Module 02: Azure Compute Services

1. Virtual Machine, App Services, Functions, ACI, AKS

A. Virtual Machines
- Infrastructure as a Service (IaaS)
- Total control over the operating system and the software
- Supports marketplace and custom images
- Best suited for
  - Custom software requiring custom system configuration
  - Lift-and-shift scenarios
- Can run any application/scenario
  - web apps & web services,
  - databases,
  - desktop applications,
  - jumpboxes,
  - gateways, etc.

B. Virtual Machine Scale Sets
- Infrastructure as a Service (IaaS)
- Set of identical virtual machines
- Built-in auto scaling features
- Designed for manual and auto-scaled workloads like web services,* batch processing, etc.
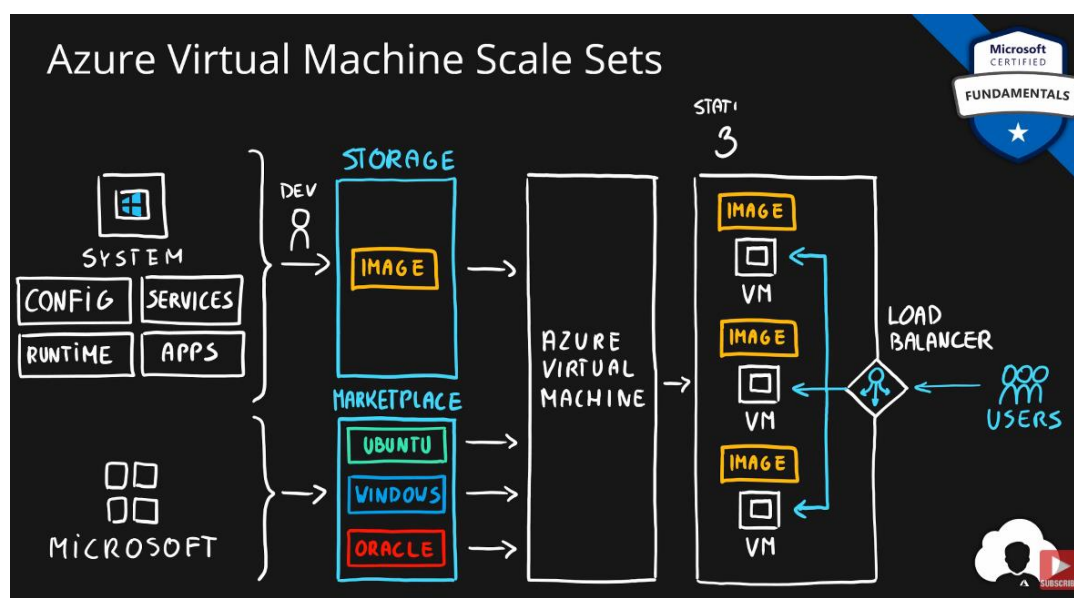
C. Azure Kubernetes Service (AKS)
- Open-source container orchestration platform
- Platform as a Service
- Highly scalable and customizable
- Designed for high scale container deployments (anything really!)

D. App Service
- Designed as enterprise grade web application service
- Platform as a Service
- Supports multiple programming languages and containers

E. Containers
- Use host's operating system
- Emulate operating system (VMs emulate hardware)
- Lightweight (no O/S)
    - Development Effort
    - Maintenance
    - Compute & storage requirements
- Respond quicker to demand changes
- Designed for almost any scenario

Summary:

- **Virtual Machines (IaaS)** - Custom software, custom requirements, very specialized, high degree of control
- **VM Scale Sets (IaaS)** - Auto-scaled workloads for VMs
- **Container Instances (PaaS)** - Simple container hosting, easy to start
- **Kubernetes Service (PaaS)** - Highly scalable and customizable * container hosting platform
- **App Services (PaaS)** - Web applications, a lot of enterprise web * hosting features, easy to start
- **Functions (PaaS) (Function as a Service) (Serverless)** - micro/nano-services, excellent consumption-based pricing, easy to start

2. Azure Networking Services

A. Azure Virtual Network

- Emulation of physical networking infrastructure
- Designed for isolation, segmentation, communication, filtering, routing between resources (internet and on-premises)
- Scoped to a single region
- VNet Peering or VPN Gateway allow cross VNet communication
- Segmented into one or more subnets
- Subnets are discrete sections used for
    - effective address allocation and
    - network filtering via Network Security Groups (NSG) or Application Security Groups (ASG)

https://cloudwithease.com/azure-virtual-network-vnet/
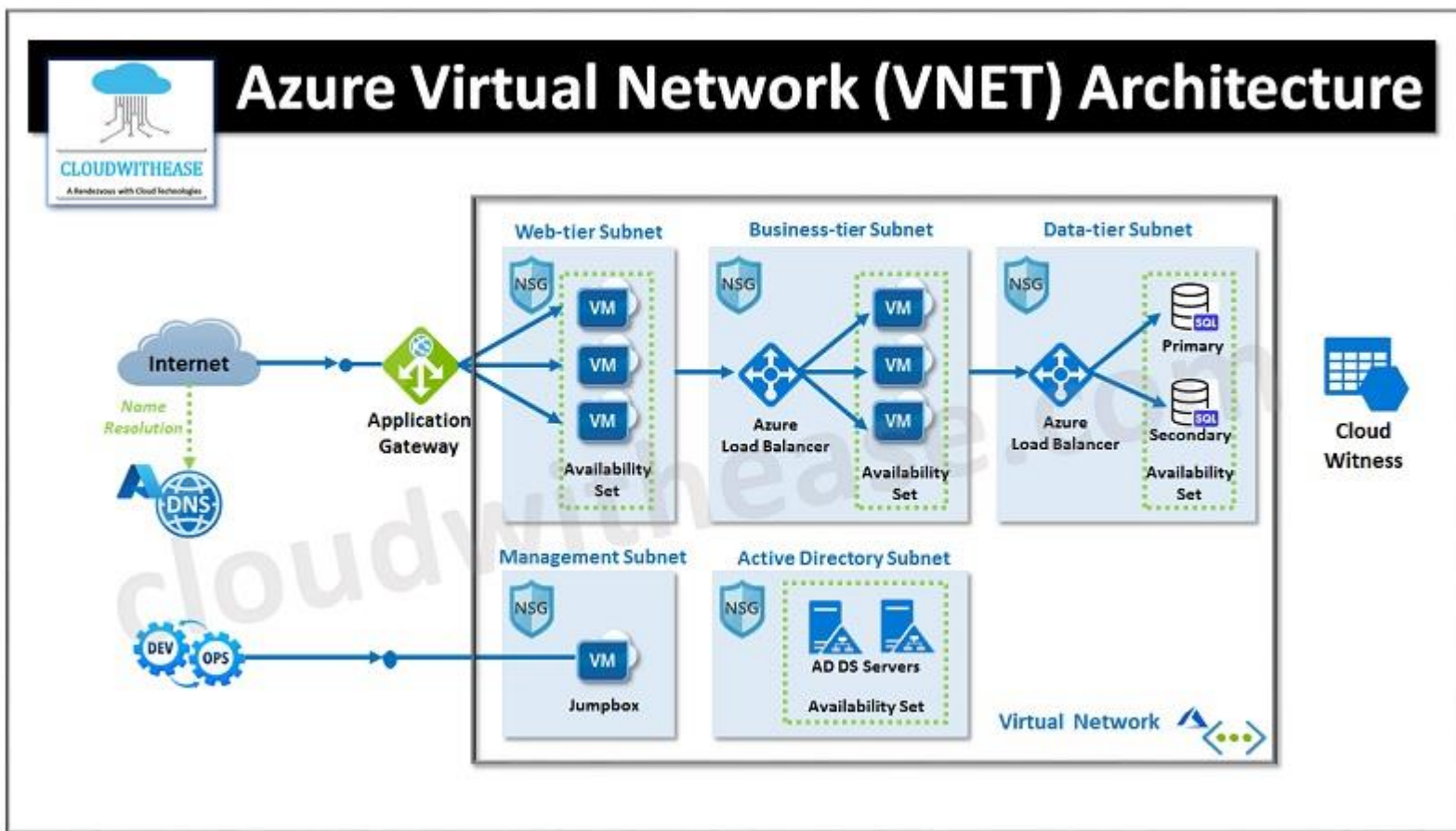
B. VPN Gateway

- Specific type of virtual network gateway for on-premises to azure traffic over the public internet

https://www.oakridgeit.com/blog1
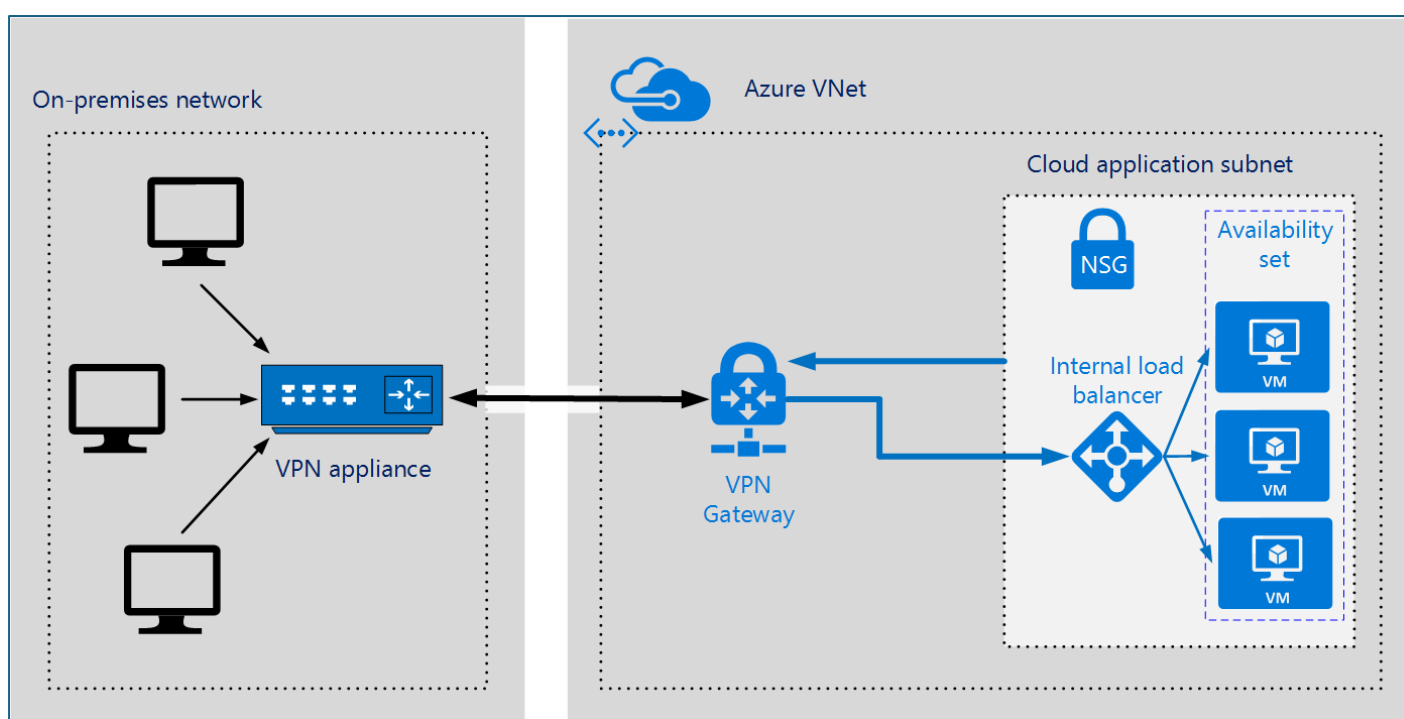
C. Azure Load Balancer
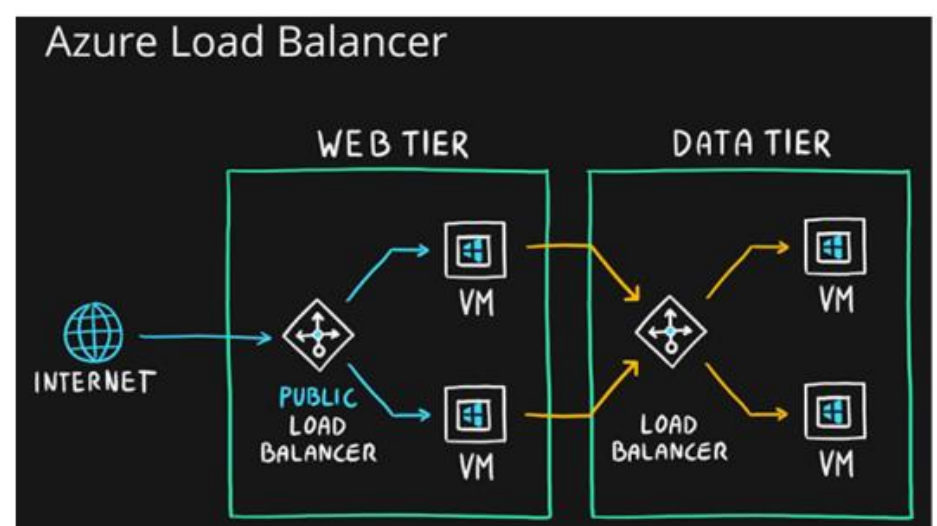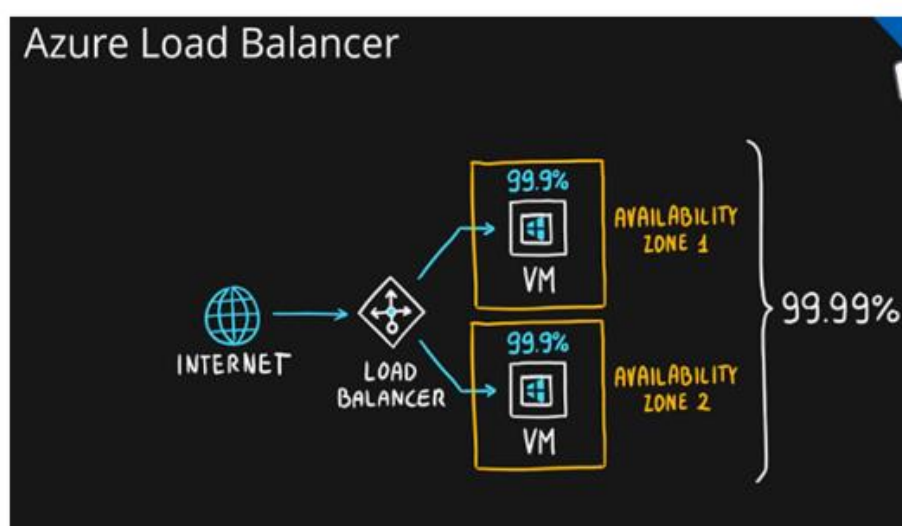
- o Even traffic distribution
- o Supports both inbound and outbound scenarios
- o High-availability scenarios
- o Both TCP (transmission control protocol) and UDP (user datagram protocol) applications

- o Internal and External traffic
- o Port Forwarding
- o High scale with up to millions of flows
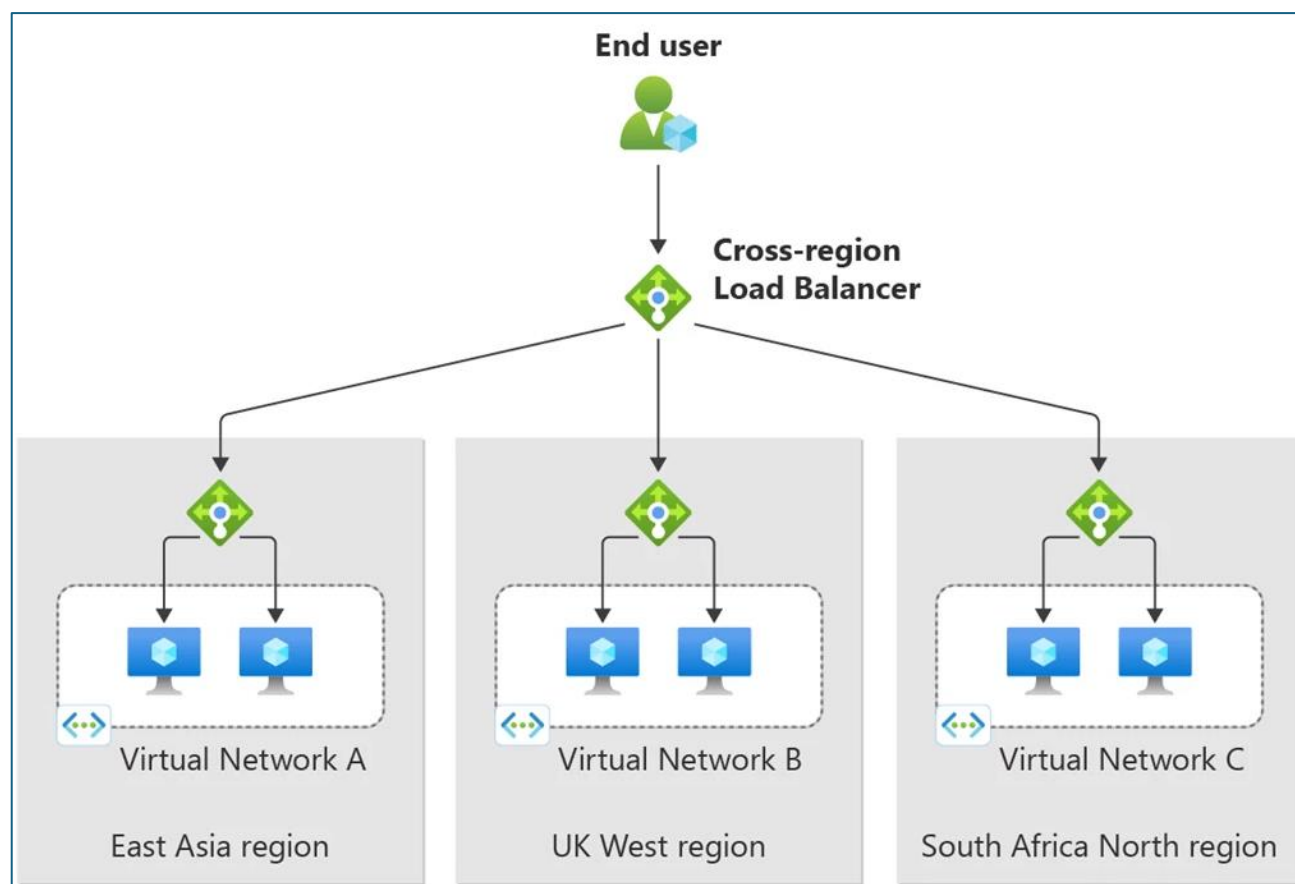
D. Application Gateway

- Web traffic load balancer
- Web application firewall
- Redirection
- Session affinity
- URL Routing
- SSL termination

E. Content Delivery Network

- Define content
- Minimize latency
- POP (points of presence) with many locations

3. Azure Storage Services

A. Storage Account
- Group of services which include
  - blob storage,
  - queue storage,
  - table storage, and
  - file storage
- Used to store
  - files,
  - messages, and
  - semi-structured data
- Highly scalable (up to petabytes of data)
- Highly durable (99.999999999% - 11 nines, up to 16 nines)
- Cheapest per GB storage

B. Blob Storage
- o **BLOB** – binary large object – file
- o Designed for storage of files of any kind

- o Three storage tiers
  - o **Hot** – frequently accessed data
  - o **Cool –** infrequently accessed data (lower availability, high durability)
  - o **Archive** – rarely (if-ever) accessed data

Azure Blob Storage

Storage for data as binary large objects (BLOBs)
Block blobs
- Large, discrete, binary objects that change infrequently
- Blobs can be up to 4.7 TB, composed of blocks of up to 100 MB
  - A blob can contain up to 50,000 blocks

Page blobs
- Used as virtual disk storage for VMs
- Blobs can be up to 8 TB, composed of fixed sized-512 byte pages

Append blobs
- Block blobs that are used to optimize append operations
- Maximum size just over 195 GB – each block can be up to 4 MB

Per-blob storage tiers
- Hot – Highest cost, lowest latency
- Cool – Lower cost, higher latency
- Archive – Lowest cost, highest latency

Azure Storage Account

Blob Container

blob1

folder1/blob2

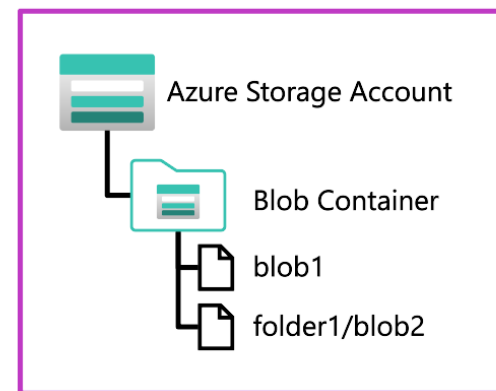Blobs can be organized in virtual directories, but each path is considered a single blob in a flat namespace – folder level operations are not supported

C. Table Storage

- o Storage for semi-structured data (NoSQL)
  - No need for foreign joins, foreign keys, relationships or strict schema
  - Designed for fast access
- o Many programming interfaces and SDKs

Azure Table Storage

Key-Value storage for application data
- Tables consist of *key* and *value* columns
  - Partition and row keys
  - Custom property columns for data values
    - A *Timestamp* column is added automatically to log data changes
- Rows are grouped into partitions to improve performance
- Property columns are assigned a data type, and can contain any value of that type
- Rows do not need to include the same property columns

Azure Storage Account

Tables

PartitionKey	RowKey	Timestamp	Property1	Property2
1	123	2022-01-01	A value	Another value
1	124	2022-01-01	This value	
2	125	2022-01-01		That value
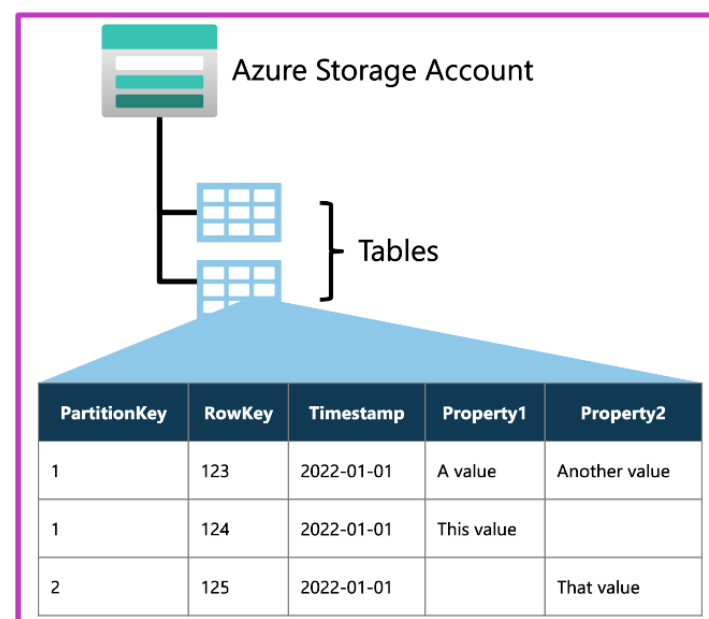
D. Queue Storage
- Storage for small pieces of data (messages)
- Designed for scalable asynchronous processing

E. File Storage
- Storage for files accessed via shared drive protocols
- Designed to extend on-premise file shares or implement lift-and-shift scenarios

Azure Files

Files shares in the cloud that can be accessed from anywhere with an internet connection

- Support for common file sharing protocols:
  - Server Message Block (SMB)
  - Network File System (NFS) – *requires premium tier*
- Data is replicated for redundancy and encrypted at rest
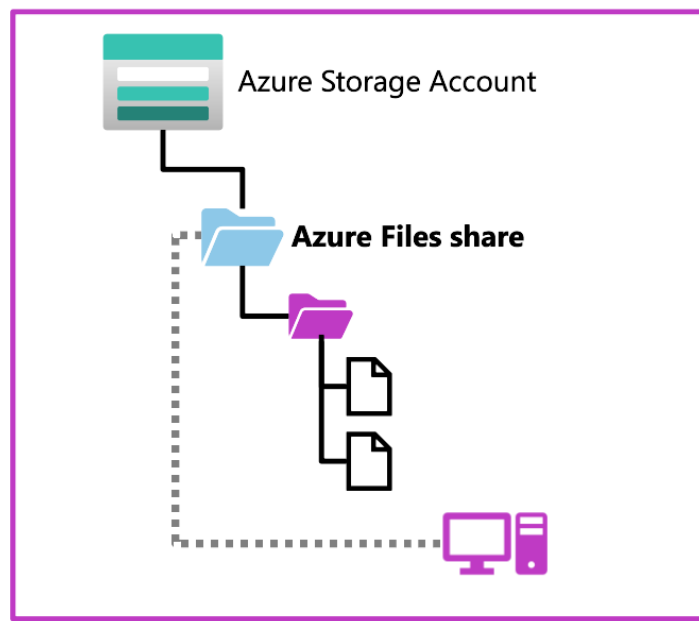
Azure Storage Account

Azure Files share

F. Disk Storage

- o Disk emulation in the cloud
- o Persistent storage for Virtual Machines
- o Different
  - sizes,
  - types (SSD, HDD)
  - performance tiers
- o Disk can be unmanaged or managed

❖ Summary

- o **Azure Storage Account** - Highly scalable and highly durable storage service consisting group of smaller services (blob, file, queue and table storage services)
- o **Azure Blob Storage** - General purpose (blob) file storage, fits any scenario
- o Azure File Storage - File share service in the cloud, lift-and-shift scenarios
- o **Azure Queue Storage** - Service for storing small messages for asynchronous processing
- o **Azure Table Storage** - Scalable NoSQL storage service for semi-structured data
- o **Azure Disk Storage** - Disk emulation service in the cloud

4. Azure Database Services

A. Data Types

- ❖ **Structured** - Data that can be represented using tables with very strict schema. Each row must follow defined schema. Some tables have defined relationships between them. Typically used in relational databases.
- ❖ **Semi-structured** - Data that can be represented using tables but without strict defined schema. Rows must only have unique key identifier.
- ❖ **Unstructured** - Any files in any format. Like binary files, application files, images, movies, etc.

What is data?

Values used to record information – Often representing *entities* that have one or more *attributes*

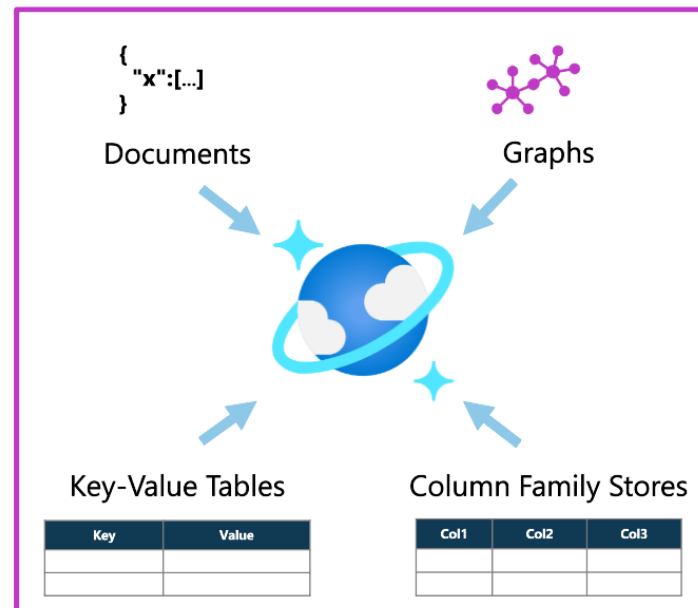## B. Cosmos DB

- o Globally distributed NoSQL (semi-structured data) Database service
- o Schema-less
- o Multiple APIs (SQL, MongoDB, Cassandra, Gremlin, Table Storage)
- o Designed for
  - ▪ Highly responsive (real time) applications with super low latency responses <10ms
  - ▪ Multi-regional applications

What is Azure Cosmos DB?

A multi-model, global-scale *NoSQL* database management system

- Support for multiple storage APIs
- Real time access with fast read and write performance
- Enable *multi-region writes* to replicate data globally; enabling users in specified regions to work with a local replica

Documents

Graphs

```
{
 "x":[...]
}
```

Key-Value Tables

Key	Value

Column Family Stores

Col1	Col2	Col3

Azure Cosmos DB APIs

Azure Cosmos DB for NoSQL

- Native API for Cosmos DB

```
SELECT *
FROM customers c
WHERE c.id =
"joe@litware.com"
```

```
{
 "id": "joe@litware.com",
 "name": "Joe Jones",
 "address": {
   "street": "1 Main St.",
   "city": "Seattle"
 }
}
```

Azure Cosmos DB for MongoDB

- Compatibility with MongoDB

```
db.products.find({
id: 123})
```

```
{
 "id": 123,
 "name": "Hammer",
 "price": 2.99}
}
```

Azure Cosmos DB for PostgreSQL
- Compatibility with PostgreSQL

id	name	dept	manager
1	Sue Smith	Hardware	Joe Jones
2	Ben Chan	Hardware	Sue Smith

Azure Cosmos DB for Table

- Key-value storage API
- Compatible with Azure Table Storage

PartitionKey	RowKey	Name
1	123	Joe Jones
1	124	Samir Nadoy

Azure Cosmos DB for Apache Cassandra
- Compatibility with Apache Cassandra

id	name	dept	manager
1	Sue Smith	Hardware	
2	Ben Chan	Hardware	Sue Smith

Azure Cosmos DB for Apache Gremlin
- Used to work with graph data
- vertices are connected via relationships (edges)
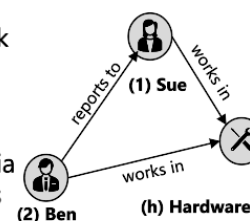
C. SQL Database

- o **Relational database** service in the cloud (PaaS) (DBaaS - Database as a Service)
- o **Structured data service** defined using schema and relationships
- o **Rich Query Capabilitie**s (SQL)
- o **High-performance**, reliable, fully managed and secure database for building – applications

Azure SQL

Family of SQL Server based cloud database services

SQL Server on Azure VMs

- Guaranteed compatibility to SQL Server on premises
- Customer manages everything – OS upgrades, software upgrades, backups, replication
- Pay for the server VM running costs and software licensing, not per database
- Great for hybrid cloud or migrating complex on-premises database configurations

Azure SQL Managed Instance

- Near 100% compatibility with SQL Server on-premises
- Automatic backups, software patching, database monitoring, and other maintenance tasks
- Use a single instance with multiple databases, or multiple instances in a pool with shared resources
- Great for migrating most on-premises databases to the cloud

Azure SQL Database

- Core database functionality compatibility with SQL Server
- Automatic backups, software patching, database monitoring, and other maintenance tasks
- *Single database or elastic pool* to dynamically share resources across multiple databases
- Great for new, cloud-based applications

IaaS

PaaS

D. Azure SQL product family

- o Azure **SQL Database** – Reliable relational database based on SQL Server
- o Azure **Database for MySQL** – Azure SQL version for MySQL database engine
- o Azure **Database for PostgreSQL** – Azure SQL version for PostgreSQL database engine
- o Azure **SQL Managed Instance** – Fully fledged SQL Server managed by cloud provider
- o Azure **SQL on VM** – Fully fledged SQL Server on IaaS
- o Azure **SQL DW (Synapse)** – Massively Parallel Processing (MPP) version of SQL Server
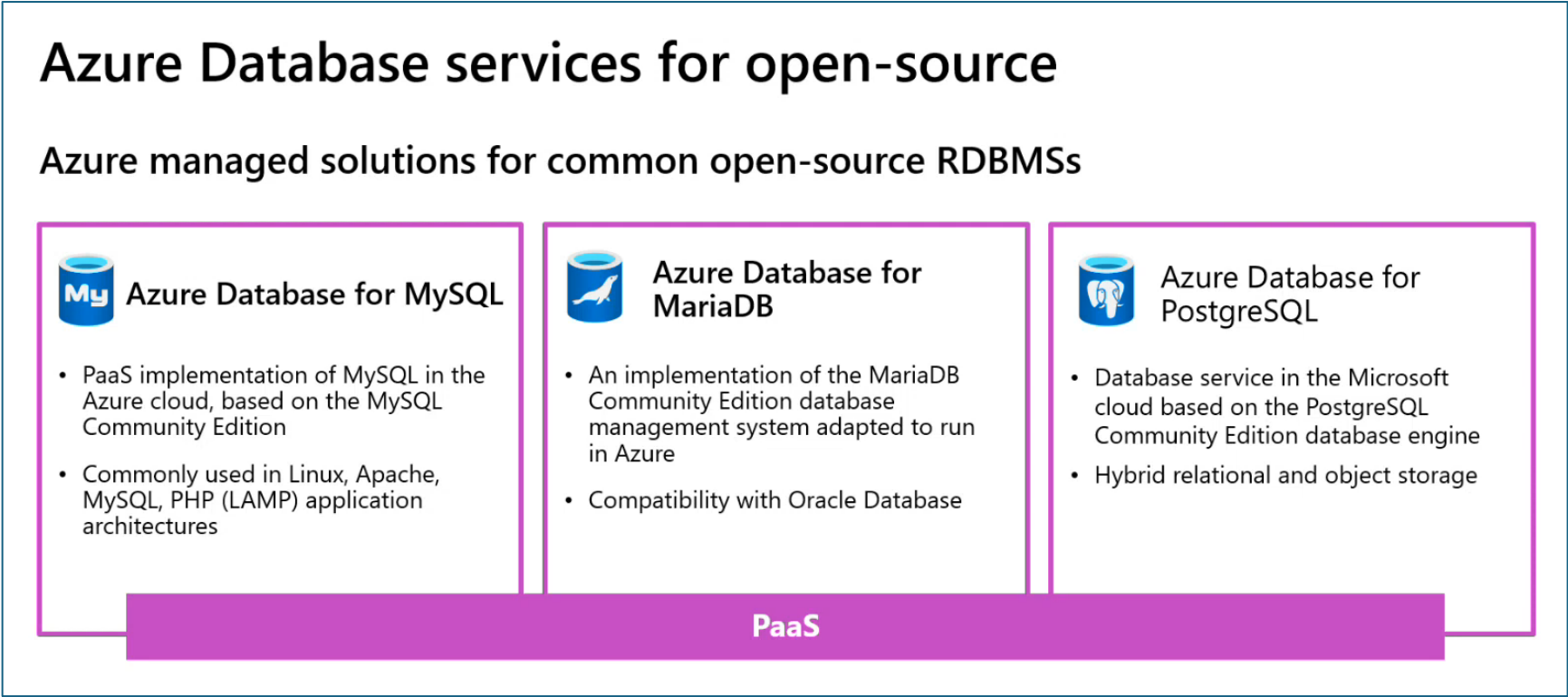
5. **Azure Market Place:**

Azure Marketplace allows customers to find, try, purchase, and provision applications and services from hundreds of leading service providers, which are all certified to run on Azure.

- Open-source container platforms.
- Solutions can leverage all service categories like IaaS, PaaS and SaaS
- Virtual machine and database images.
- Application build and deployment software.
- Developer tools.
- And much more, with 10,000+ listings!