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Adopting Azure Cloud Platform

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Abstract

This white paper aims to provide organisations with an insight to adopting the Azure cloud platform. While Azure and AWS are leading cloud platform providers offering comparable services, this document focuses on key features of Azure and assisting organisations in adopting Azure beyond just technical considerations, but also from different business perspectives such as cost, compliance and scalability. It assumes prior familiarity with cloud platform providers like AWS or GCP.

This paper is intended as guidance to implementing Azure. focusing on its key features and how organisations can best leverage Azure's capabilities. It does not cover the migration from another cloud provider to Azure.

1. History of Azure

Azure was first introduced on October 28, 2008, under the name Windows Azure. The development of Azure began as an internal project known as “Project Red Dog,” which aimed to create a cloud-based operating system.

Windows Azure was initially offered as a Platform as a Service (PaaS) solution, allowing developers to run their ASP.NET web applications and APIs.

1.1 First Generation – Red Dog and Windows OS for the Internet

In its initial release, Azure provided developers with the ability to run ASP.NET web applications and APIs, along with worker roles for background processing.

Azure also introduced SQL Azure, a relational database service that offered high availability, scalability, and security for mission-critical applications.

Azure's first-generation offerings also included a content delivery network (CDN) for efficient distribution of web content, as well as a service bus for reliable messaging between distributed applications.

These initial services provided a solid foundation for Azure to grow into a complete cloud platform that offers a diverse range of tools and services suitable for businesses of any size.

1.2 Second Generation – Embracing OSS and The Shift to IaaS

Microsoft renamed Azure to Microsoft Azure to better reflect its focus on enterprise customers.

Microsoft transformed Azure from a primarily Platform-as-a-Service (PaaS) offering to a more flexible Infrastructure-as-a-Service (IaaS) model, providing customers with more control over their virtual machines (VMs) and networking.

With the introduction of Azure Virtual Machines, customers could now run Windows and Linux VMs in the cloud, providing greater flexibility and compatibility with their existing IT infrastructure.

The second generation of Azure introduced the building blocks for cloud-based applications and services. It allowed support for containerisation, serverless computing, and microservices architecture, which simplified the process of deploying and managing cloud applications.

1.3 Third Generation – Sailing the Big Data, Analytics and IoT Wave

Azure continued to evolve with a focus on big data, artificial intelligence, and the Internet of Things (IoT).

Azure introduced a range of big data services, including Azure HDInsight for Apache Hadoop and Spark clusters, and Azure Data Lake Storage for scalable data storage and analytics.

Azure Machine Learning (AML) was introduced, enabling users to build, train, and deploy machine learning models at scale.

The third generation of Azure also saw the introduction of Azure IoT Hub, a fully managed service for bi-directional communication between IoT devices and the cloud, as well as Azure Sphere, a comprehensive security solution for IoT devices.

1.4 Fourth Generation – Intelligent Cloud and Intelligent Edge

Azure made significant steps in machine learning (ML) and artificial intelligence (AI) capabilities, with the introduction of services like Azure Machine Learning and Cognitive Services.

Azure Machine Learning offers a cloud-based platform for building, training, and deploying machine learning models, while Azure Cognitive Services offers ready-to-use application programming interfaces (APIs) that cater to various tasks such as processing natural language, and computer vision, as well as recognizing speech.

1.5 The Present and Beyond

Azure's strength is its support for Kubernetes through AKS, providing a scalable platform for containerised apps.

Azure's success is due to its flexible and scalable cloud platform, offering a range of services from PaaS, Infrastructure as a Service (IaaS) to Software as a Service (SaaS) to help businesses modernise their IT and drive innovation.

2. What is IaaS, PaaS, SaaS

2.1 IaaS

Infrastructure as a Service is a cloud computing model that offers infrastructure resources such as compute, networking, and storage on a pay-as-you-go basis.

IaaS allows businesses to scale up or down resources as needed and pay only for what they use, without having to invest in physical hardware.

2.2 Paas

Platform as a Service is a cloud computing model that provides a complete stack for developing, testing, deploying, and managing applications on a pay-as-you-go basis

PaaS includes infrastructure resources, such as computing and storage, as well as development tools, databases, middleware, and other components needed to build and run applications. With PaaS, businesses can avoid managing complex architecture and focus on building applications, as the platform takes care of the underlying infrastructure while providing the flexibility to pay for resources only as they are used.

2.3 SaaS

Software as a Service is a cloud computing model that provides complete software solutions over the internet.

SaaS is pay-as-you-go, allowing businesses to access software on a subscription basis without having to purchase or manage hardware and software.

The cloud platform manages the hardware and software, ensuring that businesses always have access to the latest software and updates.

3. Cloud Platform Market Share

AWS and Azure are the two leading cloud platforms, having 55% combined market share. AWS has a 33% market share in 2022 and has been growing 34% annually over last 2 years. Azure has a 22% market share in 2022, growing by 24% in 2022. The other main player, GCP, has a 10% market share in 2022.

4. Azure Services

4.1 Azure Region

Azure regions and availability zones are designed to ensure reliability for business-critical workloads. Azure operates in various geographical locations, each with its own distinct boundaries. These boundaries play a crucial role in defining disaster recovery strategies and ensuring compliance with data residency requirements in one or more Azure regions. By maintaining multiple regions, Azure ensures that customers receive comprehensive support and coverage across the globe. As per February 2023, As of February 2023, there are around 80 Azure regions listed below:

	Display Name	Name	Regional Display Name
1	East US	eastus	(US) East US
2	East US 2	eastus2	(US) East US 2
3	South Central US	southcentralus	(US) South Central US
4	West US 2	westus2	(US) West US 2
5	West US 3	westus3	(US) West US 3
6	Australia East	australiaeast	(Asia Pacific) Australia East
7	Southeast Asia	southeastasia	(Asia Pacific) Southeast Asia
8	North Europe	northeurope	(Europe) North Europe
9	Sweden Central	swedencentral	(Europe) Sweden Central

10	UK South	uksouth	(Europe) UK South
11	West Europe	westeurope	(Europe) West Europe
12	Central US	centralus	(US) Central US
13	South Africa North	southafricanorth	(Africa) South Africa North
14	Central India	centralindia	(Asia Pacific) Central India
15	East Asia	eastasia	(Asia Pacific) East Asia
16	Japan East	japaneast	(Asia Pacific) Japan East
17	Korea Central	koreacentral	(Asia Pacific) Korea Central
18	Canada Central	canadacentral	(Canada) Canada Central
19	France Central	francecentral	(Europe) France Central
20	Germany West Central	germanywestcentral	(Europe) Germany West Central
21	Norway East	norwayeast	(Europe) Norway East
22	Switzerland North	switzerlandnorth	(Europe) Switzerland North
23	UAE North	uaenorth	(Middle East) UAE North
24	Brazil South	brazilsouth	(South America) Brazil South
25	Central US EUAP	centraluseuap	(US) Central US EUAP
26	East US 2 EUAP	eastus2euap	(US) East US 2 EUAP
27	Qatar Central	qatarcentral	(Middle East) Qatar Central
28	Central US (Stage)	centralusstage	(US) Central US (Stage)
29	East US (Stage)	eastusstage	(US) East US (Stage)

30	East US 2 (Stage)	eastus2stage	(US) East US 2 (Stage)
31	North Central US (Stage)	northcentralusstage	(US) North Central US (Stage)
32	South Central US (Stage)	southcentralusstage	(US) South Central US (Stage)
33	West US (Stage)	westusstage	(US) West US (Stage)
34	West US 2 (Stage)	westus2stage	(US) West US 2 (Stage)
35	Asia	asia	Asia
36	Asia Pacific	asiapacific	Asia Pacific
37	Australia	australia	Australia
38	Brazil	brazil	Brazil
39	Canada	canada	Canada
40	Europe	europe	Europe
41	France	france	France
42	Germany	germany	Germany
43	Global	global	Global
44	India	india	India
45	Japan	japan	Japan
46	Korea	korea	Korea
47	Norway	norway	Norway
48	Singapore	singapore	Singapore
49	South Africa	southafrica	South Africa

50	Switzerland	switzerland	Switzerland
51	United Arab Emirates	uae	United Arab Emirates
52	United Kingdom	uk	United Kingdom
53	United States	unitedstates	United States
54	United States EUAP	unitedstateseuap	United States EUAP
55	East Asia (Stage)	eastasiastage	(Asia Pacific) East Asia (Stage)
56	Southeast Asia (Stage)	southeastasiastage	(Asia Pacific) Southeast Asia (Stage)
57	Brazil US	brazilus	(South America) Brazil US
58	East US STG	eastusstg	(US) East US STG
59	North Central US	northcentralus	(US) North Central US
60	West US	westus	(US) West US
61	Jio India West	jioindiawest	(Asia Pacific) Jio India West
62	devfabric	devfabric	(US) devfabric
63	West Central US	westcentralus	(US) West Central US
64	South Africa West	southafricawest	(Africa) South Africa West
65	Australia Central	australiacentral	(Asia Pacific) Australia Central
66	Australia Central 2	australiacentral2	(Asia Pacific) Australia Central 2
67	Australia Southeast	australiasoutheast	(Asia Pacific) Australia Southeast
68	Japan West	japanwest	(Asia Pacific) Japan West
69	Jio India Central	jioindiacentral	(Asia Pacific) Jio India Central

70	Korea South	koreasouth	(Asia Pacific) Korea South
71	South India	southindia	(Asia Pacific) South India
72	West India	westindia	(Asia Pacific) West India
73	Canada East	canadaeast	(Canada) Canada East
74	France South	francesouth	(Europe) France South
75	Germany North	germanynorth	(Europe) Germany North
76	Norway West	norwaywest	(Europe) Norway West
77	Switzerland West	switzerlandwest	(Europe) Switzerland West
78	UK West	ukwest	(Europe) UK West
79	UAE Central	uaecentral	(Middle East) UAE Central
80	Brazil Southeast	brazilsoutheast	(South America) Brazil Southeast

4.2 Compute

4.2.1 Azure VM

Azure virtual machines are an on-demand, scalable computing resource that can be used for various purposes, such as development and test, applications in the cloud, and extended data centre. They provide the flexibility of virtualization without having to buy and maintain physical hardware, but still need to be maintained. Microsoft Azure supports Linux and Windows distributions.

Design considerations for virtual machines in Azure include resource names, location, size, number of virtual machines, operating system, configuration, and related resources.

There are multiple options to manage the availability of an organization's virtual machines in Azure. They are Availability Zone and Virtual Machine Scale Set.

Availability Zones guarantee virtual machine connectivity to at least one instance 99.99% of the time, while Virtual Machine Scale Sets create and manage a group of load balanced virtual machines. Scale sets provide high availability and can be deployed into multiple availability zones or regionally.

Location specifies where virtual hard disks will be stored when creating Azure resources. This table shows some of the ways an organization can get a list of available locations.

Method	Description
Azure Portal	Select a location from the list when you create a virtual machine.
Azure PowerShell	Use the Get-AzLocation command.
REST API	Use the List locations operation.
Azure CLI	Use the az account list-locations operation

Azure offers a variety of sizes to support many types of uses and charges an hourly price based on size and operating system. Limits can be raised by filing a support ticket.

Managed Disks handle Azure Storage account creation and management, ensuring scalability limits are met. Once the disk size and performance tier has been determined, Azure will create and manage the disk. An unmanaged virtual machine could be converted to be backed with a managed disk.

4.2.2 Azure VM

Azure App Service is an HTTP-based service designed for hosting web applications, REST APIs, and mobile back ends. It adds Microsoft Azure's security, load balancing, autoscaling, and automated management capabilities, as well as DevOps capabilities.

Azure App Service is a fully managed PaaS offering for developers with multiple languages and frameworks, managed production environment, containerization and Docker, DevOps optimization, global scale with high availability, and connections to SaaS platforms and on-premises data.

Azure provides support for **ASP.NET, ASP.NET Core, Java, Ruby, Node.js, PHP,** or **Python.** It offers a wide range of services for hosting websites and web applications, including App Service, Azure Virtual Networks, Hybrid Connections, Security and Compliance, Application Templates, Visual Studio and Visual Studio Code integration, API and mobile features, Serverless Code with Azure Functions, and Azure Virtual Machines. Azure's App Service is the best choice for most scenarios.

App Service can host web apps natively on Linux. App Service on Linux supports language specific built-in images for Node.js, Java, PHP, Python, .NET Core, and Ruby. Outdated runtimes are hidden from the Portal when they are deprecated or have significant vulnerabilities. To create another web app with an outdated runtime, use the Azure CLI or export an ARM template.

App Service on Linux is not supported on the Shared pricing tier, but the features are activated on the portal. It offers a custom container option designed for heavy read-only access to content files.

App Service Environments provide high scale, isolation, secure network access, memory utilization, and RPS for stateless applications with a high RPS requirement. Customers have fine-grained control over network traffic and secure connections.

App Service Environments can be used for internal line-of-business applications, single-tenant systems, network-isolated application hosting, and multi-tier applications. Networking features are enabled at the application level and can be deployed on dedicated hardware.

An App Service Environment is a single-tenant deployment of Azure App Service that runs on a virtual network. It can have up to 200 total App Service plan instances and up to 100 instances by itself. When deployed on dedicated hardware, it has 132 vCores available.

The App Service Environment feature is a deployment of the Azure App Service into a single subnet on a virtual network. The number of addresses used by an App Service Environment v3 in its subnet will vary depending on the number of instances and the amount of traffic. The recommended size for an App Service Environment v3 subnet is a /24 Classless Inter-Domain Routing (CIDR) block with 256 addresses. The apps in an App Service Environment don't need any features enabled to access resources on the same virtual network, and traffic can be blocked by user configuration on the network.

An App Service Environment has three versions:

- App Service Environment v1,
- App Service Environment v2, and
- App Service Environment v3. **(current version)**

App Service Environment v3 is an alternative to earlier versions of the Windows Small App Service plan. It allows for no networking dependencies on the customer's virtual network, zone redundancy, faster scaling, front-end scaling adjustments, and access to apps across global peering. It also has a dedicated host group, is no zone redundant, and only one scale operation can be in effect for a combination of OS and size. Additionally, it allows users to perform backup operations on a storage account behind a firewall and access the FTPS endpoint using a custom domain suffix.

The pricing model for App Service Environment v3 varies depending on the type of deployment. There are three pricing models: App Service Environment v3, Zone Redundant v3, and Dedicated Host v3. Reserved Instance pricing is available for Isolated v2. Pricing is available at App Service pricing under the Isolated v2 plan.

App Service Environment v3 is available mostly in all regions. The details can be found in here.

4.2.3 Azure Functions

Azure Functions is a serverless offering that enables organizations to reduce code complexity, minimize infrastructure management, and achieve cost savings. It provides up-to-date resources to keep applications running, allowing developers to focus on their code.

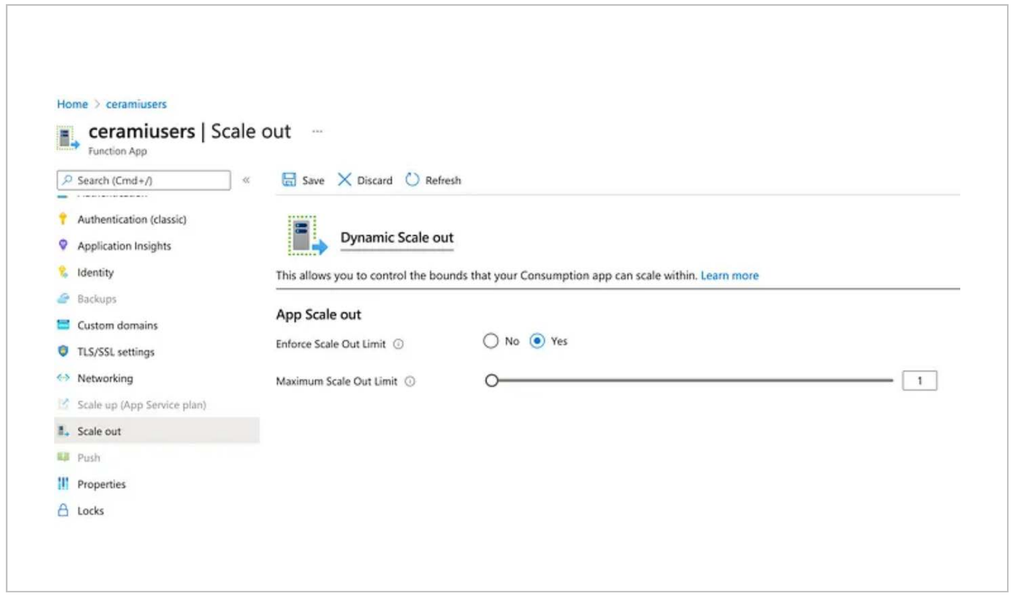
It provides “compute on-demand” that allows the system’s logic to be implemented into readily available blocks of code. The compute resource will be provided as needed to meet the application’s demand. With this approach user doesn’t have to maintain the server infrastructure.

The Function app can be built in a variety of languages such as C#, Java, JavaScript, PowerShell, Python and TypeScript, and can be deployed in a variety of ways:

- Tool-Based: Visual Studio Code Publish, Visual Studio Publish and Core Tools Publish
- App Service-Managed: Deployment Center (CI/CD) and Container Deployment
- External Pipelines: Azure Pipelines and GitHub Actions

To support troubleshooting, Azure provides the Azure monitor.

Choose a hosting plan to determine how our organization's function app is scaled, resources available, and support for advanced functionality. There are 3 basic hosting plans : Consumption Plan, Premium Plan and Dedicated (App Service) plan. Azure funcation can be scale out dynamically via Azure Portal:



4.3 Database

4.3.1 Azure SQL

Azure SQL is a family of managed, secure, and intelligent products that use the SQL Server database engine in the Azure cloud. Azure SQL Database supports modern cloud applications, Azure SQL Managed Instance modernizes existing SQL Server applications, and SQL Server on Azure VMs lift-and-shift workloads.

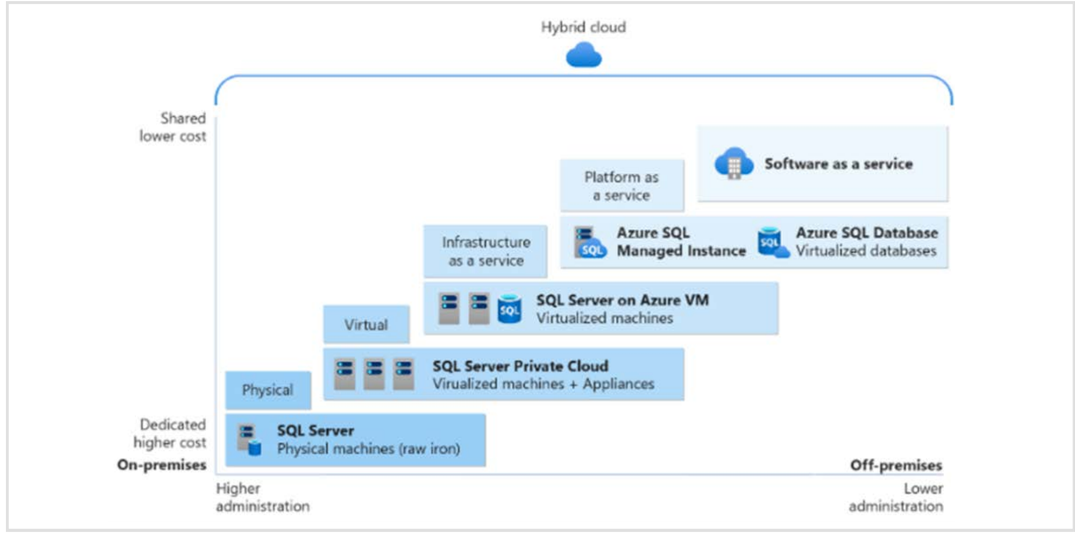
Microsoft's data platform leverages SQL Server technology and makes it available across physical on-premises machines, private cloud environments, third-party hosted private cloud environments, and the public cloud, allowing developers to modernize and develop apps.

Azure SQL provides real-time threat detection, multi-layered security controls, and comprehensive compliance coverage.

Data offerings include platform as a service (PaaS) and infrastructure as a service (IaaS). IaaS enables an organization to shut down resources while not using them, while PaaS is always running unless an organization decides to drop and re-create their resources when needed.

PaaS options reduce the amount of time needed to administer the database but limits the range of custom administration tasks and scripts. IaaS guarantees 99.99% SLA, while PaaS guarantees 99.95% SLA.

Time to migrate to Azure is no different from moving databases from one on-premise server to another. However, it will depend on the database size and the number of objects in the database. For example, it takes less than 3 minutes to migrate the database of 2 GB -1–2 minutes are used for the validation phase (prior to migration) and less than 15 seconds for the migration phase.



As seen in the diagram above, each service offering can be characterized by the level of administration an organization has over the infrastructure, and by the degree of cost efficiency. The key question when deciding between PaaS or IaaS is whether to manage our organization database, apply patches, and take backups, or delegate these operations to Azure.

Azure SQL Database is a database service provided by Azure that follows the model of Database-as-a-Service (DBaaS) and belongs to the Platform-as-a-Service (PaaS) category in the industry. It has two deployment options: as a single database with its own set of resources managed via a logical SQL server, or as an elastic pool, which is a collection of databases with a shared set of resources managed via a logical server.

Azure SQL Managed Instance is a Platform-as-a-Service (PaaS) solution that offers complete SQL Server access and feature compatibility, making it an ideal choice for migrating SQL Servers to Azure. It is similar to an instance of the Microsoft SQL Server database engine, offering shared resources and additional features.

SQL Server on Azure VM is an Infrastructure-as-a-Service (IaaS) that allows users to run SQL Server inside a fully managed virtual machine (VM) in Azure. It offers full administrative control over the SQL Server instance and underlying OS for migration to Azure, as well as full control over the database engine. It is ideal for migrating existing applications to Azure or extending existing on-premises applications to the cloud in hybrid deployments, as well as for developing and testing traditional SQL Server applications.

SQL Database and SQL Managed Instance are optimized to reduce overall management costs and increase the number of databases managed by a single IT or development resource. Elastic pools support SaaS multi-tenant application architectures, while SQL Server on Azure VMs provide DBAs with an on-premises environment.

SQL Database and SQL Managed Instance are sold as a service with several options and service tiers. With SQL Database, an organization can choose a service tier and create elastic pools to reduce costs. With an SQL Managed Instance, an organization can bring their own license and bill for outgoing Internet traffic. Additionally, the database software is automatically configured, patched, and upgraded by Azure, reducing administration costs. SQL on Azure VMs provide cost savings by allowing users to use any of the platform-provided SQL Server images or bring their own license. Operational costs depend on VM size and edition, with per-minute licensing cost and outgoing Internet traffic billed at regular data transfer rates.

Azure offers a variety of cloud services to offload complexity of administration and cost. With IaaS and PaaS, Azure administers the infrastructure, replicates data, configures and upgrades database software, manages load balancing, and does transparent failover. With SQL on Azure VM, an organization has full control over the operating system and SQL Server instance configuration. Automated features simplify patching, backup, and high availability.

Microsoft provides an availability SLA of 99.99% for Azure SQL Database and Azure SQL Managed Instance, and 99.95% for two virtual machines in an availability set or 99.99% for two virtual machines in different availability zones for SQL on Azure VM.

Azure SQL Database, Azure SQL Managed Instance, and SQL on Azure VM are all great solutions for cloud-designed applications. SQL Database and Managed Instance reduce the need for managing the underlying operating system and database, while SQL on Azure VM saves time and budget on re-architecting existing solutions.

4.3.2 Azure Cosmos

Azure Cosmos DB is a fully managed NoSQL and relational database for modern app development. It offers single-digit millisecond response times, automatic and instant scalability, guaranteed speed at any scale, SLA-backed availability and enterprise-grade security. App development is faster and more productive thanks to open-source APIs and SDKs.

It provides high-availability, high-throughput, low-latency, and tuneable consistency to build IoT, retail, gaming, and web/mobile applications.

Azure Cosmos Key Benefits:

Guaranteed speed at any scale
Gain unparalleled SLA-backed speed and throughput, fast global access, and instant elasticity.

Simplified application development
Build fast with open-source APIs, multiple SDKs, schemeless data and no-ETL analytics over operational data. Integration with Azure services such as Functions, IoT Hub, AKS, App Service, and more.

Mission – Critical Ready
Azure Cosmos DB offers SLAs, replication, encryption, and role-based access control to ensure business continuity and security.

Fully Managed and Cost – Effective
End-to-end database management with serverless and automatic scaling for unpredictable or sporadic workloads, saves developers time and money.

Azure Synapse Link for Azure Cosmos DB
Azure Synapse Link for Azure Cosmos DB enables near real-time analytics over operational data, with no ETL jobs to manage, optimized for large-scale analytics workloads.

4.4 Networking

4.4.1 Azure VNet

Azure Virtual Network enables Azure resources to securely communicate with each other, the internet, and on-premises networks, providing scale, availability, and isolation.

Key scenarios that an organization can accomplish with a virtual network include:

Communication of Azure resources with the internet
Virtual networks can communicate inbound and outbound to the internet.

Communication between Azure resources
Azure resources communicate securely with each other in one of the following ways:

- Through a virtual network
- Through a virtual network service endpoint
- Through virtual network peering

Communication with on-premises resources
An organization can connect their on-premises computers and networks to a virtual network using any of the following options:

- Point-to-site virtual private network (VPN)
- Site-to-site VPN
- Azure ExpressRoute

Filtering network traffic
An organization can filter network traffic between subnets using either or both of the following options:

- Network security groups
- Network virtual appliances

Routing network traffic
Azure routes traffic between subnets, connected virtual networks, on-premises networks, and the Internet, by default. An organization can implement either or both of the following options to override the default routes Azure creates:

- Route Tables
- Border Gateway Protocol (BGP) routes

Integration with Azure services

Integrating Azure services to an Azure virtual network enables private access to the service from virtual machines or compute resources in the virtual network. An organization can integrate Azure services in their virtual network with the following options:

- Deploying dedicated instances of the service into a virtual network
- Using Private Link to access privately a specific instance of the service from their virtual network and from on-premises networks
- Access the service using public endpoints by extending a virtual network to the service, through service endpoints

Increase networking limits on virtual network limits page. Virtual networks and subnets can be configured to accommodate zona resources without dividing them by availability zones. Azure Virtual Network is free, but charges apply for resources.

4.4.2 Azure CDN

Azure CDN offers developers a global solution for rapidly delivering high-bandwidth content to users by caching content at strategically placed physical nodes. The benefits of using Azure CDN to deliver web site assets include:

- Better performance and improved user experience for end users.
- Large scaling to handle high loads during product launches.
- Edge servers distribute user requests and content to reduce traffic.

Azure CDN offers the following key features:

- *Dynamic site acceleration*

  The purpose of Dynamic site acceleration is to improve the performance of web pages by speeding up the delivery of dynamic content.

- *CDN caching rules*

  CDN Caching rules are used to modify default expiration behaviour, allowing global or custom conditions.

- *HTTPS custom domain support*

  HTTPS is automatically enabled when we create the endpoint hostname by default which secures the sensitive data through TLS/SSL.

- *Azure diagnostics logs*

  Using azure diagnostic logs will enable the user to view the core analytics and export them into Azure Storage Account or Log analytic workspace or Azure event hubs.

- *File compression*

  File compression enhances transfer speed, page-load performance, bandwidth costs, and user responsiveness by reducing file size.

- *Geo-filtering*

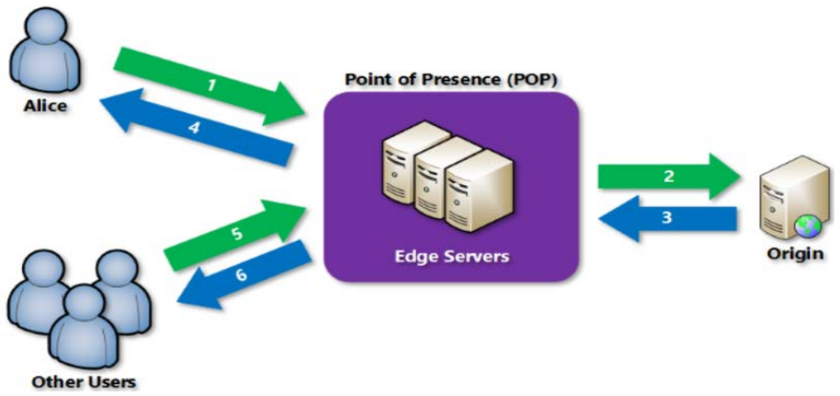
  Geo-filtering allows users to restrict access to content by country/region by creating rules on specific paths on CDN endpoints.

How it works

1. The DNS routes a user's request (Alice and other users) to the closest POP location.
2. POP requests file from origin server if no edge servers have it.
3. The origin server returns the file to an edge server in the POP.
4. Edge server caches file and returns it to original requestor until TTL expires.
5. Users can request the same file using the same URL.
6. POP edge server returns files directly from cache for faster user experience.

Azure CDN requires a subscription, a CDN profile, and multiple profiles to create a mix of pricing tiers. Pricing is applied at the CDN profile level.

Azure subscription limits resources for CDN profiles, endpoints, and custom domains.



4.5 Storage

4.5.1 Azure Storage

Azure Storage is Microsoft's cloud storage solution for modern data storage scenarios, providing highly available, massively scalable, durable, and secure storage for data objects.

Azure Storage services provide benefits for application developers and IT professionals.

- Durable and highly available. Redundancy ensures data is safe in the event of hardware failures or natural disaster.
- Azure Storage provides secure data storage with control.
- Azure Storage is scalable to meet data storage and performance needs.
- Azure manages hardware maintenance, updates, and critical issues.
- Azure Storage is accessible from anywhere, with client libraries in a variety of languages, REST API, scripting, and visual solutions.

The Azure Storage platform includes the following data services:

Azure Blob

Azure Blob Storage is Microsoft's object storage solution for the cloud, optimized for storing massive amounts of unstructured data. It can be accessed from anywhere in the world via HTTP or HTTPS, with client libraries available for multiple languages.

Azure Files

Azure Files enables an organization to set up highly available network file shares that can be accessed using the SMB, NFS, and REST API protocols. It also allows for access from anywhere in the world using a URL with a shared access signature (SAS) token. File shares can be used for many common scenarios, such as migration of on-premises applications, configuration files, tools and utilities, resource logs, metrics, and crash dumps.

Azure Queues

The Azure Queue service is used to store and retrieve messages, which can be up to 64 KB in size and contain millions of messages. Queues are used to store lists of messages to be processed asynchronously, allowing for more control.

Azure Tables

Azure Table Storage is now part of Azure Cosmos DB. Azure Cosmos DB for Table offers throughput-optimized tables, global distribution, and secondary indexes.

Azure Managed Disks

Azure managed disks are virtual hard disks stored as page blobs, with Azure taking care of the rest.

Azure Storage requires authorization for all requests. Below are the following authorization methods:

- Azure AD integration for blob, queue, and table data provides superior security and ease of use.
- Azure AD DS or on-premises Active Directory Domain Services enable identity-based authorization over SMB for Azure Files.
- Shared Key authorization allows clients to sign requests using storage account access key.
- Shared access signatures encapsulate security tokens to authorize storage resources.

There are two basic kinds of encryption available for Azure Storage:

Encryption at rest
Azure Storage encryption protects and safeguards data to meet security and compliance commitments.

Client-side encryption
Azure Storage encrypts data before sending and decrypting at rest.

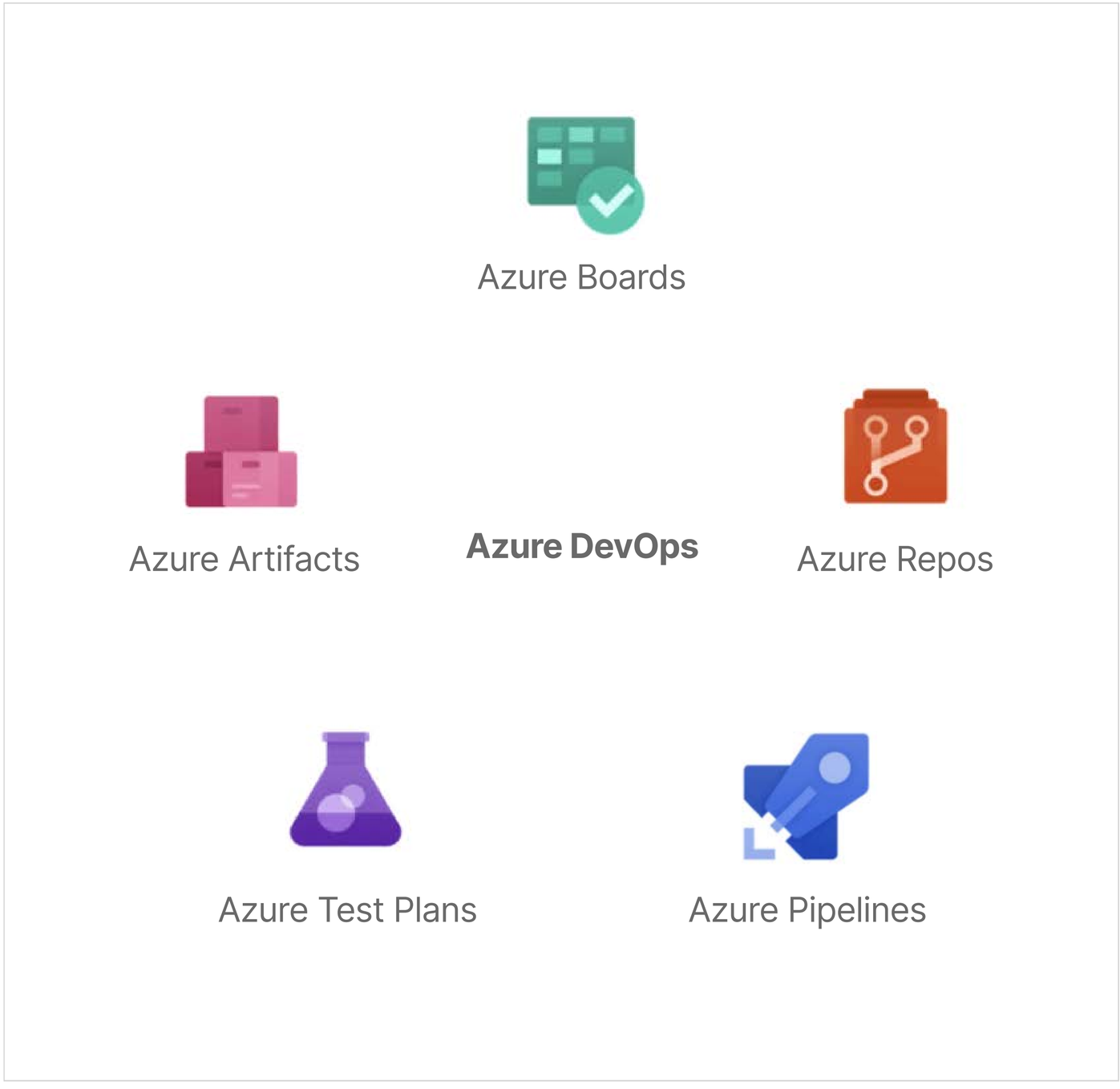
Azure Storage stores multiple copies of data to ensure durability. Meanwhile moving data into or out of Azure Storage depends on size and bandwidth. For the pricing of azure storage please refer to this link.

4.6 DevOps

4.6.1 Azure DevOps

Azure DevOps is a modern DevOps tool for planning, developing, testing and deploying modern apps to help organizations create and improve software faster than traditional approaches. It provides integrated features to complement existing workflows and supports adding extensions and integrating with other services.

Azure DevOps includes Azure Boards, Azure Repos, Azure Pipelines, Azure Test Plans, and Azure Artifacts.



Azure Board

Azure Boards provides a flexible platform for managing and tracking work items, supports agile methodologies, and provides features to help teams collaborate and stay organized. It supports Agile methodologies including Scrum and Kanban.

Azure Boards also provides end-to-end traceability, tracking work from requirements to deployment, allowing users to create branches, create pull requests, run tests, merge pull requests, and monitor requirements traceability.

Azure Repos

Azure Repos is a set of version control tools that help track changes and coordinate code changes across a team. It saves snapshots of files and keeps a history of development, making it easy to review and roll back to any version.

Azure Repos provides two types of version control:

- **Git** - Git is a distributed version control system that makes it easy to work offline or remotely, using local repositories and tools.
- **Team Foundation Version Control** - TFVC is a centralized version control system with path-based branches.

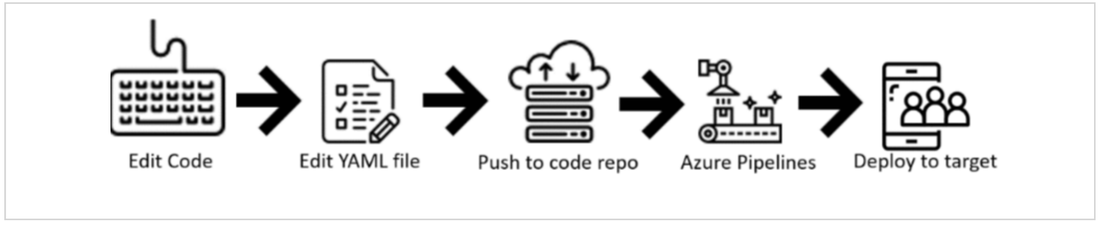
Azure Pipelines

Azure Pipelines combines CI and CD to build, test, and deliver code to any destination. Azure Pipelines have several key components:

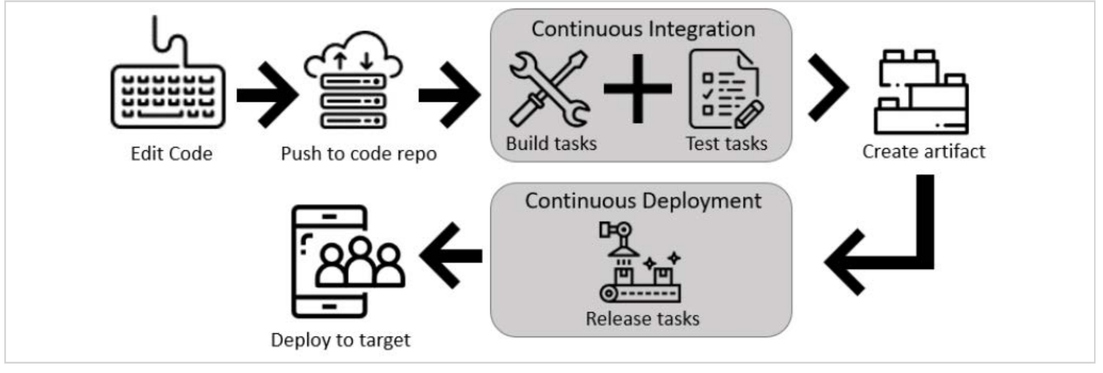
- **Azure Pipeline Tasks** - Tasks are packaged scripts or procedures that are executed sequentially when a job is executed. These demands defined prerequisites that must be installed on agents.
- **Azure Pipeline Templates** - Templates can be used to inject reusable content and control what is allowed in a pipeline, helping to define security.
- **Azure Pipeline Parameters** - Runtime parameters can be used to provide different values for scripts and actions, dynamically select jobs and stages, and specify default values.
- **Azure Pipeline Variables** - Variables are stored as strings and can be modified at runtime. They can be used in expressions to conditionally assign values and customize the pipeline. Variables with the largest local scope take precedence.
- **Azure Pipeline Secrets** - Secret variables are encrypted with a 2048-bit RSA key and are available to agents through tasks and scripts.
- **Azure Pipeline Triggers** - Triggers allow an organization to automatically run pipelines when certain events occur.

There are 2 options to operate the Azure Pipelines:

- **Define pipeline using YAML Syntax** - Azure Pipelines provides YAML configuration to define pipeline as code.



- **Azure pipeline using classic interface** - Azure Pipelines provides a UI to define pipelines and artifacts.



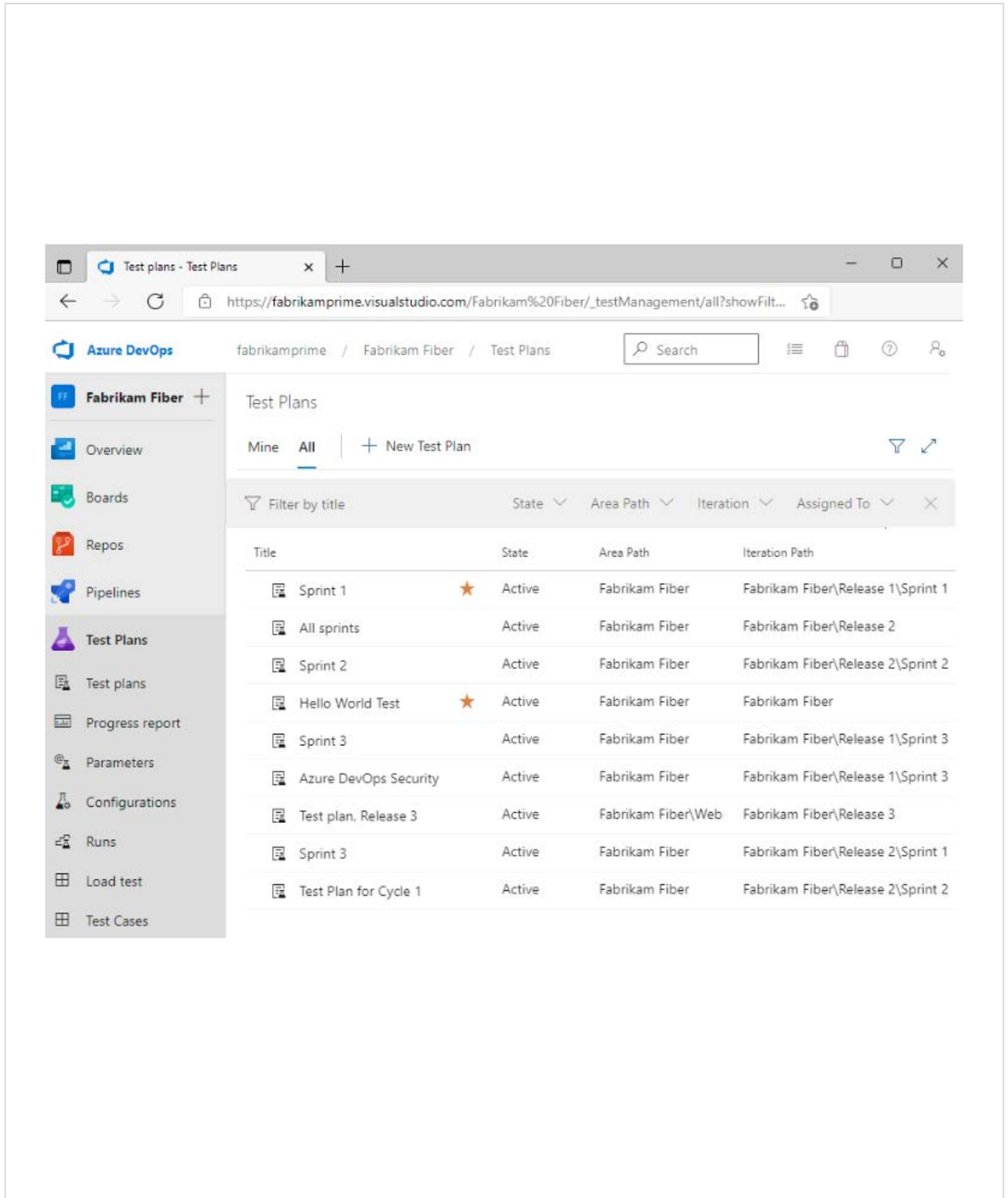
Azure Test Plans

Azure Test Plans provides powerful tools to improve code quality and collaborate. It supports test objectives through browser-based tools. Below are the following test objectives:

- Manual and Exploratory Testing
  a. Planned Manual Testing
  b. User Acceptance Testing
  c. Exploratory Testing
  d. Stakeholder Feedback
- Automated Testing
- Traceability
- Reporting and Analysis

Azure Test Plan has several benefits:

- Test on any platform
- Rich diagnostic data collection
- End to end traceability
- Integrated Analytics
- Extensible platform



Azure Artifacts

Azure Artifacts enable developers to share code efficiently and manage packages from one place, supporting multiple package types, simplify job building, and integrate with Azure Pipelines.

Azure Artifacts is free up to 2 GB, but limits can be exceeded. Below is the detail feature ability of azure Artifacts:

Package type	Azure DevOps Services	Azure DevOps Server	TFS-2018
NuGet packages	✓	✓	✓
Npm packages	✓	✓	✓
Maven packages	✓	✓	✓
Phyton packages	✓	Server 2019 Update 1 and Newer, Server 2020 and Server 2022	✓
Universal packages	✓	✗	✗

Azure DevOps works well with most of the DevOps tools.

Category	Tools Name
Configuration Tool	Chef, Ansible, Puppet
Continuous Integration	Jenkins
Microservices	Docker
Collaboration	Slack, Trello
Monitoring	Kibana, Grafana
Development	Visual Studio

5. Certification Path

Microsoft has arranged IT certification into different levels; fundamental, associate expert and speciality.

Fundamental certification is beginner certification aimed at people that have just started the journey learning cloud concepts.

Associate certification is intermediate level certification aimed at people that are already familiar with the Azure platform.

Expert certification is advanced level certification that aimed at people that have extensive experience with and a deep understanding of Azure.

List of the certification and the level and description as follows:

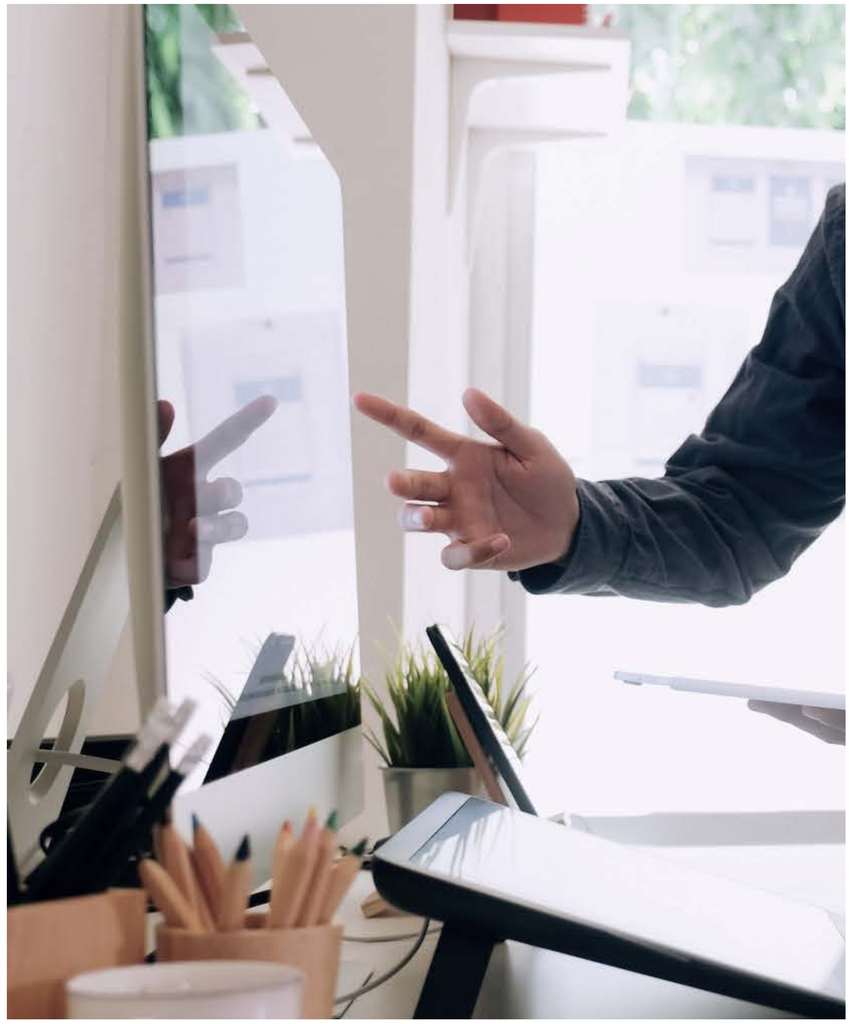
No	Certification	Level	What it's best for
1	Azure AI Fundamentals (AI-900)	Fundamentals	Demonstrating participant AI skills on the cloud and the services Azure can offer in this area
2	Azure Data Fundamentals (DP-900)	Fundamentals	Developing a strong foundation in the core concepts of data and data analytics
3	Azure Fundamentals (AZ-900)	Fundamentals	Demonstrating participant knowledge of cloud concepts, models, and services and showing participant expertise in Azure
4	Azure Administrator Associate (AZ-104)	Associate	Building on subject matter expertise managing an organization's Microsoft Azure environment
5	Azure AI Engineer Associate (AZ-102)	Associate	Learning to build, manage, and deploy AI solutions within Azure
6	Azure Data Engineer Associate (DP-203)	Associate	Storing and using datasets for analysis and managing data pipelines and data stores
7	Azure Data Fundamentals (DP-900)	Associate	Working with data in the cloud

8	Azure Data Scientist Associate (DP-100)	Fundamentals	Exploring data science and using Azure Machine Learning and Azure Databricks
9	Azure Data Fundamentals (DP-900)	Fundamentals	Developing a strong foundation in the core concepts of data and data analytics
10	Azure Database Administrator Associate (DP-300)	Fundamentals	Managing the operational aspects of data platform solutions built with Microsoft SQL Server and Microsoft Azure Data Services
11	Azure Developer Associate (AZ-204)	Associate	Building on participant cloud developer experience and learning about developing Azure computing and storage
12	Azure Enterprise Data Analyst Associate (DP-500)	Associate	Building expertise in data analytics solutions, including how to design, create, and deploy them
13	Azure Network Engineer Associate (AZ-700)	Associate	Validating participant knowledge and skills in Azure network solutions planning, implementation, and maintenance
14	Azure Security Engineer Associate (AZ-500)	Associate	Planning and implementing cloud-based management and security; building on participant experience in code, security operations processes, cloud capabilities, and Azure services

15	Azure Stack Hub Operator Associate (AZ-600)	Associate	Enhancing participant skills in providing platform as a service (PaaS) and infrastructure as a service (IaaS) using Azure Stack Hub
16	Azure DevOps Engineer Expert (AZ-400)	Expert	Building on participant experience as an infrastructure administrator or developer, with expertise in DevOps, Azure administration, or development
17	Azure Solutions Architect Expert (AZ-305)	Expert	Building on participant expertise in designing cloud and hybrid solutions that run on Microsoft Azure, as well as participant advanced experience and knowledge in IT operations, Azure administration, Azure development, and DevOps processes

Conclusion

Azure continues to grow consistently; it is the 2nd most widely used cloud platform after AWS. It is expected that Azure will continue to grow in the future. An organisation adopting the Azure platform is assured that it will receive continued support either from Microsoft or the community in the future.



Azure offers a wide variety of services starting from compute, networking, AI, database, DevOps and many others. This enables organisations to build their infrastructure in the cloud without having to worry that their use cases may not being supported by the Azure cloud platform.

With many certification opportunities, organisations will not have to worry about difficulties in finding qualified human resources. Organisations can grow their talent and organisational capabilities using the certification path provided by Microsoft

About Mitrais

Mitrais is a world-class technology company based in Indonesia and a part of the global CAC Holdings Group. We have been recognized as Indonesia's leading provider of offshore development services by Forrester Research, and our goal is to help your business meet and exceed your expectations. Combining Western innovation with Eastern productivity, Mitrais maintains its preeminent position in the Asia Pacific region. As a member of the Microsoft Partner Network with a Gold Application Development competency, we demonstrate the highest level of competence and expertise with Microsoft technologies. Our close working relationship with Microsoft enables us to deliver exceptional software development services. Through collaboration with trusted partners and our team of talented software engineers, we are committed to providing outstanding solutions to our valued clients.

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Terima Kasih　　**Thank** You　　**ありがとう**ございました