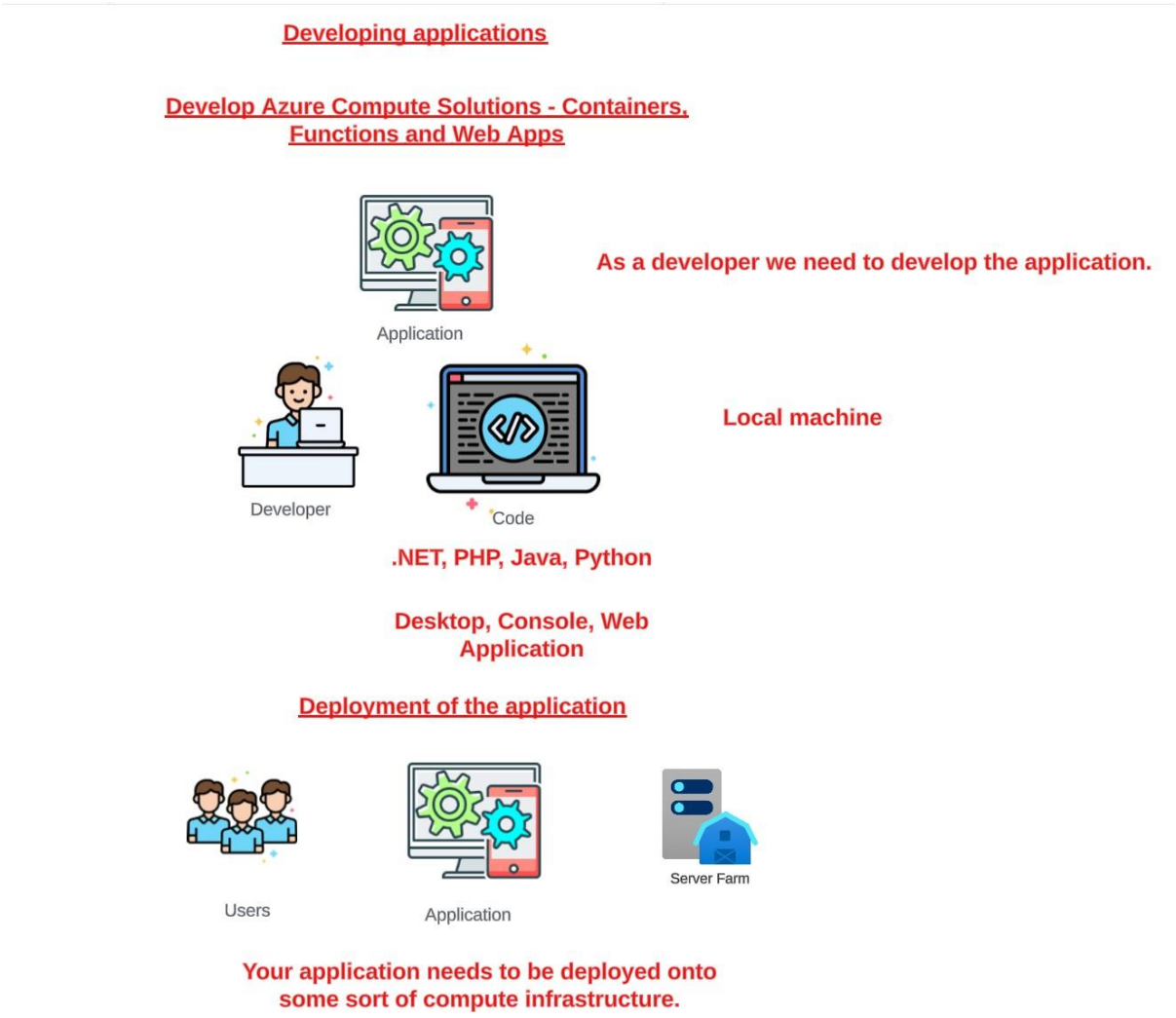
Introduction

Development and using Azure services



Develop Azure compute solutions - Azure Virtual Machines

What are we going to do

ASP.NET Core 8

PHP

Application

Code

We will look at simple applications.

We will deploy these applications onto Virtual Machines.

We will use Visual Studio Code as our development tool.

What goes into deploying a virtual machine

What is the Azure Virtual Machine service

Generally what does a company need in order to host an application and make it available to users.

Buy physical servers

Buy storage

Setup a network

All of this costs money, there is an initial investment that the company needs to undertake.

Large companies will normally setup data centers. These centers contain a number of servers, storage devices, racks, cooling devices etc.

All of this is an investment from the company.

The first service we are going to look into is the Azure Virtual Machine service.

Virtual Machine

This is a compute service that allows you to host virtual machines on the Azure cloud network.

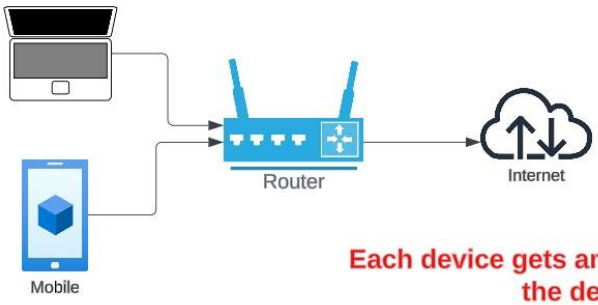
What is involved in the deployment of a virtual machine.

What is the size of virtual machine - number of vCPU's, RAM

What is the number and size of the disks you want allocated for the virtual machine.

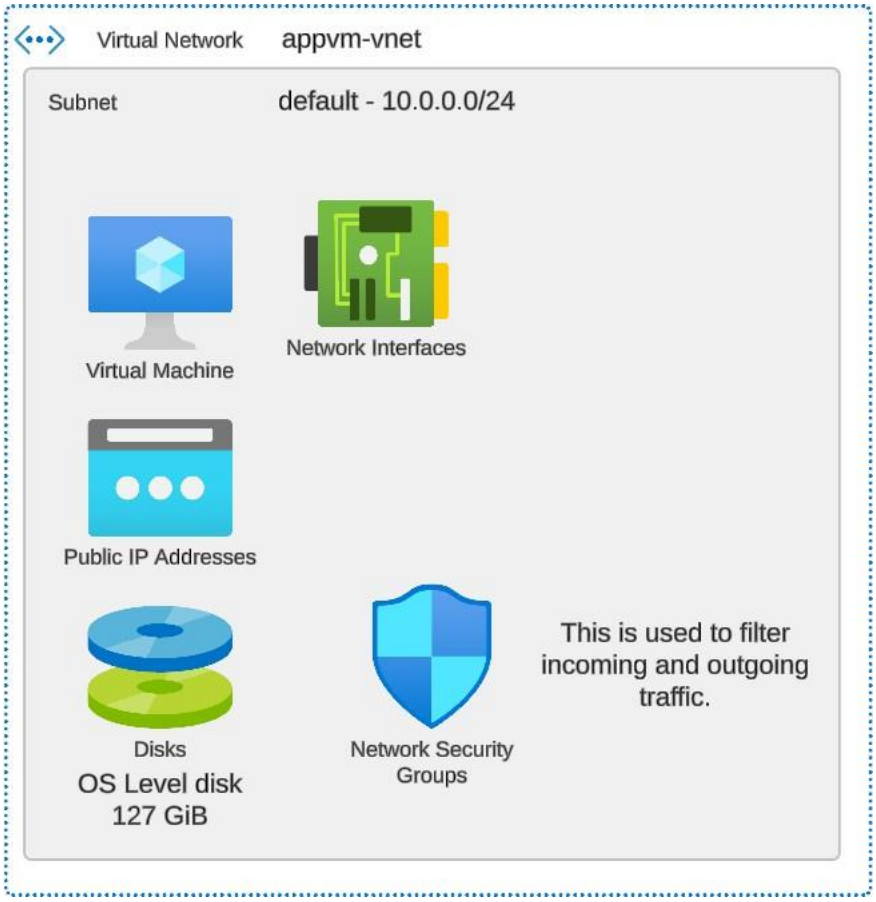
What is the underlying operating system - Ubuntu, Windows Server.

The network details for the virtual machine.

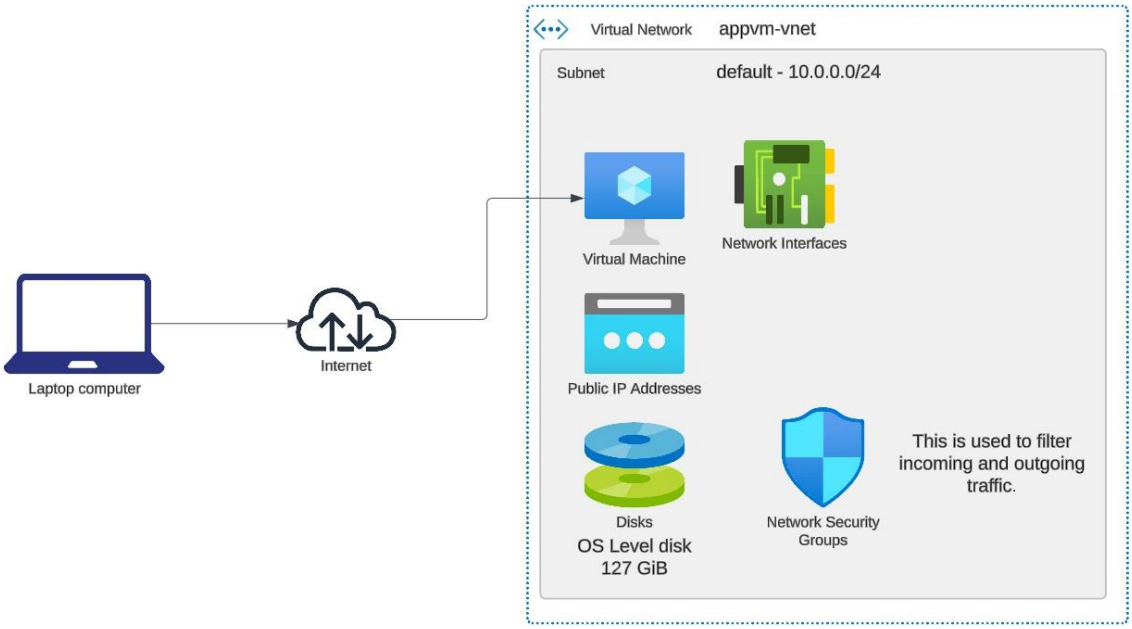


Each device gets an IP address. This helps to identify the device on the network.

A network allows devices to communicate with each other.



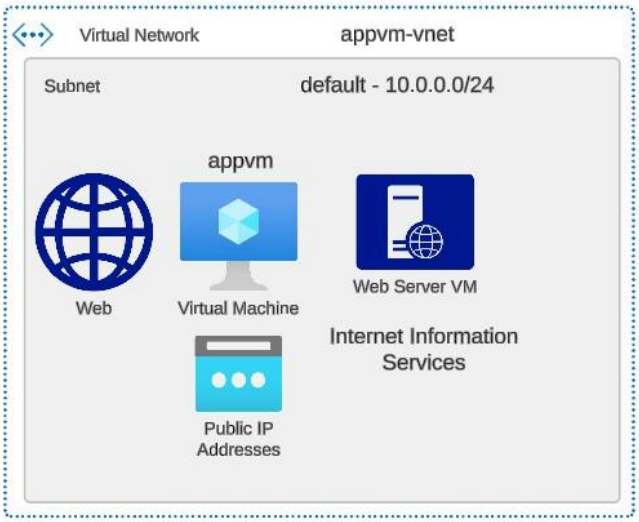
Lab - Connecting to the Virtual Machine



Develop Azure compute solutions - Azure Web Apps

Introduction onto Azure Web Apps

We understand the concept wherein we can host web applications on Azure virtual machines



Physical server

Azure Datacenter

Azure Web App Service

web application

Azure Websites

Virtual Machine

Physical server

This is a managed service. Here the virtual machine and physical infrastructure is managed for you.

There is support for web applications based on .NET, Java, Node.js, PHP, Python.

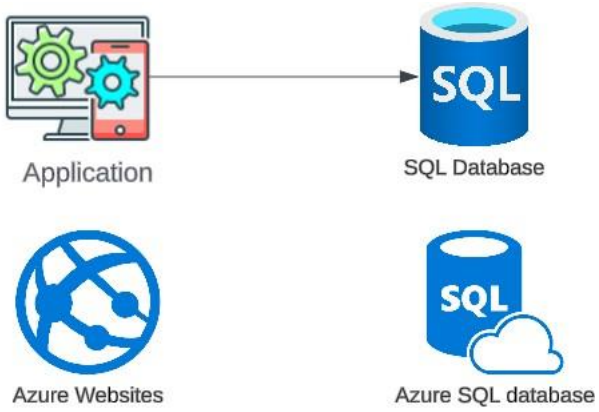
Here the patching of the framework and the operating system is managed by the service.

You also get other features such as High Availability.

If you have a web application that fits the framework and you don't want to manage the virtual machines, then you can opt for the Azure Web App service.

But if you need to host a custom application that needs to be installed, then you would probably need to use the Azure virtual machine service.

What does it mean to upgrade our App Service Plan



When we create an Azure Web App, we also need to have an App Service Plan in place.

The App Service Plan decides on the features and hardware specifications available to the Azure Web App.

Web App.

Hardware view Feature view Showing 23 App Service pricing plans

	Name	ACU/vCPU	vCPU	Memory (GB)	Remote Storage (GB)	Cost per hour (instance)	Cost per month (instance)
	Dev/Test (For less demanding workloads)						
☐	Free F1	60 minutes/day...	N/A	1	1	**Free**	**Free**
	Shared D1	240 minutes/da...	N/A	1	1	**0.013 USD**	**9.49 USD**
☑	Basic B1	100	1	1.75	10	**0.075 USD**	**54.75 USD**
	Basic B2	100	2	3.5	10	**0.15 USD**	**109.50 USD**
	Basic B3	100	4	7	10	**0.30 USD**	**219.00 USD**
	Production (For most production workloads)						
	Standard S1	100	1	1.75	50	**0.10 USD**	**73.00 USD**
	Premium v3 P0V3	195*	1	4	250	**0.209 USD**	**152.205 USD**
	Premium v3 P1V3	195	2	8	250	**0.328 USD**	**239.44 USD**

Application

Azure Websites

Virtual Machine

In the end the Azure Web App needs to be hosted on some sort of compute infrastructure which has CPU and Memory.

The underlying machine will be based on a desired operating system and it will have the underlying web server configured.

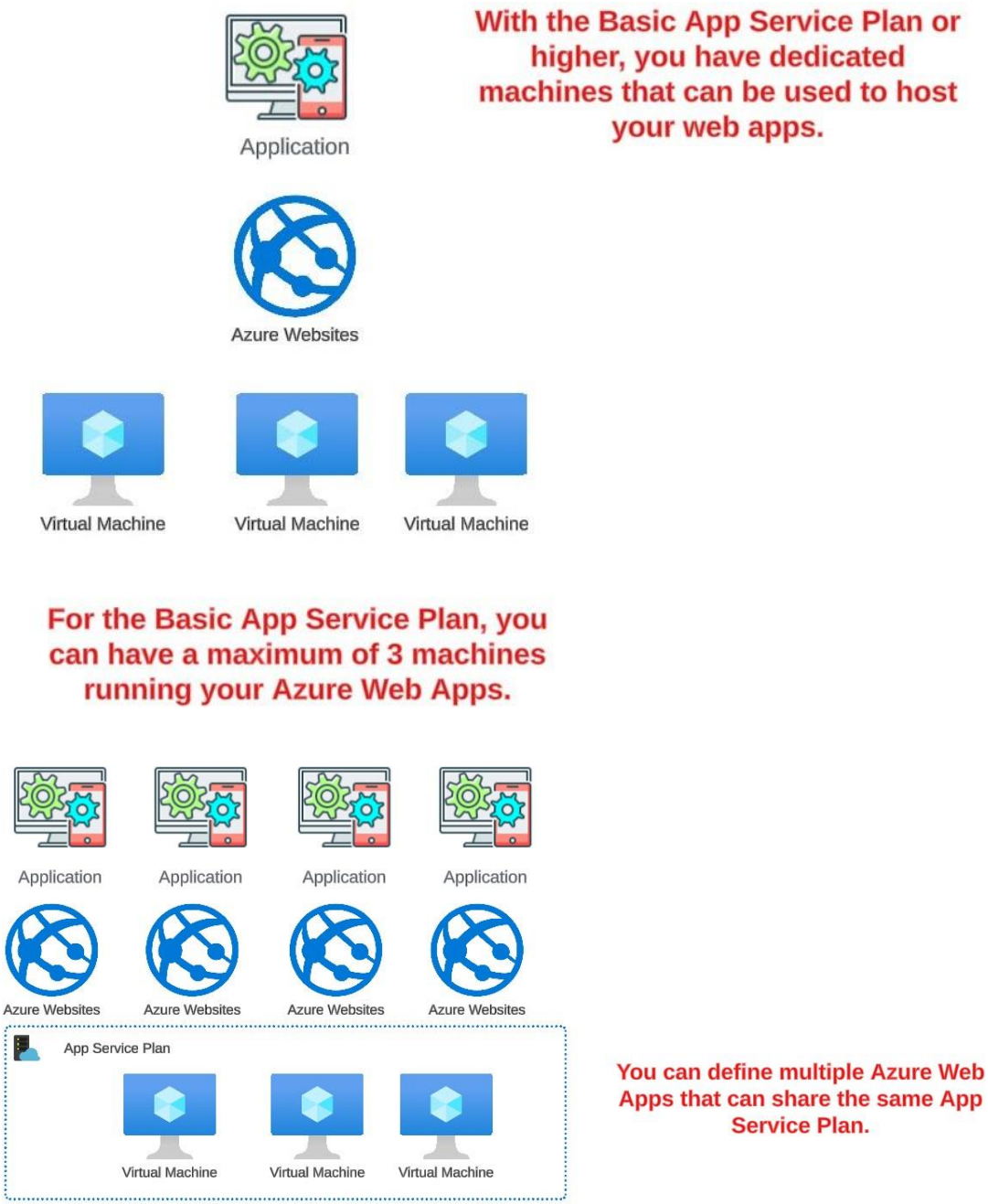
○ Hardware view ◉ Feature view

Showing 23 App Service pricing plans

	Name	Custom domain	Auto Scale	Daily backups	Staging slots	Cost per hour (instance)	Cost per month (instance)
⌄	**Dev/Test** (For less demanding workloads)						
	Free F1	-	N/A	N/A	N/A	**Free**	**Free**
	Shared D1	-	N/A	N/A	N/A	**0.013 USD**	**9.49 USD**
☑	Basic B1	✓	Manual	N/A	N/A	**0.075 USD**	**54.75 USD**
	Basic B2	✓	Manual	N/A	N/A	**0.15 USD**	**109.50 USD**
	Basic B3	✓	Manual	N/A	N/A	**0.30 USD**	**219.00 USD**
⌄	**Production** (For most production workloads)						
	Standard S1	✓	Rules	10	5	**0.10 USD**	**73.00 USD**
	Premium v3 P0V3	✓	Rules	50	20	**0.209 USD**	**152.205 USD**
	Premium v3 P1V3	✓	Rules, Elastic	50	20	**0.328 USD**	**239.44 USD**
	Premium v3 P2V3	✓	Rules, Elastic	50	20	**0.656 USD**	**478.88 USD**
	Premium v3 P3V3	✓	Rules, Elastic	50	20	**1.312 USD**	**957.76 USD**
	Premium v3 P1mv3	✓	Rules	50	20	**0.362 USD**	**263.968 USD**

LAB : Deploying a webapp on azure

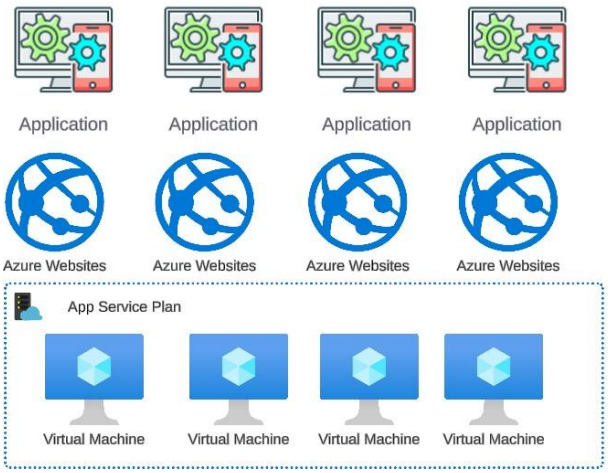
AutoScaling for your Azure Web App



With the Standard App service plan and higher, you can also configure autoscaling based on rules.

With the Premium App service plan and higher you can configure automatic scaling.

Example - Standard App Service Plan



Here we can have a maximum of 10 machines running as part of our infrastructure.

But instead of manually scaling out or scaling in, we can set rules to autoscale based on conditions.

For example, if the CPU threshold goes beyond 70%, then scale our infrastructure out by one machine. If the CPU threshold goes down, then scale down by one machine.

LAB: AUTOSCALING

Deployment Slots

Application

We have deployed our application

Azure Websites

Application v1

Now before we actually deploy the newer version of the application, we would ideally first want to test the application. At one phase, with a set of business users.

We now have a newer version of the application.

Application v1

Azure Websites - Test

1. Create a new Azure Web App
2. Deploy the newer application
3. Test the application
4. Publish the application after successful testing to the primary Azure Web App

In Azure Web Apps , we can make use of deployment slots.

Azure Websites

This feature is available with the Standard, Premium and Isolated App Service Plan.

Production - Web Slots

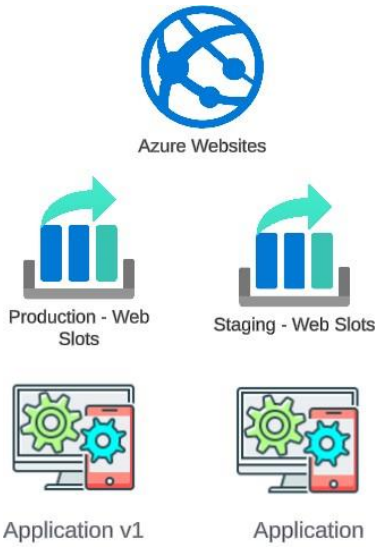
Staging - Web Slots

Create a new slot and publish the newer version of the application to the slot.

Application

Application v1

Each slot is a live web application with its own host name.



Then at any point in time, you can swap the slots. So that the newer version of the application runs as part of the production slot.

This helps in first testing of the application in the staging slot and then swapping the slots at any point in time.

It also helps in recovery from failure. If the swap succeeds , but the newer version of the application is not working, you can easily swap back at any point in time.

LAB: DEPLOYMENT SLOTS

Publishing code from a git-based repository

Normally you will have a set of developers working on an application.

During the lifecycle of the application, you can have many changes to the application itself.

For this we need to be able to maintain different versions of our application.

For this we can make use of Git which is a popular version-control software.

Git repository

We can also maintain the versions in an online repository on the Internet via the use of GitHub.

GitHub

LAB: PUBLISHING FROM GITHUB REPO using Deploymnt centre

Develop Azure compute solutions - Azure Functions

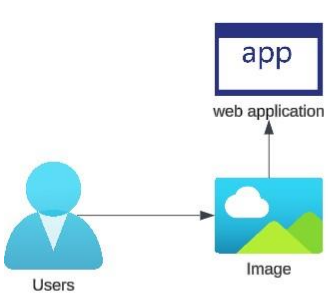
What are Azure Function Apps

This is a serverless solution where the infrastructure is managed for you.

Here the underlying compute is managed for you.

What's the purpose of using Azure Functions?

There are different use cases , let's look at a use case.



An application is hosted on an Azure Web App. The application allows users to upload images.

The application is responsible for processing the image and storing the image.

The code base would have different modules for different functionality.

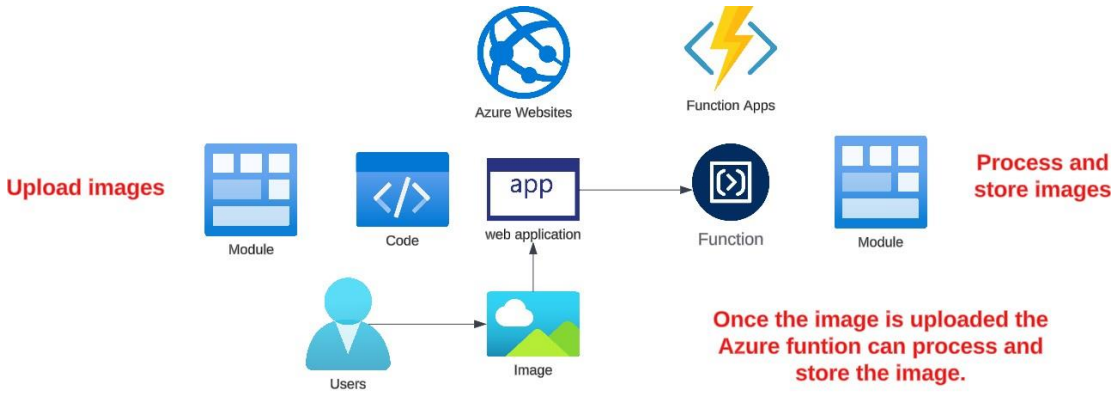
Upload images

Process and store images

The module for processing and storing the images can be in the same code base as the application.

But maybe this code module needs to be reused by other applications.

We can therefore look towards hosting that code module in Azure Functions.

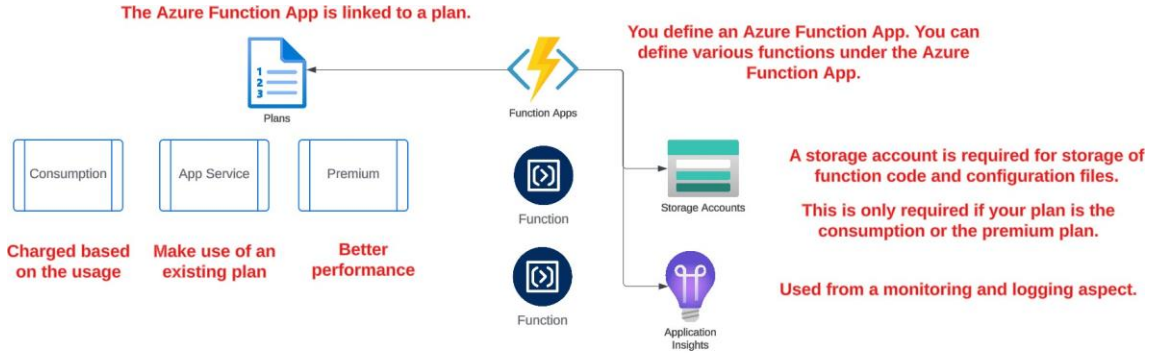


Some of the core advantages

Other applications can invoke the same Azure Function. Its now like a shared service.

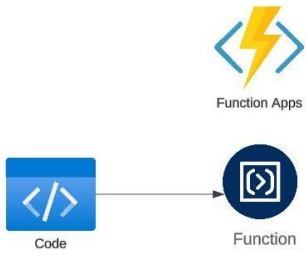
We can update and maintain the code base for Processing and storing images seperately.

Our web application can make full use of the capacity of the Azure App Service Plan just for the web application needs.



The Functions have support for languages - C#, Java, JavaScript, Python, PowerShell.

Lab - Creating a function in the portal



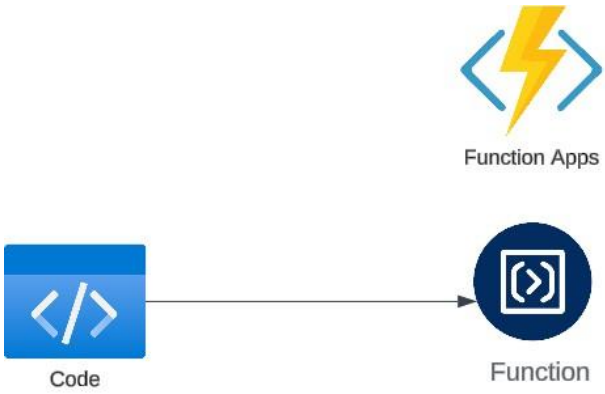
When you define a function, you specify a trigger for the function. How would the function get invoked.

Initially we will select an HTTP trigger.

```
module.exports = async function (context, req) {
    context.log('JavaScript HTTP trigger function processed a request.');

    const name = (req.query.name || (req.body && req.body.name));
    const responseMessage = name
        ? "Hello, " + name + ". This HTTP triggered function executed successfully."
        : "This HTTP triggered function executed successfully. Pass a name in the query string or in the request body for a personalized response.";

    context.res = {
        // status: 200, /* Defaults to 200 */
        body: responseMessage
    };
}
```



Here our function is based on an HTTP trigger. With the HTTP protocol a request is sent onto a destination and a response is sent back.

When sending an HTTP request, there is a method associated with the request. This helps to establish what is the type of request that is being sent across.

GET Method - This is used to request data.

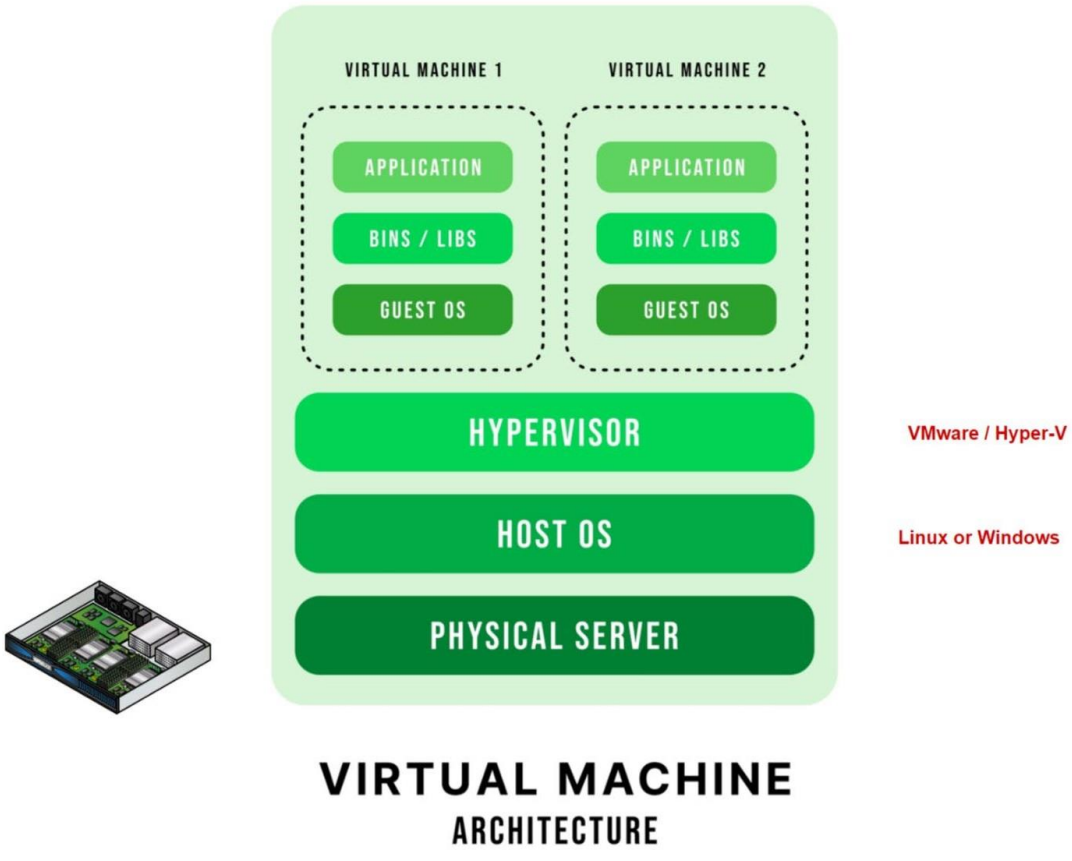
With the GET request you can pass in query string parameters.

POST Method - This is used to send data to create or update a resource.

Here you can pass data in the body of the request.

Develop Azure compute solutions - Containers

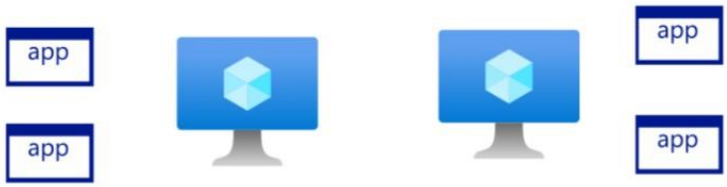
What is the need for containers



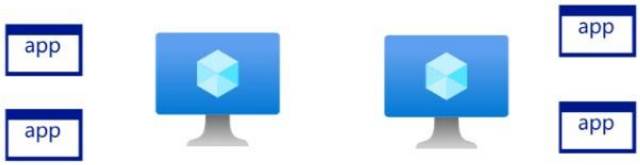
VIRTUAL MACHINE
ARCHITECTURE

Each virtual machine can make use of resources such as CPU/Memory from the underlying physical server.

Each virtual machine is isolated from each other.



Containers

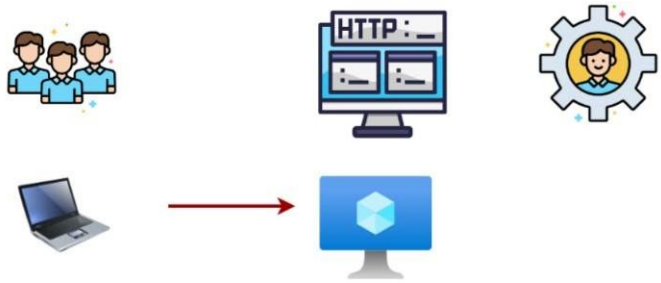


Having virtual machines was a big breakthrough

Companies could host multiple virtual machines on a physical server and make use of the server.

But then there were issues when it came to deploying applications.

Developers develop the application on their machines



When the application is deployed to a virtual machine it does not work as intended.

This could be because of differences in machine software configuration, libraries not present etc.

You have 2 applications on the same machine.

One application update requires a library/component to be installed.

This causes the other application to stop working.

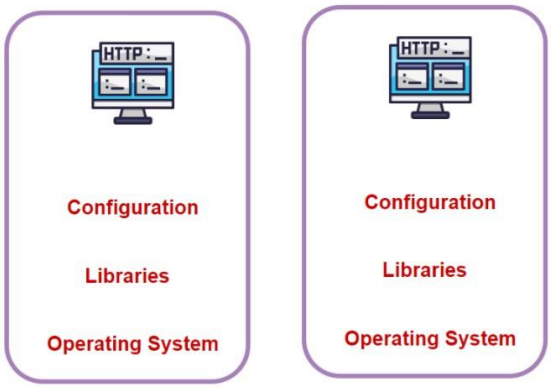
Welcome to containers

This is a unit of software that packages up all the code and dependencies that are required for the application to run.

CONTAINER
ARCHITECTURE

The underlying container will have a light-weight operating system, the application, libraries etc.

Each container runs in isolation

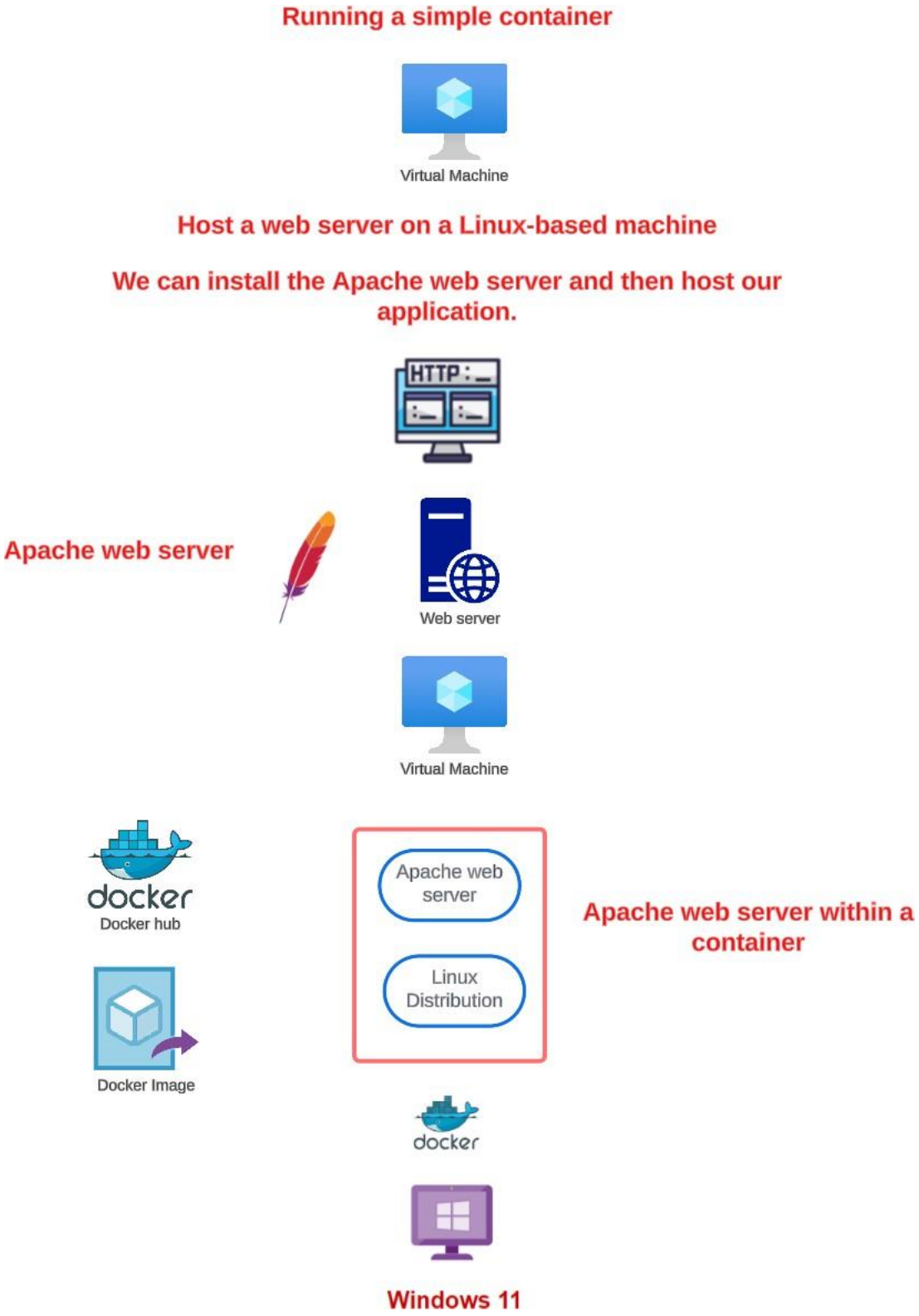


Ubuntu 20.04

Ubuntu 22.04

Ubuntu 22.04

Running a simple container

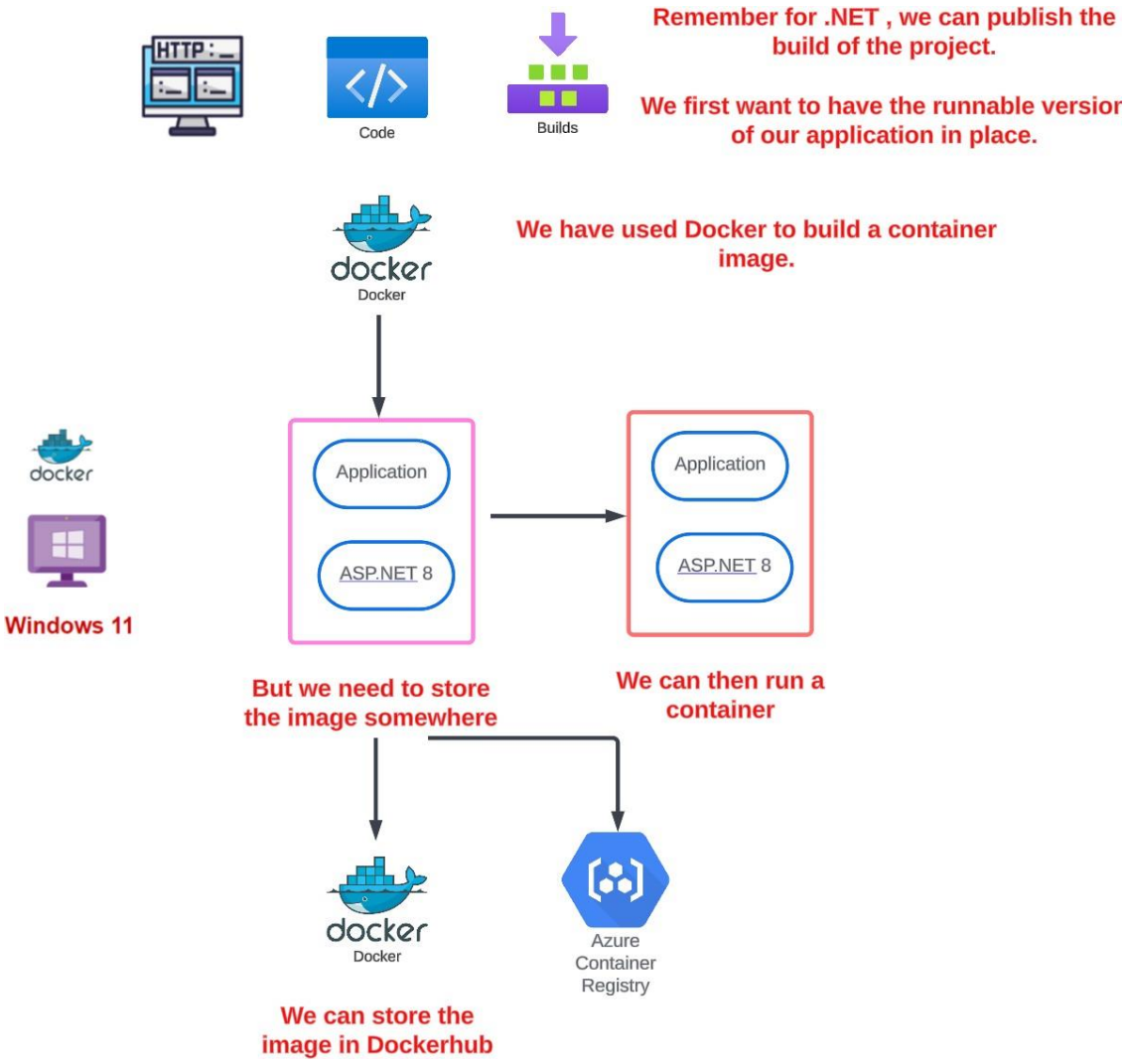


Containerizing an application

We will then create a file known as a Dockerfile and place it in the folder that has our runnable code.

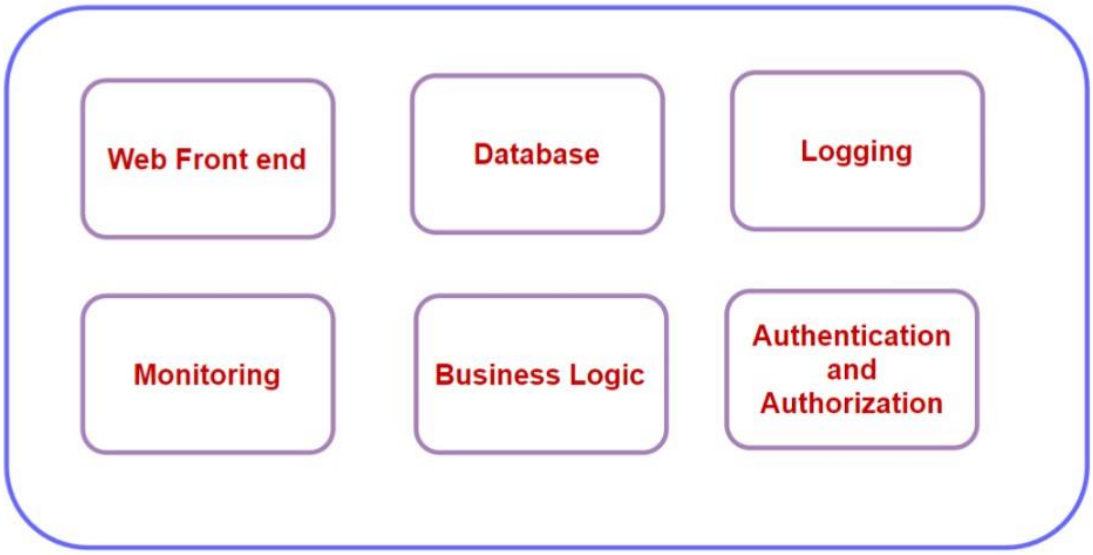
Docker can use the Dockerfile instructions to build a Docker image.

The need for a registry



What is Azure Kubernetes

Applications can be built around multiple containers.



And when a company develops multiple container-based applications, things can become complicated.

Companies can then look towards using Orchestration tools.

A popular tool when it comes to container-orchestration is Kubernetes.

It's an open source platform that is used for managing your containerized workloads and services.

Features provided

1. It can restart containers if they fail
2. You can load balance traffic across your containers.
3. You can dictate the state of the services that need to run.
4. You can mount different storage systems when it comes to persistence of data.
5. You can scale up your services whenever required.

Develop Azure compute solutions - Other tools

What are ARM templates

Test Environment

We need to rebuild the Test environment everytime a new testing cycle starts.

We want to have a repeatable and reliable way to build the resources everytime.

Templates

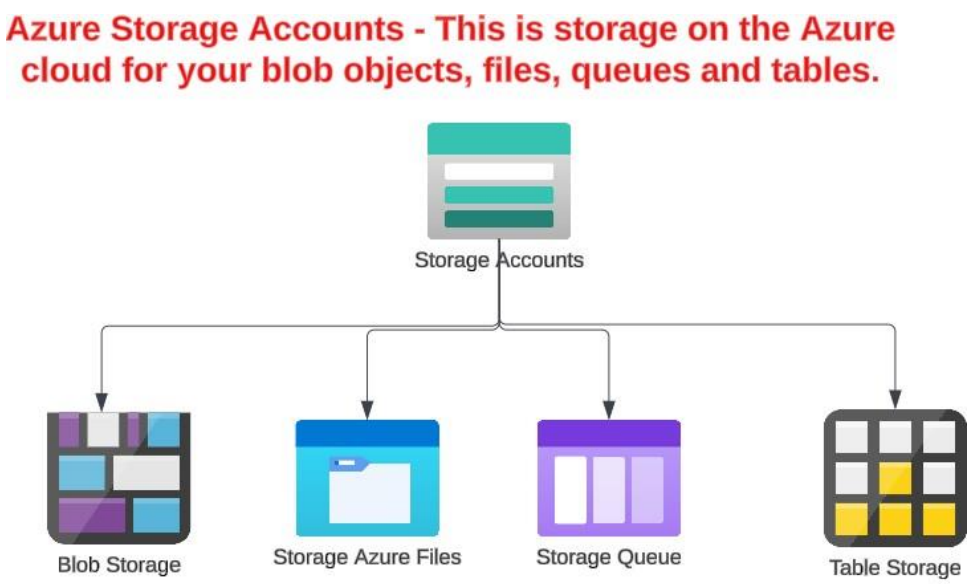
We can build an ARM (Azure Resource Manager) template that has the resources defined.

We then submit the template to Azure and the resources will be deployed accordingly.

This is also known as Infrastructure as code.

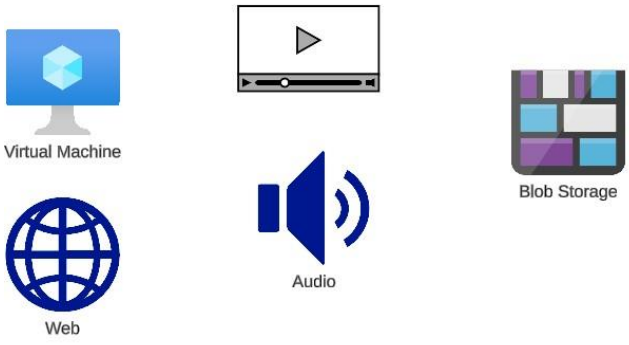
Develop for Azure Storage - Azure Storage Accounts

What are Azure S torage Accounts

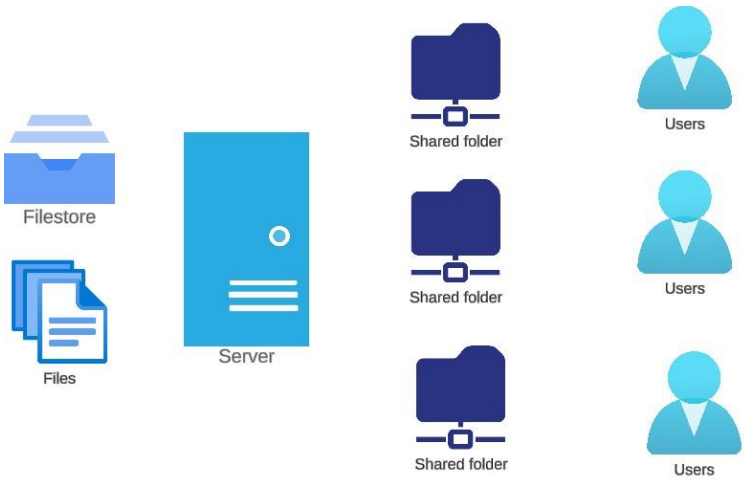


Azure Storage Accounts provides 4 services.

This is used for storing a large amount of unstructured data. Suitable for storing images, documents, video and audio files.



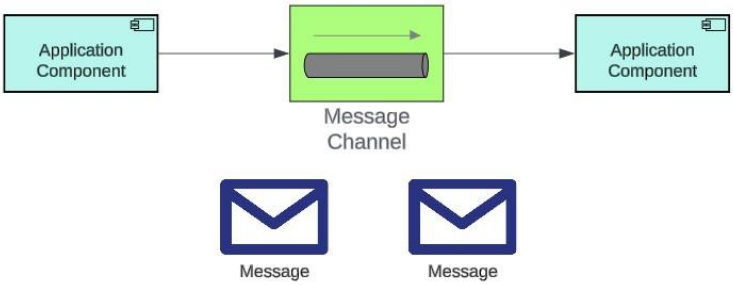
The video and audio files could be stored in an Azure storage account.



Here you need to maintain the file server and ensure enough storage is in place.

Instead you can create file shares using the Azure File share service. Here the storage is managed for you.

If messages need to be shared across multiple application components. Here you need to have the message software and maintain it.



Instead we can make use of the Queue service which provides the basic messaging service.

If an application needs to store data (non-relational structured data), like let's say data about users.

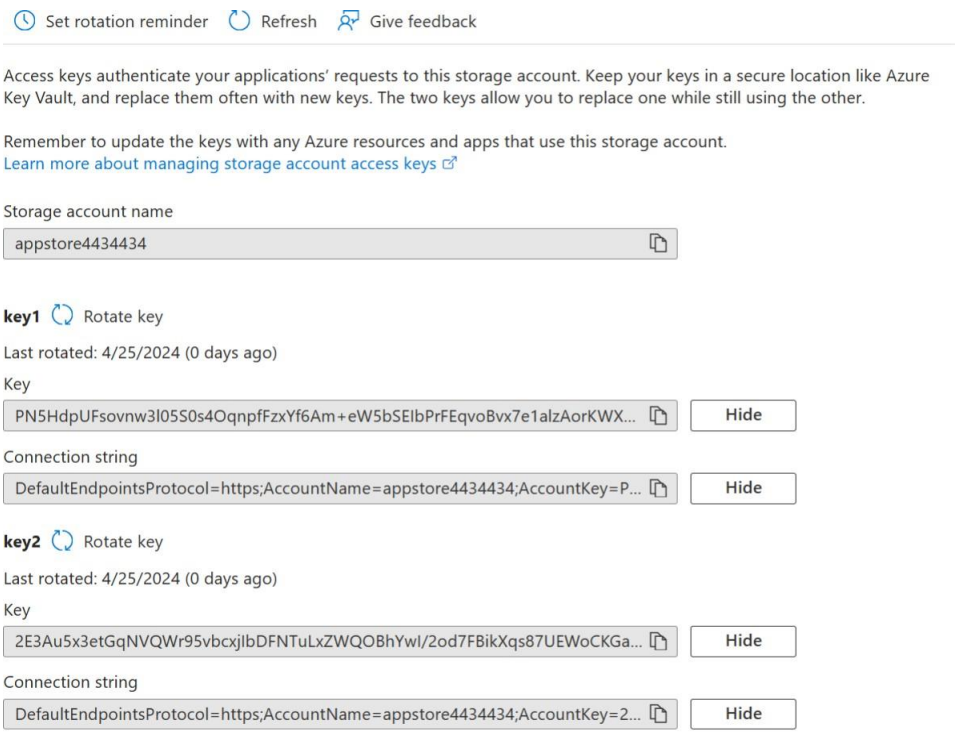
Azure Storage Accounts - Different authorization techniques

Let's say you are using an Azure Storage account to store images via the use of the Blob service.

One way to give access is to enable anonymous access. But this gives access to the Blobs at the container level.

Another broader way of giving access is via the use of Access Keys.

This gives access to all services in the storage account.



Another way of granting access is via the use of Shared Access Signatures.

Another way of granting access is via the use of Shared Access Signatures.

Here you can put more restrictions on the access - You can also grant time limited access.

Storage Accounts - Access Tiers

Storage Accounts

A company can look towards millions of objects in an Azure Storage Account.

Blob Storage

Storage Container

Files

Data storage prices pay-as-you-go	Premium	Hot	Cool	Cold	Archive
First 50 terabyte (TB) / month	$0.15 per GB	$0.018 per GB	$0.01 per GB	$0.0036 per GB	$0.00099 per GB
Next 450 TB / month	$0.15 per GB	$0.0173 per GB	$0.01 per GB	$0.0036 per GB	$0.00099 per GB
Over 500 TB / month	$0.15 per GB	$0.0166 per GB	$0.01 per GB	$0.0036 per GB	$0.00099 per GB

A company would want to monitor their storage costs.

An this can especially be the case if objects are not being used.

Storage Accounts

Blob Storage

Image

Image

A thousand images have been uploaded on a particular day. During the first week the images are being used regularly.

But after a week the images are not being accessed. Should be still pay the same when it comes to storage costs.

We can use Access tiers to help in this regard.

Hot	This is the default tier for objects. Here this is optimized for objects that are accessed frequently.
Cool	This is ideal for objects that are infrequently accessed. An object can be set to the Cool Access tier. Here the object needs to be stored for a minimum of 30 days. Here the storage costs are lower when compared with the Hot access tier, but the access costs are higher.
Cold	This is ideal for objects that are rarely accessed or modified, but you still need access to them. An object can be set to the Cool Access tier. Here the object needs to be stored for a minimum of 90 days. Here the storage costs are lower when compared with the Cool access tier, but the access costs are higher.
Archive	This is ideal for objects that are rarely accessed. And if you need to access them, you don't mind waiting for the data to be restored first. Here the data needs to be stored for a minimum of 180 days.

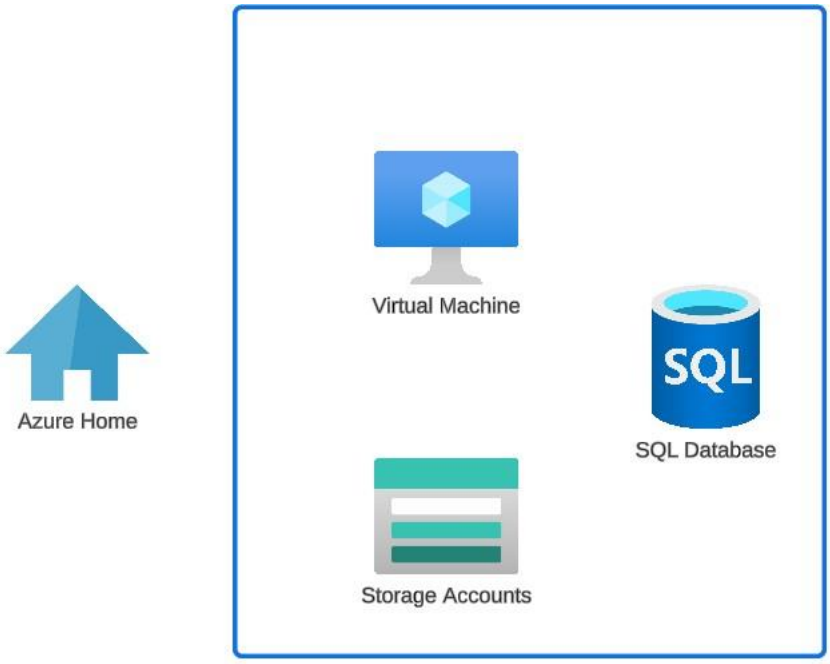
Lab :

creation of storage account and access to blobs from ui

Creating an Azure storage account
Blob service - Uploading a blob
Shared Access Signatures - At the Storage Account Level
Azure Storage Accounts - Stored Access Policy
Blob Versioning

Implement Azure security

What is Microsoft Entra ID



So far we have been working with Azure resources with our Azure Admin Account.

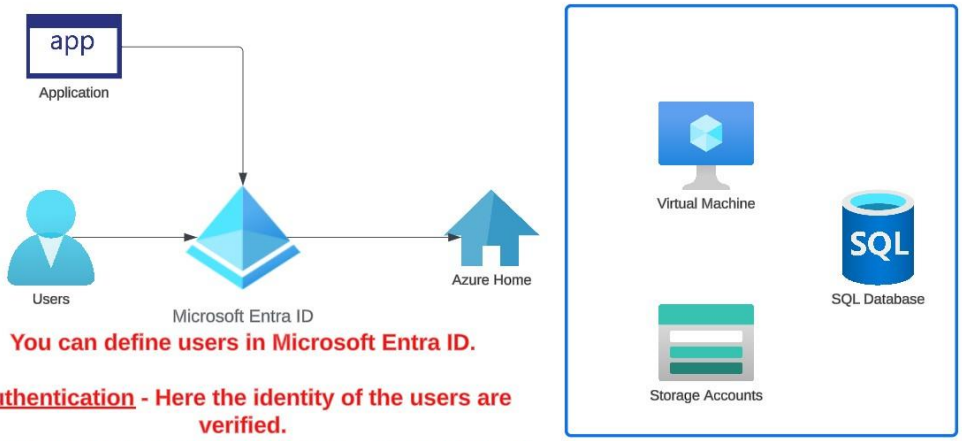
But in an organization, you want to have users who can access and manage resources.

Who has permission to create resources. Who has permission to access resources.

We need to create users and be able to assign permissions.

Microsoft Entra ID - This is a cloud-based identity and access management service. This identity service can be used for Azure, Microsoft 365 and even other Software-as-a-service applications.

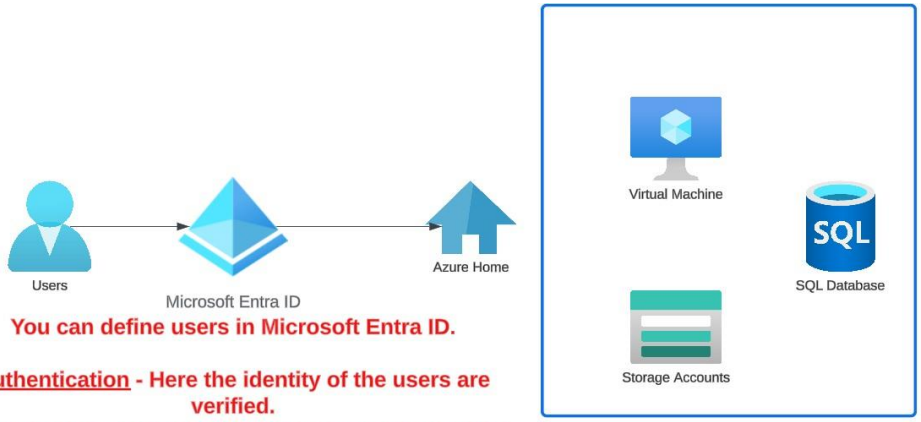
Even Applications can be linked to identities and be given access accordingly.



You can define users in Microsoft Entra ID.

Authentication - Here the identity of the users are verified.
Authorization - Here the permissions are checked for the users.

Lab - Role-based access control



You can define users in Microsoft Entra ID.

Authentication - Here the identity of the users are verified.
Authorization - Here the permissions are checked for the users.

Role

Role-based access control

We can assign different roles to a user.

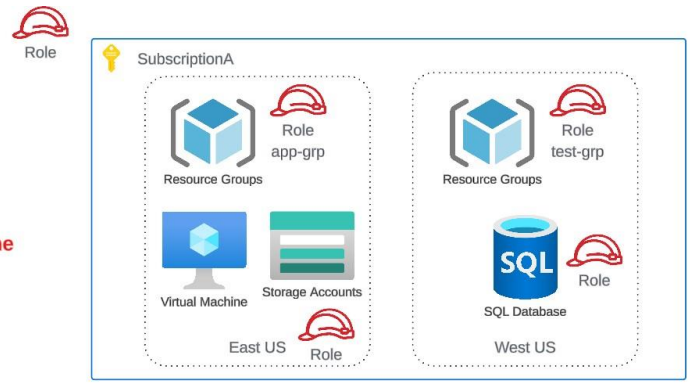
There are many in-built roles.

You can also define your own custom roles.

You can assign a role at the subscription level.

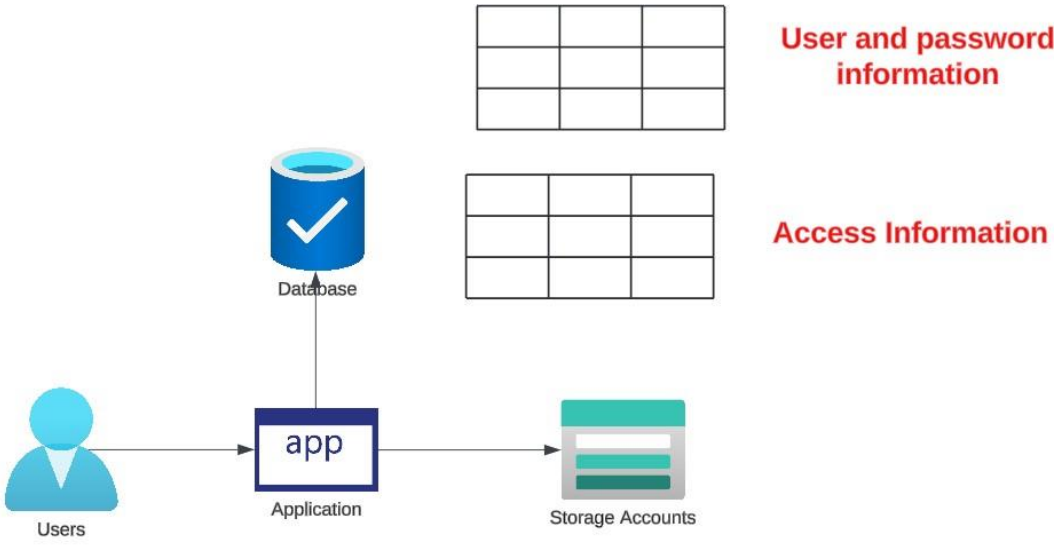
You can assign a role at the resource group level.

You can assign a role at the resource level.



Owner Role	Contributor Role	User Access Administrator Role	Reader Role
Here the user would have complete access and be able to manage the resources. The user can also delegate access to other users.	Here the user would have complete access and be able to manage the resources.	Here the user would be able to delegate access to other users.	Here the user would be just be able to read the properties for the resources.

Introduction to Application Objects

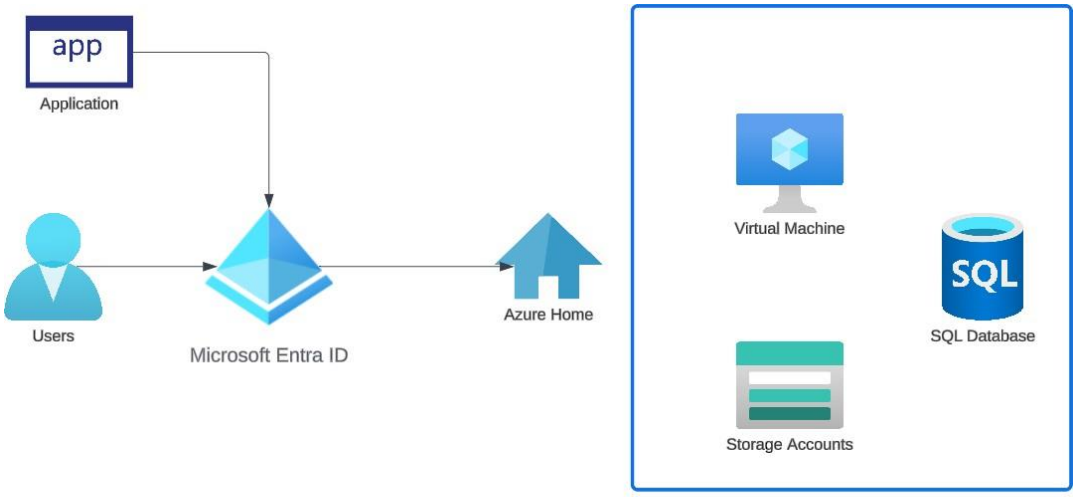


Consider an application that needs to authenticate users and authorize them to use resources on Azure.

The application would need to maintain a data store that has information for the different users and their access permissions.

The company maintaining the application would need to maintain the database of credentials , their security and the required protocols used to authenticate and authorize users.

Instead we can make use of Microsoft Entra ID as the authentication and authorization provider. We delegate these tasks to Microsoft Entra ID.



In order for the Application to use Microsoft Entra ID, it needs to be registered in Entra ID. This is done by creating an Application Object.

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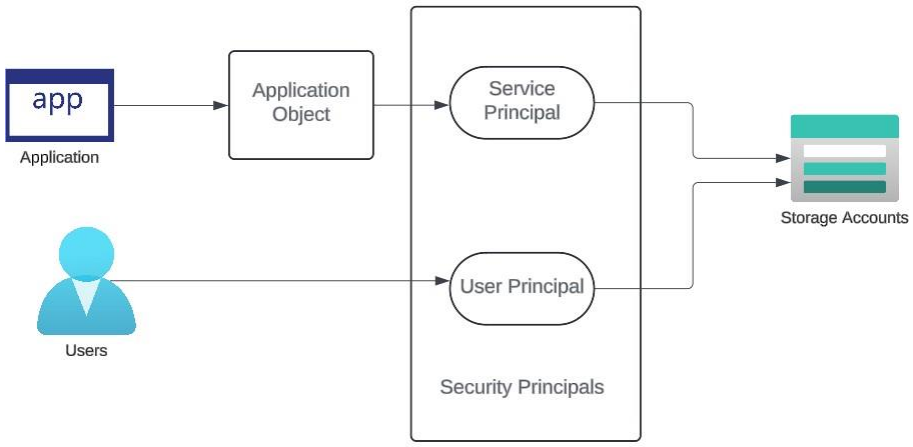


The Application Object is associated with a service principal. This principal is then given permissions to access resources.

Lab - Application Object - Blob objects

Revisit the program that was used to download a blob from a storage account in .NET

```
using Azure.Storage.Blobs;

string connectionString="DefaultEndpointsProtocol=https;AccountName=appstore4554646;AccountKey=kSDxUAJ/sBqu9GdBofHe

BlobServiceClient blobServiceClient=new BlobServiceClient(connectionString);

string containerName="scripts";
string fileName="01.sql";
string path=@"C:\tmp4\01.sql";

BlobContainerClient blobContainerClient=blobServiceClient.GetBlobContainerClient(containerName);
BlobClient blobClient=blobContainerClient.GetBlobClient(fileName);

await blobClient.DownloadToAsync(path);

Console.WriteLine("Download operation is complete");
```

At that point we used connection strings to connect to the storage account.

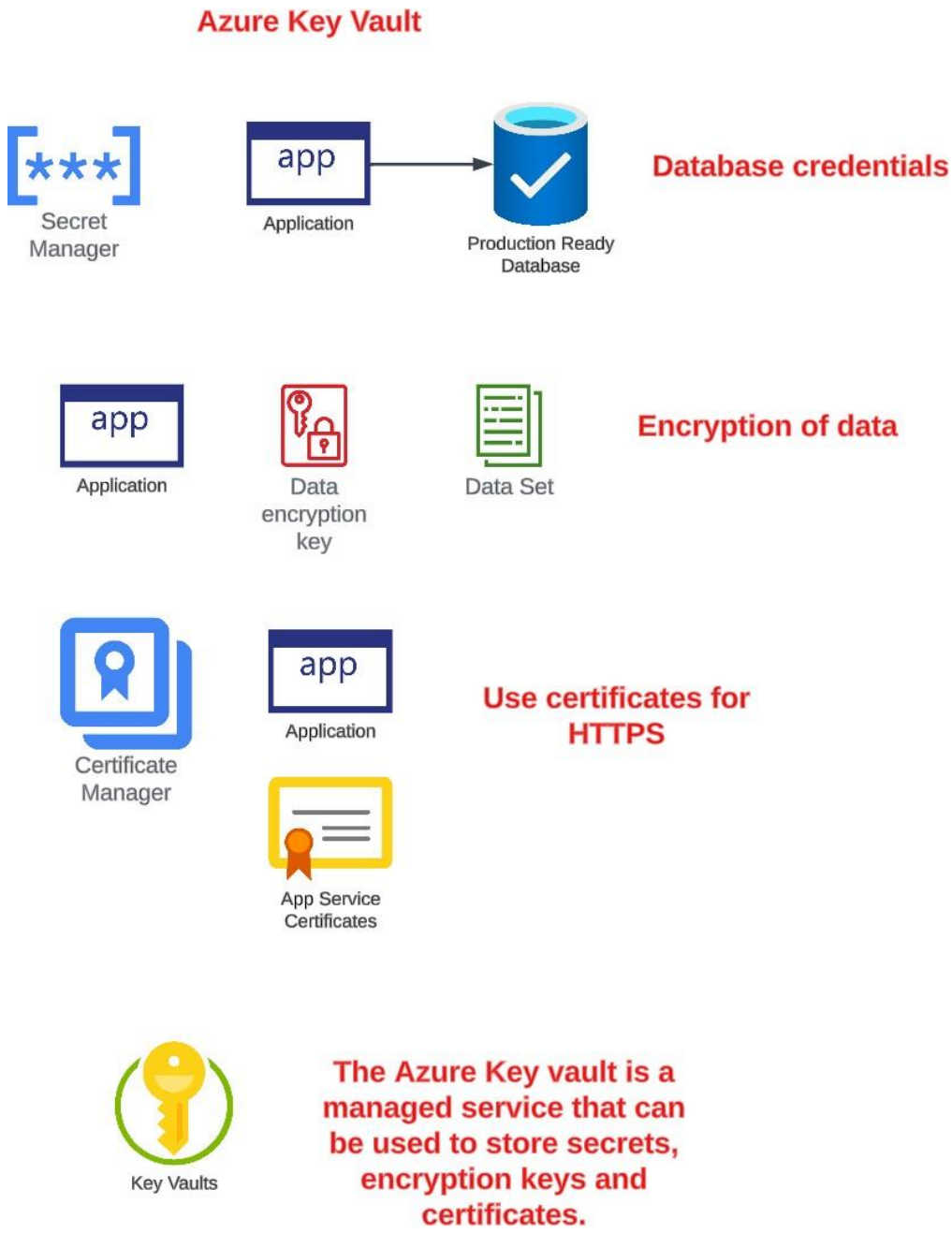
We now want to make use of an Application Object.

In Microsoft Entra ID, we will first create an Application Object.

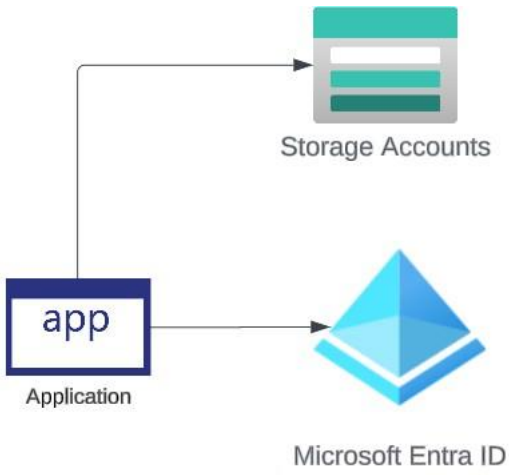
We wil give permissions for the Application Object to access our Storage Account - We will provide Role-based access to the service principal attached to the Application Ob

Then in our .NET code , we wil make the required changes to make use of the Application Object instead of the connection string.

Azure Key Vault



Managed Identities

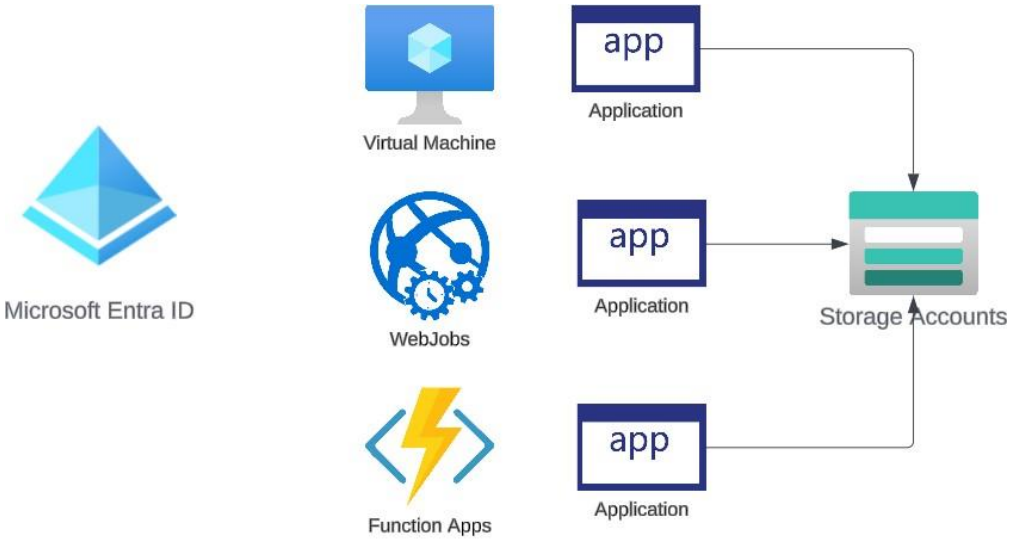


Application uses an Application Object to access an Azure Storage account

The application with the help of the in-built classes would get the required access tokens to access the storage account.

Even though we now make use of RBAC, we still need to embed the credentials of the Application Object in our code.

You can make use of Managed Identities. This gives a way for applications to authenticate to Azure resources without the need of embedding credentials.



Your application could be hosted on a service that supports managed identities.

The managed identity for the resource can be registered in Microsoft Entra ID. This would create a service principal for that resource.

You can then provide RBAC access for that service principal onto the resource. And in your code you don't embed any sort of credentials.

We will look into an example of having an application hosted on a Virtual Machine that is accessing the blob service.