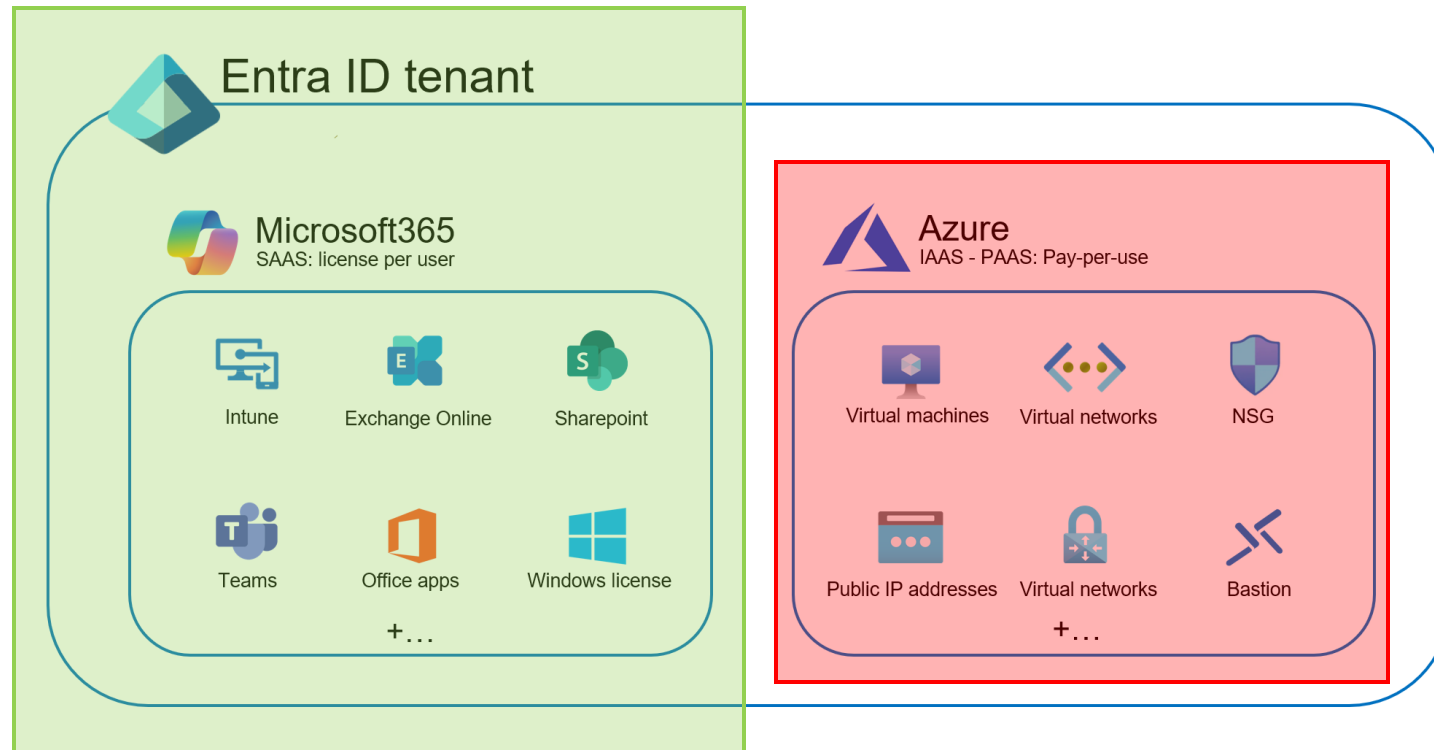# 5.Azure Fundamentals

Cloud Advanced

Klaas Thys

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Lab Environment

1.Microsoft365 demo tenant
Entra Tenant: demo

2.Azure for students
Entra Tenant: PXL

In a real environment, a single Entra tenant manages both the Microsoft 365 subscription and Azure services, ensuring centralized and consistent authorization. In our lab environment the Entra setup differs between the Microsoft 365 demo tenant and the Azure Environment

Microsoft Azure certifications

Microsoft Learn

AZ-900 Azure Fundamentals

Microsoft Learn

AZ-104 Azure Administrator Associate

All Azure Certifications
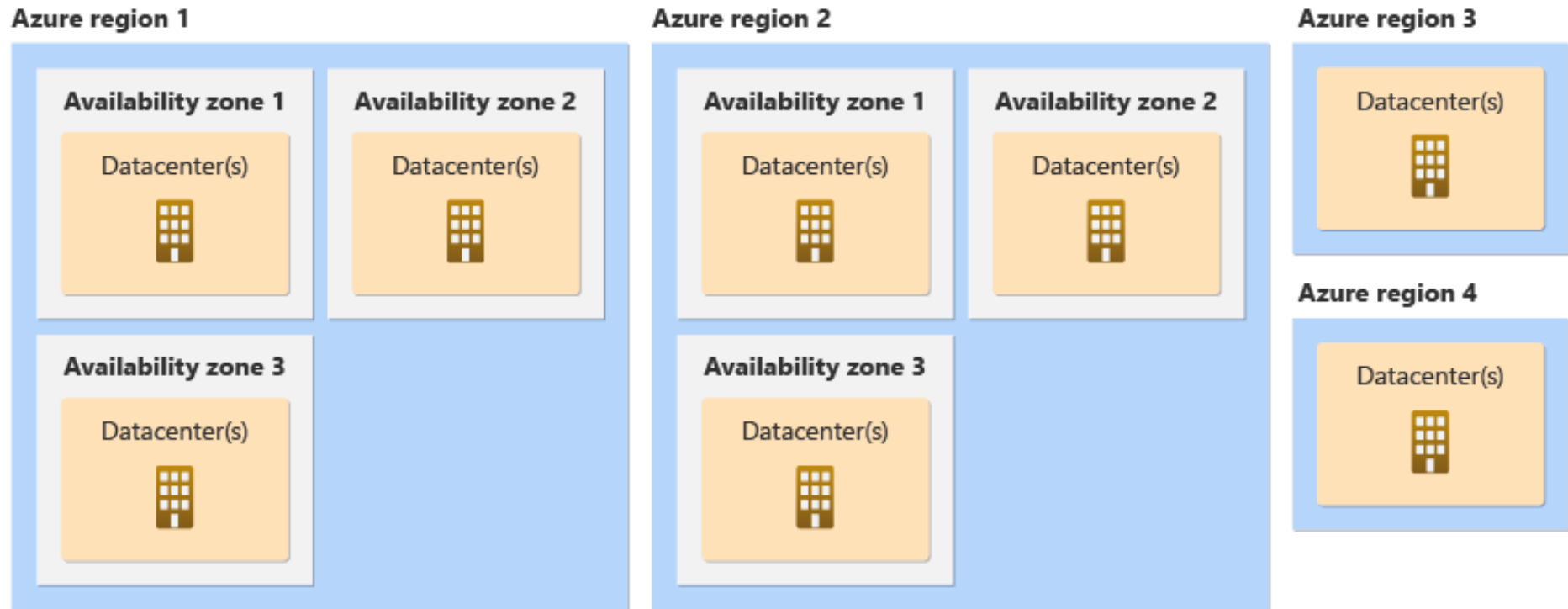
5.Azure fundamentals

1.Core architectural components

2.Resources

3.Resource management

4.Cost Management

Core components

Datacenters Microsoft

Core components

- **Datacenter:** Physical facilities equipped with servers, storage devices and network equipment. Physical foundation for the Azure services.

- **Availability zone:** physically separate grouping of one or more datacenters within a region. Each zone has independent power, cooling, and networking to ensure fault isolation and high availability.

- **Region:** geographic area that consists of one or more availability zones. It serves as a broader location where users can deploy their applications and data.

When deploying an Azure resource you will select an Azure region.

Region selection

1. **Compliance & Data Residency:** Ensuring that the region meets legal and regulatory requirements for data storage (e.g., GDPR for Europe).

2. **Latency & Performance:** Choosing a region that provides the lowest latency and best network performance for users. *Azure network round-trip latency statistics* - *Azure Speedtest*

3. **Availability of Services:** Not all Azure services are available in every region, so selecting a region that supports the required services is important. *Product availability by region*

4. **Resiliency & Disaster Recovery:** Using regions with multiple availability zones or paired regions for high availability and disaster recovery.

5. **Cost**: Pricing for Azure services varies by region, so cost considerations may influence selection. *Azure pricing calculator*

Paired regions

- **Geo-redundancy:** Data and workloads can be replicated between the paired regions to improve resiliency.

- **Disaster Recovery:** In case of a regional outage, Microsoft prioritizes recovery of one region over its pair to minimize downtime.

- **Controlled Updates:** Azure ensures that planned updates and maintenance are rolled out sequentially to paired regions, reducing the risk of simultaneous failures.

- **Physical Separation:** The paired regions are located far enough apart to reduce the impact of regional disasters (e.g., earthquakes, floods).

Azure Region lists

Point of Presence (PoP)

A Point of Presence is a **network edge location** that connects users to Microsoft's global cloud infrastructure.

- **Edge Location:** Acts as an entry point to Microsoft's global backbone network.

- Supports services like Azure Front Door (Azure's **Content Delivery Network**) to cache and deliver content more efficiently.

- Located in strategic locations worldwide to ensure low-latency access.

Management levels and hierarchy

- **Management group:** manage access, policy, and compliance for multiple subscriptions

- **Management levels and hierarchy:** Azure provides four levels of management: management groups, subscriptions, resource groups, and resources.
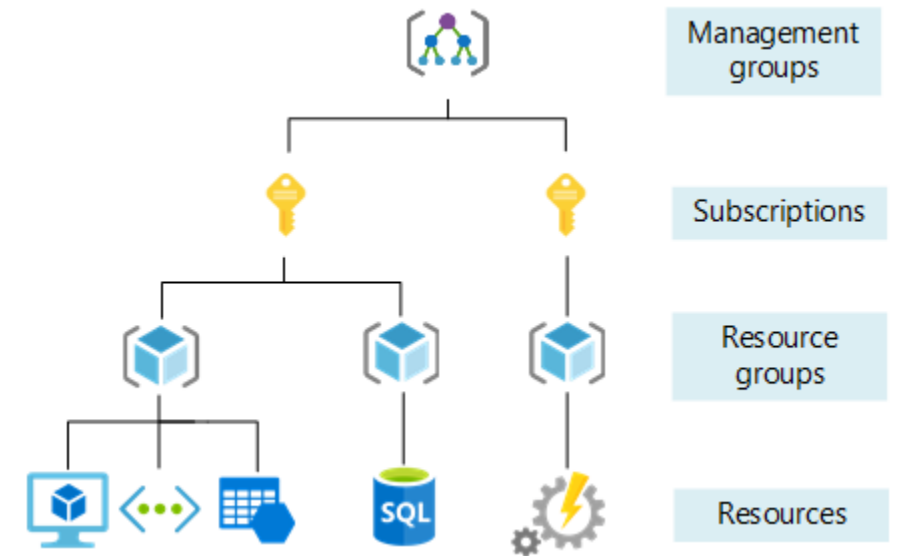
Resource group

- **Resource:** Anything you create, provision, deploy,… is a resource. Virtual machines, virtual networks, network security groups, storage, SQL database IP's,…

- **Resource groups:** Groupings of resources

  - A convenient way to structure and organize resources.

  - A resource can only be in one in resource group at a time.

  - Deleting the resource group will remove all resources within it.

  - There are no strict rules, so structure resource groups for maximum usefulness.
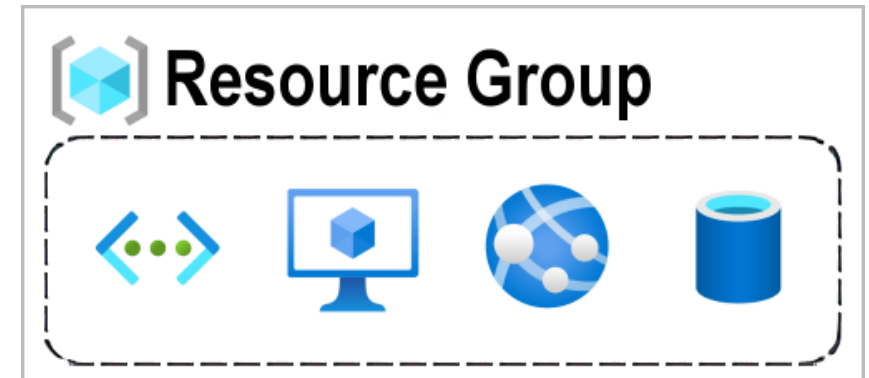
Azure subscriptions

- **Azure subscriptions** are a unit of management, billing and scale.

- Subscriptions allow you to logically organize your resources groups and facilitate billing.

- Each subscription has limits or quotas on the amount of resources it can create and use.

- Organizations can use subscriptions to manage costs and the resources created by users, teams, and projects.
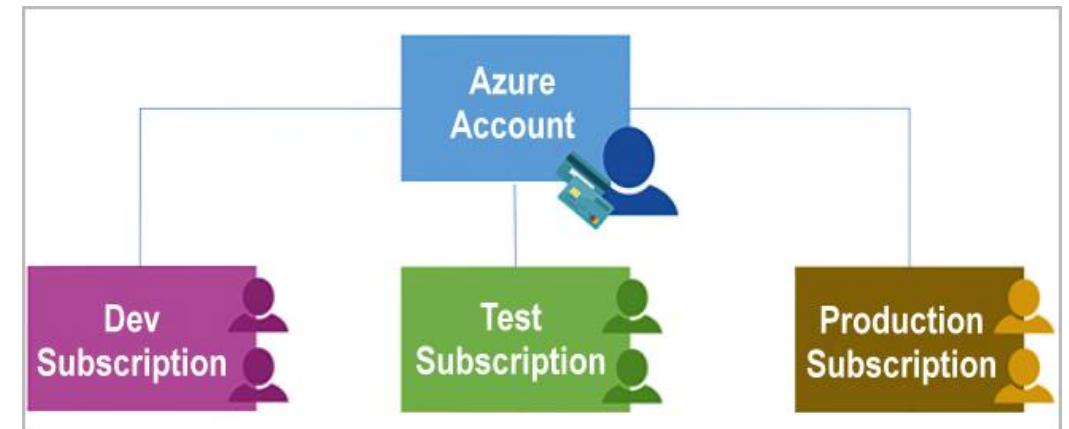
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Virtual machine series

series	Description	Example workload
A	**Entry-level VMs** for dev/test. Low-cost option to get started with Azure.	development and test servers, low traffic web servers, small to medium databases, servers for proof-of-concepts, and code repositories.
Bs	**Burstable VMs**: Economical VM that runs at a low to moderate baseline CPU, but sometimes need to burst to a higher CPU utilization when demand rises. Not hyperthreaded	Low-traffic webservers, development and test servers. Small databases, micro services, servers for proof-of-concepts.
D	**General purpose compute:** Offer a combination of vCPUs, memory, and temporary storage able to meet the requirements associated with most production workloads.	
E	**Optimized for in-memory applications:** high memory-to-core ratios, making them ideal for memory-intensive enterprise apps, large databases, and in-memory analytics.	Large databases, in-memory analytics and real-time data processing.

Azure virtual machine series

Virtual machine series

series	Description	Example workload
F	**Compute optimized virtual machines:** higher CPU-to-memory ratio, optimized for compute intensive workloads	Batch processing, web servers, analytics and gaming.
G	**Memory and storage optimized virtual machines**	large SQL and NoSQL databases, ERP, SAP, and data warehousing solutions.
H	**High Performance Computing virtual machines**	financial analysis, weather simulation, and silicon RTL modeling, seismic processing,…
Ls	are **storage optimized,** and are ideal for applications requiring low latency, high throughput, and large local disk storage	NoSQL databases such as Cassandra, MongoDB, Cloudera, and Redis
M	memory optimized and are ideal for **heavy in-memory workload**	SAP HANA, SAP S/4 HANA, SQL Hekaton and other large in-memory business
N	Azure Virtual Machines with **GPU capabilities**	simulation, deep learning, graphics rendering, video editing, gaming and remote visualization

Virtual Machines

When you create a virtual machine, the following resources are automatically created (unless you select an existing resource).

Virtual Machine

Virtual Network

Public IP address

Network Security Group

Network Interface

Managed disk

SSH key

| Name ↑↓	Type ↑↓	Location ↑↓
FirstVM	Virtual machine	West Europe
FirstVM-ip	Public IP address	West Europe
FirstVM-nsg	Network security group	West Europe
FirstVM-vnet	Virtual network	West Europe
firstvm279	Network Interface	West Europe
FirstVM_key	SSH key	West Europe
FirstVM_OsDisk_1_96a7107055624f2c9c226f243bf941c5	Disk	West Europe

Virtual Machines
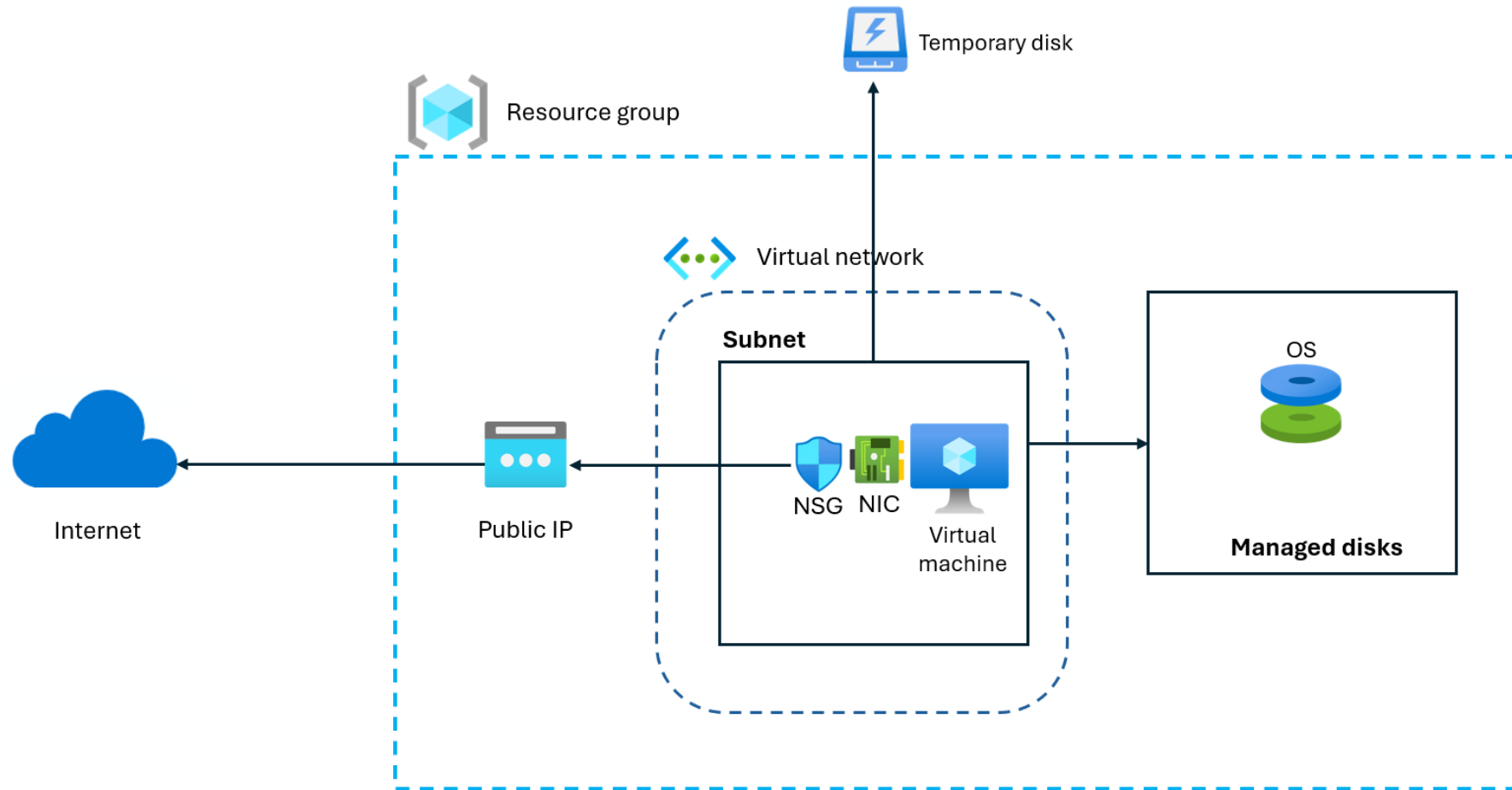
Azure storage

	Description	Use case
Azure Blobs	Scalable cloud storage for storing unstructured data, such as documents, images, backups.	• Static website hosting – serve web assets like HTML, CSS and Javascript files • Host and stream images, videos and audio files • Storing backups and restore data • Retaining logs
Azure Files	Offers fully managed cloud file shares that you can access from anywhere via the industry standard SMB and NFS protocol	• Mounting Azure file share from cloud or on premises deployments of Windows, Linux and Macos.
Azure managed disks	Block-level storage volumes for Azure Virtual machines.	• Virtual machine storage
Azure Tables	NoSQL store for schemaless storage of structured data	• Flexible datasets like user data for web applications, address books, device information, or other types of metadata.

Storage Blobs

- **Storage account:** Unique namespace for data.

- **Container:** Organizes a set of blobs, similar to a directory in a file system. A storage account can include an unlimited number of containers.

- **Blob:** The actual file or object stored inside a container, such as a document, image, video

-
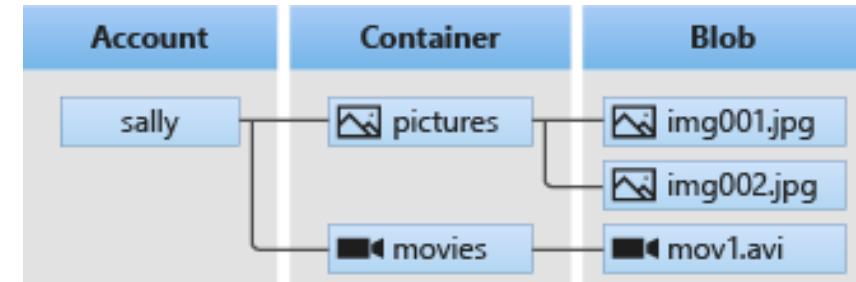
The diagram shows the relationships between these resources

Storage account   **container**   **blob**

URI   https://myaccount.blob.core.windows.net/mycontainer/blob

Managed disks

- Fully Managed, high-performance disk storage for Azure Virtual Machines

- Eliminates the need for manual management of underlying storage accounts.

- When creating an Azure virtual machine, two disks are created:

  - **OS disk:** Stores the operating system of the virtuel machine

  - **Temporary disk:** isn't a managed disk. Short-term storage for applications and processes. Intended for page files, swap files, or SQL temdp files. On Azure Linux VMs /dev/sdb on Azure Windows VMs D

Network security groups

A **network Security Group (NSG)** controls inbound and outbound network traffic to resources, by defining rules based on **IP addresses** and **ports**.

- A NSG is stateful, meaning it automatically allows response traffic for inbound without needing explicit rules for outbound.

- Can be linked to following resources:

  - **Virtual network subnets:** to control traffic to and from resources within a subnet.
  - **Network Interface:** Control inbound and outbound traffic to individual virtual machines.

Virtual Networks

A Virtual Network (VNet) in Azure is a key networking component that enables communication between Azure resources securely.

- An Azure Virtual Network consists of one ore more **subnets.**

- **Network Security Groups (NSGs)** control inbound and outbound traffic for a subnet.

- Resources within the same subnet can **communicate directly by default**, as they share the same IP address range and Azure automatically allows traffic between them.

Public IP

A Public IP can be attached to following resources:

- **NIC (Network Interface Card)** associated with a VM. Used for direct access via RDP (Windows) or SSH (Linux)

- **NAT gateway**, assigns a public IP to outbound traffic from private subnets.

- **VPN gateway**, when configuring site-to-site or point-to-site VPN's

- **Bastion**, uses a public IP to provide secure RDP/SSH access to VMs without exposing them to the internet.

- **Load balancer**, Public IP is assigned to the frontend configuration of an Azure Load Balancer. Distributes incoming traffic across backend VMs or instances.

- Azure Firewall, Requires a static public IP for outbound and inbound traffic inspection.

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PXL

Microsoft

Azure Resource Manager

Azure Resource Manager (ARM) is the deployment and management service for Azure. Every time you create, update, or delete resources—whether through the Azure portal, command line, REST API, or Azure SDK—Azure Resource Manager handles the request.
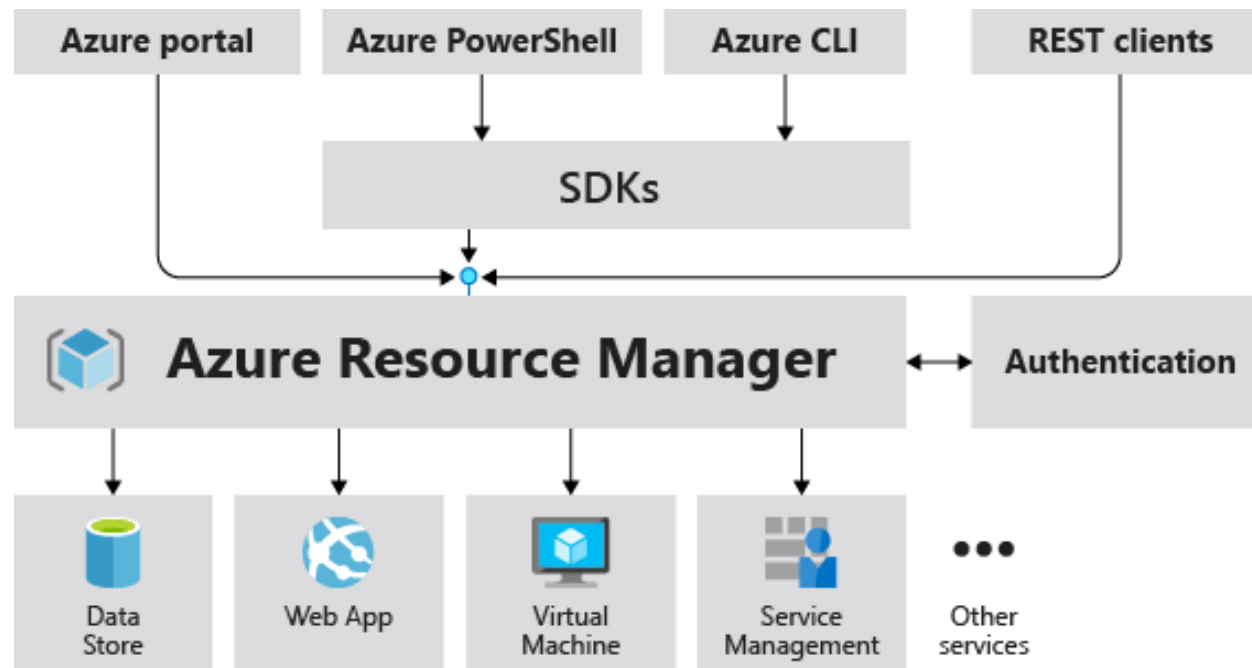
Azure CLI

You can install the Azure CLI on your **host operating system** and use it directly from your terminal application:

- Windows

- Linux

- MacOS

You can use the Azure CLI either in **PowerShell** or **Bash**, depending on your preferred command-line environment. Most Azure CLI documentation is written and tested in Bash using Azure Cloud Shell.

Azure CLI: structure command

```
az <group> <command> --options
```

1. **az:** The main az CLI command

2. **<group>:** Specifies the main Azure resource type you are working with, such as **vm** for virtual machines or **storage** for storage-related operations.

3. **<command>:** The action you want to perform, such as create, list, show, delete, etc.

4. **--options:** Additional parameters that customize the command

Azure CLI: structure command

```
az group create --name RG-AzureCLI --location westeurope
```

1. **az:** The main az CLI command

2. **group:** *resource type* = resource group

3. **create:** *action* **=** creating

4. **--name RG-AzureCLI:** resource group name is RG-AzureCLI

5. **--location westeurope:** region westeurope

Azure CLI: Cloud Shell

The Azure CLI commands will run in a cloud container in Azure instead of locally. You can open the **Cloud Shell** in two ways:

1. Windows Terminal
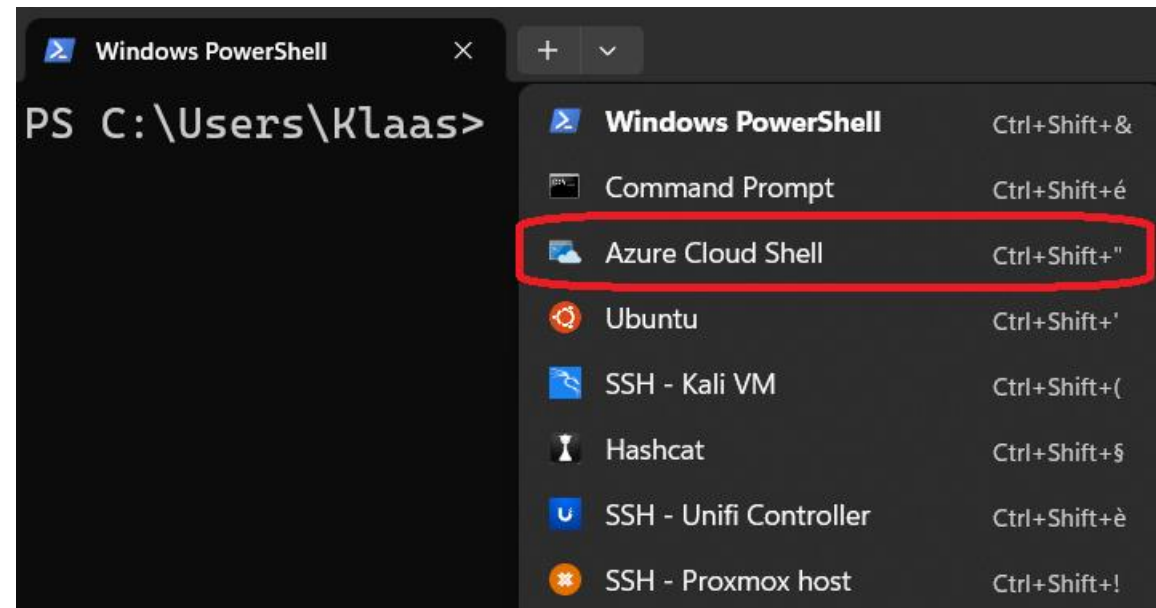
2. From the Azure Portal

Azure CLI: Local vs Cloud Shell

Feature	Azure CLI (Local)	Azure Cloud Shell
Execution environment	Runs on your local computer	Runs in a cloud-based container
Installation	You need to install Azure CLI manually	No installation required (pre-configured)
Access to local resources	Full access to local files, scripts, …	Limited access (Cloud shell has persistent storage in $HOME)
Authentication	Requires manual login (az login)	Automatically authenticated with your Azure account
Persistent data	All files and settings are stored locally	Only $HOME directory is persistent (uses Azure file storage)
How to access	Run az commands in Windows terminal or Powershell	Access via Azure Portal or Windows Terminal ((Ctrl+Shift+P > "Cloud Shell")

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Cost
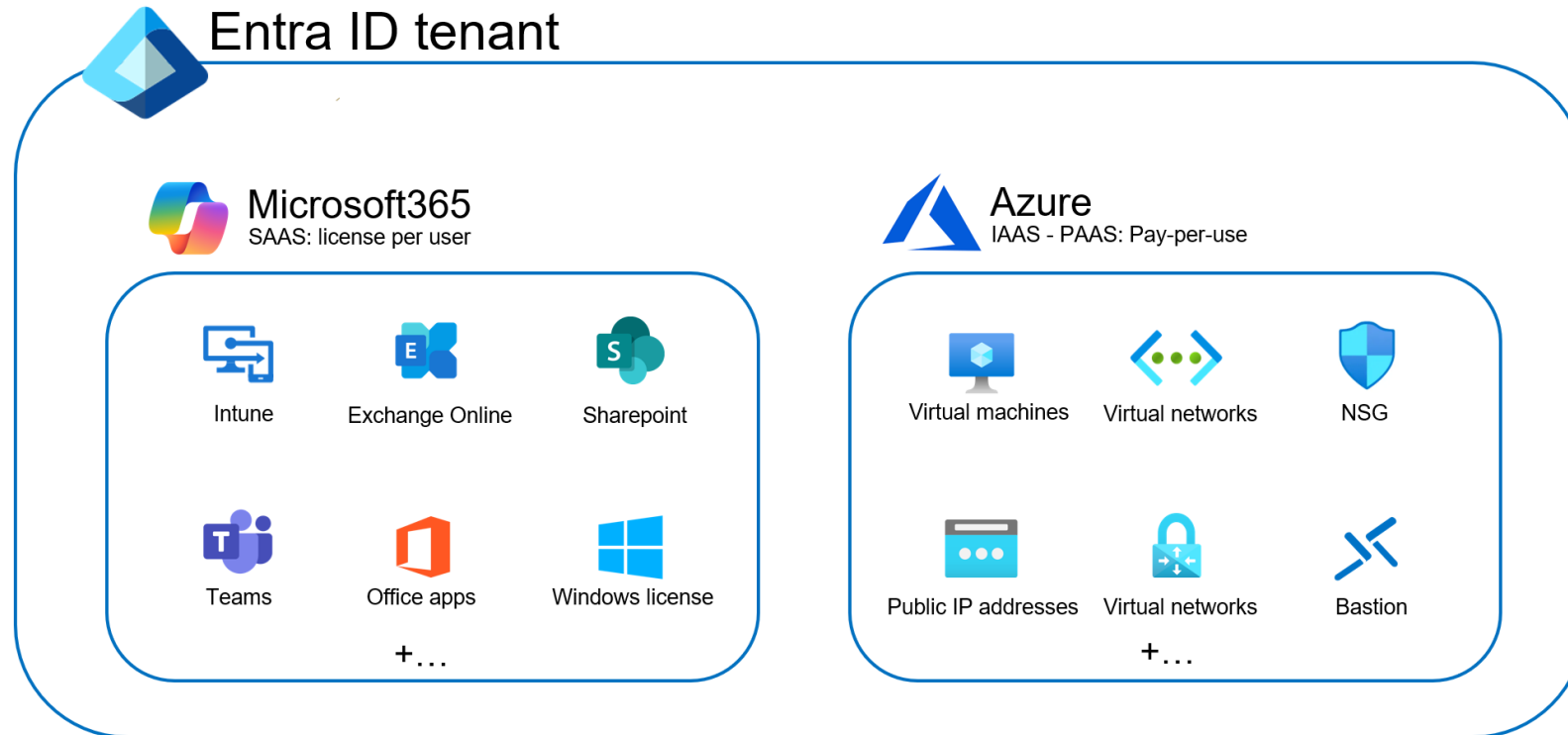
Microsoft365: subscription based

Total price depends on type of subscription and number of users.

Azure: Pay as you go

The total price depends on the actual usage of cloud resources.

Cost

Azure pricing calculator

This cost calculator provides a general estimate of a resource's cost, but the actual cost also depends on harder-to-predict factors like data traffic and disk write operations.

Cost Analysis

Azure Cost Analysis provides detailed insights into cloud spending with various breakdowns and filters.

- **Cost Breakdown:** View costs per day, month, or year to track trends over time.

- **Resource-Level Insights:** Analyze costs per resource, resource group, or subscription for detailed spending visibility.

- **Forecasting & Trends:** Predict future costs based on historical usage patterns.

Filter rows			< Mar 2025 >

Total (EUR) ⓘ	Average	Budget: None (create)
€0.03	<€0.01 / day	--

Showing 4 of 4 resource groups

Name		Subscription	Total ↓
> 🔷 firstvm	...	Azure for Students	€0.02
> 🔷 webserverlab	...	Azure for Students	<€0.01
> 🔷 rg-firstvm	...	Azure for Students	<€0.01
> 🔷 test	...	Azure for Students	<€0.01

Budget management

Azure Budget Management helps control cloud spending trough:

- **Budget Creation:** Set spending limits for subscriptions, resource groups, or services.

- **Alerts & Notifications:** Get notified when spending approaches or exceeds set budgets.

- **Forecasting:** Estimate future costs based on historical usage trends.

- **Automation:** Trigger actions like resource scaling or policy enforcement when budget limits are reached.

Budget alerts

Alert conditions

Type	↑↓	% of budget	↑↓	Amount	↑↓	Action group	↑↓	Action
Actual		20%		$10		None		
Actual		40%		$20		None		
Actual		60%		$30		None		
Actual		80%		$40		None		
Actual		100%		$50		None		