

# Cloud Computing- Basics



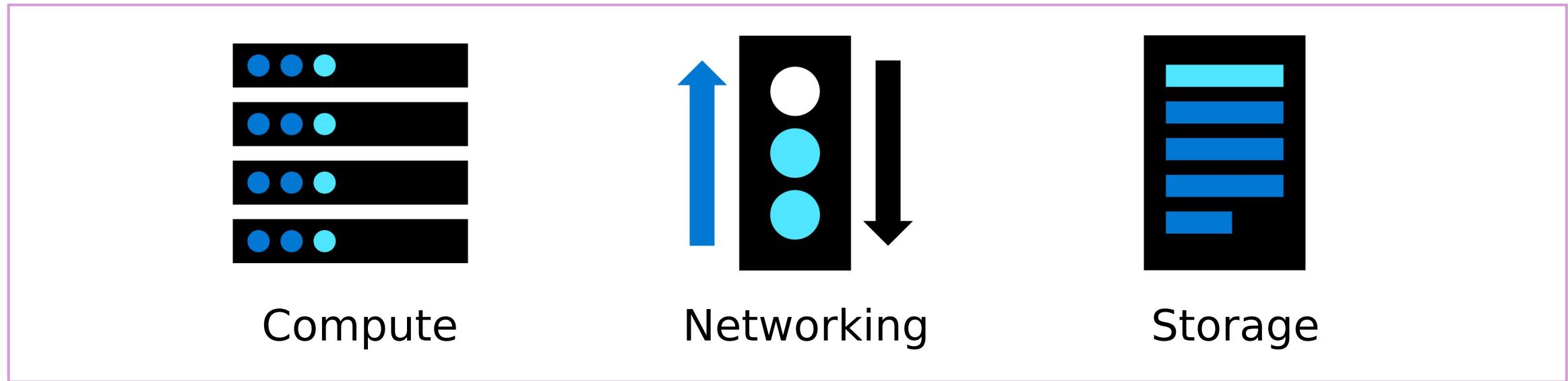
# Cloud computing

# Cloud computing—objective domain

- Define cloud computing.
- Define cloud models, including public, private, and hybrid.
- Identify appropriate use cases for each cloud model.
- Describe the consumption-based model.
- Compare cloud pricing models.

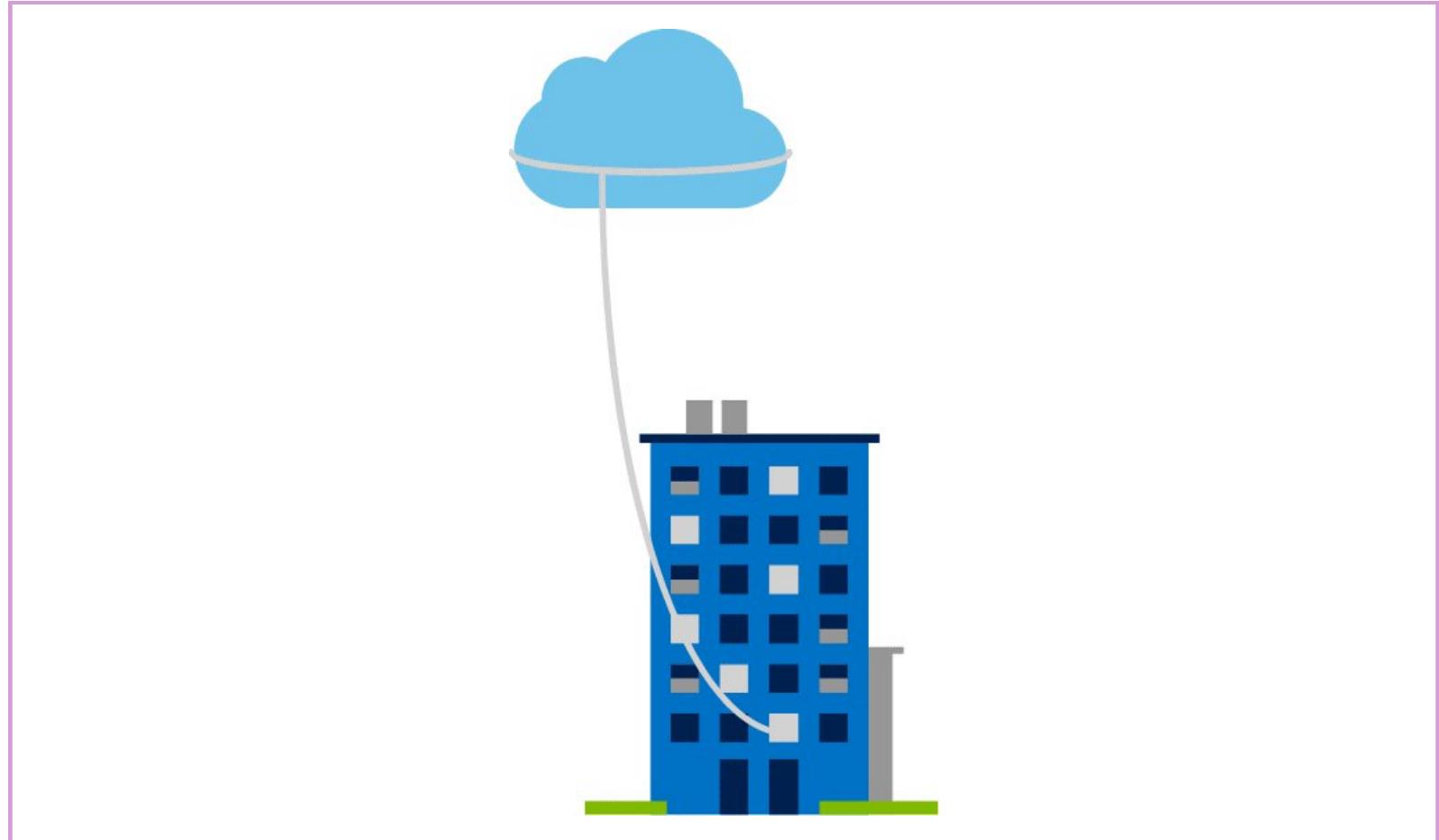
# What is cloud computing?

**Cloud computing** is the delivery of computing services over the internet, enabling faster innovation, flexible resources, and economies of scale.



# Private cloud

- Organizations create a cloud environment in their datacenter.
- Organizations are responsible for operating the services they provide.
- Does not provide access to users outside of the organization.



# Public cloud

- Owned by cloud services or hosting provider.
- Provides resources and services to multiple organizations and users.
- Accessed via secure network connection (typically over the internet).



# Hybrid cloud



Combines **public** and **private** clouds to allow applications to run in the most appropriate location.

# Cloud model comparison

## Public cloud

- No capital expenditures to scale up.
- Applications can be quickly provisioned and deprovisioned.
- Organizations pay only for what they use.

## Private cloud

- Hardware must be purchased for start-up and maintenance.
- Organizations have complete control over resources and security.
- Organizations are responsible for hardware maintenance and updates.

## Hybrid cloud

- Provides the most flexibility.
- Organizations determine where to run their applications.
- Organizations control security, compliance, or legal requirements.

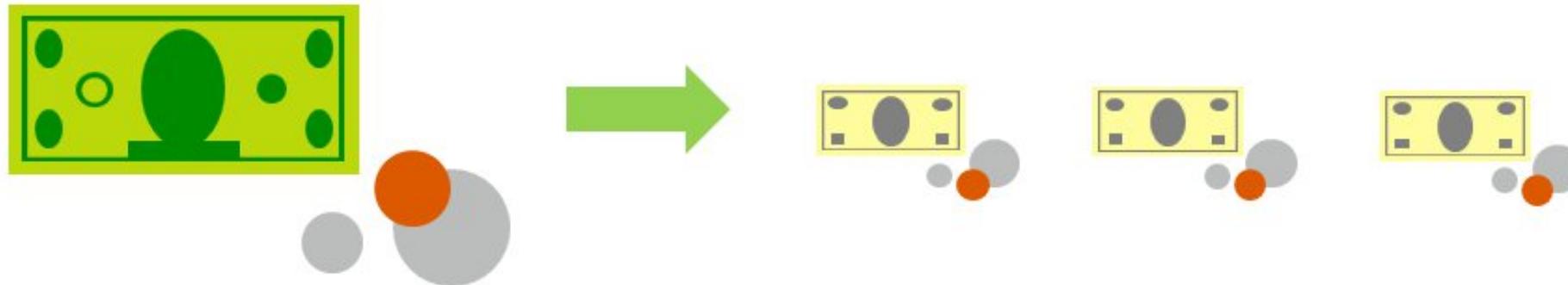
# Compare CapEx vs. OpEx

## Capital expenditure (CapEx)

- The upfront spending of money on physical infrastructure.
- Costs from CapEx have a value that reduces over time.

## Operational expenditure (OpEx)

- Spend on products and services as needed,  
pay-as-you-go.
- Get billed immediately.



# Consumption-based model

Cloud service providers operate on a consumption-based model, which means that end users only pay for the resources that they use.

- Better cost prediction.
- Prices for individual resources and services are provided.
- Billing is based on actual usage.

# Cloud benefits

# Cloud benefits—objective domain

- Describe the benefits of high availability and scalability in the cloud.
- Describe the benefits of reliability and predictability in the cloud.
- Describe the benefits of security and governance in the cloud.
- Describe the benefits of manageability in the cloud.

# Cloud benefits

High availability

Elasticity

Scalability

Reliability

Predictability

Security

Governance

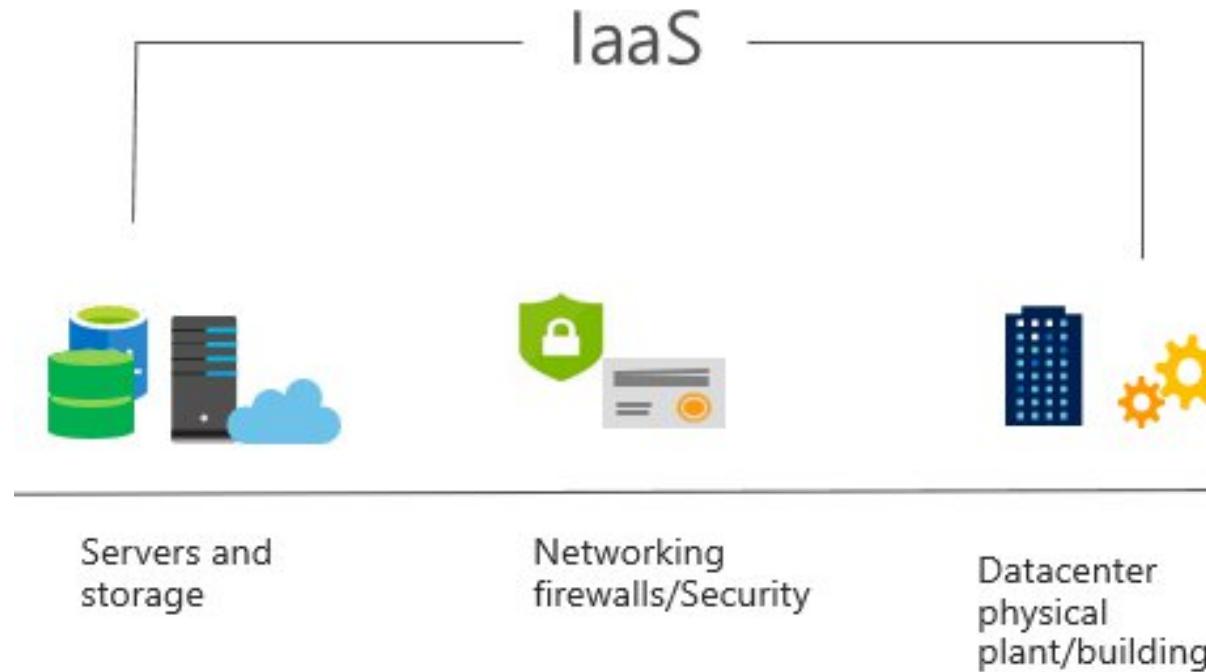
Manageability

# Cloud service types

# Cloud services—objective domain

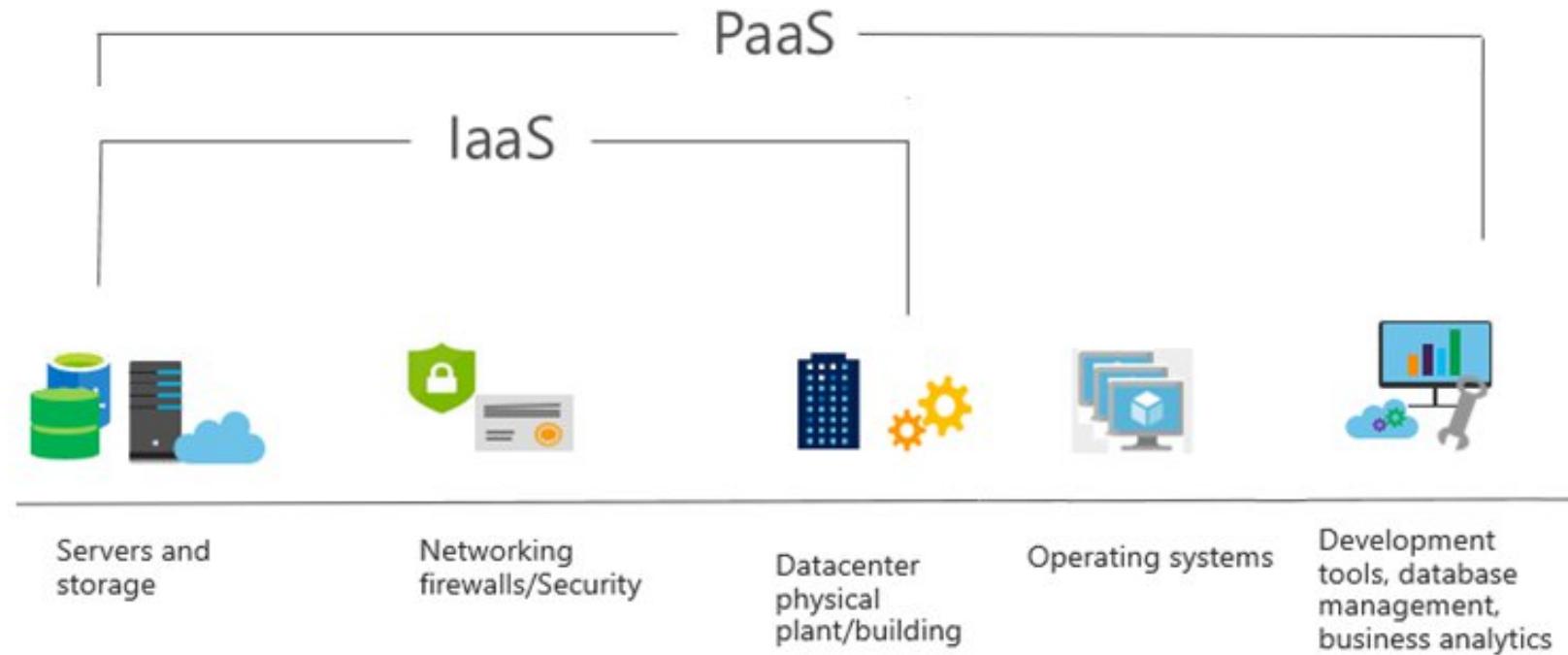
- Describe infrastructure as a service (IaaS).
- Describe platform as a service (PaaS).
- Describe software as a service (SaaS).
- Describe the shared responsibility model.
- Identify appropriate use cases for each cloud service (IaaS, PaaS, SaaS).

# Infrastructure as a service (IaaS)



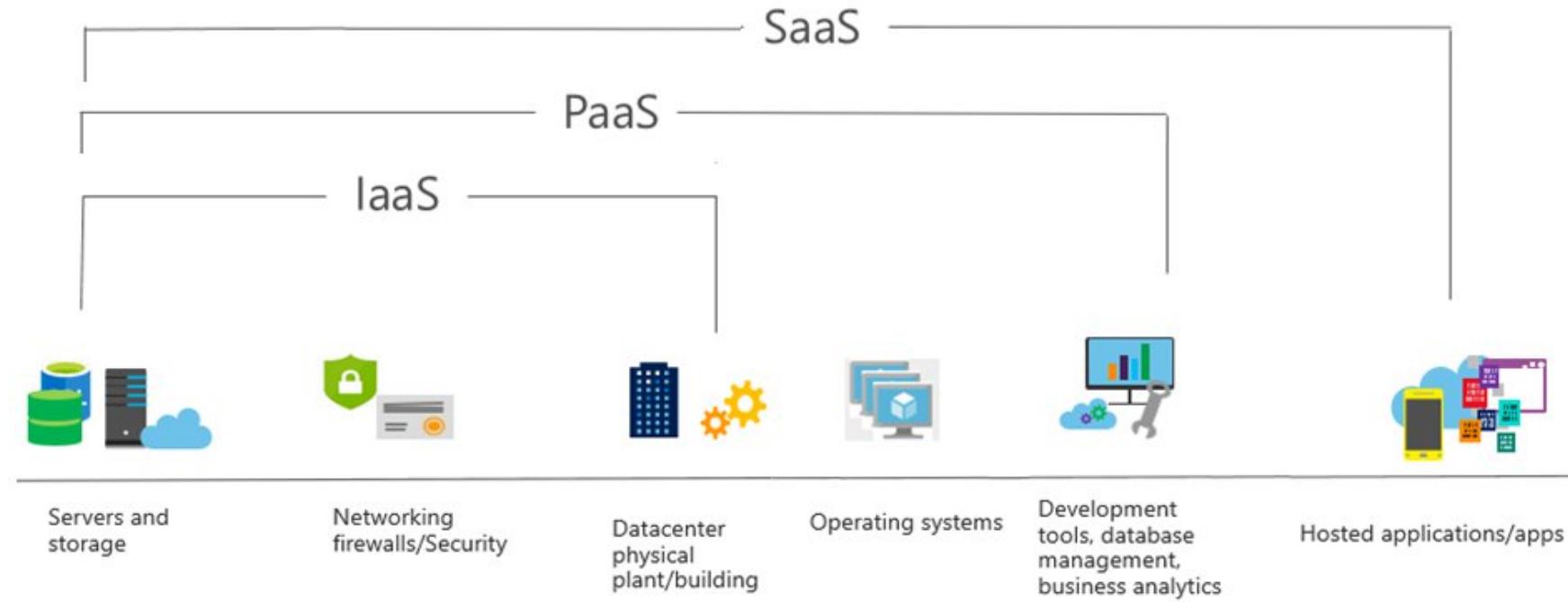
Build pay-as-you-go IT infrastructure by renting servers, virtual machines, storage, networks, and operating systems from a cloud provider.

# Platform as a service (PaaS)



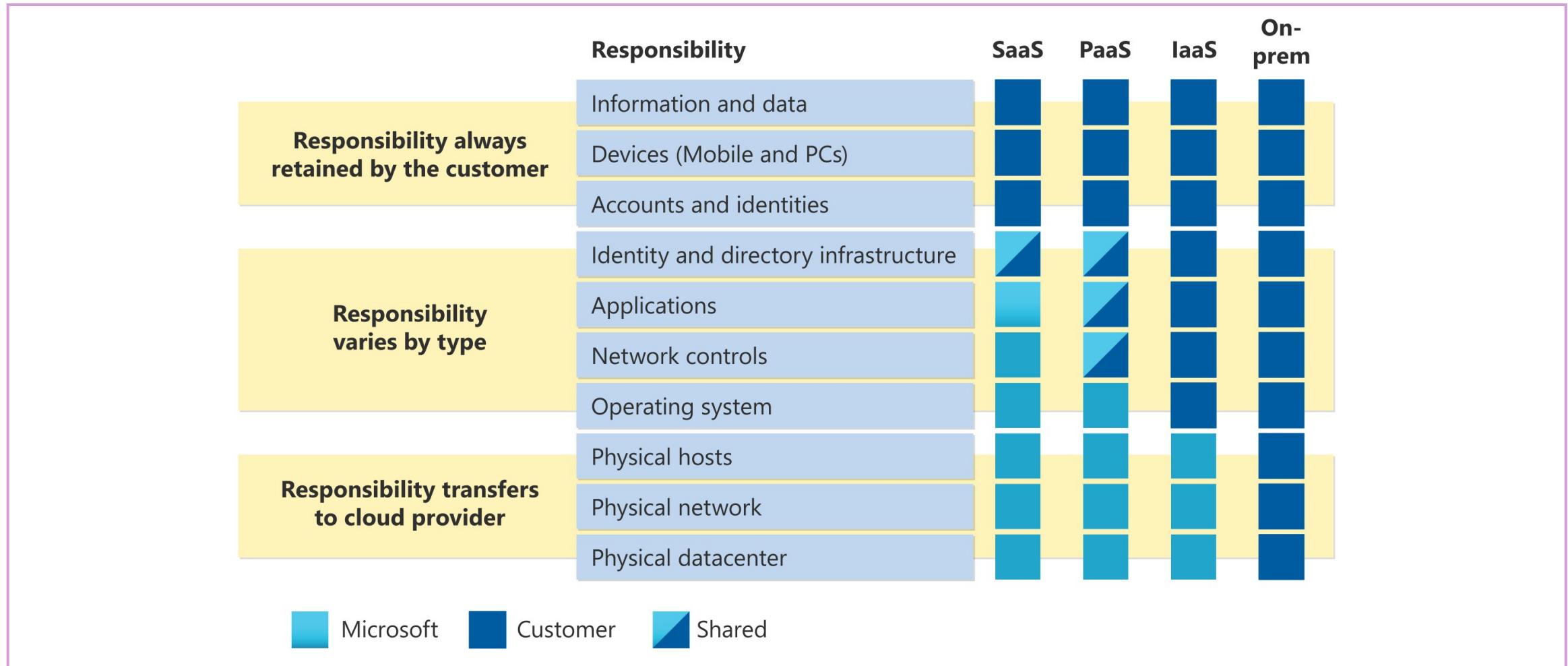
Provides an environment for building, testing, and deploying software applications; without focusing on managing underlying infrastructure.

# Software as a service (SaaS)



Users connect to and use cloud-based apps over the internet: for example, Microsoft Office 365, email, and calendars.

# Shared responsibility model



# Cloud service comparison

## IaaS

- The most flexible cloud service.
- You configure and manage the hardware for your application.

## PaaS

- Focus on application development.
- Platform management is handled by the cloud provider.

## SaaS

- Pay-as-you-go pricing model.
- Users pay for the software they use on a subscription model.

# Exploring Cloud in Azure

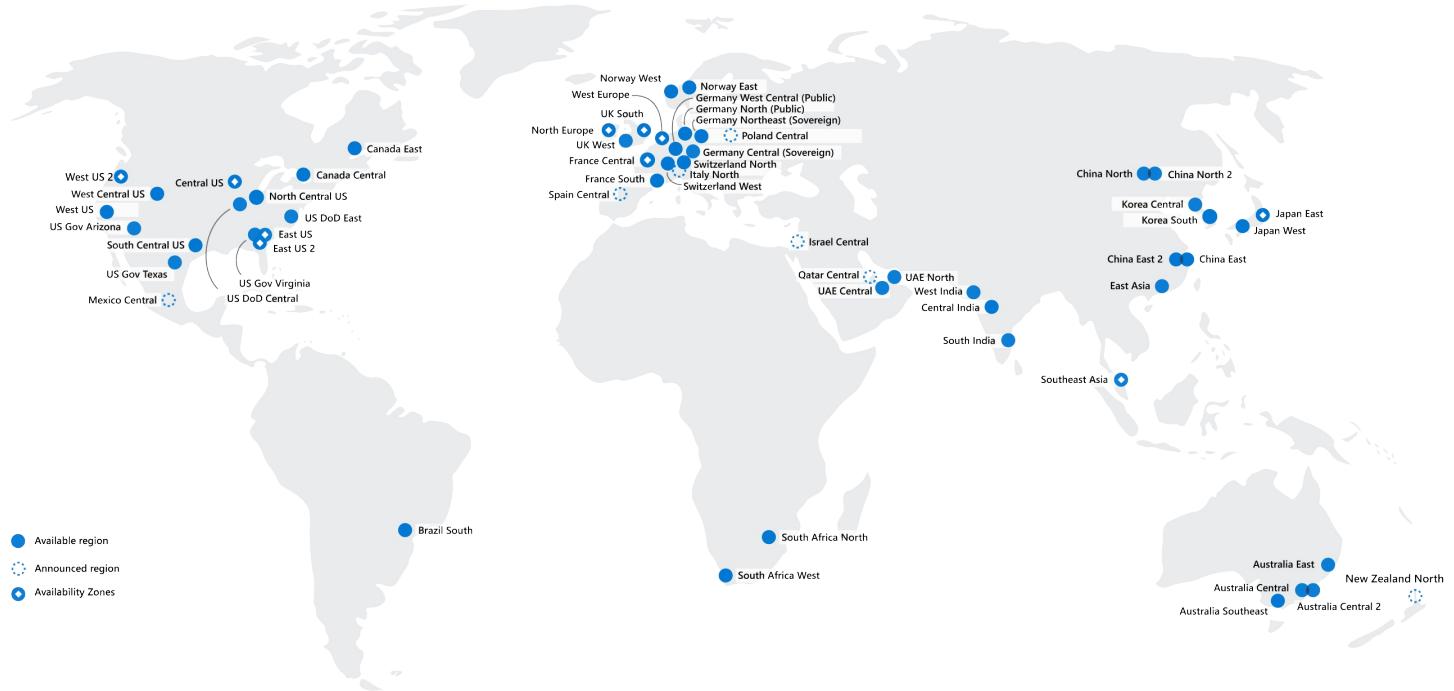


# Azure architectural components



# Regions

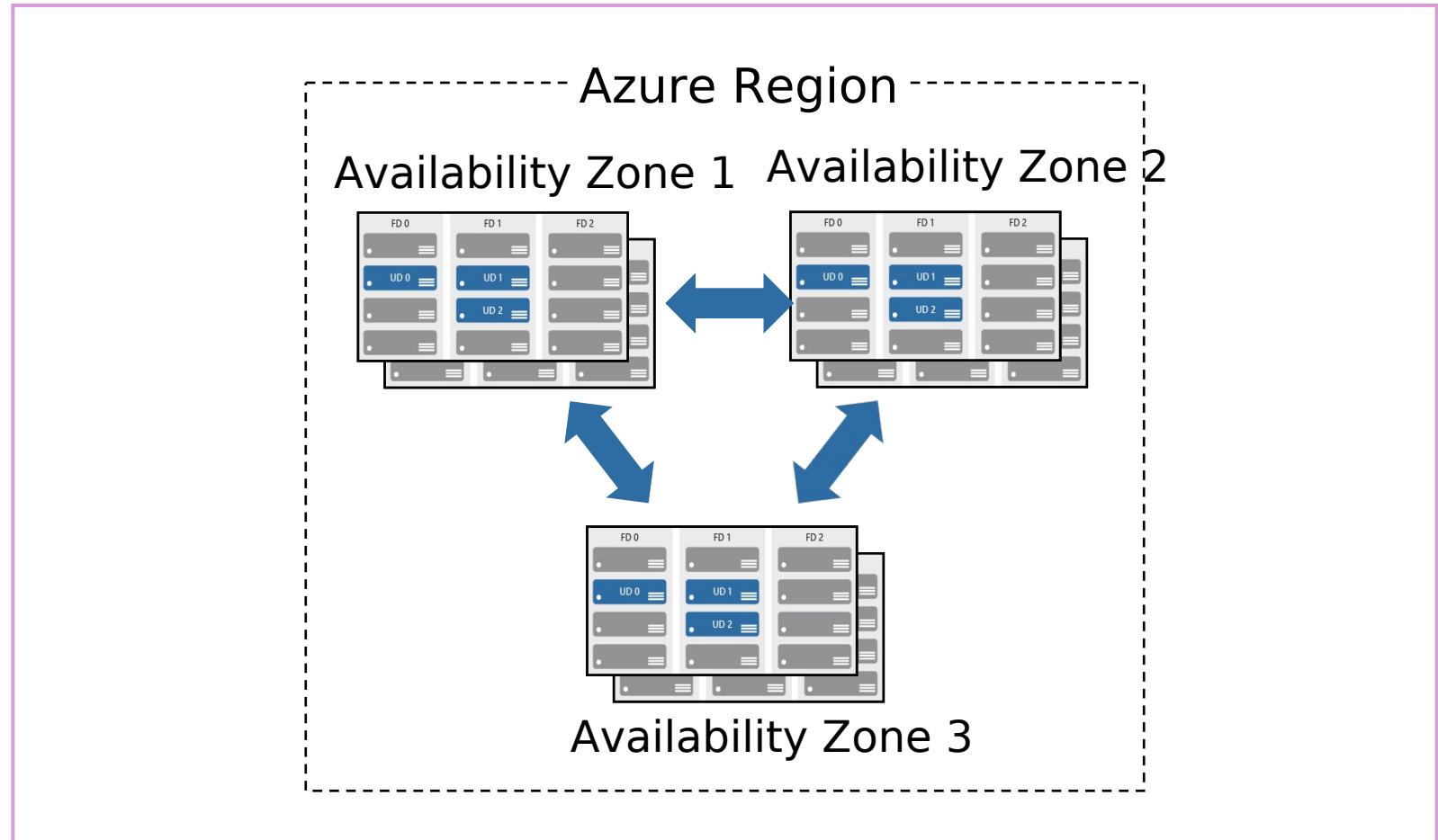
*Azure offers more global regions than any other cloud provider with 60-plus regions representing over 140 countries*



- Regions are made up of one or more datacenters in close proximity.
- They provide flexibility and scale to reduce customer latency.
- Regions preserve data residency with a comprehensive compliance offering.

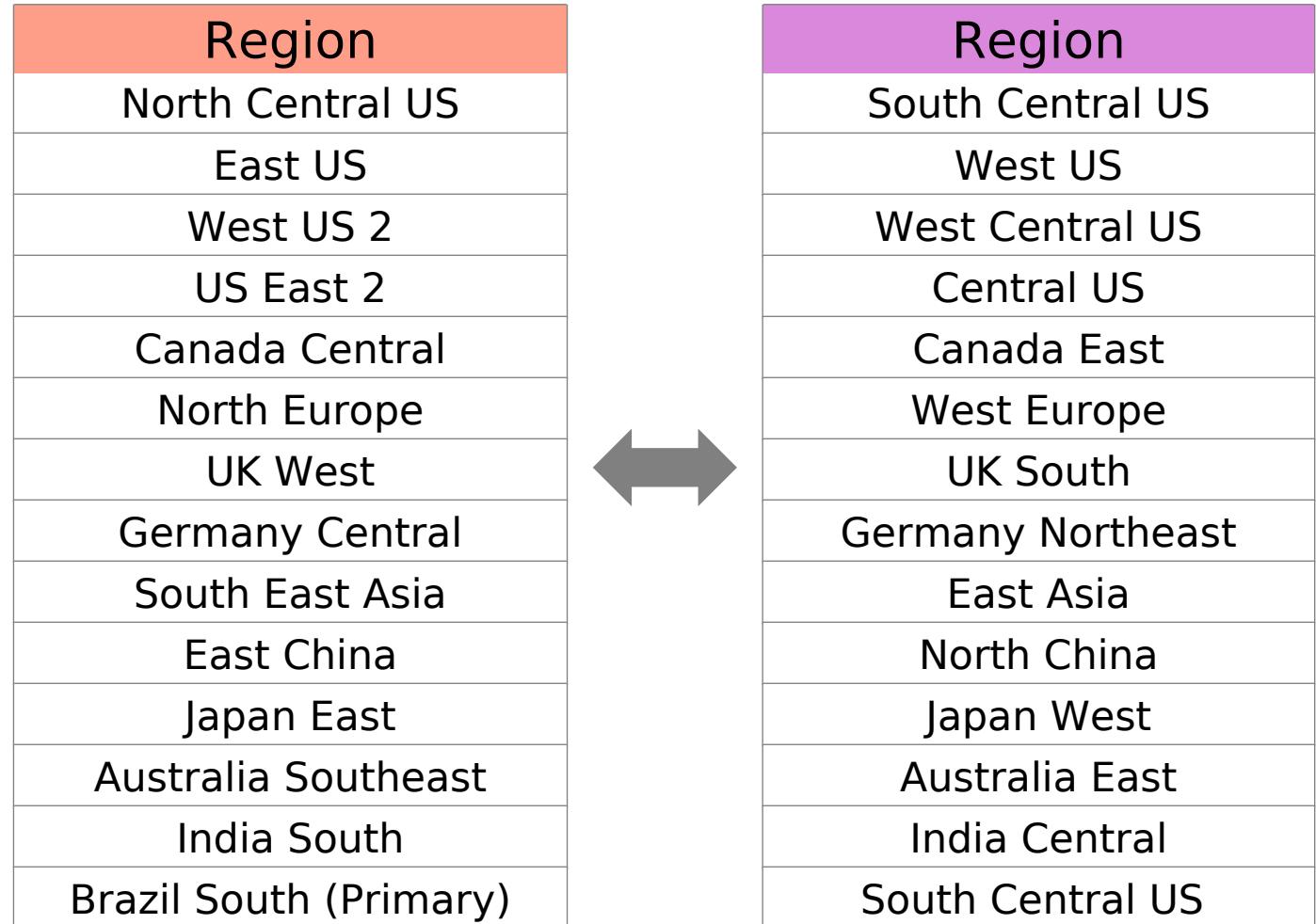
# Availability zones

- Provide protection against downtime due to datacenter failure.
- Physically separate datacenters within the same region.
- Each datacenter is equipped with independent power, cooling, and networking.
- Connected through private fiber-optic networks.



# Region pairs

- At least 300 miles of separation between region pairs.
- Automatic replication for some services.
- Prioritized region recovery in the event of outage.
- Updates are rolled out sequentially to minimize downtime.
- Web link:  
<https://aka.ms/PairedRegions>

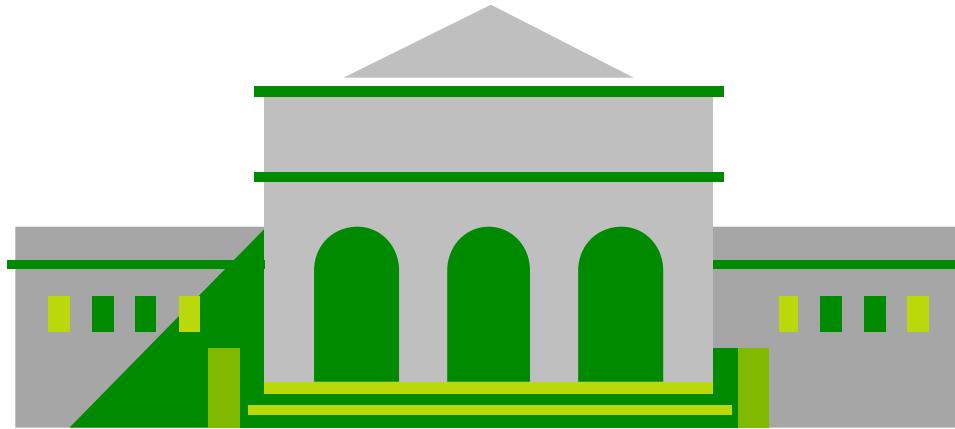


# Azure sovereign regions (US government services)

Meets the security and compliance needs of US federal agencies, state and local governments, and their solution providers.

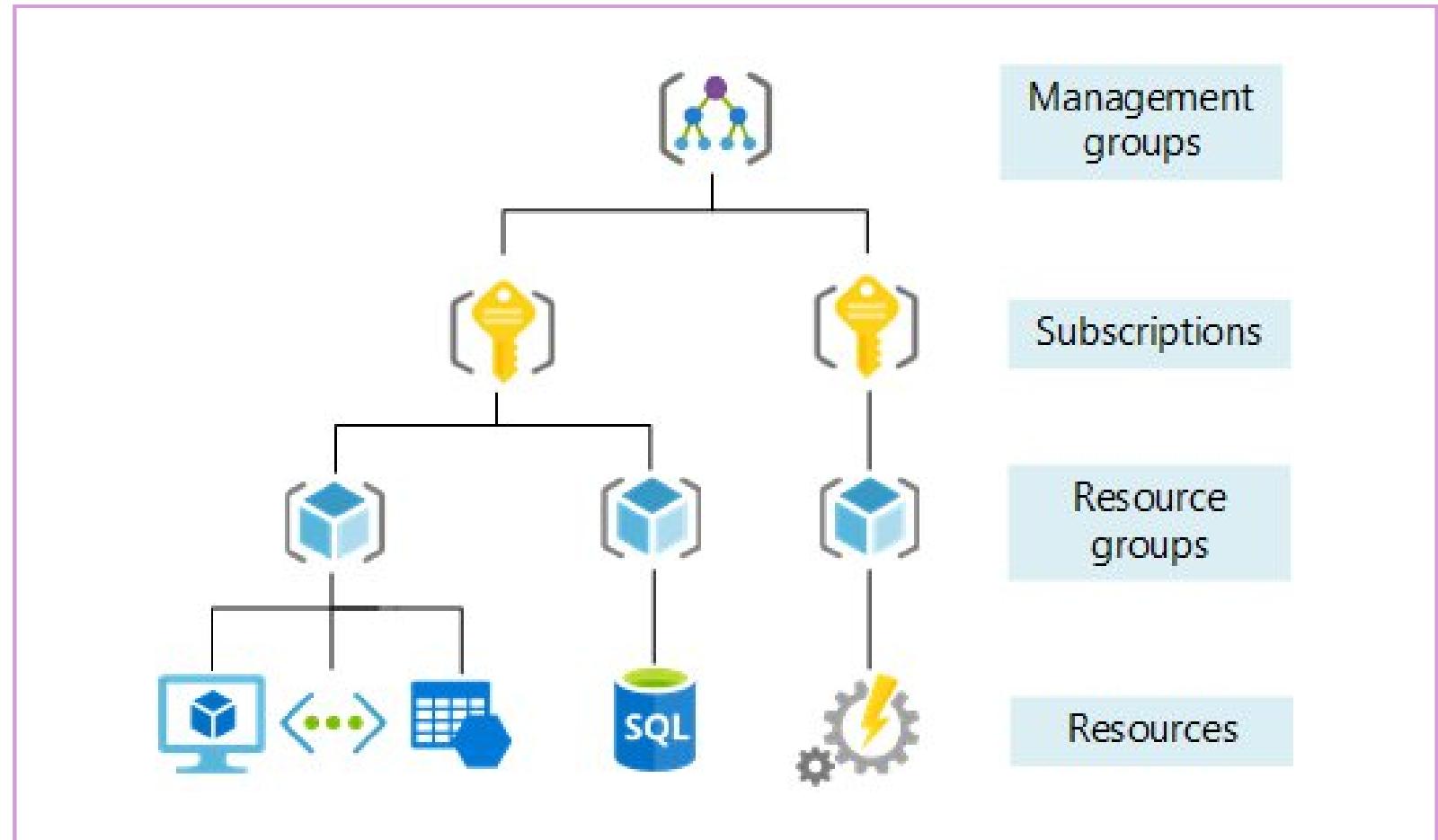
Azure government:

- Separate instance of Azure.
- Physically isolated from non-US government deployments.
- Accessible only to screened, authorized personnel.



# Management groups

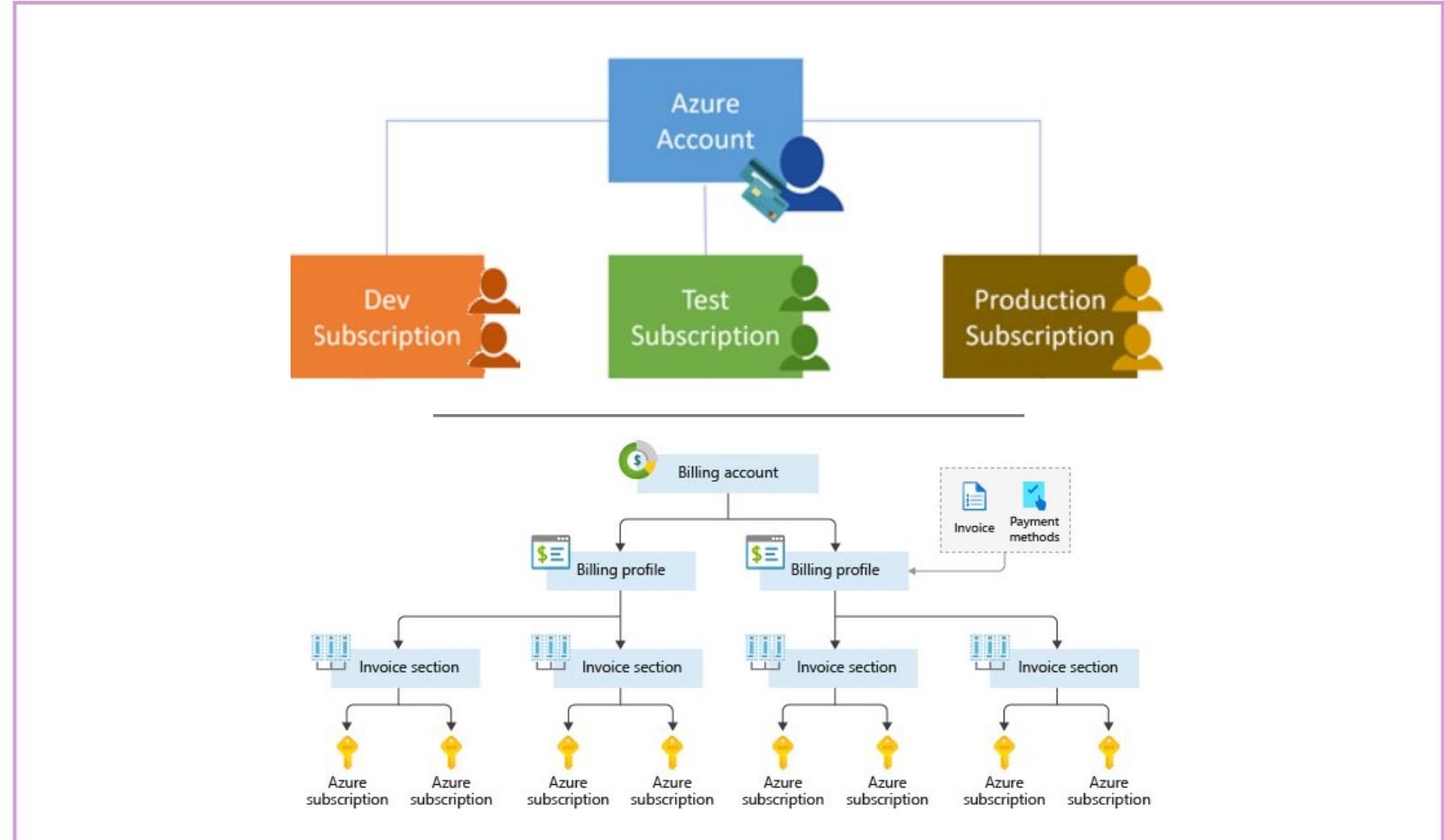
- Management groups can include multiple Azure subscriptions.
- Subscriptions inherit conditions applied to the management group.
- 10,000 management groups can be supported in a single directory.
- A management group tree can support up to six levels of depth.



# Azure subscriptions

An Azure subscription provides you with authenticated and authorized access to Azure accounts.

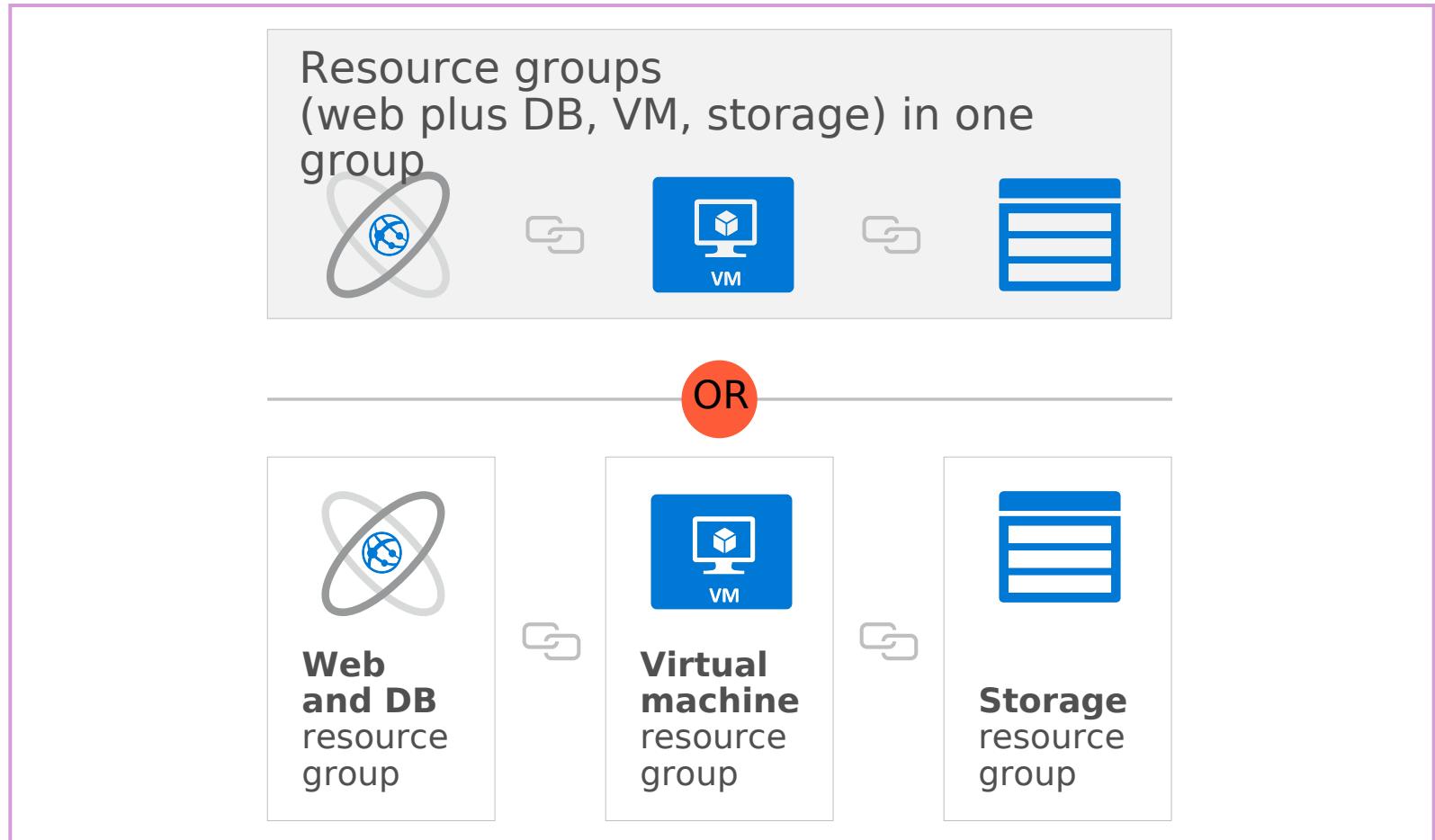
- **Billing boundary:** Generate separate billing reports and invoices for each subscription.
- **Access control boundary:** Manage and control access to the resources that users can provision with specific subscriptions.



# Resource groups

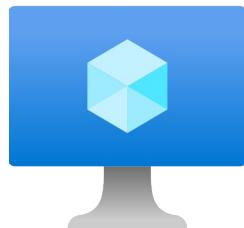
A **resource group** is a container you use to manage and aggregate resources in a single unit.

- Resources can exist in only one resource group.
- Resources can exist in different regions.
- Resources can be moved to different resource groups.
- Applications can utilize multiple resource groups.



# Azure resources

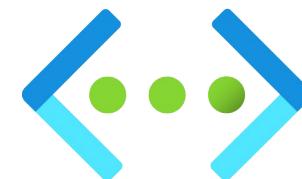
Azure **resources** are components like storage, virtual machines, and networks that are available to build cloud solutions.



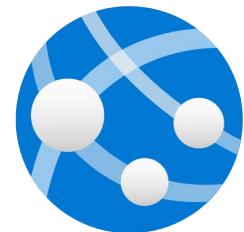
Virtual machines



Storage accounts



Virtual networks



App services



SQL databases



Functions

# Compute and Networking



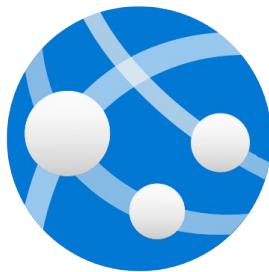
# Azure compute services

Azure **compute** is an on-demand service that provides computing resources such as disks, processors, memory, networking, and operating systems.

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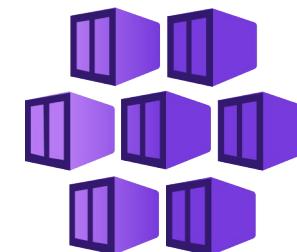
Virtual  
Machines



App  
Services



Container  
Instances



Azure Kubernetes  
Services (AKS)

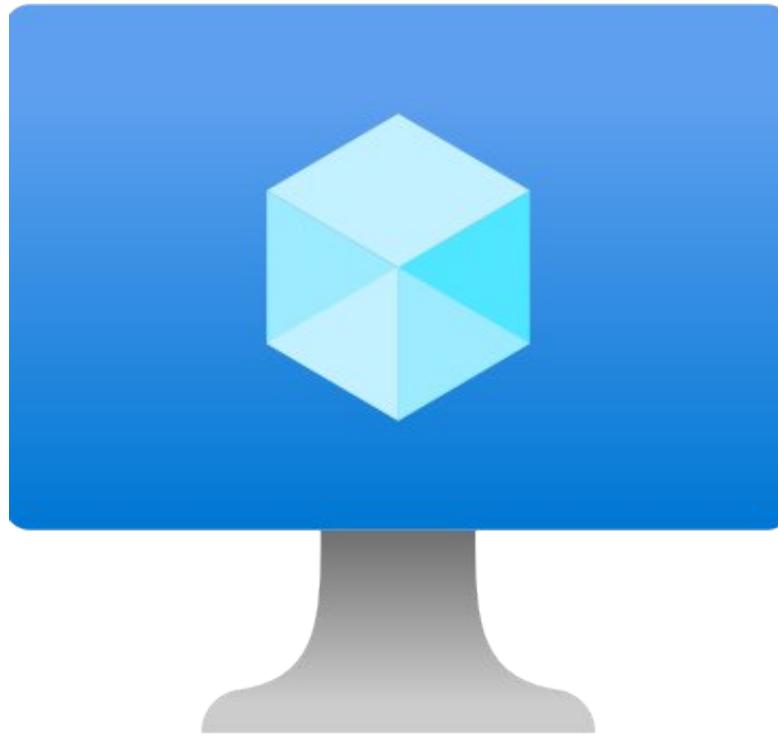


Azure Virtual  
Desktop

# Azure virtual machines

Azure **virtual machines (VMs)** are software emulations of physical computers.

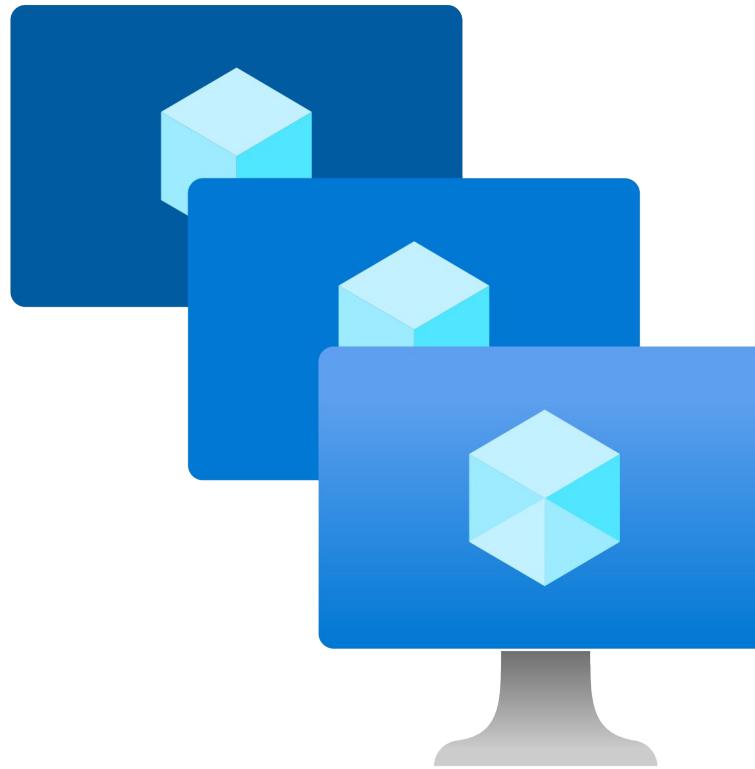
- Includes virtual processor, memory, storage, and networking.
- IaaS offering that provides total control and customization.



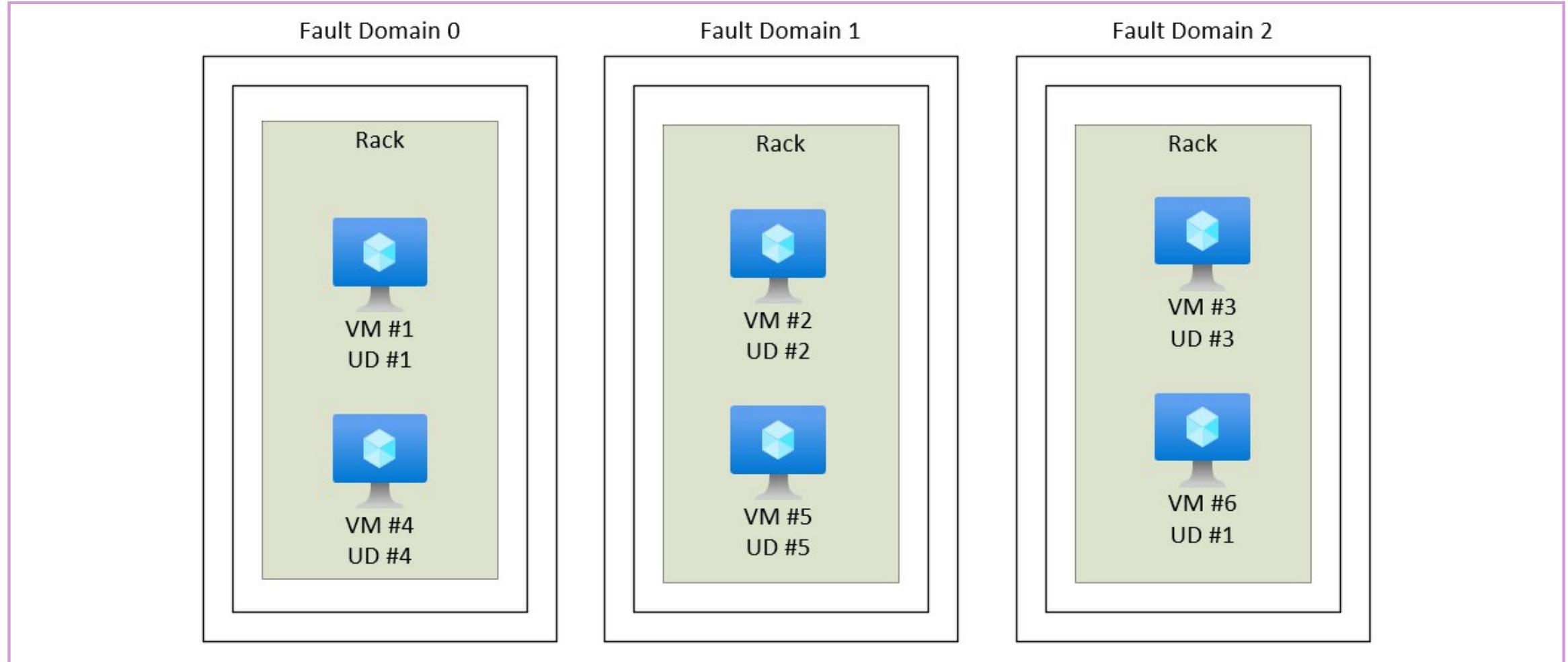
# VM scale sets

Scale sets provide a load-balanced opportunity to automatically scale resources.

- Scale out when resource needs increase.
- Scale in when resource needs are lower.



# VM availability sets



# Azure App Services



.NET



Node.js



PHP



Java



Python (on Linux)



HTML



Custom Windows/Linux Container

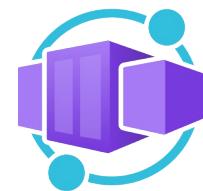
- Includes Web Apps, API Apps, Mobile Apps, and Function Apps
- Fully managed environment enabling high productivity development
- Platform-as-a-service (PaaS) offering for building and deploying highly available cloud apps for web and mobile
- Platform handles infrastructure so developers focus on core web apps and services
- Developer productivity using .NET, .NET Core, Java, Python and a host of others
- Provides enterprise-grade security and compliance

# Azure container services

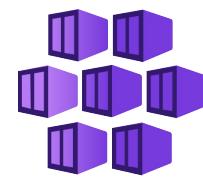
Azure **containers** provide a lightweight, virtualized environment that does not require operating system management, and can respond to changes on demand.



**Azure Container Instances:** A PaaS offering that runs a container or pod of containers in Azure.



**Azure Container Apps:** A PaaS offering, like container instances, that can load balance and scale.



**Azure Kubernetes Service:** An orchestration service for containers with distributed architectures and large volumes of containers.

# Azure Virtual Desktop

**Azure Virtual Desktop** is a desktop and app virtualization that runs in the cloud.

- Create a full desktop virtualization environment without having to run additional gateway servers.
- Reduce risk of resource being left behind.
- True multisession deployments.



# Comparing Azure compute options

## Virtual machines

- Cloud-based server that supports either Windows or Linux environments.
- Useful for lift-and-shift migrations to the cloud.
- Complete operating system package, including the host operating system.

## Virtual Desktop

- Provides a cloud-based personal computer Windows desktop experience.
- Dedicated applications to connect and use, or accessible from any modern browser.
- Multiclient login allows multiple users to log into the same machine at the same time.

## Containers

- Lightweight, miniature environment well suited for running microservices.
- Designed for scalability and resiliency through orchestration.
- Applications and services are packaged in a container that sits on top of the host operating system. Multiple containers can sit on one host OS.

# Azure App Services

Azure **App Services** is a fully managed platform to build, deploy, and scale web apps and APIs quickly.

- Works with .NET, .NET Core, Node.js, Java, Python, or php.
- PaaS offering with enterprise-grade performance, security, and compliance requirements.



# Azure networking services



**Azure Virtual Network (VNet)** enables Azure resources to communicate with each other, the internet, and on-premises networks.

- Public endpoints, accessible from anywhere on the internet.
- Private endpoints, accessible only from within your network.
- Virtual subnets segment your network to suit your needs.
- Network peering connects your private networks directly together.



# Azure DNS

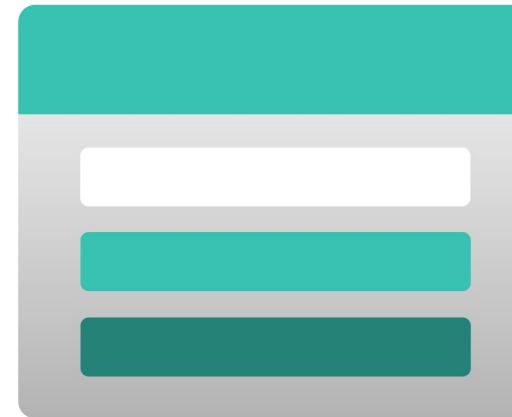
- Reliability and performance by leveraging a global network of DNS name servers using Anycast networking.
- Azure DNS security is based on Azure resource manager, enabling role-based access control and monitoring and logging.
- Ease of use for managing your Azure and external resources with a single DNS service.
- Customizable virtual networks allow you to use private, fully customized domain names in your private virtual networks.
- Alias records support alias record sets to point directly to an Azure resource.

# Storage



# Storage accounts

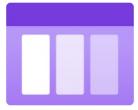
- Must have a globally unique name.
- Provide over-the-internet access worldwide.
- Determine storage services and redundancy options.



# Storage redundancy

Redundancy configuration	Deployment	Durability
Locally redundant storage (LRS)	Single datacenter in the primary region	11 nines
Zone-redundant storage (ZRS)	Three availability zones in the primary region	12 nines
Geo-redundant storage (GRS)	Single datacenter in the primary and secondary region	16 nines
Geo-zone-redundant-storage (GZRS)	Three availability zones in the primary region and a single datacenter in the secondary region	16 nines

# Azure storage services

-  Azure Blob: Optimized for storing massive amounts of unstructured data, such as text or binary data.
-  Azure Disk: Provides disks for virtual machines, applications, and other services to access and use.
-  Azure Queue: Message storage service that provides storage and retrieval for large amounts of messages, each up to 64 KB.
-  Azure Files: Sets up a highly available network file share that can be accessed by using the Server Message Block protocol.
-  Azure Tables: Provides a key/attribute option for structured nonrelational data storage with a schema-less design.

# Storage service public endpoints

Storage service	Public endpoint
Blob Storage	<code>https://&lt;storage-account-name&gt;.blob.core.windows.net</code>
Data Lake Storage Gen2	<code>https://&lt;storage-account-name&gt;.dfs.core.windows.net</code>
Azure Files	<code>https://&lt;storage-account-name&gt;.file.core.windows.net</code>
Queue Storage	<code>https://&lt;storage-account-name&gt;.queue.core.windows.net</code>
Table Storage	<code>https://&lt;storage-account-name&gt;.table.core.windows.net</code>

# Azure storage access tiers

Hot	Cool	Cold	Archive
Optimized for storing data that is accessed frequently.	Optimized for storing data that is infrequently accessed and stored for at least 30 days.	Optimized for storing data that is infrequently accessed and stored for at least 90 days.	Optimized for storing data that is rarely accessed and stored for at least 180 days with flexible latency requirements.

# Azure Data Box

- Store up to 80 terabytes of data.
- Move your disaster recovery backups to Azure.
- Protect your data in a rugged case during transit.
- Migrate data out of Azure for compliance or regulatory needs.
- Migrate data to Azure from remote locations with limited or no connectivity.



# File management options

## AzCopy

- Command-line utility.
- Copy blobs or files to or from your storage account.
- One-direction synchronization.

## Azure Storage Explorer

- Graphical user interface (similar to Windows Explorer).
- Compatible with Windows, MacOS, and Linux.
- Uses AzCopy to handle file operations.

## Azure File Sync

- Synchronizes Azure and on-premises files in a bidirectional manner.
- Cloud tiering keeps frequently accessed files local, while freeing up space.
- Rapid reprovisioning of failed local server (install and resync).

# Identity, access, and security



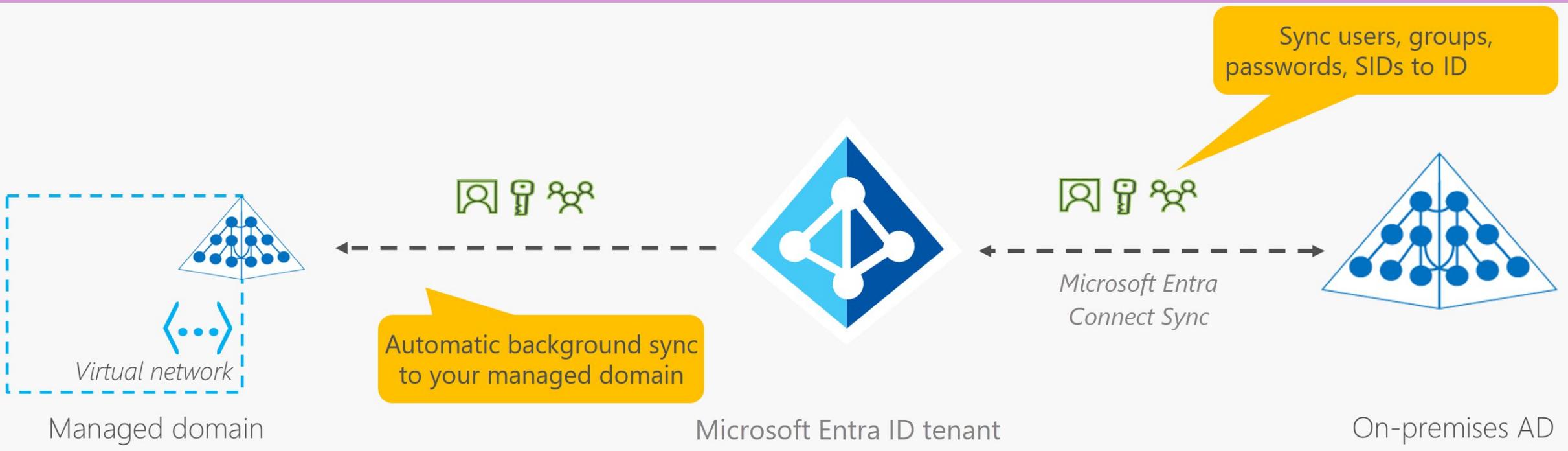
# Microsoft Entra ID

**Microsoft Entra ID** is Microsoft Azure's cloud-based identity and access management service.

- Authentication (employees sign in to access resources).
- Single sign-on (SSO).
- Application management.
- Business to Business (B2B).
- Device management.



# Microsoft Entra Domain Services



- Gain the benefit of cloud-based domain services without managing domain controllers.
- Run legacy applications (that can't use modern auth standards) in the cloud.
- Automatically sync from Microsoft Entra ID.

# Compare authentication and authorization

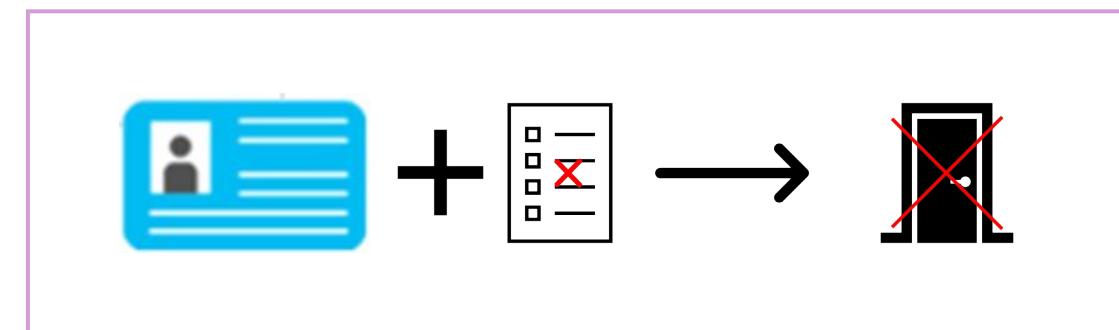
## Authentication

- Identifies the person or service seeking access to a resource.
- Requests legitimate access credentials.
- Basis for creating secure identity and access control principles.



## Authorization

- Determines an authenticated person's or service's level of access.
- Defines which data they can access, and what they can do with it.



# Multifactor authentication



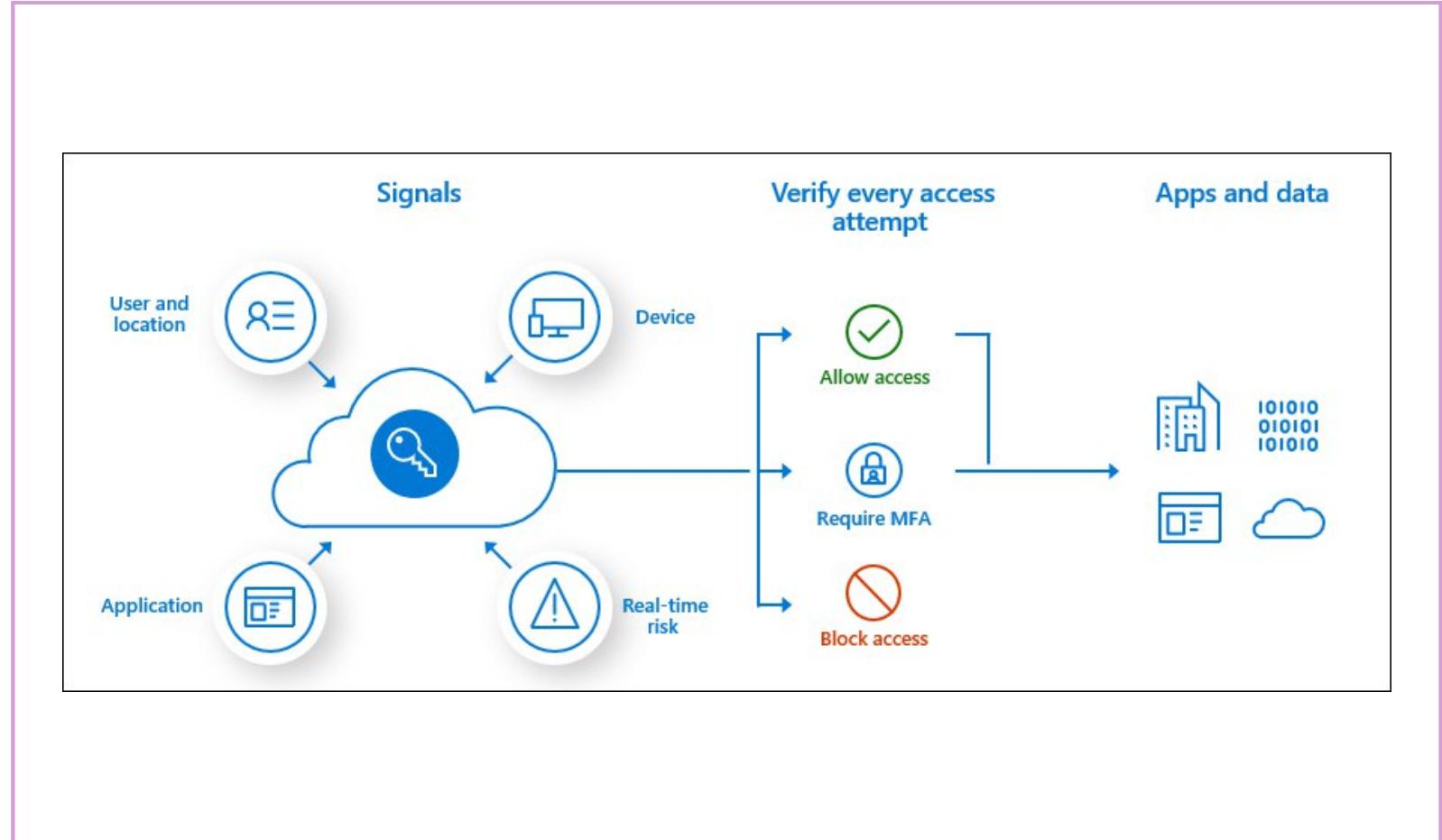
Provides additional security for your identities by requiring two or more elements for full authentication.

- Something you know ☰
- Something you possess ☰
- Something you are ☰

# Conditional Access

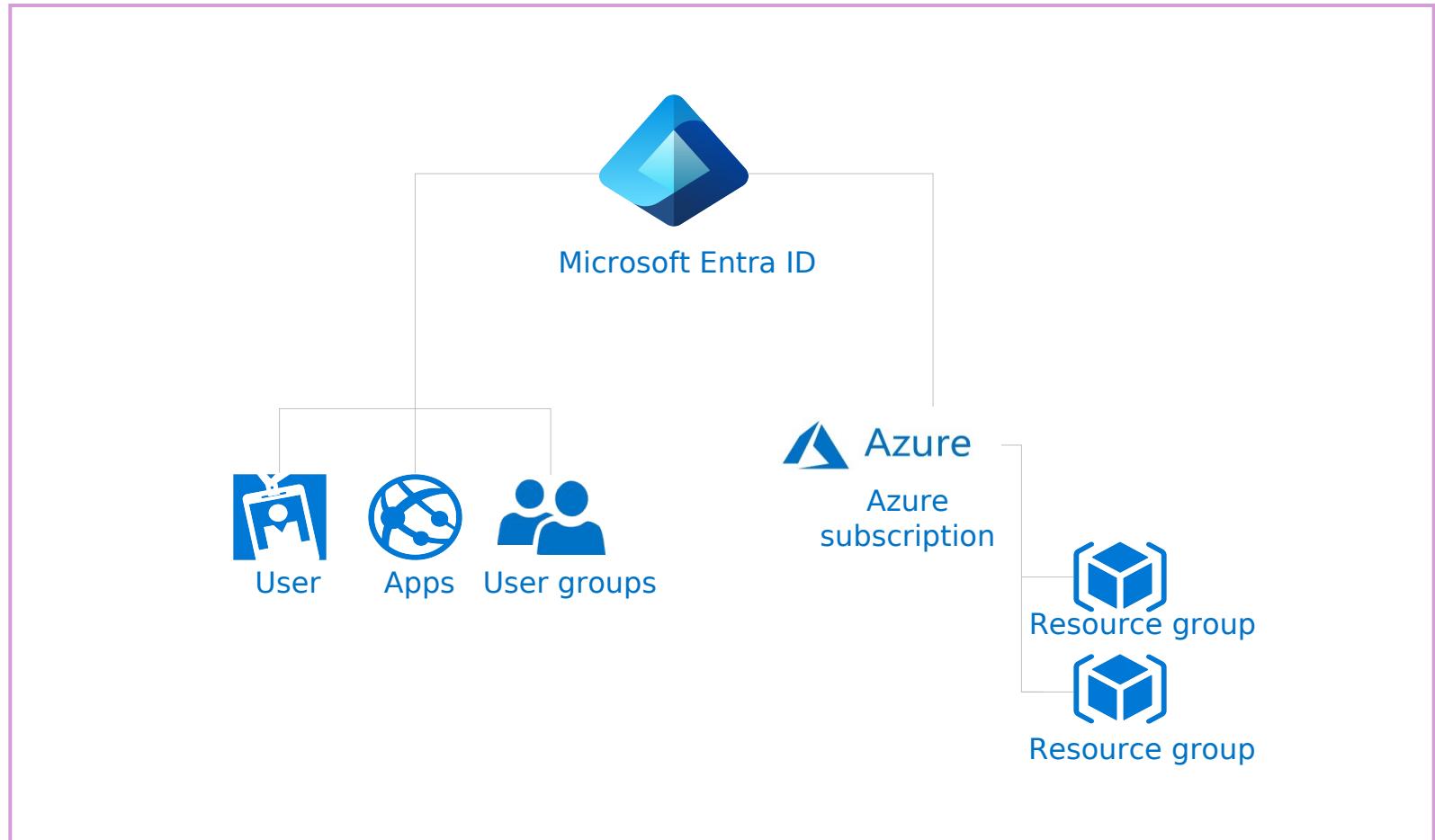
**Conditional Access** is used to bring signals together, to make decisions, and enforce organizational policies.

- User or group membership
- IP location
- Device
- Application
- Risk detection



# Role-based access control

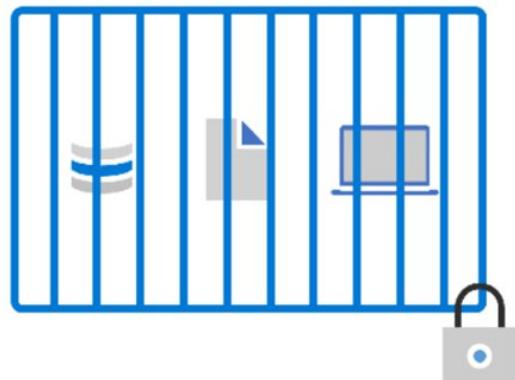
- Fine-grained access management.
- Segregate duties within the team and grant only the amount of access to users that they need to perform their jobs.
- Enables access to the Azure portal and controlling access to resources.



# Zero Trust

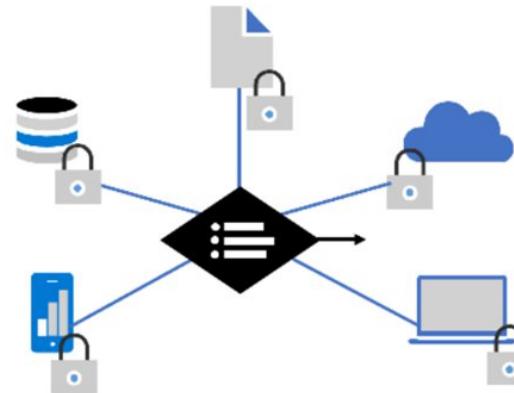
Secure assets where they are with Zero Trust

Simplify security and make it more effective



## Classic Approach

Restrict everything to a 'secure' network

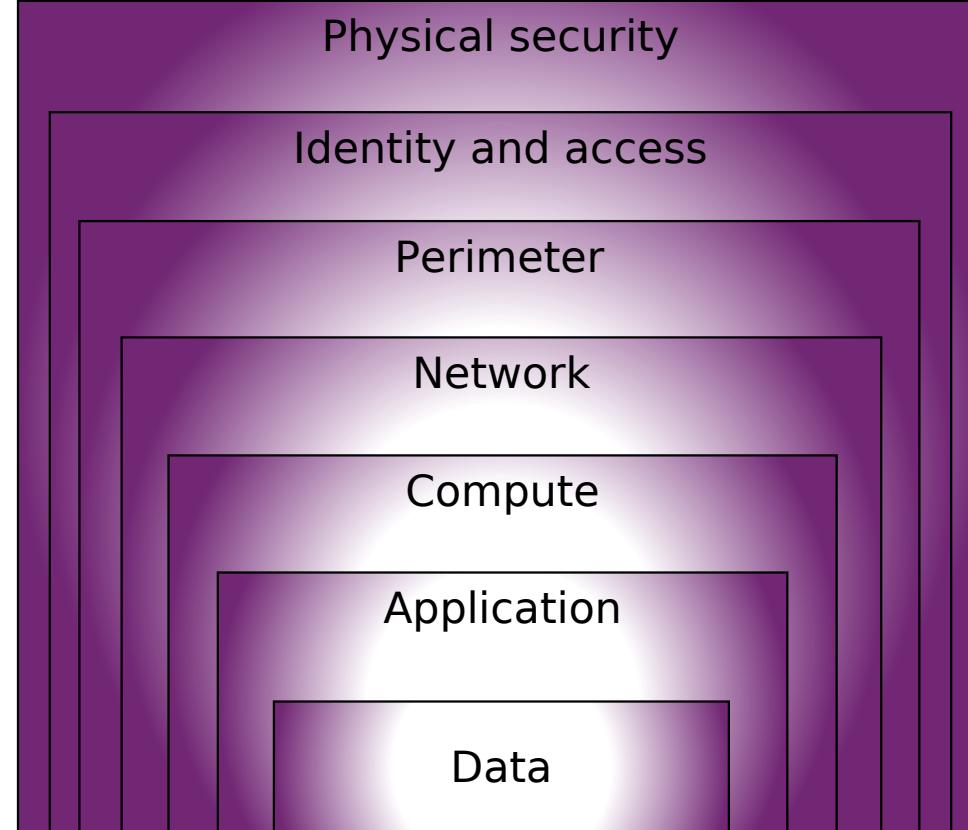


## Zero Trust

Protect assets anywhere with central policy

# Defense in depth

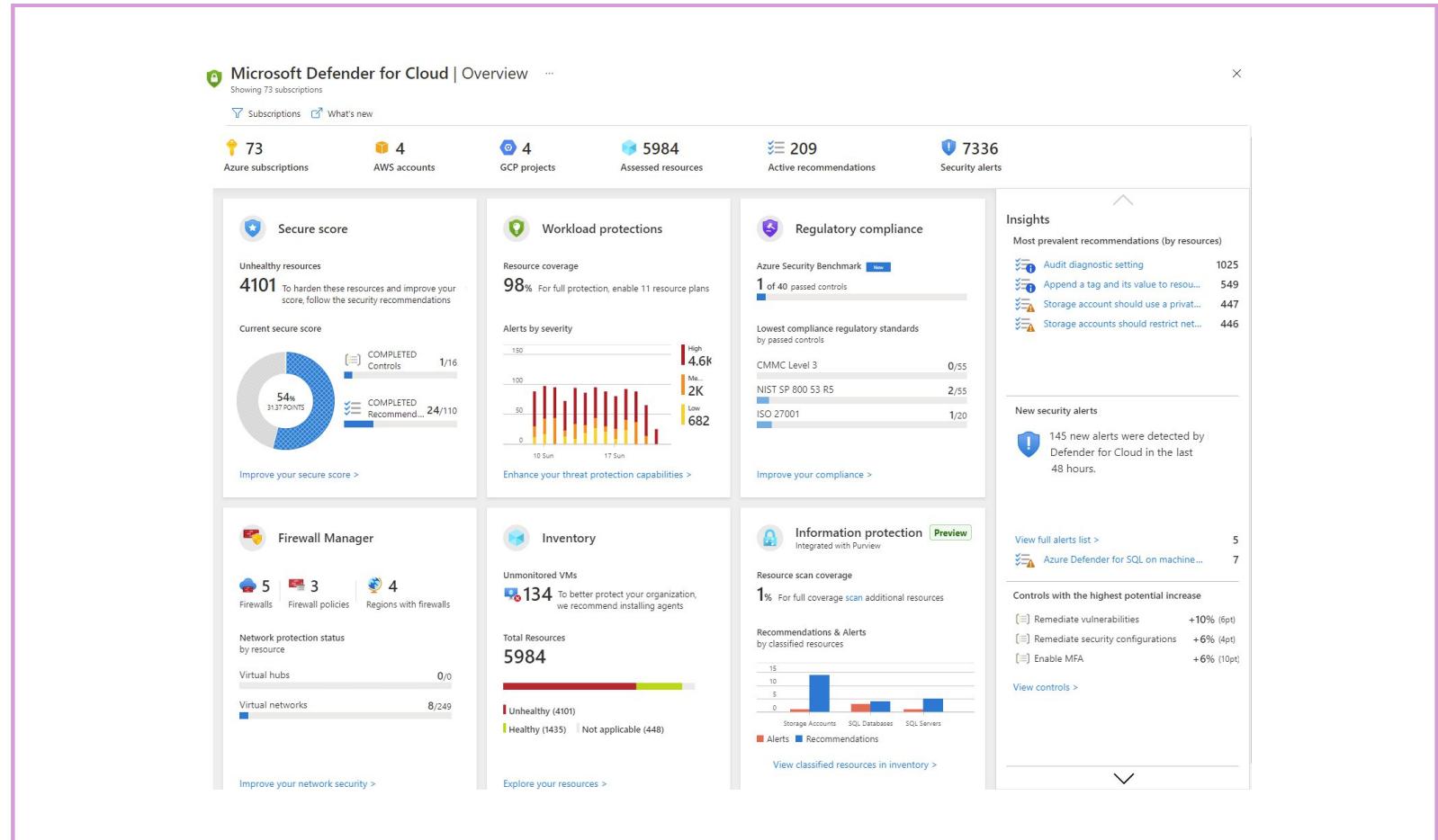
- A layered approach to securing computer systems.
- Provides multiple levels of protection.
- Attacks against one layer are isolated from subsequent layers.



# Microsoft Defender for Cloud

Microsoft Defender for Cloud is a monitoring service that provides threat protection across both Azure and on-premises datacenters.

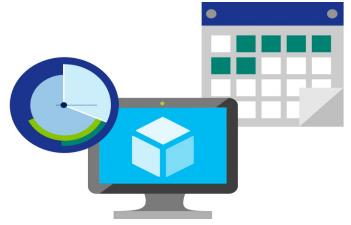
- Provides security recommendations.
- Detect and block malware.
- Analyze and identify potential attacks.
- Just-in-time access control for ports.



# Cost management



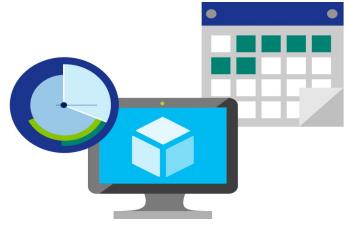
# Factors affecting costs (part 1)



These are some of the factors affecting costs:

1) Resource type	2) Consumption	3) Maintenance
Costs are resource-specific, so the usage that a meter tracks and the number of meters associated with a resource, depend on the resource type.	With a pay-as-you-go model, consumption is one of the biggest drivers of costs.	Monitoring your Azure footprint and maintaining your environment can help you identify and mitigate costs that aren't necessary, such as shutting down underused virtual machines.

# Factors affecting costs (part 2)



These are some of the factors affecting costs:

4) Geography	5) Network traffic	6) Subscription
The same resource type can cost different amounts depending on the geographic area, which has an impact on Azure costs.	While some inbound data transfers are free, the cost for outbound data or data between Azure resources is impacted by billing zones.	The type and configuration of your subscription can also impact your cost. For example, the free trial lets you explore some Azure resources for free.

# Explore Azure Marketplace

## 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 platforms.

- Virtual machine and database images.
- Application build and deployment software.
- Developer tools.
- And much more, with 10,000-plus listings!



# Pricing calculator

The **pricing calculator** is a tool that helps you estimate the cost of Azure products. The options that you can configure in the pricing calculator vary between products, but basic configuration options include:

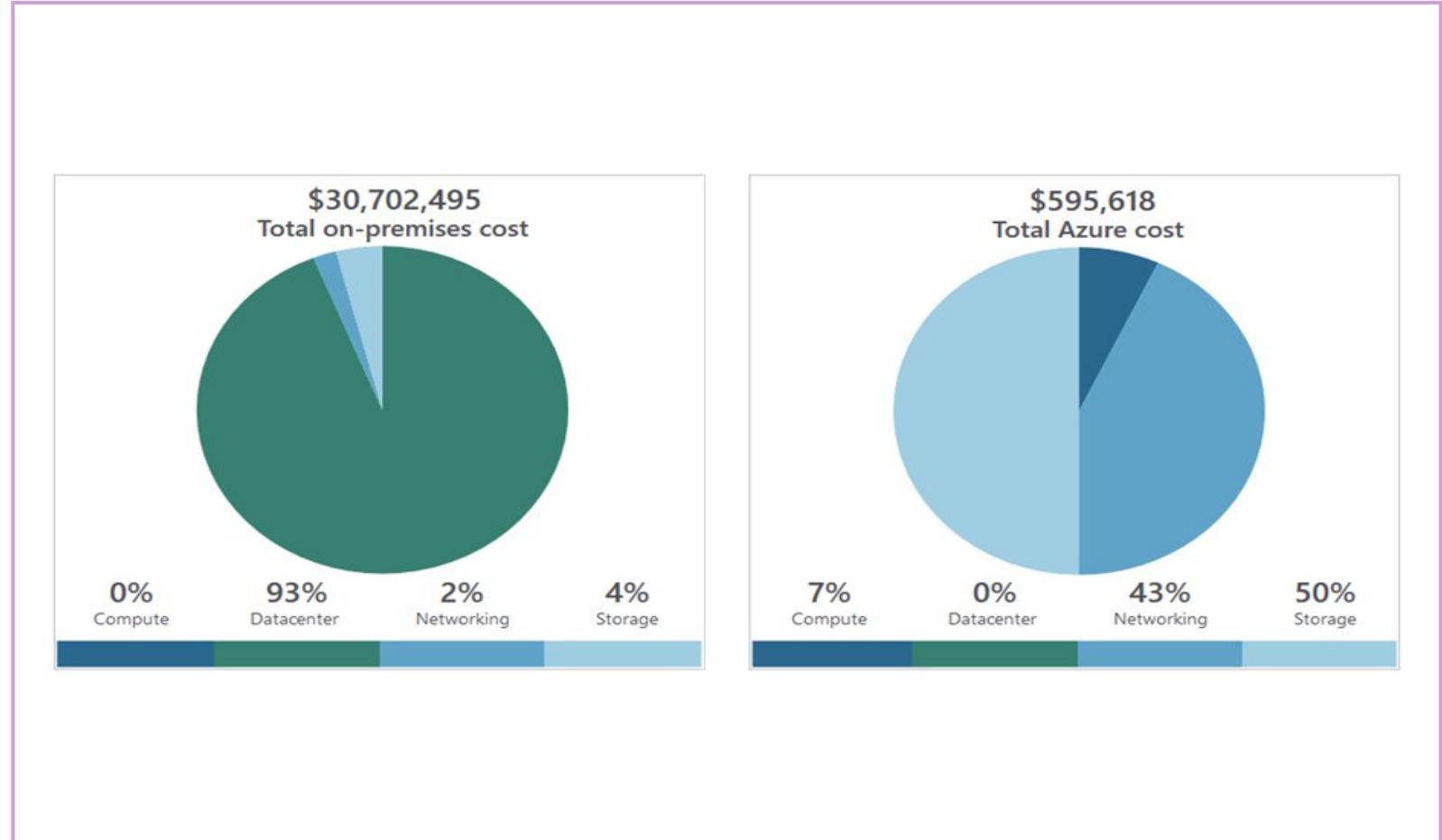
- Tier
- Billing options
- Support options
- Programs and offers
- Azure dev/test pricing

The screenshot shows the Azure Pricing Calculator interface. At the top, it displays "Your Estimate" and a summary row for "Virtual Machines": "1 D2 v3 (2 vCPUs, 8 GB RAM) x 730 Hours (...)" with "Upfront: USD 0.00" and "Monthly: USD". Below this are several dropdown menus and input fields:

- Virtual Machines**:
  - REGION: West US
  - OPERATING SYSTEM: Windows
  - TYPE: (OS Only)
  - TIER: Standard
- Virtual Machines**:
  - CATEGORY: All
  - INSTANCE SERIES: All
  - INSTANCE: D2 v3: 2 vCPUs, 8 GB RAM, 50 GB Temporary storage, USD 0.209/hour
- Virtual machines**:
  - 1
  - x
  - 730
  - Hours

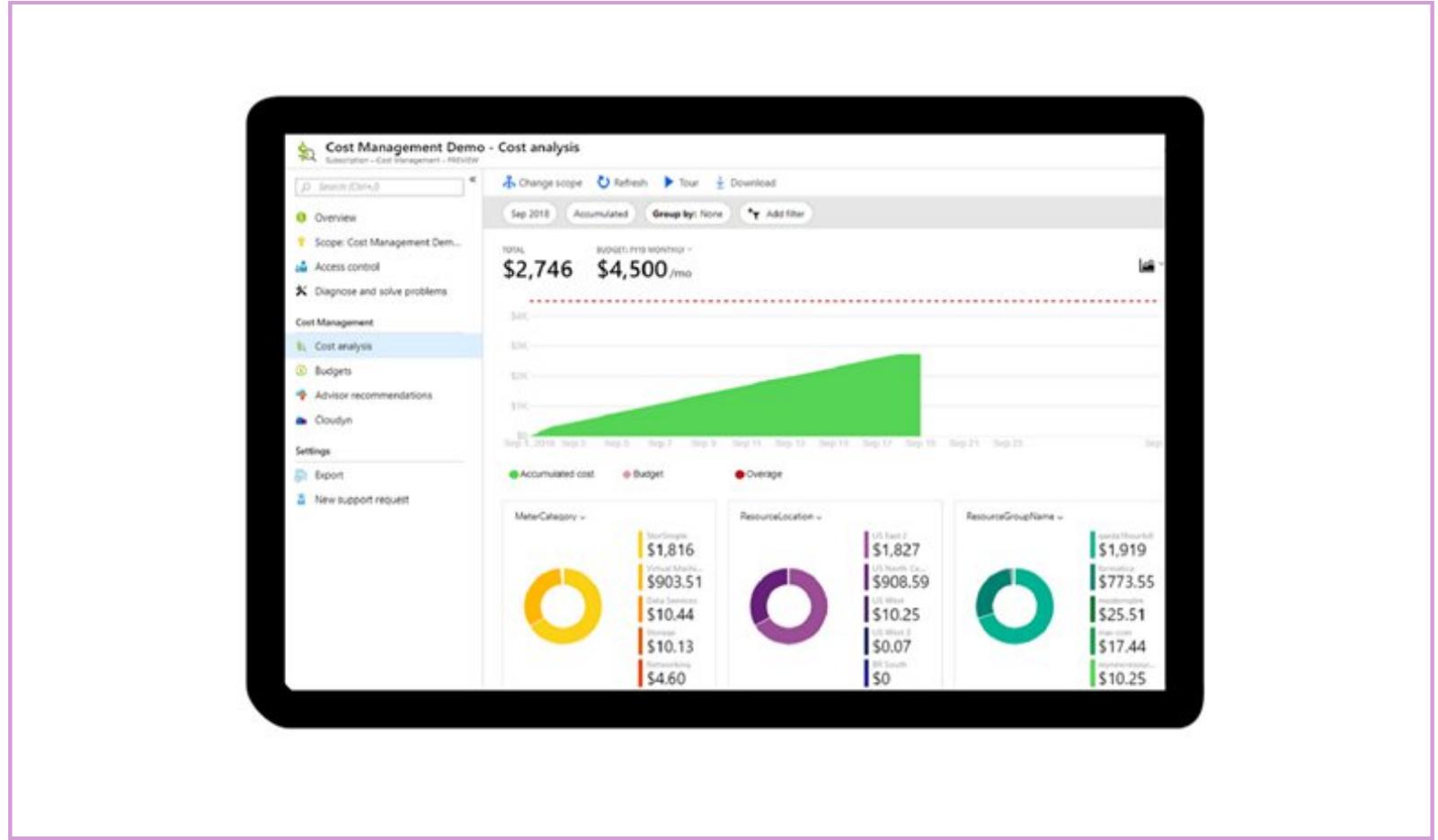
# Total Cost of Ownership (TCO) calculator

- A tool to estimate cost savings you can realize by migrating to Azure.
- A report compares the costs of on-premises infrastructures with the costs of using Azure products and services in the cloud.



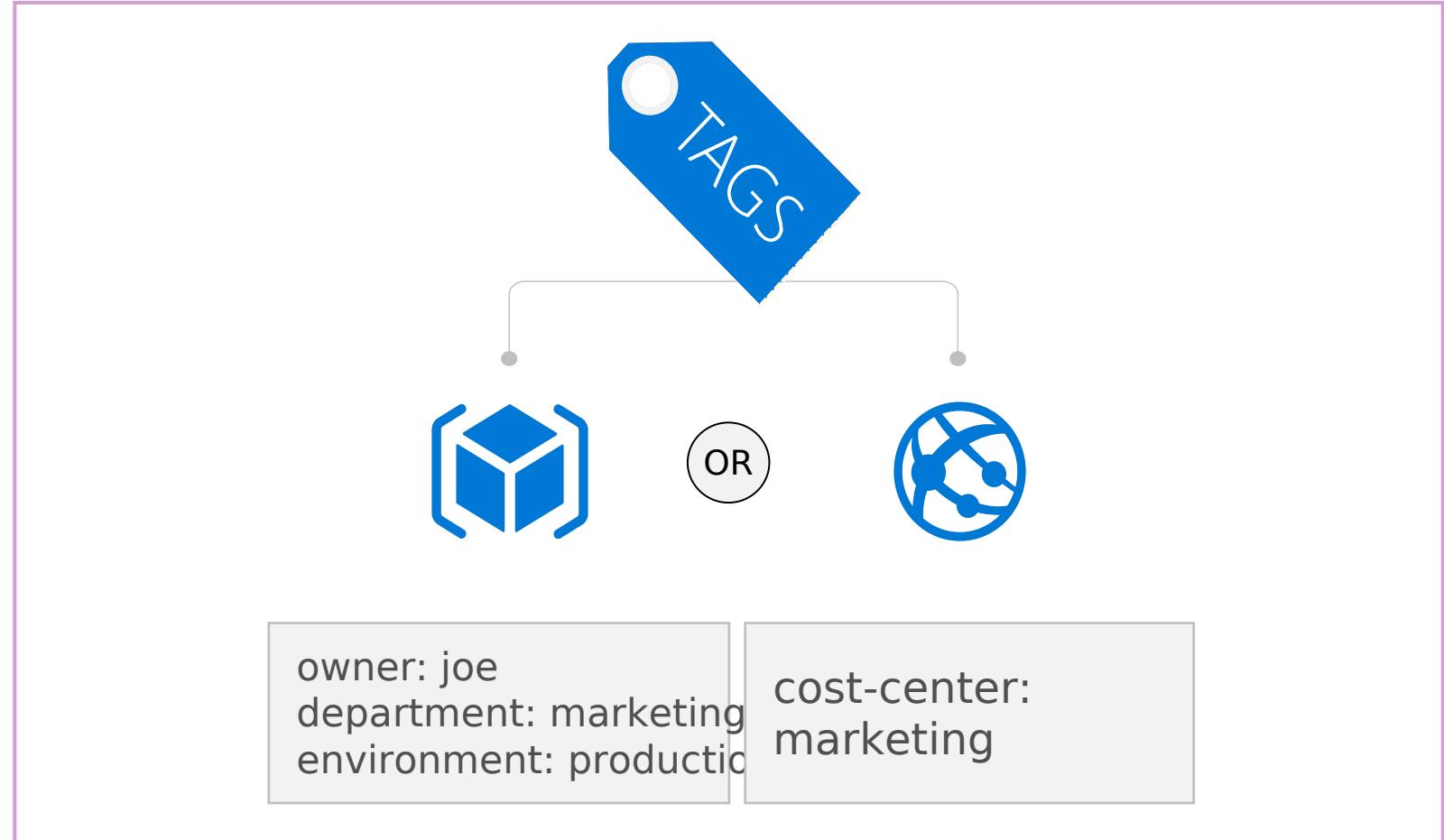
# Azure Cost Management

- Reporting: Billing reports
- Data enrichment
- Budgets: Set spend budget
- Alerting: When cost exceed limits
- Recommendation: Cost recommendations



# Tags

- Provides metadata for your Azure resources.
- Logically organizes resources into a taxonomy.
- Consists of a name-value pair.
- Very useful for rolling up billing information.



# Governance and compliance

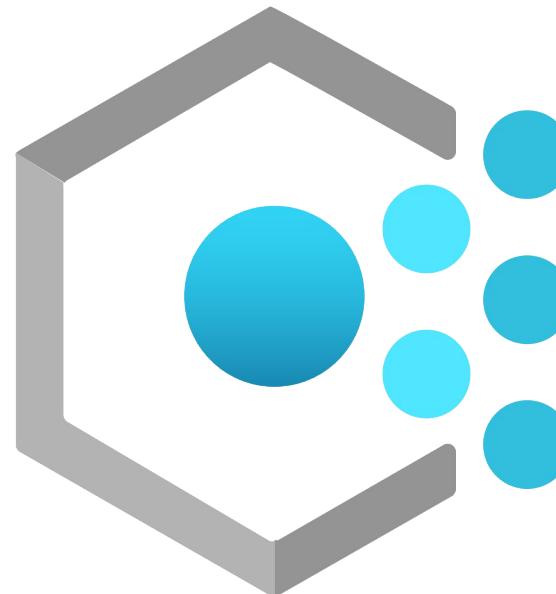


# Azure Policy

**Azure Policy** helps to enforce organizational standards and to assess compliance at scale.

Provides governance and resource consistency with regulatory compliance, security, cost, and

- Evaluates and identifies Azure resources that do not comply with your policies.
- Provides built-in policy and initiative definitions, under categories such as Storage, Networking, Compute, Security Center, and Monitoring.



# Resource locks

- Protect your Azure resources from accidental deletion or modification.
- Manage locks at subscription, resource group, or individual resource levels within the Azure portal.

Lock Types	Read	Update	Delete
Delete	Yes	Yes	No
ReadOnly	Yes	No	No

# Microsoft Purview

**Microsoft Purview** is a family of data governance, risk, and compliance solutions that helps you get a single, unified view into your data. Microsoft Purview brings insights about your on-premises, multicloud, and software as a service data together.



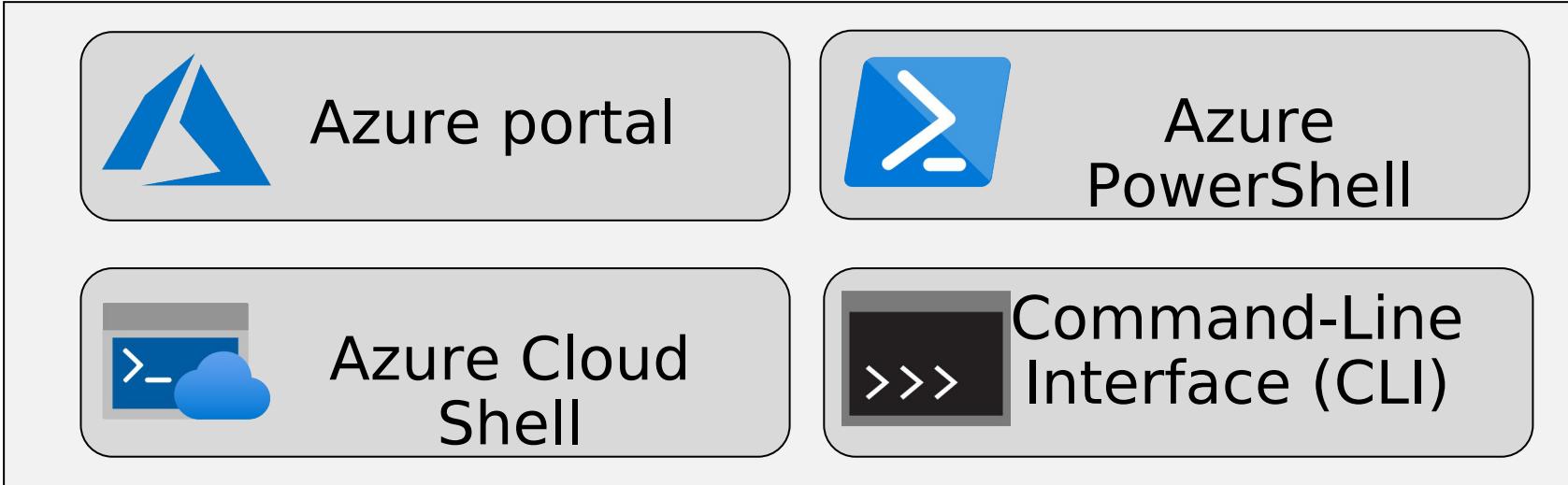
# Management and deployment tools



# Management and deployment tools—objective domain

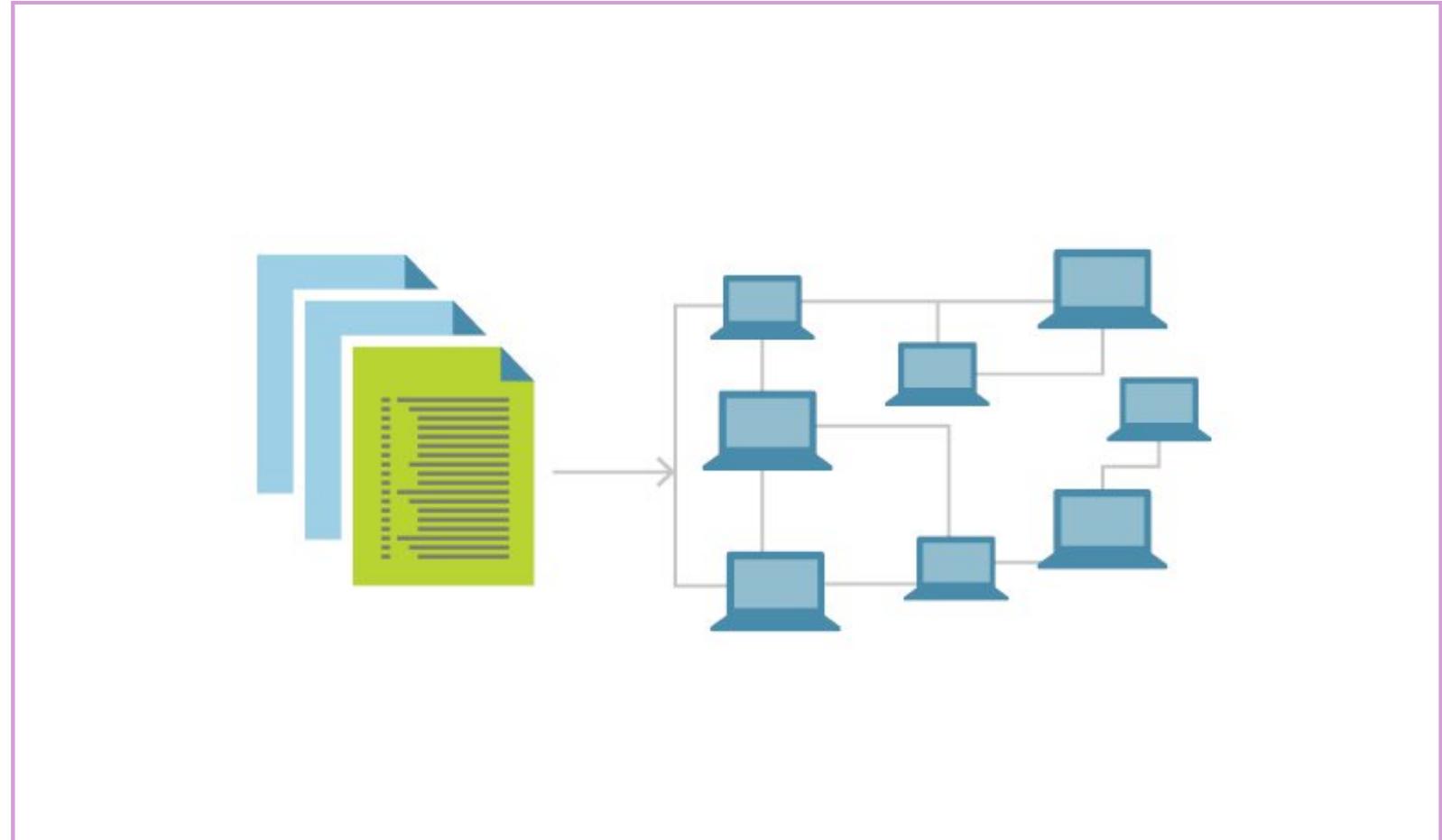
- Describe Azure portal.
- Describe Azure Cloud Shell, including Azure CLI and Azure PowerShell.
- Describe the purpose of Azure Arc.
- Describe Azure Resource Manager (ARM) and Azure ARM templates.

# Tools for interacting with Azure



# Infrastructure as code

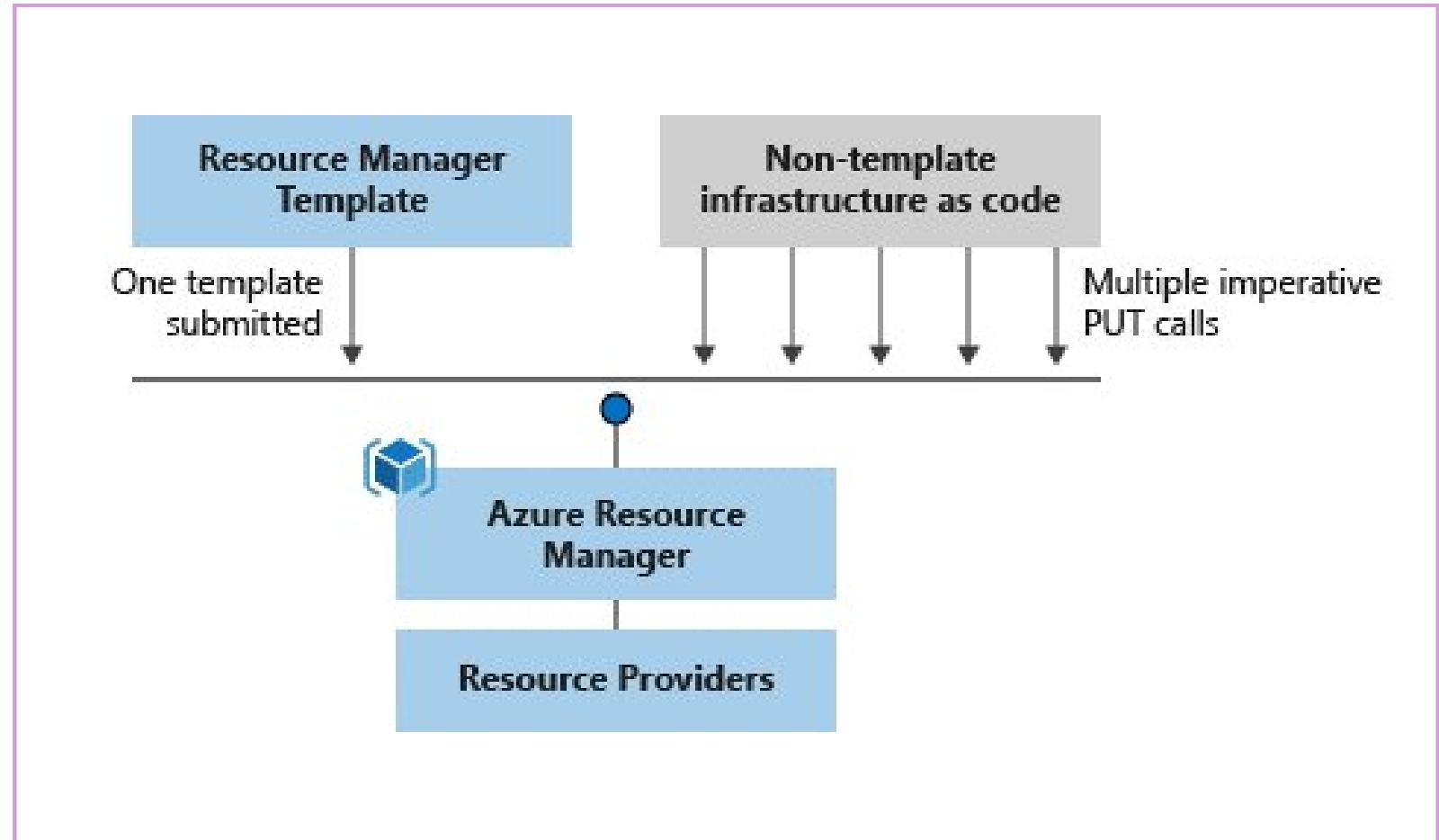
- Ensure consistency in deployment across your cloud ecosystem.
- Manage configuration at scale.
- Rapidly provision additional environments based on a standard configuration and build.



# Azure Resource Manager (ARM) templates

**Azure Resource Manager (ARM)** templates are JavaScript Object Notation (JSON) files that can be used to create and deploy Azure infrastructure without having to write programming commands.

- Declarative syntax
- Repeatable results
- Orchestration
- Modular files
- Built-in validation
- Exportable code



# Bicep

Bicep

```
param location string = resourceGroup().location
param storageAccountName string = 'toylaunch${uniqueString(resourceGroup().id)}'

resource storageAccount 'Microsoft.Storage/storageAccounts@2021-06-01' = {
    name: storageAccountName
    location: location
    sku: {
        name: 'Standard_LRS'
    }
    kind: 'StorageV2'
    properties: {
        accessTier: 'Hot'
    }
}
```

# Azure monitoring tools



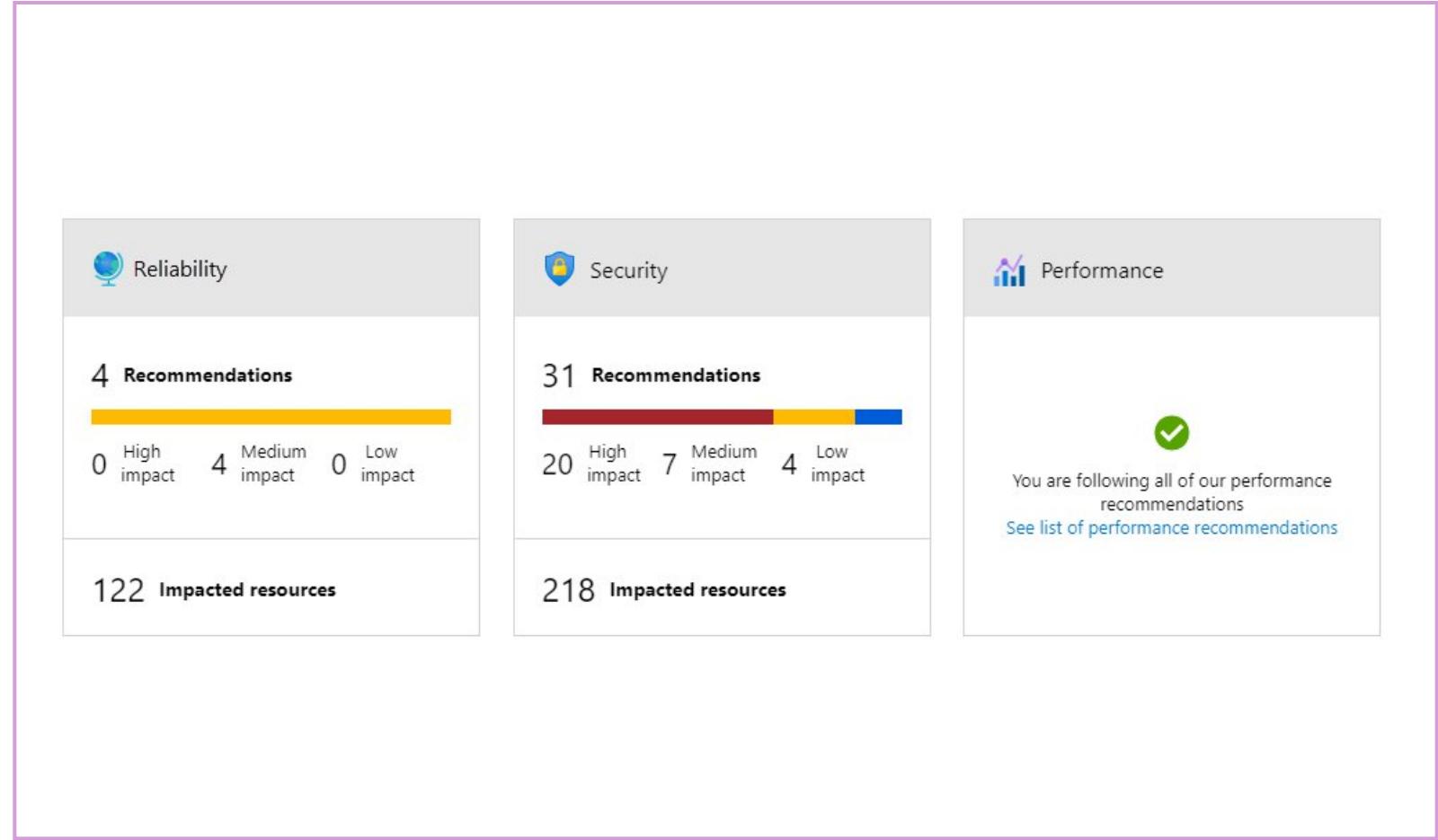


# Azure Advisor

**Azure Advisor** analyzes deployed Azure resources and makes recommendations based on best practices to optimize Azure deployments.

- Reliability
- Security

- Performance
- Cost
- Operational excellence

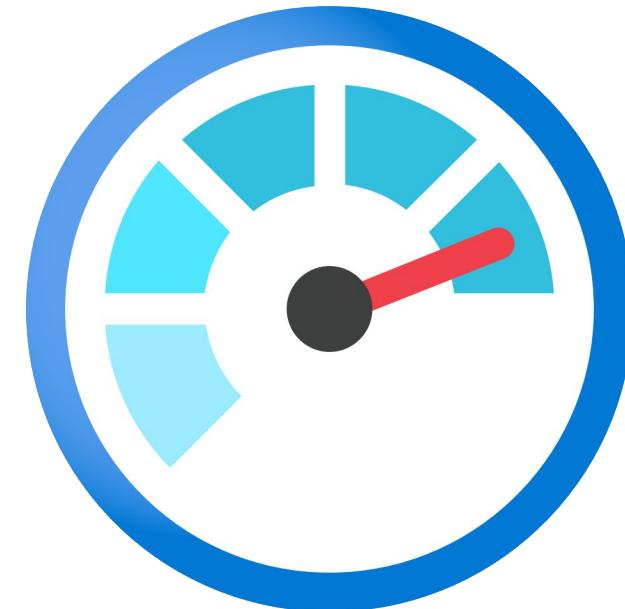


# Azure Monitor

## Azure Monitor

maximizes the availability and performance of applications and services by collecting, analyzing, and acting on telemetry from cloud and on-premises environments.

- Application Insights
- Log Analytics
- Smart alerts
- Automation actions
- Customized dashboards

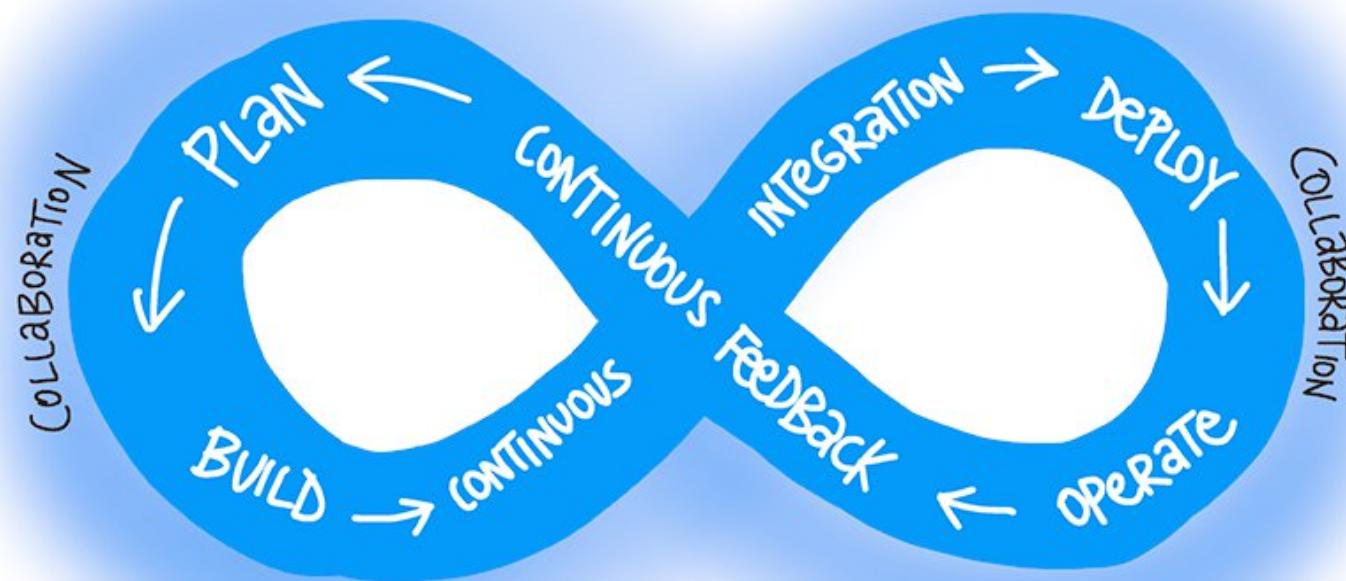


# DevOps-Introduction

# What is DevOps?

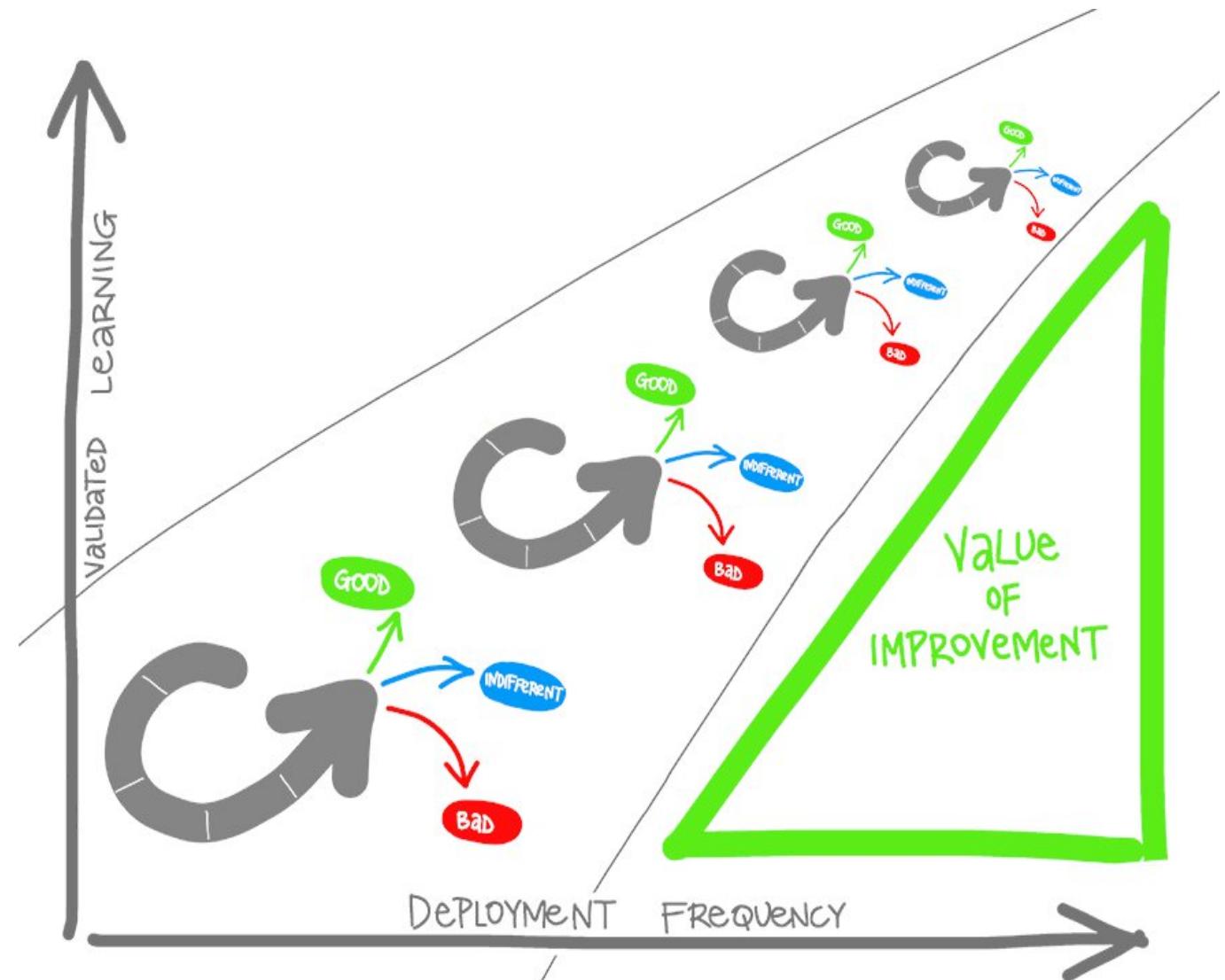
*“DevOps is the union of people, process, and products to enable continuous delivery of value to end users.”*

— Donovan Brown,  
[What is DevOps?](#)



# What is DevOps? (continued)

- Understand your cycle time
- Become data-informed
- Strive for validated learning
- Shorten your cycle time
- Optimize validated learning



# Explore the DevOps journey

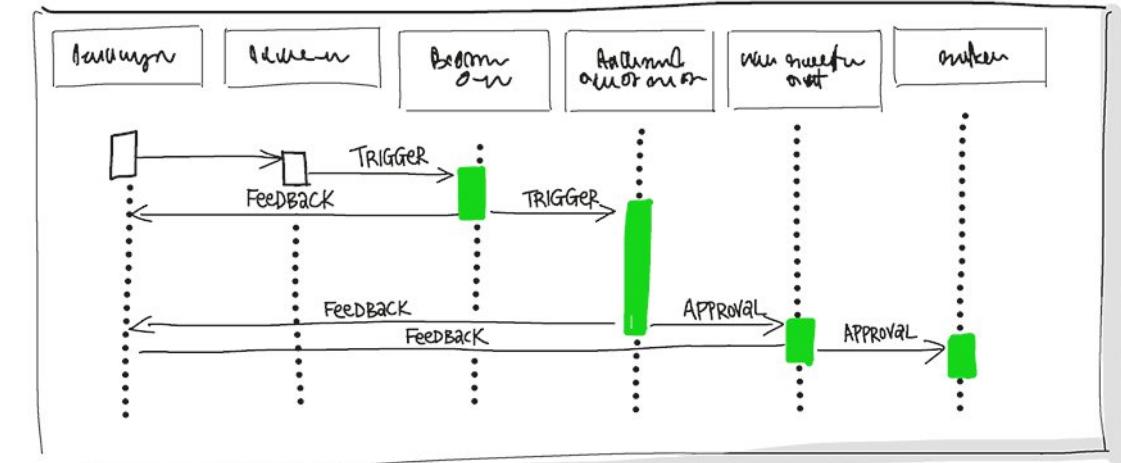
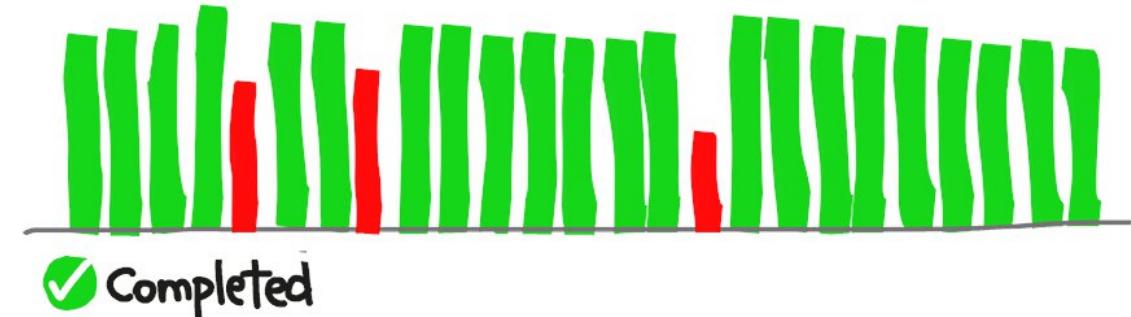
## Continuous Integration

- Continuous Integration drives the ongoing merging and testing of code, which leads to finding defects early.

## Continuous Delivery

- Continuous Delivery of software solutions to production and testing environments helps organizations quickly fix bugs and respond to ever-changing business requirements.

BUILD Succeeded



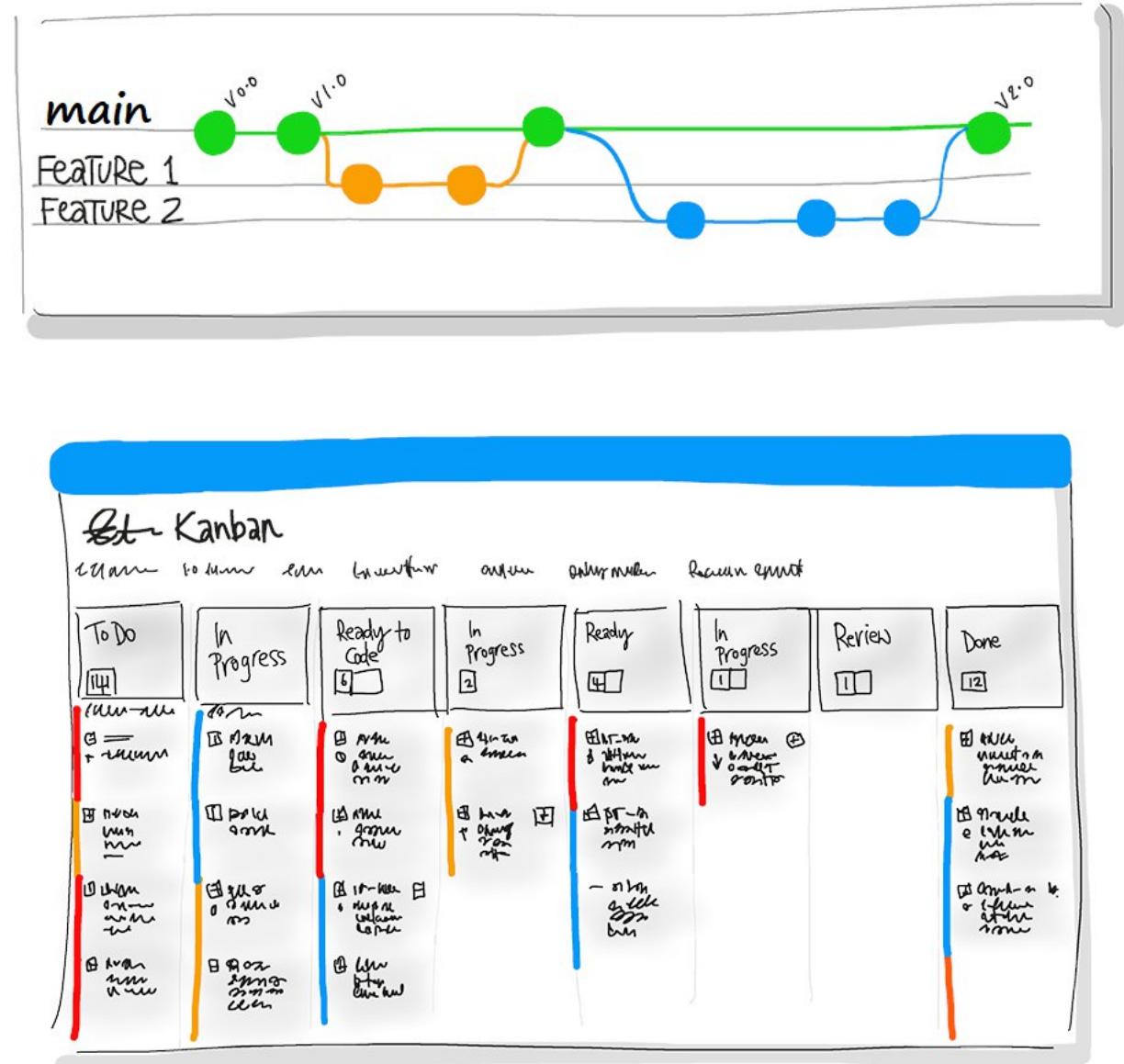
# Explore the DevOps journey (continued)

## Version Control

- Version Control, usually with a Git-based Repository, enables teams located anywhere in the world to communicate effectively during daily development activities.

## Agile/lean

- Plan and isolate work into sprints.
- Manage team capacity and help teams quickly adapt to changing business needs.
- A DevOps Definition of Done is working software collecting telemetry against the intended business goals.



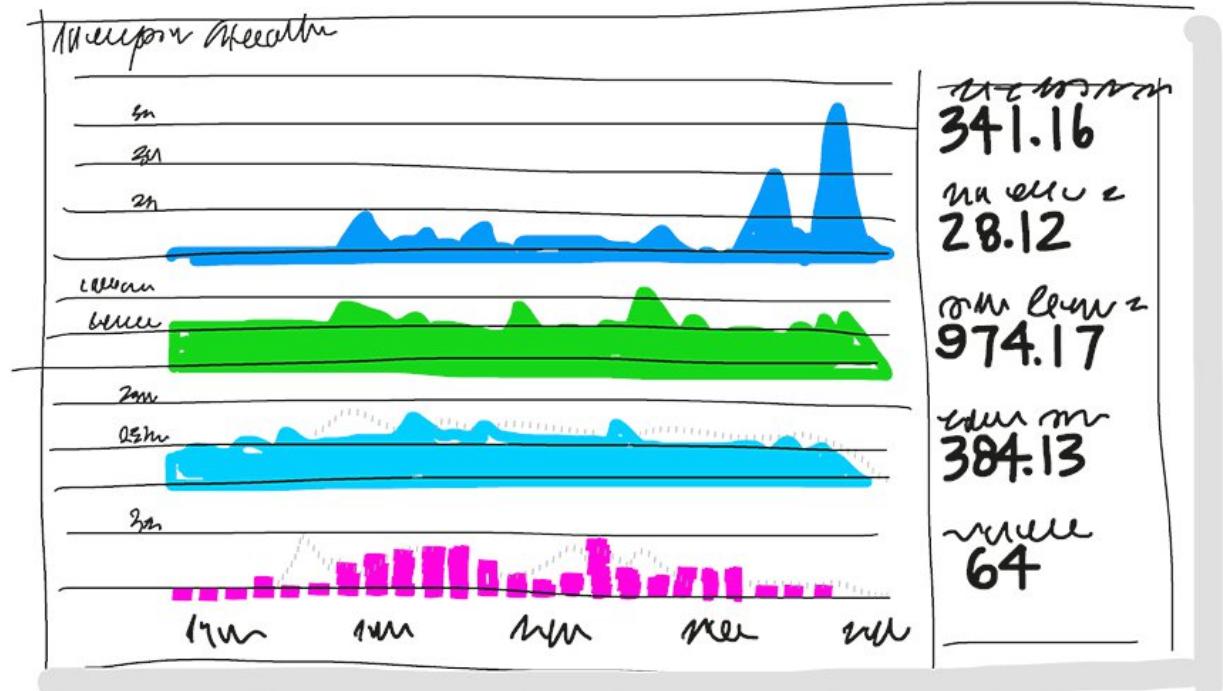
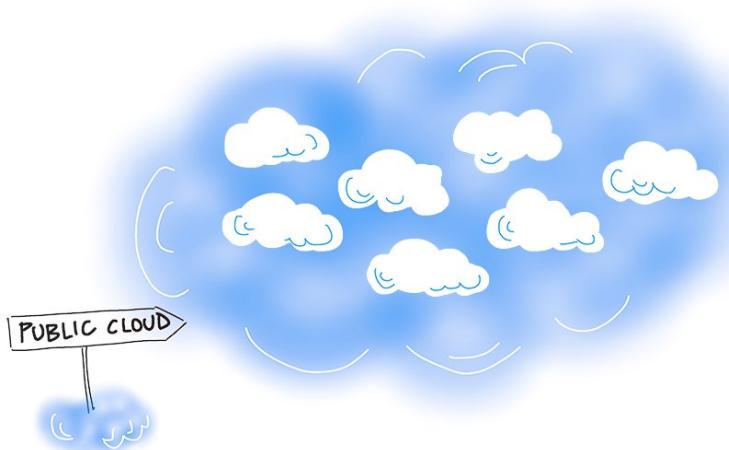
# Explore the DevOps journey (continued)

## Monitoring and logging

- Monitoring and Logging of running applications.

## Cloud

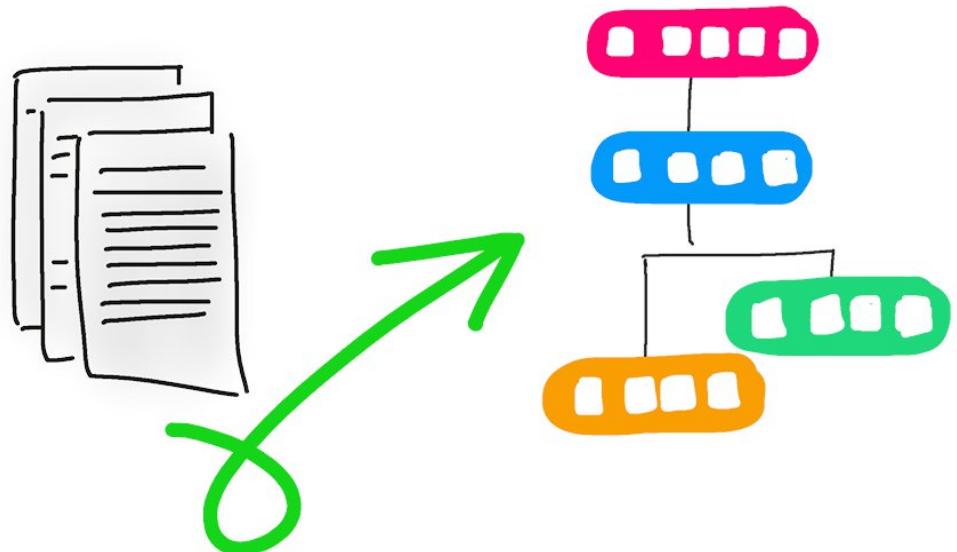
- Public and Hybrid Clouds have made the impossible easy.



# Explore the DevOps journey (continued)

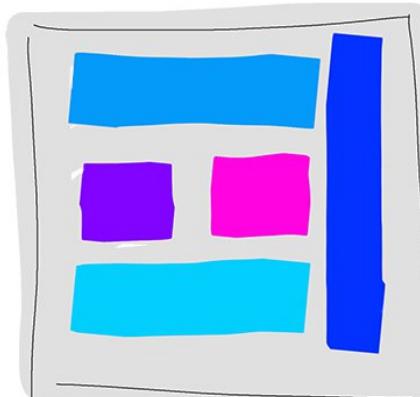
## Infrastructure as Code (IaC)

- Enables the automation and validation of the creation and teardown of environments to help with delivering secure and stable application hosting platforms.

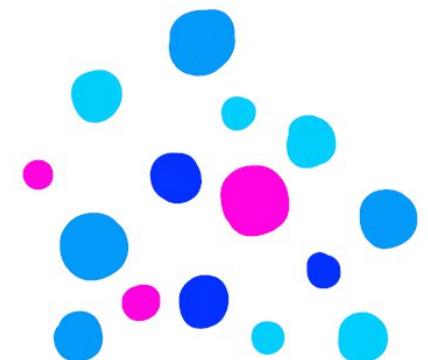


## Microservices

- Isolate business use cases into small reusable services that communicate via interface contracts.



MONOLITHIC/LAYERED



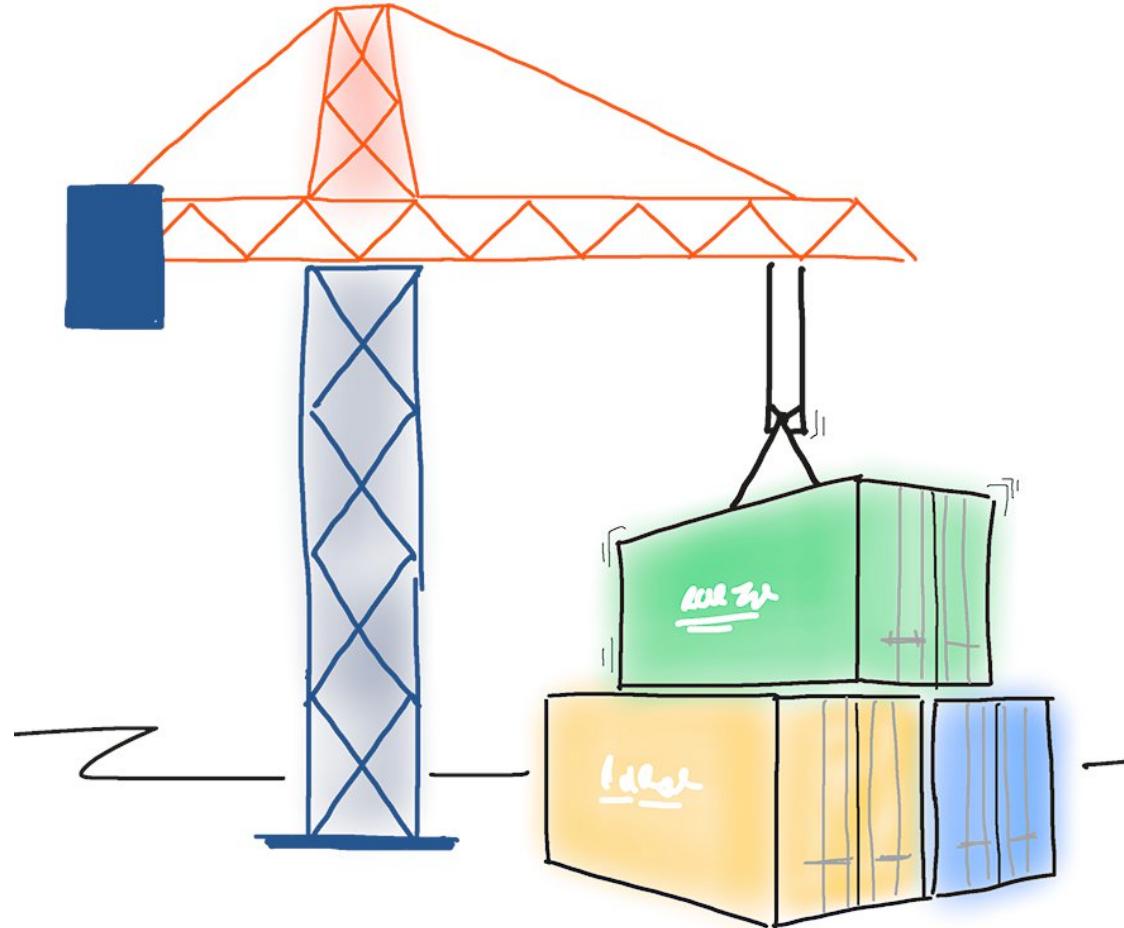
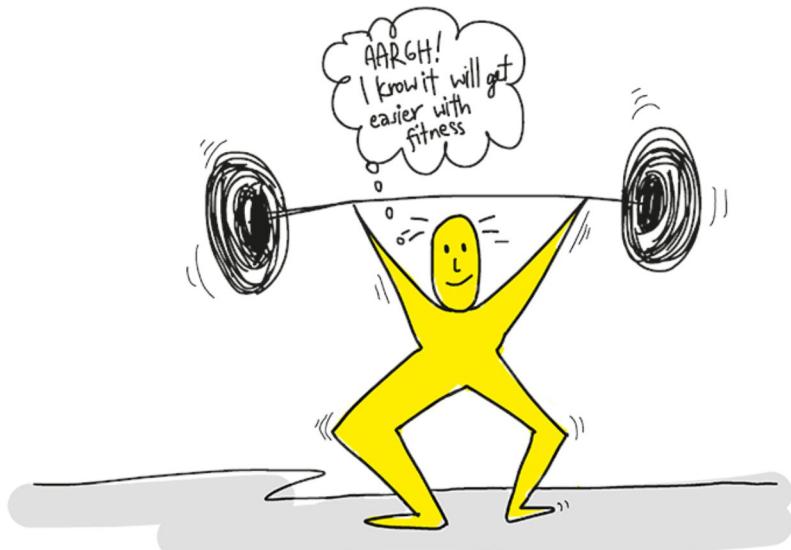
MICROSERVICES

# Explore the DevOps journey (continued)

## Containers

- Containers are the next evolution in virtualization.

DevOps may hurt at first



# Explore agile development practices

1

## Waterfall approach:

- Define, analyze, build and test, and deliver
  - Hard to accurately define requirements, which can change over time, including during development
  - Requires change requests and additional cost after delivery
- 

2

## Agile approach:

- Emphasizes constantly adaptive planning, and early delivery with continual improvement
- Development methods are based on releases and iterations
- At the end of each iteration, should have tested working code
- Is focused on shorter-term outcomes

# Explore principles of agile development

- 1 Satisfy the customer through early and continuous delivery of valuable software
- 2 Welcome changing requirements
- 3 Deliver working software frequently
- 4 Work together throughout the project
- 5 Build projects around motivated individuals
- 6 Use face-to-face conversation
- 7 Measure progress through working software
- 8 Agile processes promote sustainable development
- 9 Continuous attention to technical excellence and good design
- 10 Simplicity – The art of maximizing the amount of work not done
- 11 Use self-organizing teams
- 12 Reflect on how to become more effective

Source: <https://www.agilealliance.org/agile101/12-principles-behind-the-agile-manifesto/>

# Identify transformation teams

1

There are several challenges when creating teams:

- Availability of staff
  - Disruption of current procedures and processes
- 

2

To overcome the challenges, create a team that is:

- Focused on the transformation
- Well respected in their subject areas
- Internal and external to the business



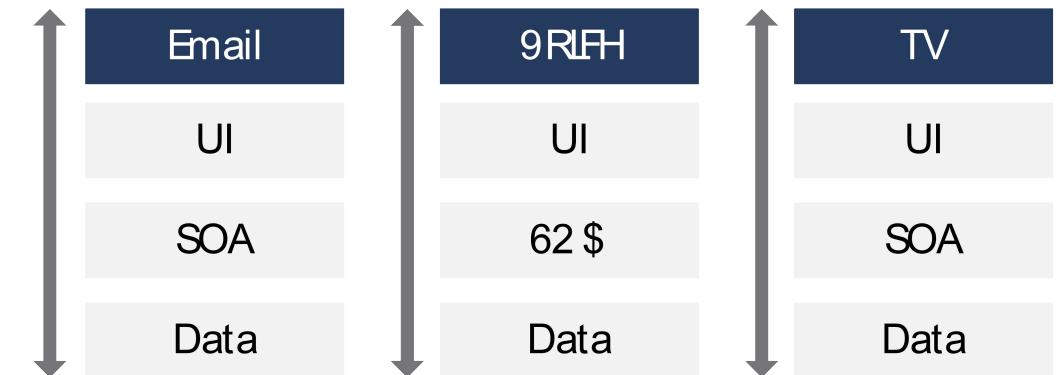
A transformation project can conflict with ongoing business needs

# Define organization structure for agile practices

Horizontal team structures divide teams according to the software architecture.



Vertical teams span the architecture and are aligned with product outcomes, and scaling can occur by adding teams.



✓ Vertical teams have been shown to provide stronger outcomes in Agile projects

# Explore shared goals and define timelines

1

Projects must have a clearly-defined set of measurable outcomes, like:

- Reduce the time spent on fixing bugs by 60%
- Reduce the time spent on unplanned work by 70%
- Reduce the out-of-hours work required by staff to no more than 10% of total working time
- Remove all direct patching of production systems



One of the key aims of DevOps is to provide greater customer value, so outcomes should have a customer value focus

# Explore shared goals and define timelines (continued)

**1** Measurable goals should have timelines that challenging yet achievable

**2** Timelines should be a constant series of short-term goals - each clear and measurable

**3** Shorter timelines have advantages:

- Easier to change plans or priorities when necessary
- Reduced delay between doing the work and getting feedback
- Easier to keep organizational support when positive outcomes are apparent

# What is Azure DevOps?

- 1** Azure Boards: Agile planning, work item tracking, visualization and reporting tool
- 2** Azure Pipelines: A language, platform and cloud agnostic CI/CD platform with support for containers or Kubernetes
- 3** Azure Repos: Provides cloud-hosted private git repos
- 4** Azure Artifacts: Provides integrated package management with support for Maven, npm, Python and NuGet package feeds from public or private sources
- 5** Azure Test Plans: Provides an integrated planned and exploratory testing solution