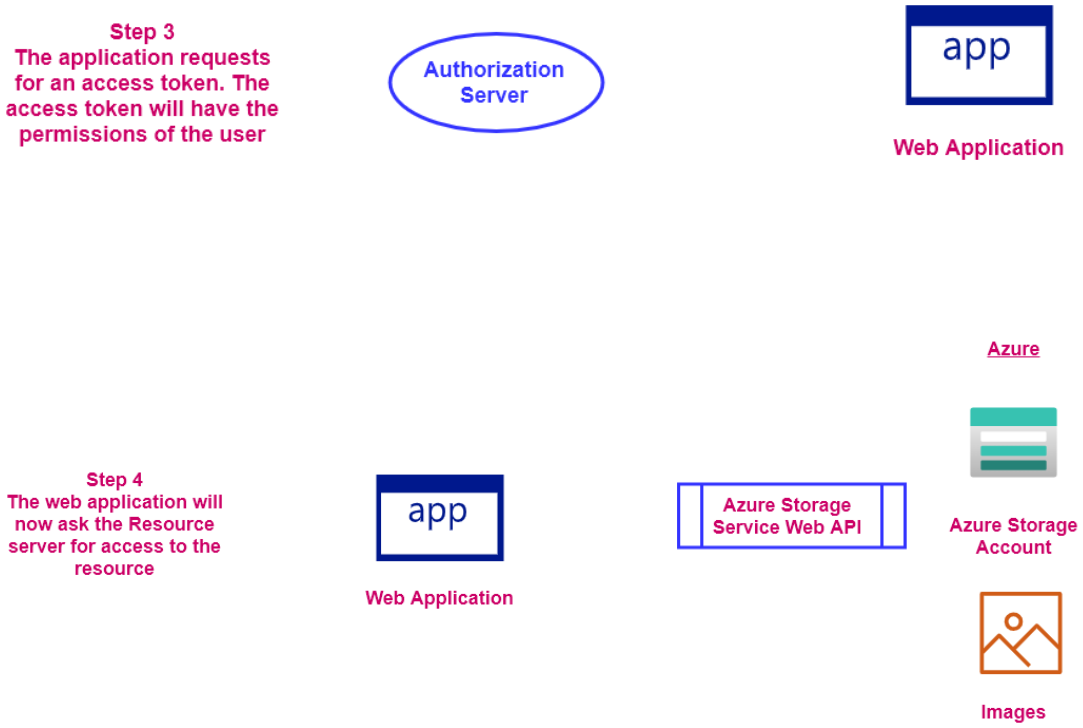
Step 2
The authorization server sends the authorization code to the application

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

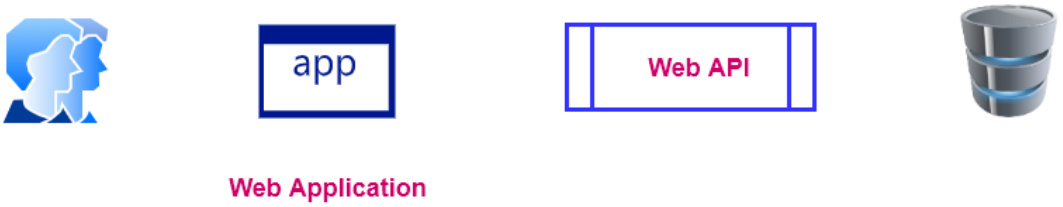
The authorization code is viewable in the browser

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.



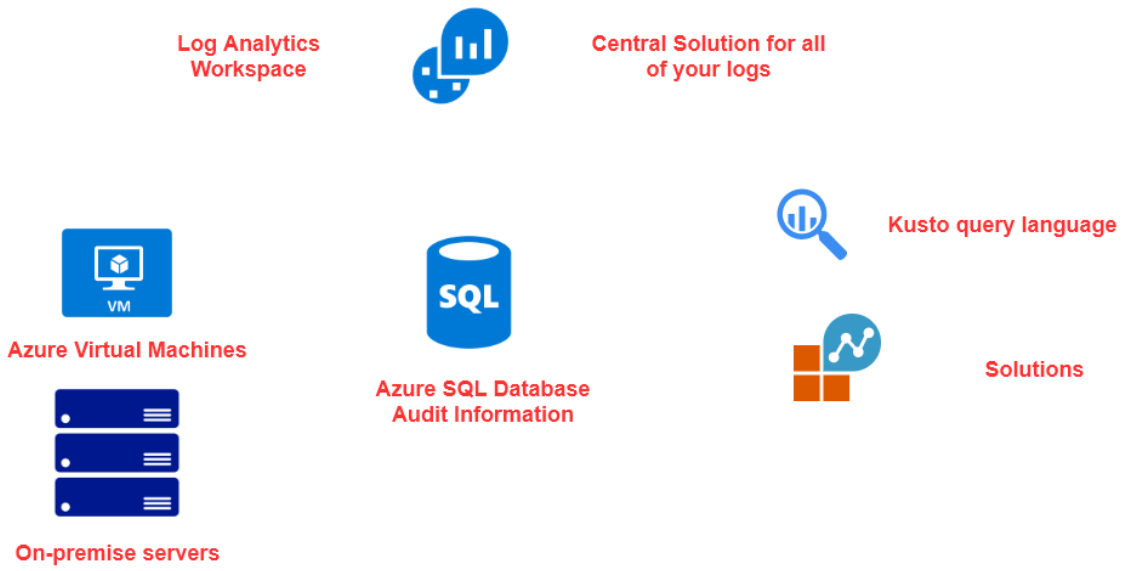
Lab - Getting an access token

Lab - Creating our Web API

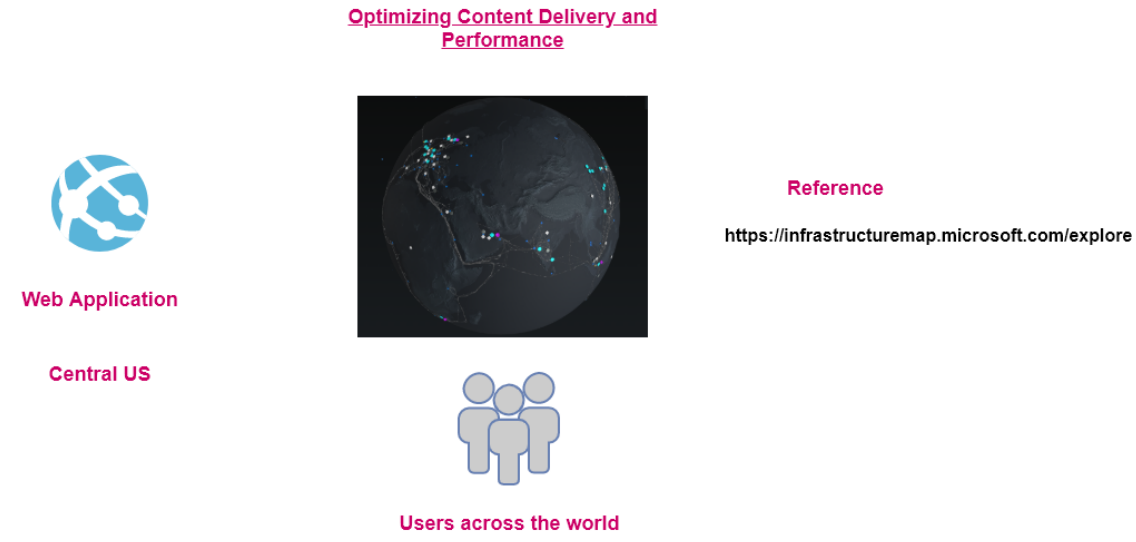


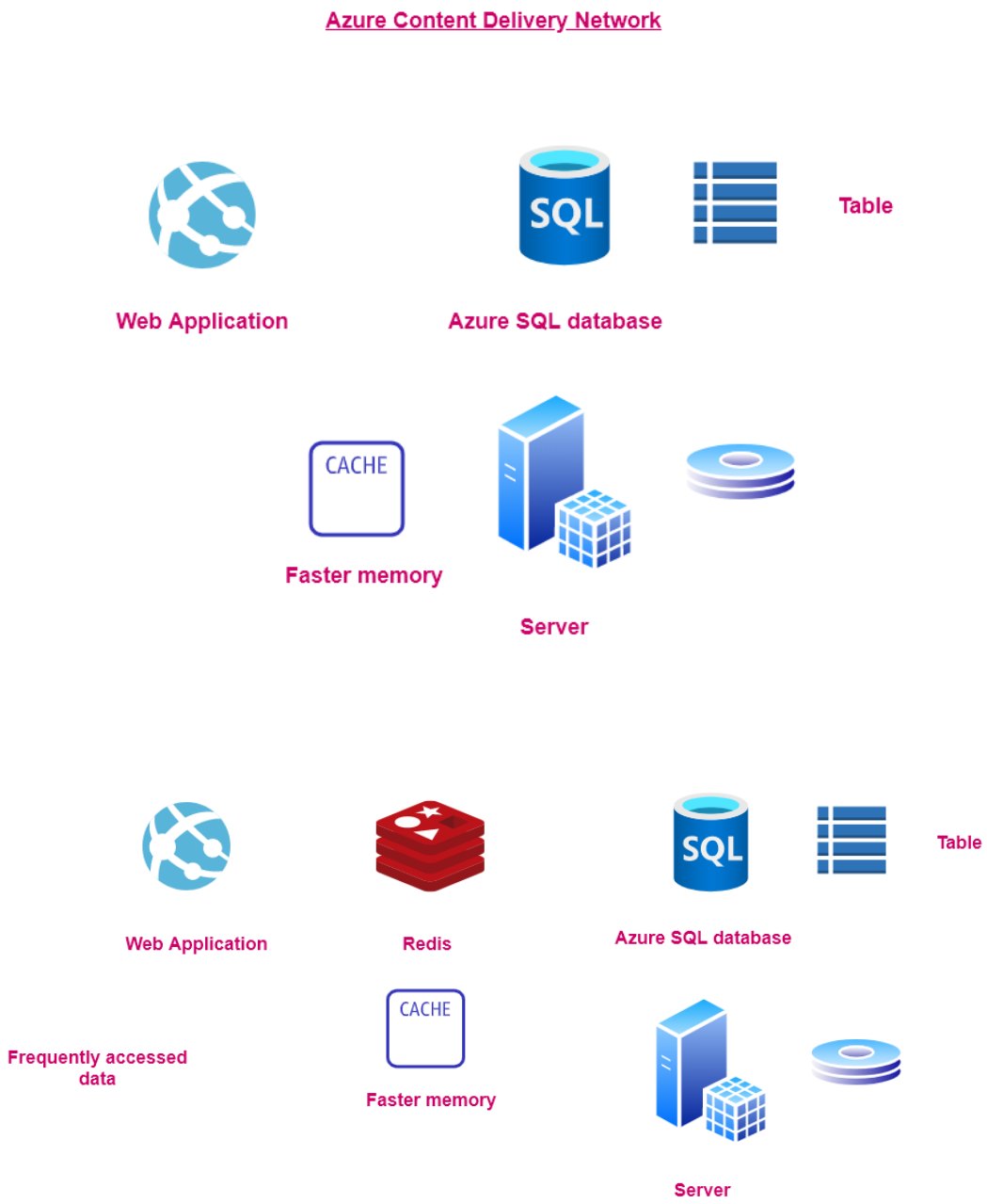
Monitor, troubleshoot, and optimize Azure solutions

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

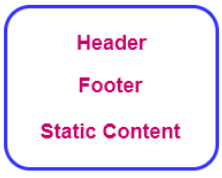
The application would first calculate the top 10 courses based on the data in the database

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

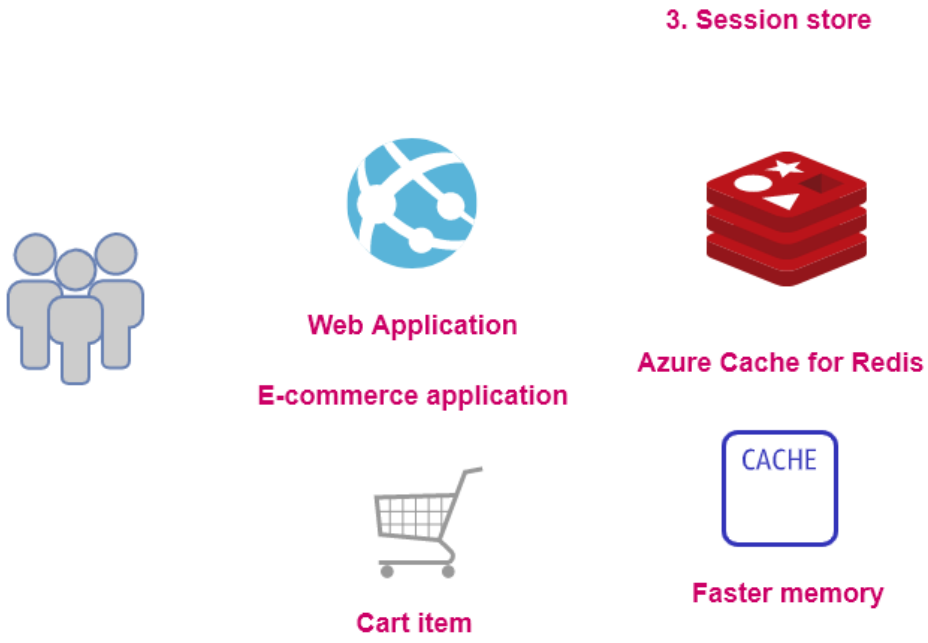


Web page

Web Application

Azure Cache for Redis

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

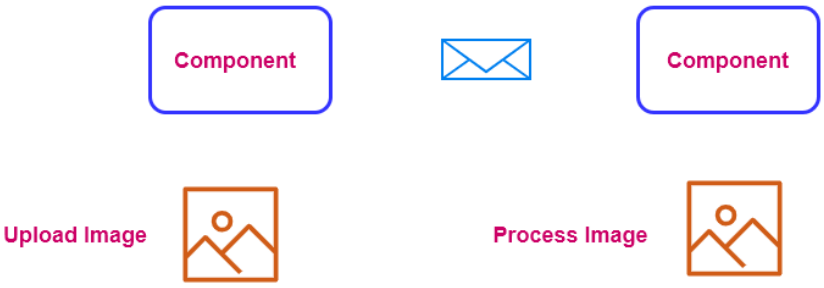
Azure Storage queues

Azure Service Bus

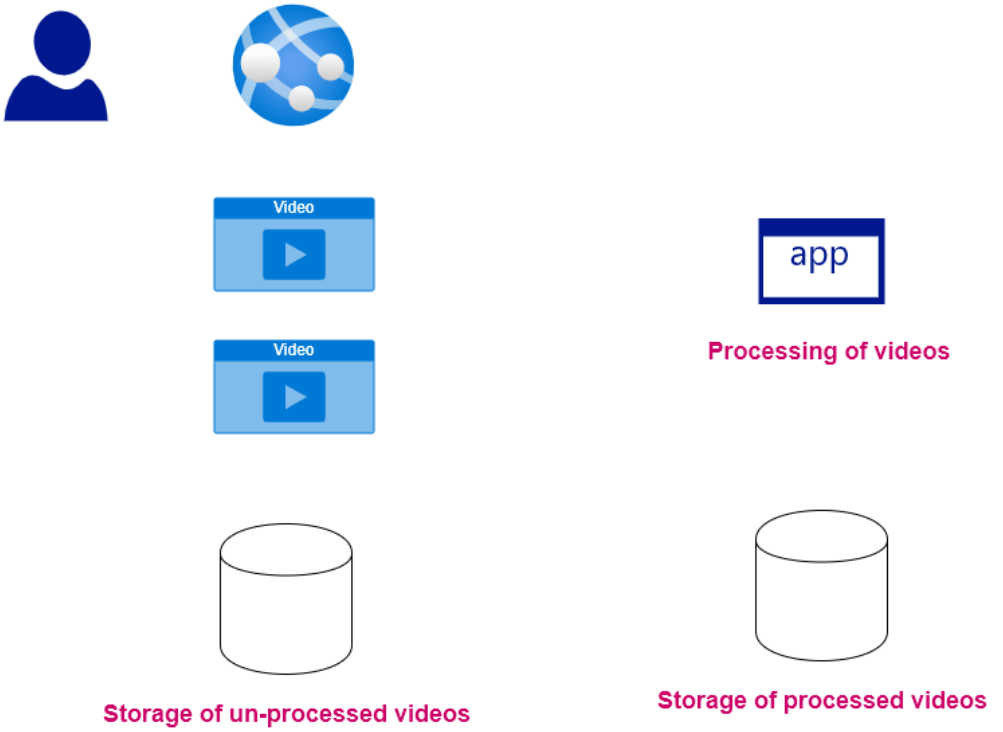
Component

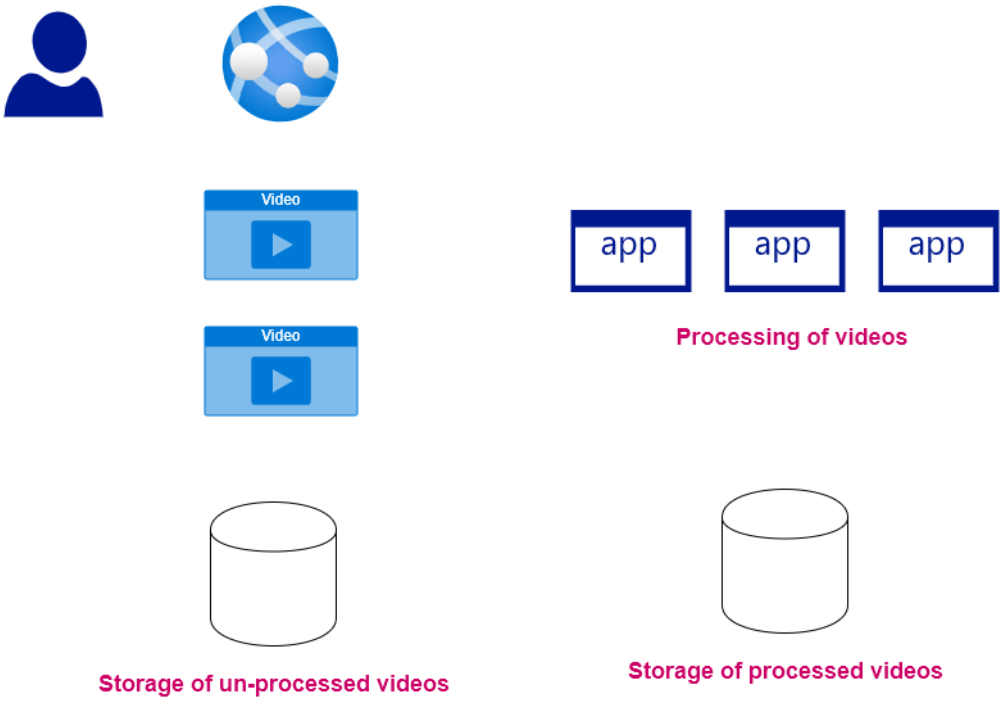
Component

System



The purpose of the queue service


Video
Video
app
Processing of videos
Storage of un-processed videos
Storage of processed videos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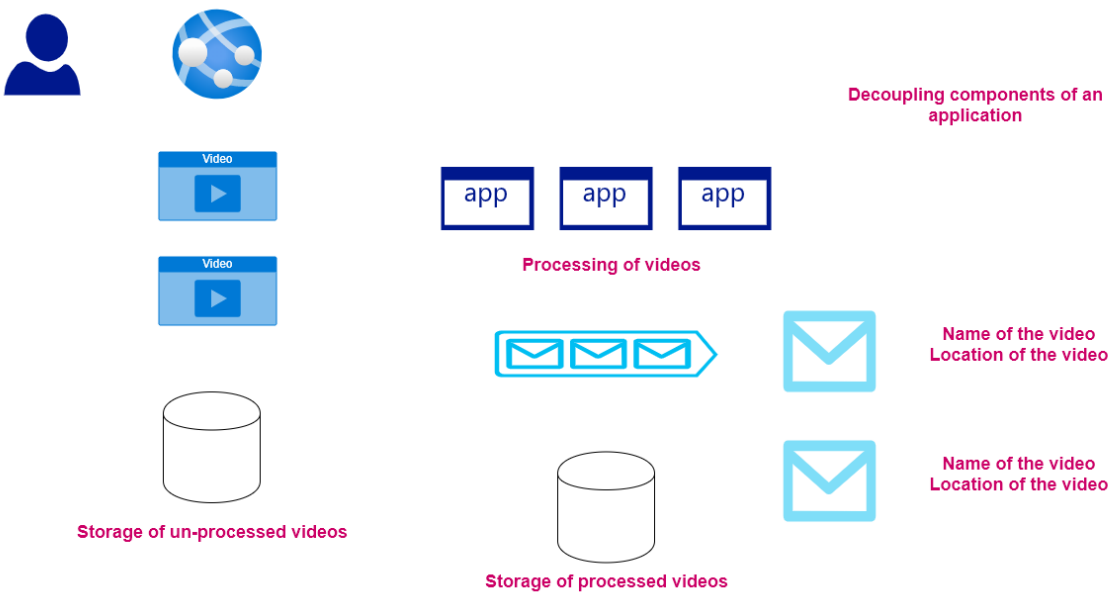


What is Azure Service Bus

Azure Service Bus

Fully managed Enterprise message broker

Data can include structured encoded data with formats - JSON, XML, Apache Avro

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

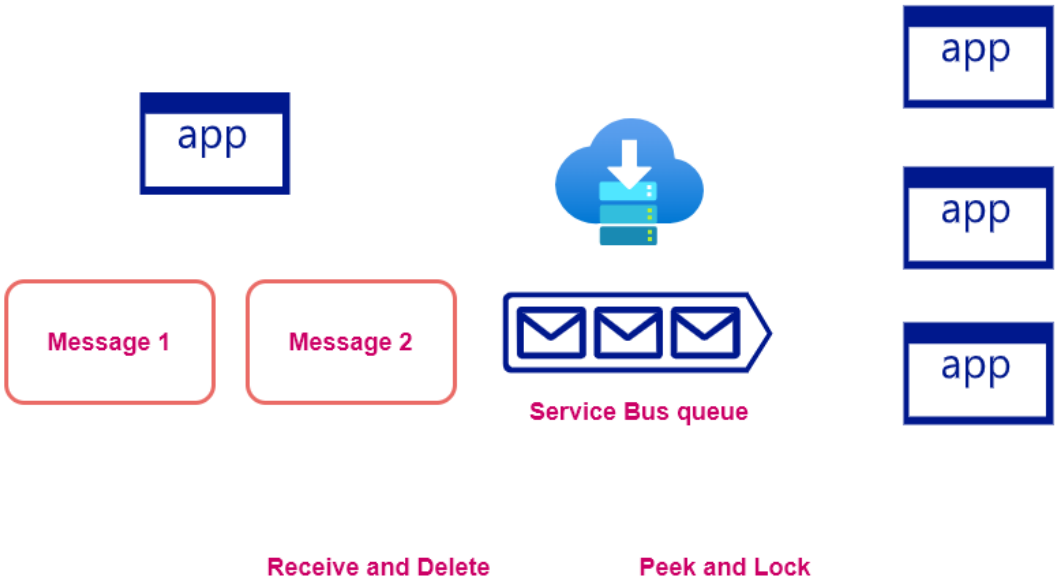
Sender

Receiver

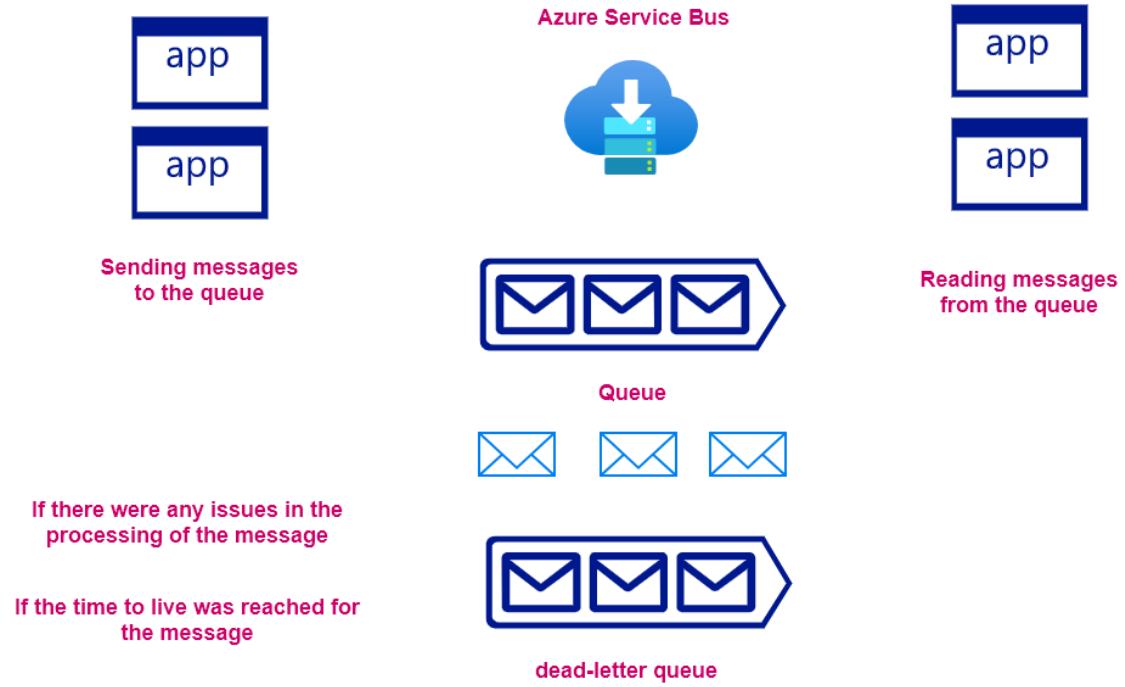
The subscriber to the topic will receive a copy of the message sent to the topic

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

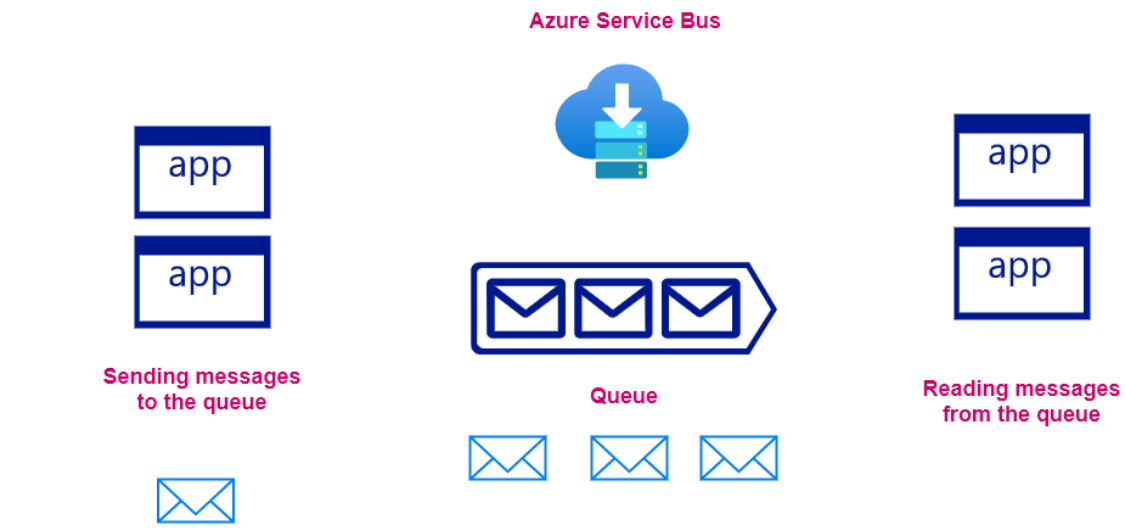
Azure Service Bus queue - Message lock duration



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

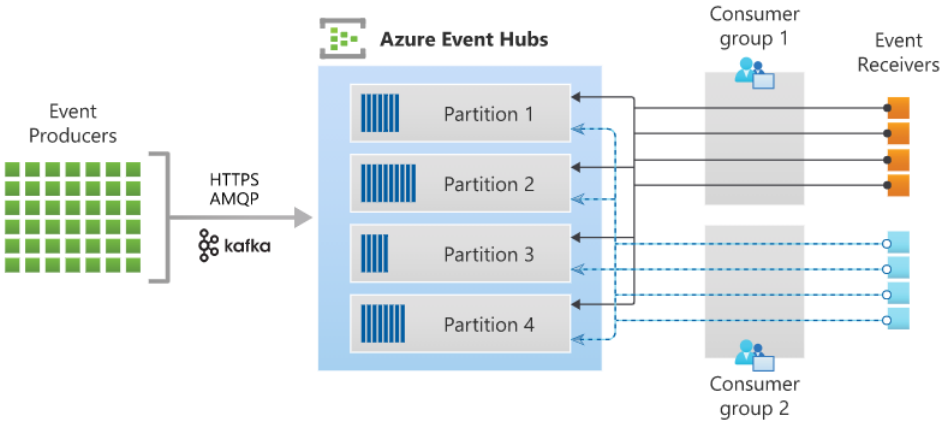
Companies want to perform analysis of data in real time

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

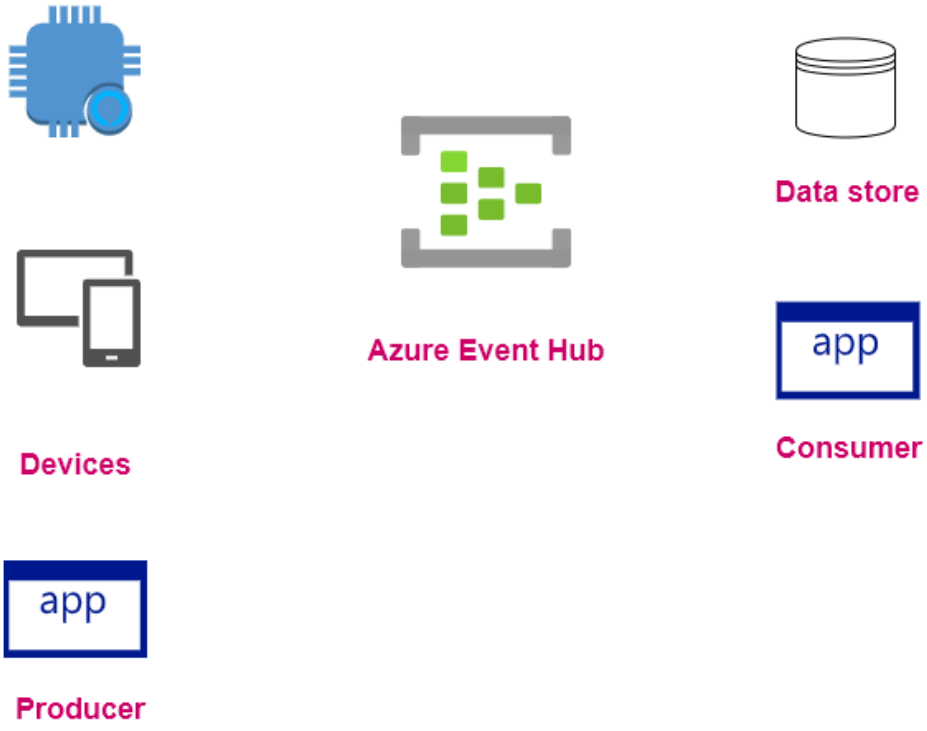
Partitions - The data is split across partitions. This allows for better throughput of your data onto Azure Event Hubs

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.

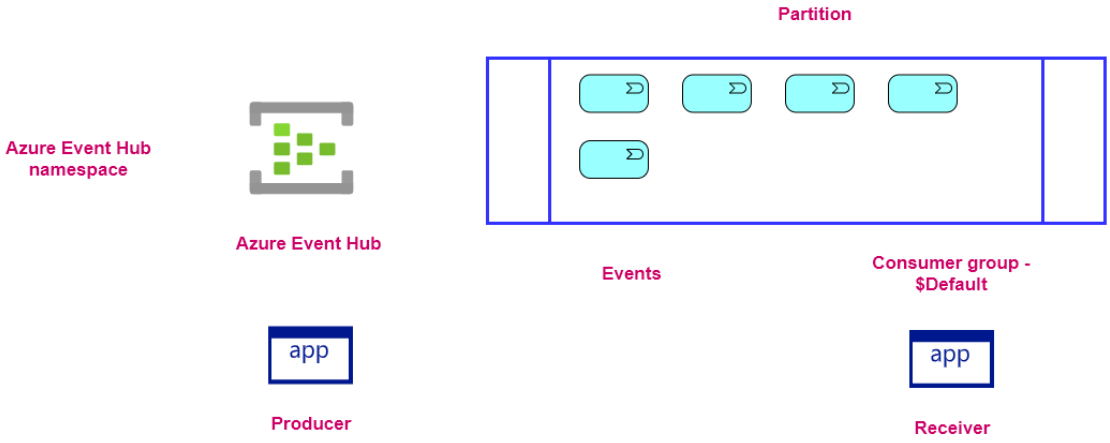
Your program needs to keep track of events being read.

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

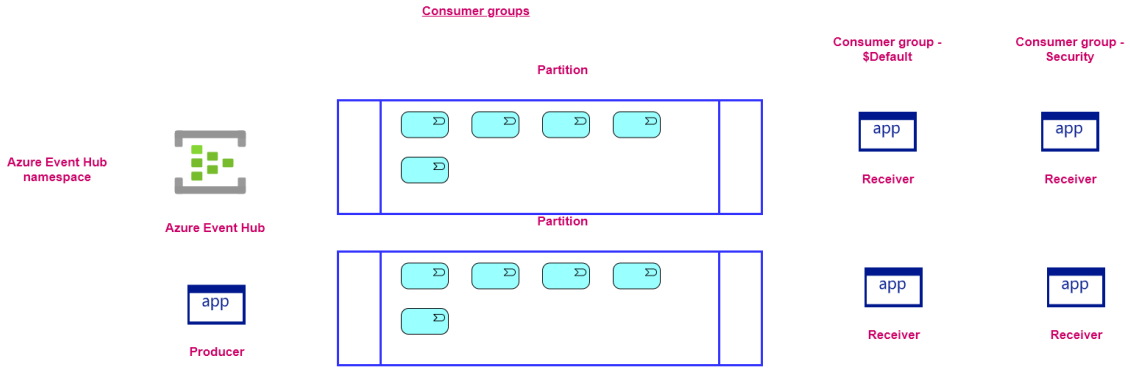
Partitions

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.

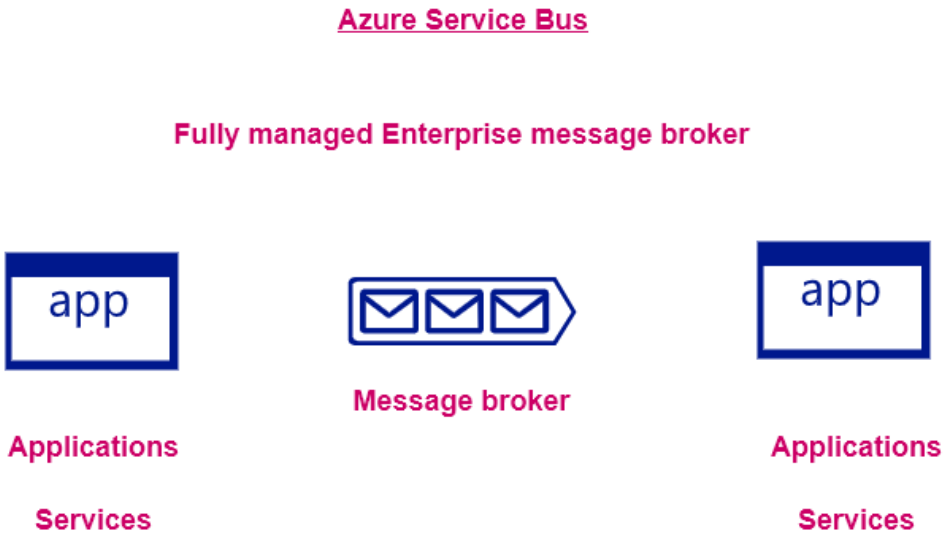


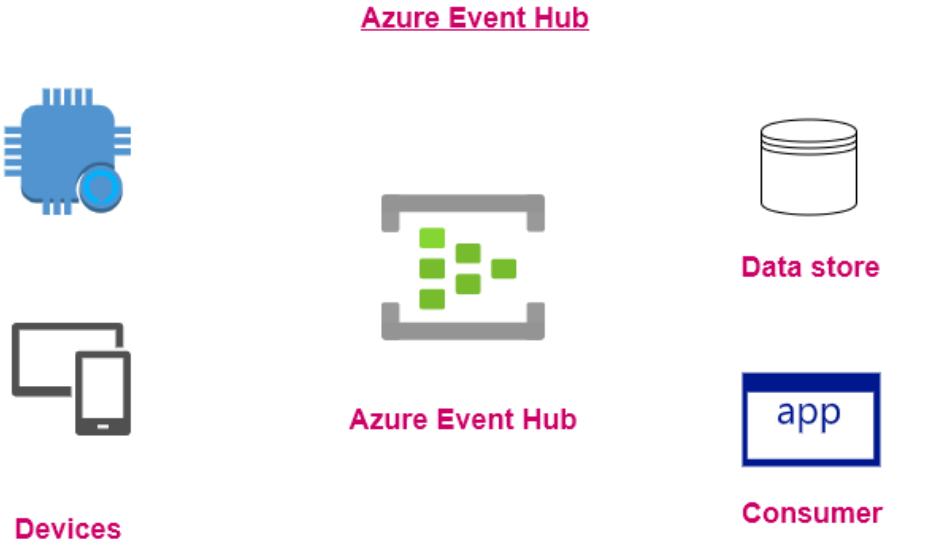
The recommendation is to have one receiver per partition

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

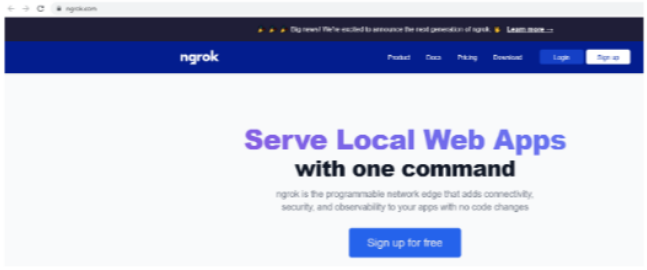
Developing Azure Function with Event Grid locally

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

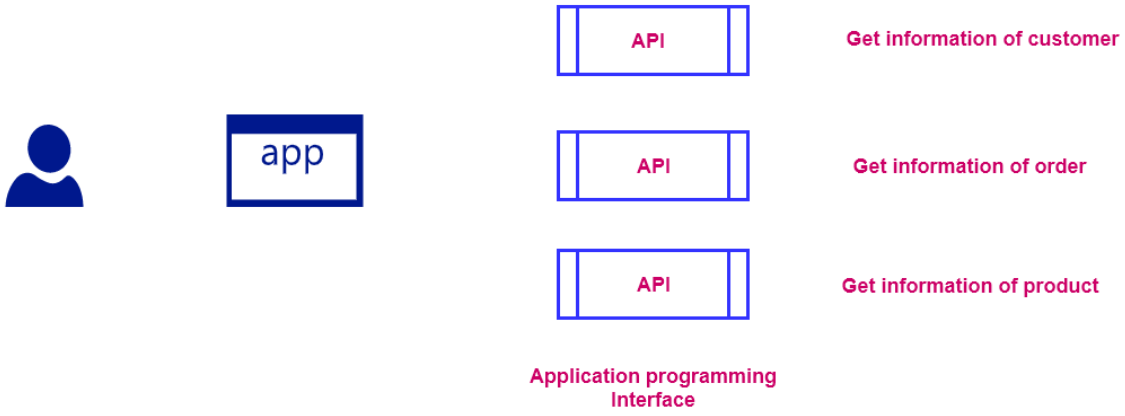
Azure Functions Visual Studio

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

ngrok

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

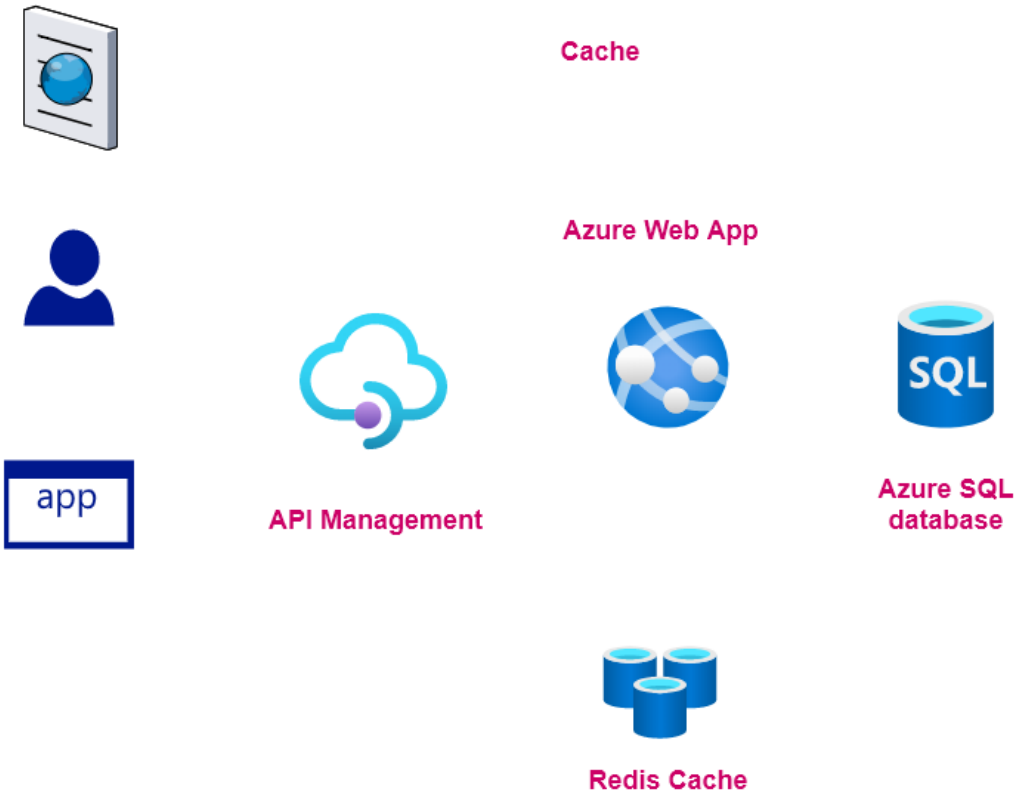
What is the API Management service



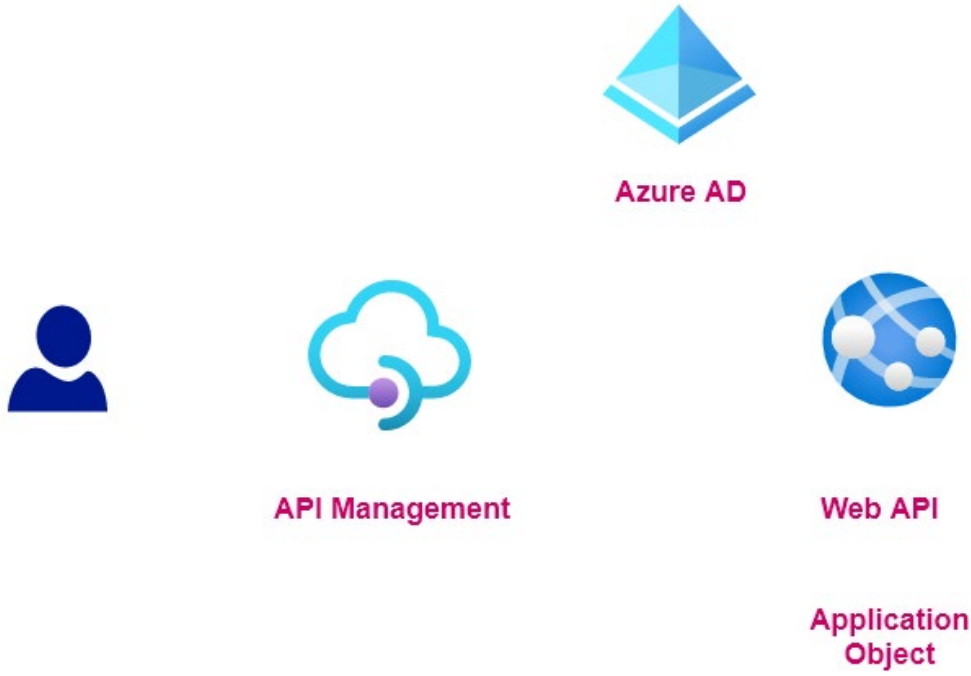
API Management service

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

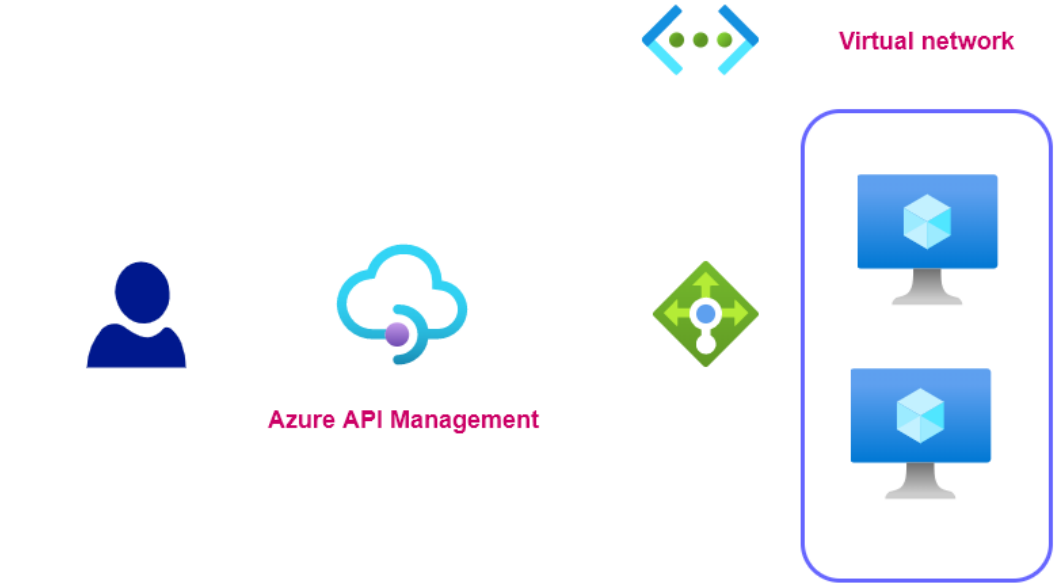
API management policy – Cache



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