



## Azure Fundamentals (AZ-900) Course

Gain knowledge of Azure cloud concepts and services





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@zaalion



# Creating an Azure Subscription

- You can create a free Azure account using the link below or use your own paid subscription.

Popular services free for 12 months

40+ other services free always

+

Start with USD200\* Azure credit

You'll have 30 days to use it—in addition to free services.

<https://azure.microsoft.com/en-ca/free/>



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# Course GitHub Repository

<https://github.com/zaalion/oreilly-az900ondemand>



# What is Cloud Computing?

# Cloud Computing

Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user.



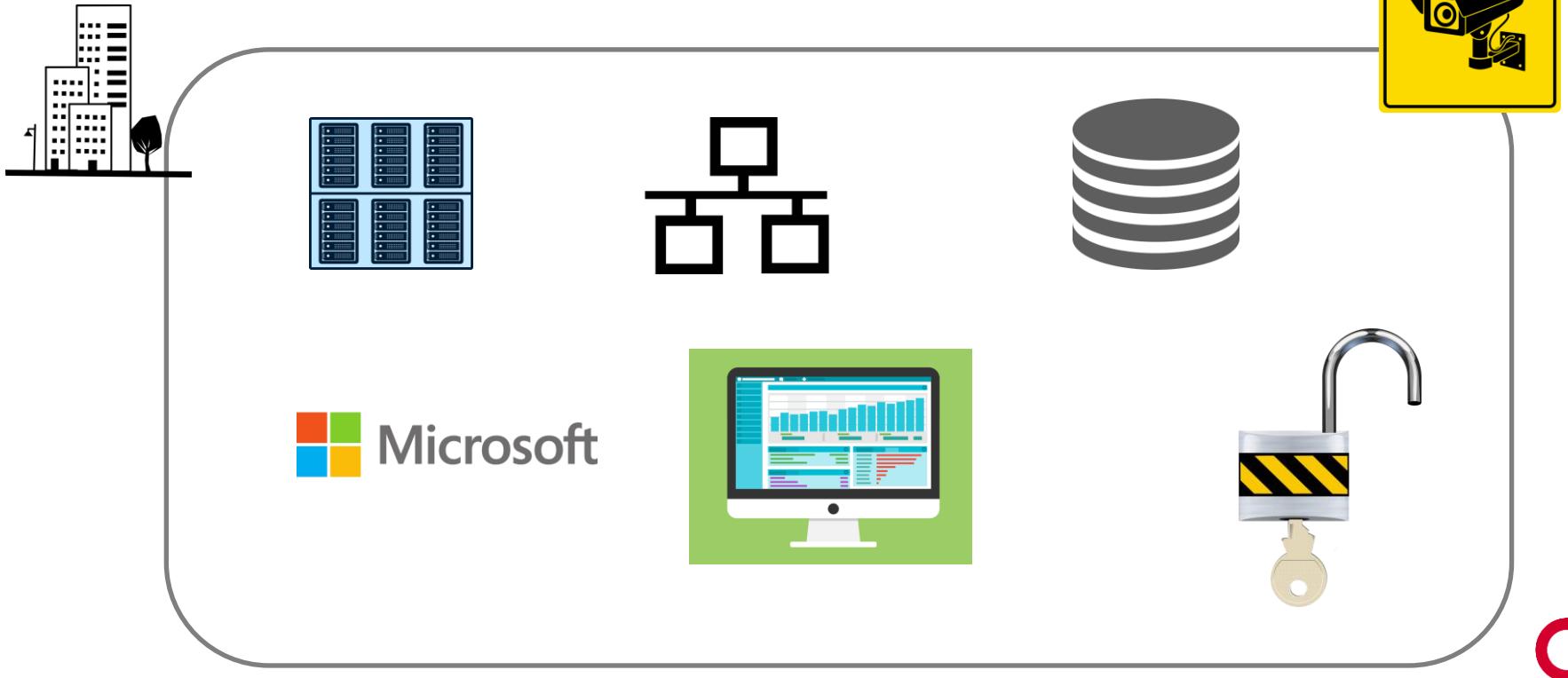
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# Cloud Computing

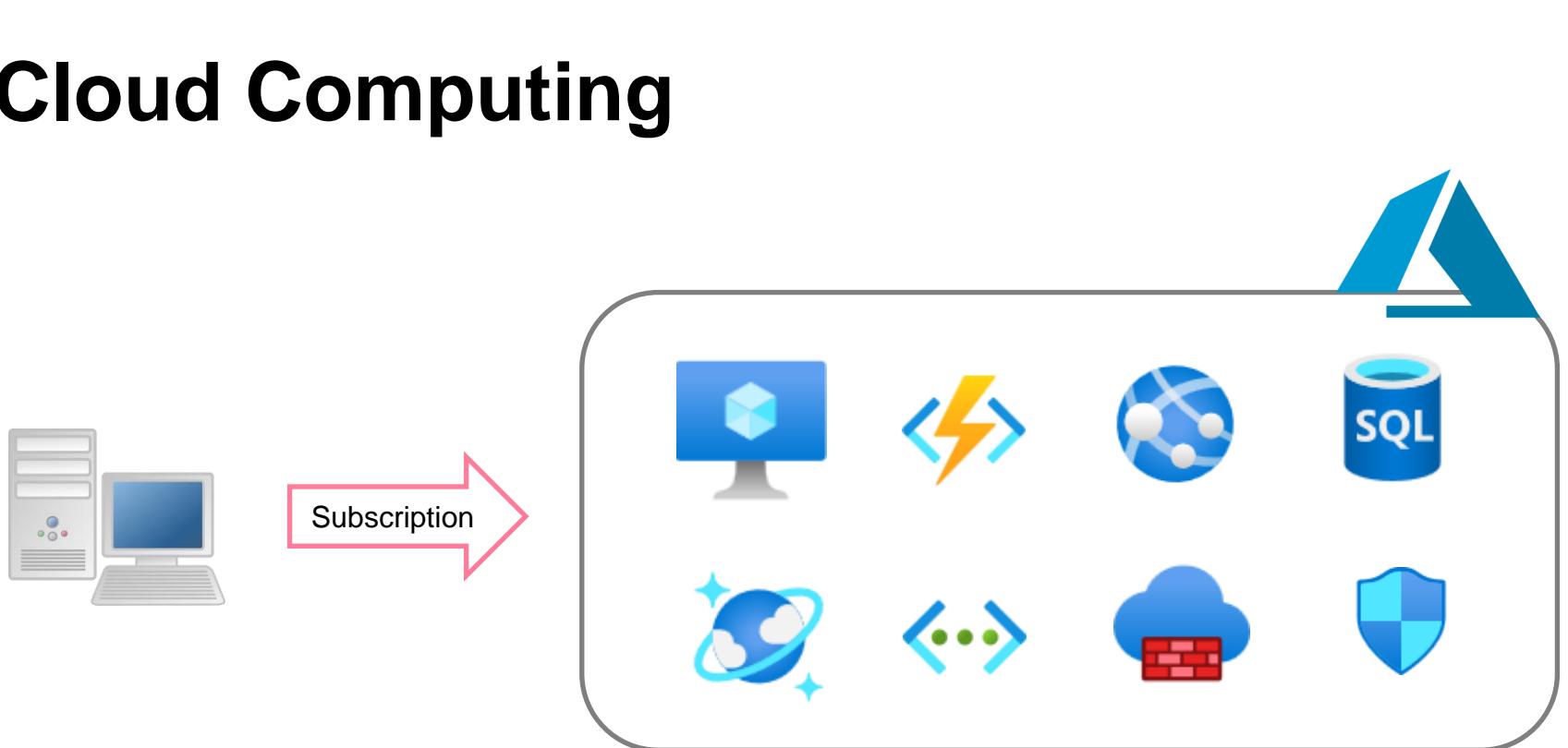
- On-demand
- Computer systems
- Data storage
- Computing power
- No direct active management by the user



# On-Premises Computing



# Cloud Computing

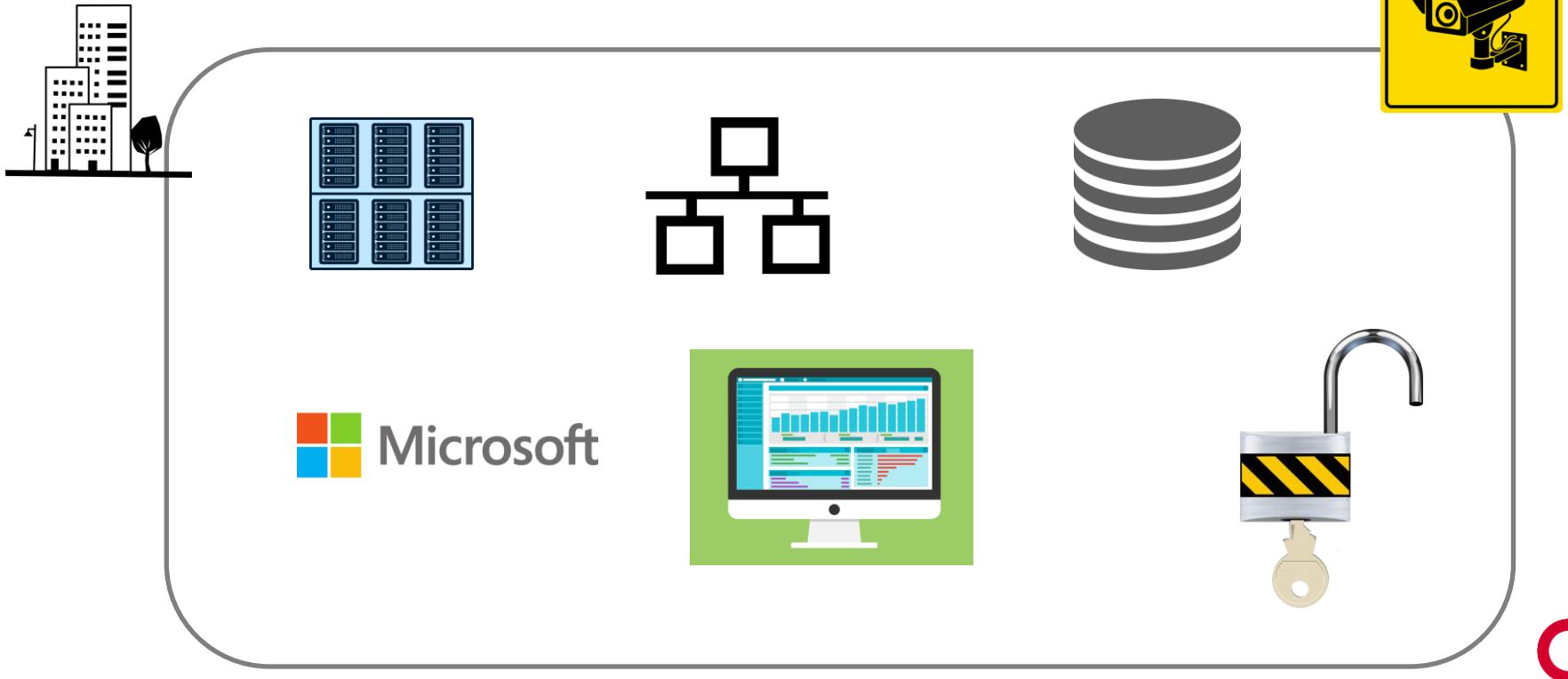


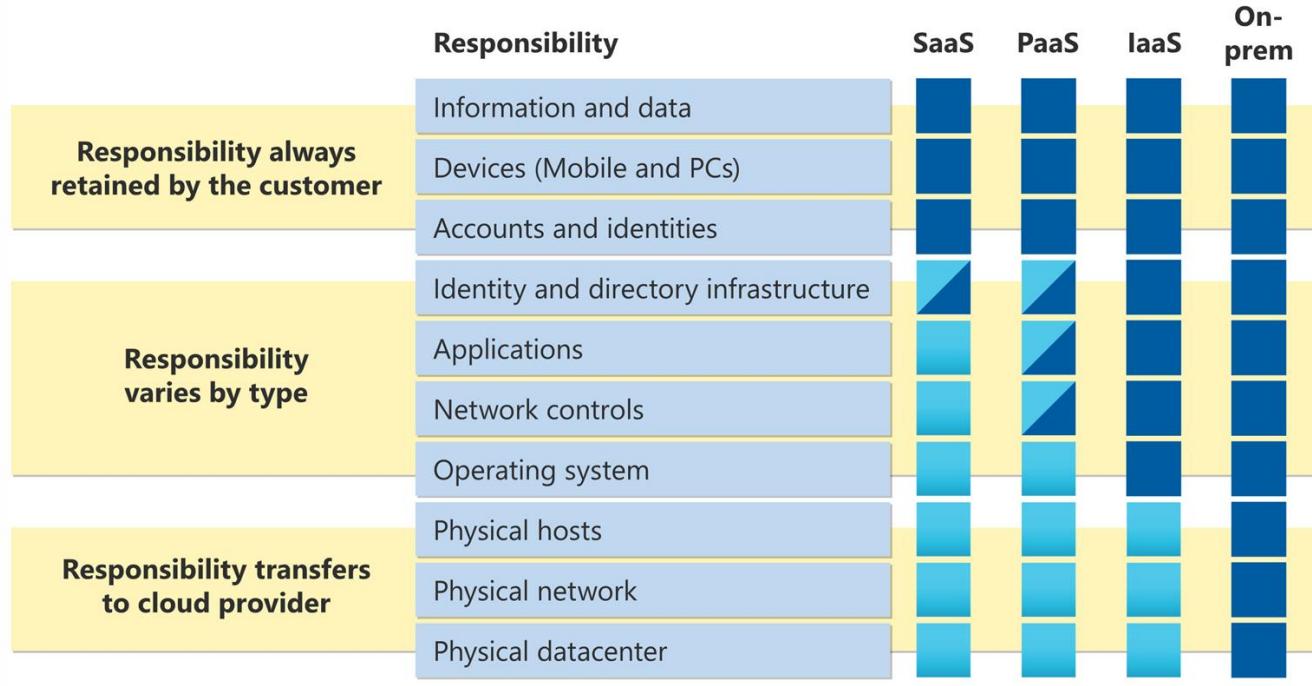
# Shared Responsibility in the Cloud

Depending on the cloud service type you choose, the management tasks are divided between the cloud provider (Microsoft) and you (the user).



# On-Premises Computing





# Understanding Public and Private Clouds

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# Cloud Models

- Public cloud
- Private cloud (premises infrastructure)
- Hybrid cloud

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



# Public Cloud

The cloud servers are owned and managed by a cloud service provider and delivered over the internet.



<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



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# Advantages of a Public Cloud

- Ease of use: Your team can start using the services in minutes
- No initial expenditure is required
- Ease of maintenance

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



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# Private Cloud

Private cloud computing resources are exclusively used by one organization.

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



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# Private Cloud

- The infrastructure is located at the organization's on-site datacenter, or
- It can be hosted by a third-party service provider
- The services and infrastructure are always maintained on a private network
- The hardware and software are dedicated solely to the organization

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



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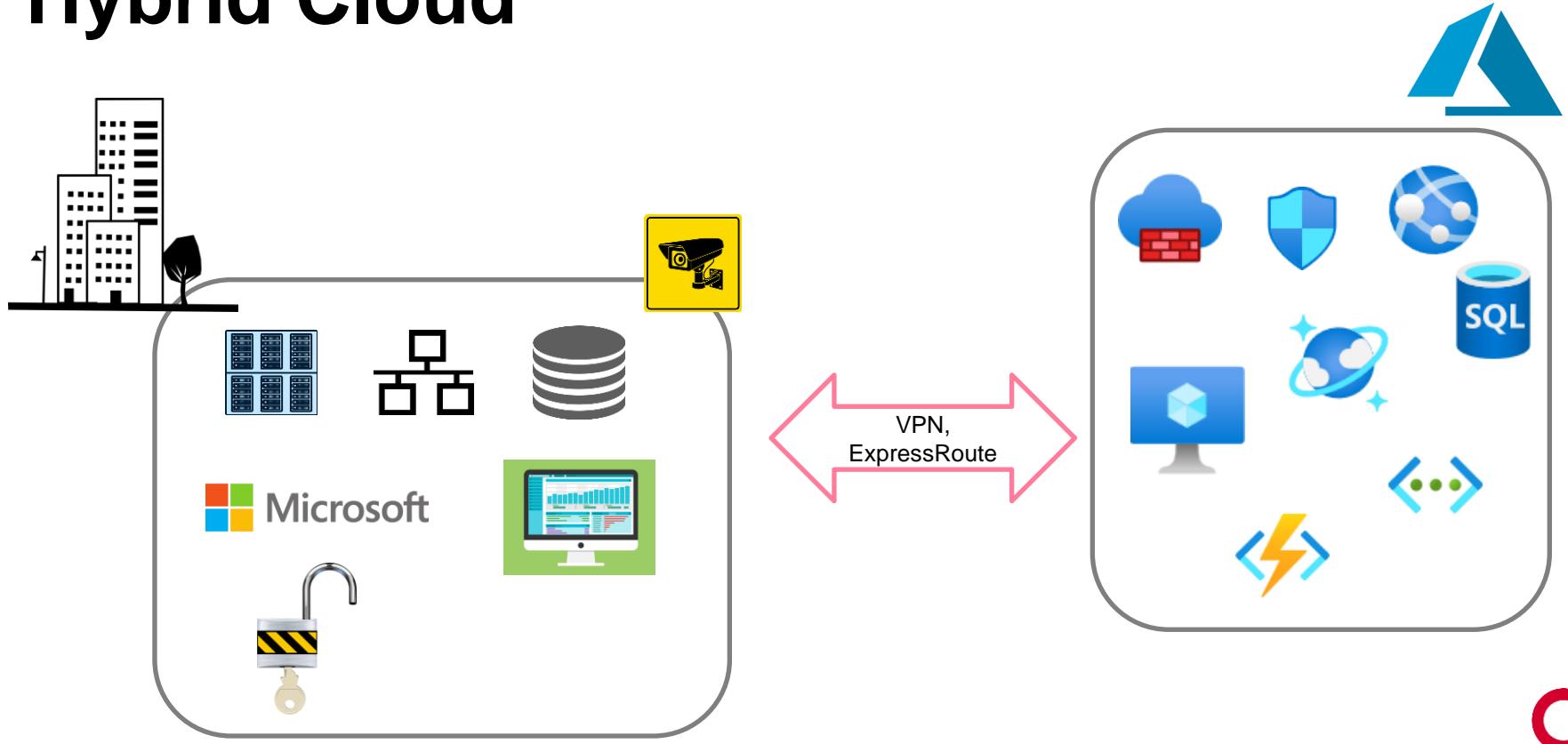
# Advantages of a Private Cloud

- Flexibility: Customize the cloud environment to meet specific business needs
- Control: Higher levels of control and privacy are possible.
- Control security and compliance

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



# Hybrid Cloud



# Hybrid Cloud

- On-premises infrastructure, or a private cloud + a public cloud
- Data moves between the two environments
- Meeting regulatory and data sovereignty requirements
- Taking advantage of the on-premises infrastructure/investment
- Achieving low latency

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-are-private-public-hybrid-clouds/>



# Cloud Pricing Models

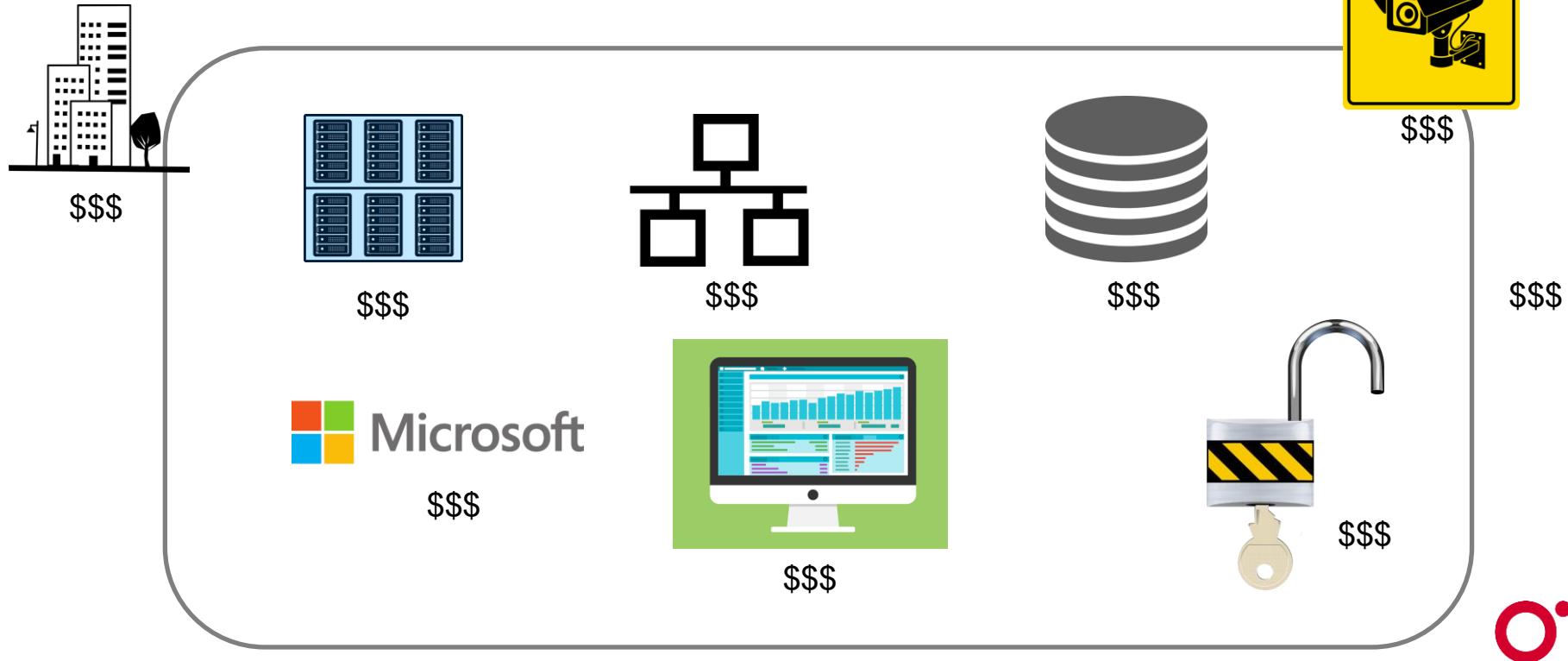
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# Cloud Pricing Models

- Fixed-cost
- Consumption-based (Pay-as-you-go)



# On-Premises Computing



# Fixed-cost Pricing Model

You provision Azure resources, and you will be charged for those resources, whether you use them or not.



App Services



Virtual Machines



Azure SQL Database

# Consumption-based Pricing Model

You are only charged for what you use. This model is also known as the Pay-As-You-Go rate.



Cognitive Services



Azure Function Apps  
(Serverless tier)



Cosmos DB  
(Serverless offering)



Azure SQL Database  
(Serverless offering)

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# Serverless



All Azure serverless services use  
consumption-based pricing.

# **Availability, Scalability, Reliability, and Predictability**

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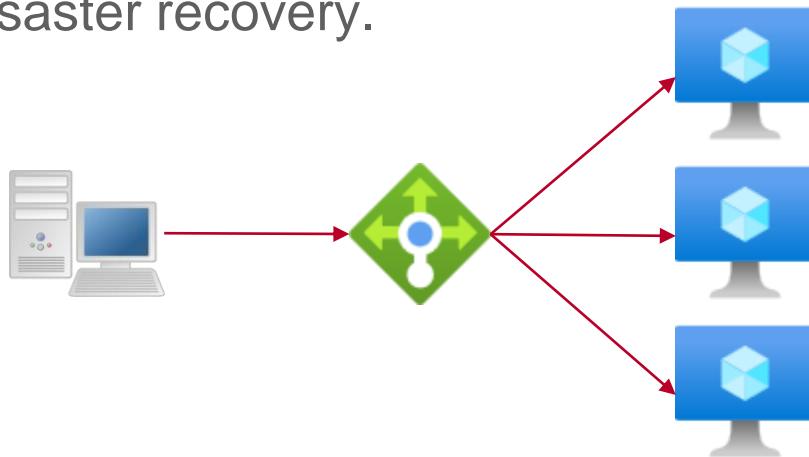
# Cloud Benefits

- Availability
- Scalability
- Reliability
- Predictability



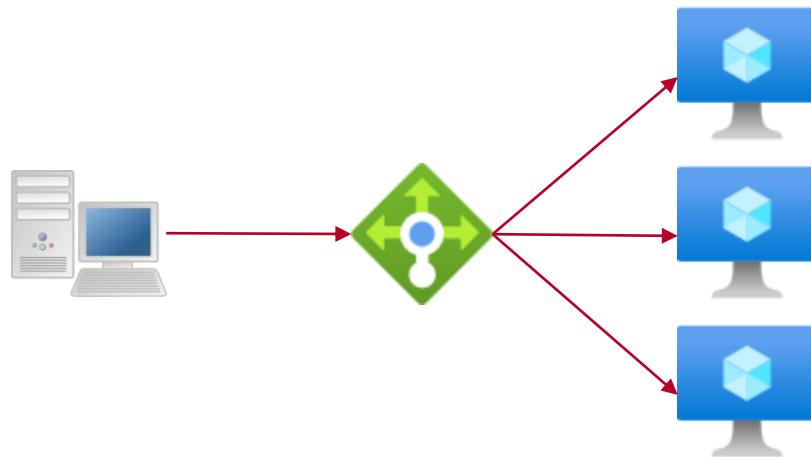
# Availability

Availability improves with the use of multiple redundant sites, which makes well-designed cloud computing suitable for business continuity and disaster recovery.



# Scalability

Scalability and elasticity via automatic provisioning of resources when they are needed.



[https://en.wikipedia.org/wiki/Cloud\\_computing](https://en.wikipedia.org/wiki/Cloud_computing)



# Reliability, and Predictability

Azure services offer financially-backed service-level agreements (SLAs) to maintain uptime, and connectivity.

## SLA for Virtual Machines

Last updated: July 2020

- For all Virtual Machines that have two or more instances deployed across two or more Availability Zones in the same Azure region, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.99% of the time.
- For all Virtual Machines that have two or more instances deployed in the same Availability Set or in the same Dedicated Host Group, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.95% of the time.

<https://azure.microsoft.com/en-us/explore/reliability/>  
[https://azure.microsoft.com/en-ca/support/legal/sla/virtual-machines/v1\\_9/](https://azure.microsoft.com/en-ca/support/legal/sla/virtual-machines/v1_9/)



# Service-level agreements

Read the SLAs to learn about our uptime guarantees and downtime credit policies

Service-level agreements (SLAs) describe Microsoft's commitments for uptime and connectivity. The SLA for individual Azure services are listed below.

Search all products	
AI + machine learning	Management
Analytics	Media
Compute	Migration
Containers	Mixed reality
Databases	Mobile
Developer tools	Networking
DevOps	Storage
Hybrid + multicloud	Security
Identity	Web
Integration	Virtual desktop

**AI + machine learning**

**Azure Bot Services**  
Create bots and connect them across channels

**Microsoft Genomics**  
Power genome sequencing & research insights

**Machine Learning Studio (classic)**  
ML Studio is the GUI-based integrated development environment for constructing and operationalizing Machine Learning workflows

**Azure Machine Learning**  
Use an enterprise-grade service for the end-to-end machine learning lifecycle

**Azure Cognitive Services**  
Add cognitive capabilities to apps with APIs and AI services

**Azure Form Recognizer**  
Accelerate information extraction from documents

**Health Bot**  
A managed service purpose-built for development of virtual healthcare assistants

**Azure Applied AI Services**  
Specialized services that enable organizations to accelerate time to value in applying AI to solve common scenarios

<https://azure.microsoft.com/en-us/support/legal/sla/>

# Security, Governance, and Manageability

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# Cloud Benefits

- Security
- Governance
- Manageability

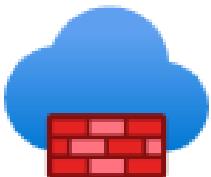


# Azure Security

Microsoft Azure offers multi-layered security across datacenters, infrastructure, networks, and operations.



Physical  
security



Firewall



NSG



Key Vault



Conditional  
Access



Microsoft  
Defender

# Defense in Depth

Create multiple layers of security controls (defense) in your system. Its intent is to provide extra layers of defense in the event a security control fails.

<https://docs.microsoft.com/en-us/azure/security/fundamentals/end-to-end>

<https://docs.microsoft.com/en-us/learn/modules/azure-well-architected-security/2-defense-in-depth>



# Azure Governance

Maintain control over your Azure resources, to enforce company standards, comply with government laws, and uphold security best practices.



Azure Policy



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# Use Azure Policy to

- Limit the resource deployment locations (regions)
- Limit what resource types can get deployed
- Enforce security best practices on your databases
- ...





# Azure compliance documentation

If your organization needs to comply with legal or regulatory standards, start here to learn about compliance in Azure.

## Compliance offerings

### Global

- ☰ CIS benchmark
- ☰ CSA STAR Attestation
- ☰ CSA STAR Certification
- ☰ CSA STAR self-assessment
- ☰ SOC 1
- ☰ SOC 2
- ☰ SOC 3

### Global

- ☰ ISO 20000-1
- ☰ ISO 22301
- ☰ ISO 27001
- ☰ ISO 27017
- ☰ ISO 27018
- ☰ ISO 27701
- ☰ ISO 9001
- ☰ WCAG

### US government

- ☰ CJIS
- ☰ CMMC
- ☰ CNSSI 1253
- ☰ DFARS
- ☰ DoD IL2
- ☰ DoD IL4
- ☰ DoD IL5
- ☰ DoD IL6
- ☰ DoE 10 CFR Part 810
- ☰ EAR

<https://docs.microsoft.com/en-us/azure/compliance/>



# Azure Manageability

Microsoft Azure provides rich management tools and APIs to enable you to provision, manage, secure, govern, and monitor your Azure resources with ease.



# Cloud Service Types

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# Cloud Service Types

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)



# Cloud Service Types



Building



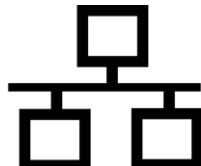
Servers



Application/data  
VMs



Security



Network



Install and patch  
OS



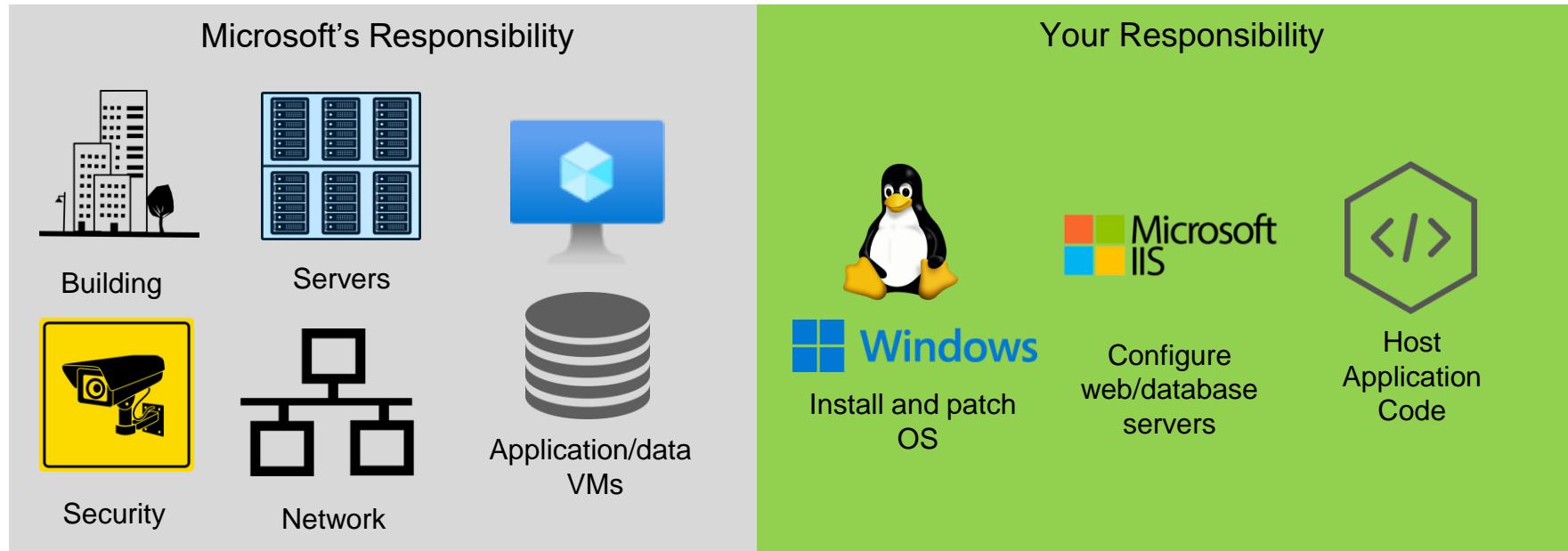
Configure  
web/database  
servers



Host  
Application  
Code



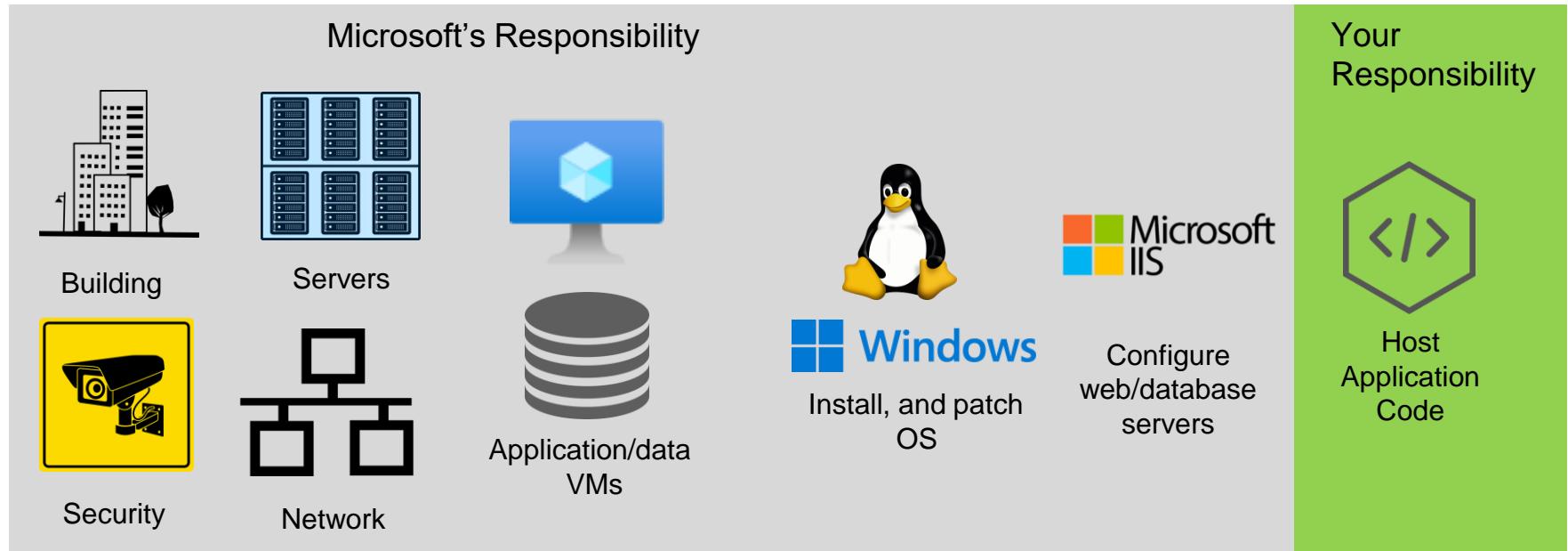
# Infrastructure as a Service (IaaS)



<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-iaas/#overview>



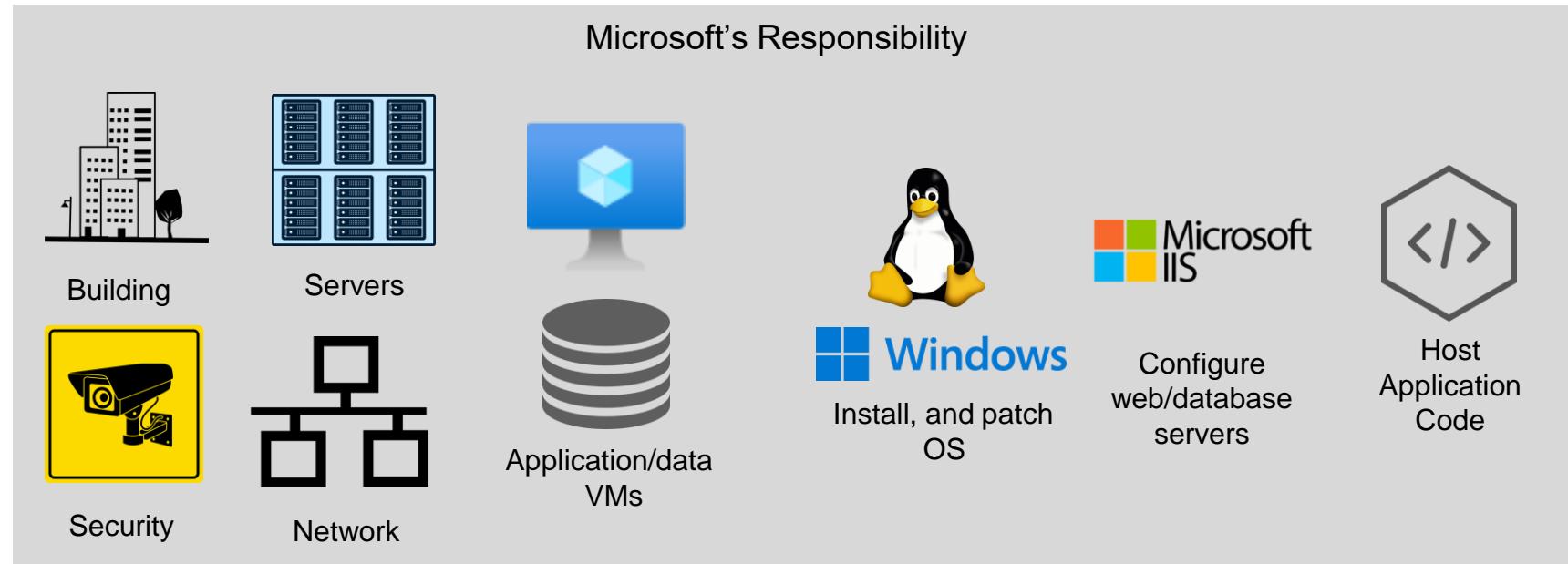
# Platform as a Service (PaaS)



<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-paas/>



# Software as a Service (SaaS)



<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-saas/>



# Infrastructure as a Service (IaaS)

- Gives you the most control, and flexibility
- Lots of management overhead
- Try to use SaaS or PaaS solutions if possible
- Use IaaS for workloads which cannot be hosted on Azure PaaS offerings  
(e.g. old legacy applications, etc.)



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# Platform as a Service (PaaS)

- Offers the best balance between flexibility and management overhead
- Try to use it for any new project
- Migrate IaaS solutions to PaaS if possible
- Make sure you are aware of any SaaS offering before investing in PaaS

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-paas/>



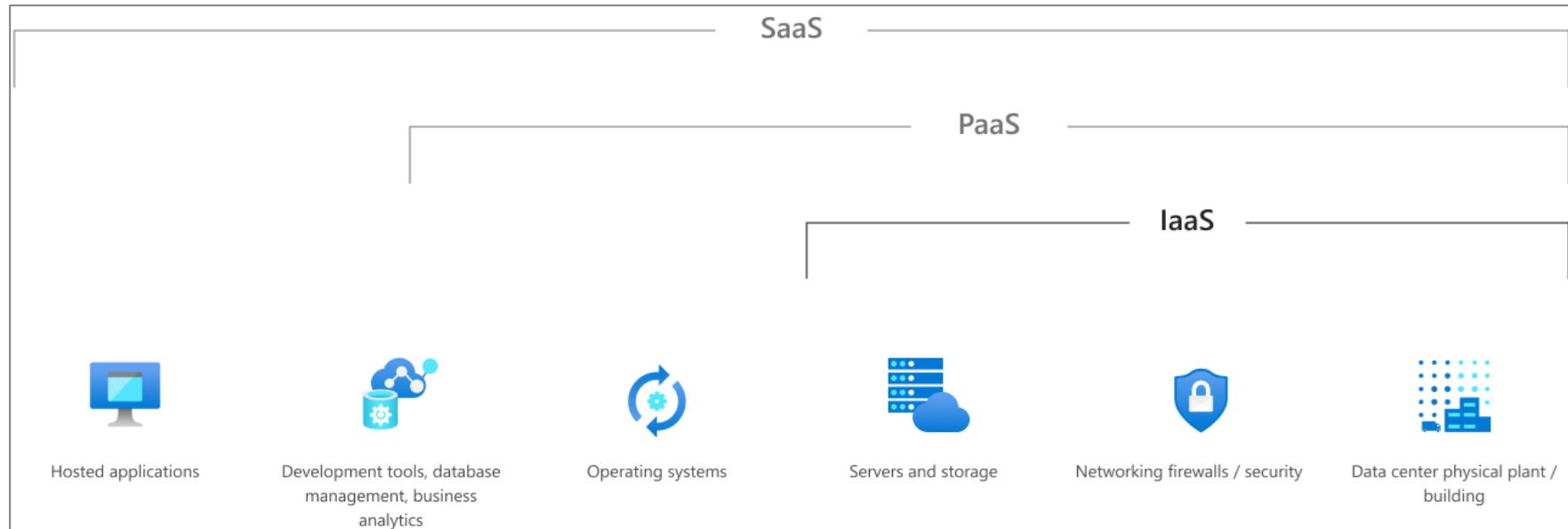
# Software as a Service (SaaS)

- Offers the least flexibility, but no management overhead
- Look for available SaaS solutions before investing in PaaS
- Microsoft Outlook, Salesforce, Microsoft SharePoint, SAP, etc.

<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-saas/>



# IaaS, PaaS, and SaaS



<https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-iaas/#overview>



# Azure Data Center Regions and Availability Zones

# Azure Data Center

“Azure datacenters are unique physical buildings—located all over the globe—that house a group of networked computer servers.”



# Azure Data Center Regions

Microsoft Azure has data centers in 70+ locations (regions) throughout the globe. Choose Azure regions which are closest to you and your customers.



<https://azure.microsoft.com/en-us/global-infrastructure/geographies/#overview>



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# Azure Data Center Regions

- Proximity to you and your customers
- Data residency laws and compliance (e.g. EU GDPR)
- Data redundancy
- Higher availability

<https://azure.microsoft.com/en-us/global-infrastructure/geographies/#overview>



# Azure Data Center Regions

```
az account list-locations --query "[].displayName"
```

```
"East US",
"East US 2",
"South Central US",
"West US 2",
"West US 3",
"Australia East",
"Southeast Asia",
"North Europe",
"Sweden Central",
"UK South",
"West Europe",
"Central US",
"South Africa North"
"Central India",
"East Asia",
"Japan East",
"Korea Central",
"Canada Central",
"France Central",
"North Europe",
"Germany West Central",
"Norway East",
"Switzerland North",
"UAE North",
"Brazil South",
"East US 2 EUAP",
"Qatar Central",
"Central US (Stage)",
"East US (Stage)",
"East US 2 (Stage)",
"North Central US (Stage)",
"South Central US (Stage)",
"West US (Stage)",
"West US 2 (Stage)",
"Asia",
"Asia Pacific",
"Australia",
"Brazil",
"Canada",
"France Central",
"North Central US",
"West US",
"Jio India West",
"Central US EUAP",
"West Central US",
"South Africa West",
"Australia Central",
"Australia Central 2",
"Australia Southeast",
"Japan West",
"Jio India Central",
"Korea South",
"South India",
"West India",
"Canada East",
"France South",
"Germany North",
"Norway West",
"Switzerland West",
"UK West",
"UAE Central",
"Brazil Southeast"
```



# Azure Data Center Regions



East US  
Region



West US  
Region

Japan East  
Region

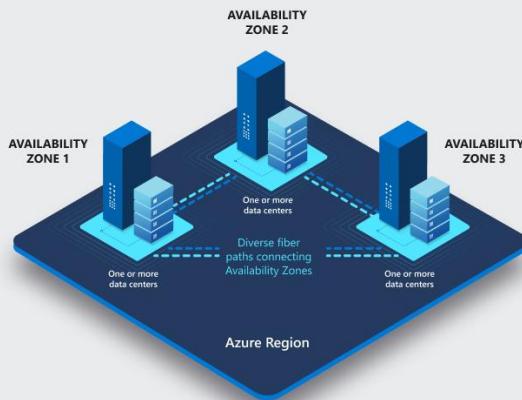


Regions	Central US <a href="#">Start free &gt;</a>	East US <a href="#">Start free &gt;</a>	East US 2 <a href="#">Start free &gt;</a>	East US 3 Coming soon	North Central U <a href="#">Start free &gt;</a>
LOCATION	Iowa	Virginia	Virginia	Georgia	Illinois
YEAR OPENED	<a href="#">2014</a>	<a href="#">2012</a>	<a href="#">2014</a>	<a href="#">Coming soon</a>	<a href="#">2009</a>
AVAILABILITY ZONES PRESENCE	Available with 3 zones	Available with 3 zones	Available with 3 zones	Coming soon	Coming soon
Compliance	<a href="#">Azure compliance offerings</a>	<a href="#">Azure compliance offerings</a>	<a href="#">Azure compliance offerings</a>	<a href="#">Azure compliance offerings</a>	<a href="#">Azure compliar</a>
DATA RESIDENCY	Stored at rest in the United States <a href="#">Learn more</a>	Stored at rest in the United States <a href="#">Learn more</a>	Stored at rest in the United States <a href="#">Learn more</a>	Stored at rest in the United States <a href="#">Learn more</a>	Stored at rest in the United States <a href="#">Learn more</a>
DISASTER RECOVERY	Cross-region options: <a href="#">Azure Site Recovery</a> <a href="#">Region Pairing</a> In-region option: <a href="#">Zonal DR with Azure Site Recovery</a>	Cross-region options: <a href="#">Azure Site Recovery</a> <a href="#">Region Pairing</a> In-region option: <a href="#">Zonal DR with Azure Site Recovery</a>	Cross-region options: <a href="#">Azure Site Recovery</a> <a href="#">Region Pairing</a>	Coming soon	Cross-region o <a href="#">Azure Site Rec <a href="#">Region Pairing</a></a>
PRODUCTS BY REGION	<a href="#">See products in this region</a>	<a href="#">See products in this reaion</a>	<a href="#">See products in this reaion</a>	Coming soon	<a href="#">See products ir</a>
AVAILABLE TO	All customers and partners	All customers and partners	All customers and partners	Coming soon	All customers a

<https://azure.microsoft.com/en-us/global-infrastructure/geographies/#overview>

# Azure Availability Zones

Azure availability zones are physically separate locations within each Azure region.



Regions	Central US	East US
<a href="#">Start free &gt;</a>		<a href="#">Start free &gt;</a>
LOCATION	Iowa	Virginia
YEAR OPENED	<a href="#">2014</a>	<a href="#">2012</a>
AVAILABILITY ZONES PRESENCE	Available with 3 zones	Available with 3 zones

<https://docs.microsoft.com/en-us/azure/availability-zones/az-overview>



# Azure Availability Zones



East US  
Region



Zone 3

Zone 2

Zone 1



West US  
Region

Japan East  
Region



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# Azure Availability Zones



**Deploy your resources to more than one  
availability zone to protect yourself against  
local failures within the same region.**

# Azure Availability Zones



# Azure regions with availability zones

Azure provides the most extensive global footprint of any cloud provider and is rapidly opening new regions and availability zones. Azure has availability zones in every country in which Azure operates a datacenter region. The following regions currently support availability zones.

Americas	Europe	Middle East	Africa	Asia Pacific
Brazil South	France Central	Qatar Central	South Africa North	Australia East
Canada Central	Germany West Central	UAE North*		Central India
Central US	North Europe			Japan East
East US	Norway East			Korea Central
East US 2	UK South			Southeast Asia
South Central US	West Europe			East Asia
US Gov Virginia	Sweden Central			China North 3
West US 2	Switzerland North			
West US 3				



# Azure Regional Pairs

- Azure regions offer protection against local disasters with availability zones.
- Azure regions can also provide protection from regional or large geographical disasters by making use of another region that uses cross-region replication.
- Regions which support replication are grouped into **region pairs**.



<https://docs.microsoft.com/en-us/azure/availability-zones/cross-region-replication-azure>



# Azure cross-region replication pairings for all geographies

Regions are paired for cross-region replication based on proximity and other factors.

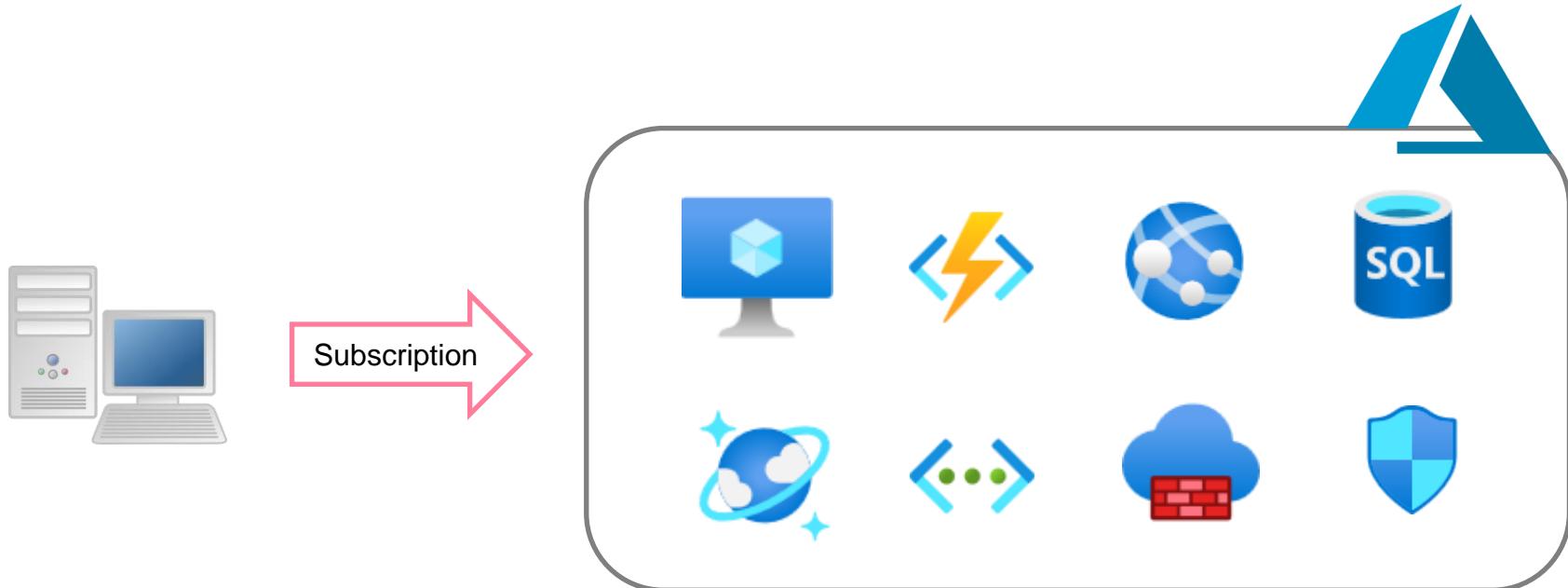
## Azure regional pairs

Geography	Regional pair A	Regional pair B
Asia-Pacific	East Asia (Hong Kong)	Southeast Asia (Singapore)
Australia	Australia East	Australia Southeast
Australia	Australia Central	Australia Central 2*
Brazil	Brazil South	South Central US
Brazil	Brazil Southeast*	Brazil South
Canada	Canada Central	Canada East
China	China North	China East
China	China North 2	China East 2



# Resource Hierarchy in Azure

# Azure Resources



# Azure Resources

You create “resources” in order to use the services provided by Azure.

These entities are managed by Microsoft Azure.

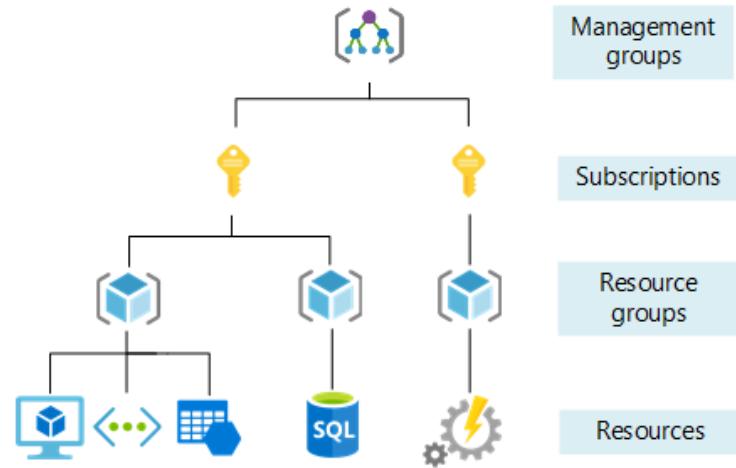


<https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/govern/resource-consistency/resource-access-management#what-is-an-azure-resource>

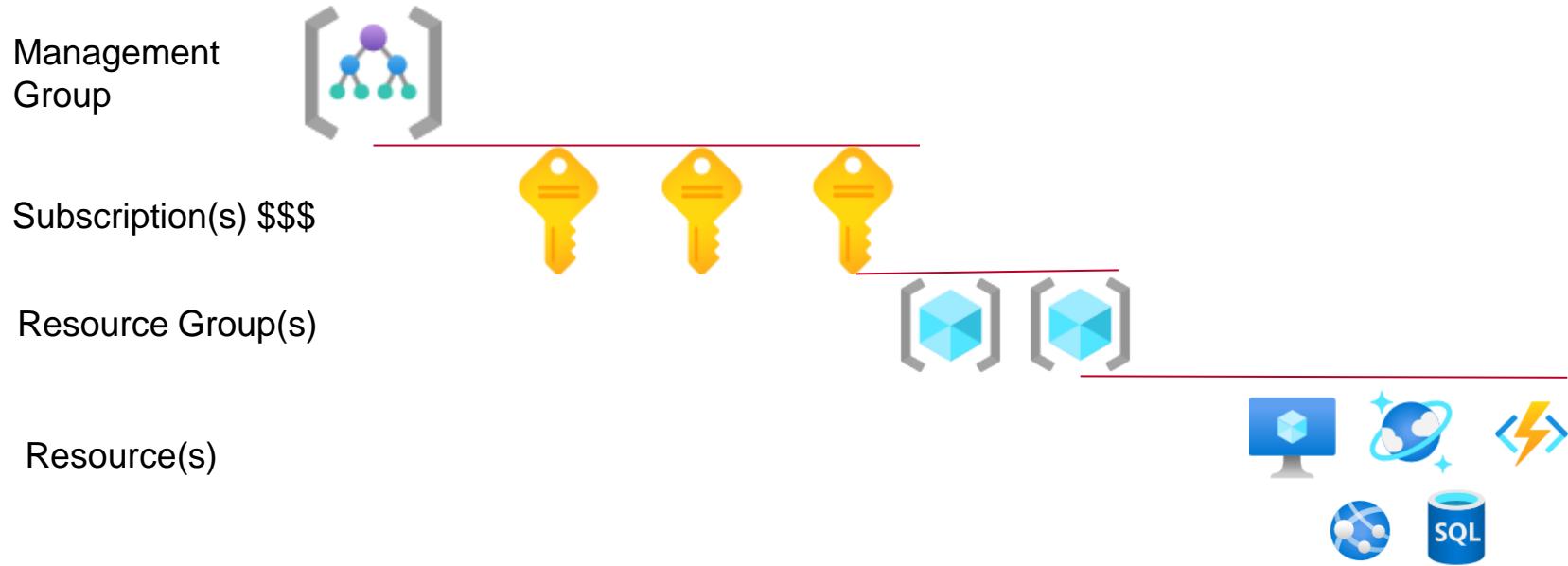


# Resource Hierarchy in Azure

Use Azure resource hierarchy to organize your Azure resources, and to secure, manage, and track their cost.



# Resource Hierarchy in Azure

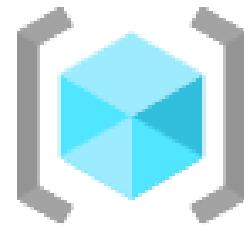


<https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/ready/azure-setup-guide/organize-resources>



# Resource Group

Every resource in Azure must belong to a resource group. A resource group is a logical container that groups multiple resources, enabling you to manage them as a single entity.



# Azure Subscription

An Azure subscription is a logical container that associates resource groups and their respective resources. Your resources' cost is billed against their subscription.

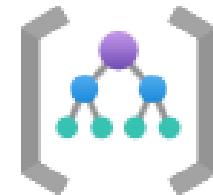


<https://docs.microsoft.com/en-us/azure/cloud-adoption-framework/govern/resource-consistency/resource-access-management#what-is-an-azure-subscription>



# Management Group

If your organization has many Azure subscriptions, you can group them into a manageable entity called a Management Group. This enables you to manage access, policies, and compliance for those subscriptions.



# Nested Hierarchy



You cannot have resource groups within a  
resource group, or subscriptions within a  
subscription.

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# Nested Hierarchy



You can have management groups within a  
parent management group!

# Compute Service Types in Azure

# Compute Services in Azure

Azure compute provides the infrastructure you need to run your application code.



Azure  
VMs



Azure  
App Services



Azure  
Functions



Azure  
AKS



Azure  
Container  
Instances

<https://azure.microsoft.com/en-ca/products/>



# Azure Virtual Machines

Run a virtual machine in Azure using Azure VMs. Like other VMs, you need to maintain the virtual machine by configuring, patching, and installing the software that runs on it.



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# Azure Virtual Machines

- Is an IaaS service
- Gives you more flexibility comparing to PaaS and SaaS options
- More administrative overhead (patching, scaling, monitoring apps, etc.)
- Use for legacy applications that can't be hosted on other compute services



# Azure App Services

Azure App Service is an HTTP-based service for hosting web applications, REST APIs, and mobile back ends. It can host .NET, .NET Core, Java, Ruby, Node.js, PHP, or Python code



# Azure App Services

- Is a PaaS service, which means less administrative overhead comparing to IaaS services
- The service is managed by Azure. You just deploy your code and run it
- Host websites and RESTful APIs using the web app feature
- Other apps such as mobile app back ends or automated business processes
- Use for legacy and new applications
- Global scale with high availability



# Azure Functions

- Run isolated pieces of code in a serverless solution.
- Best to host microservices and APIs (HTTP, and other types)



<https://docs.microsoft.com/en-us/azure/azure-functions/functions-overview>



# Azure Functions

- A serverless PaaS
- The service is managed by Azure. Just deploy your code and run it
- Host APIs and microservices
- Use for legacy and new applications
- Automatic scale and high availability

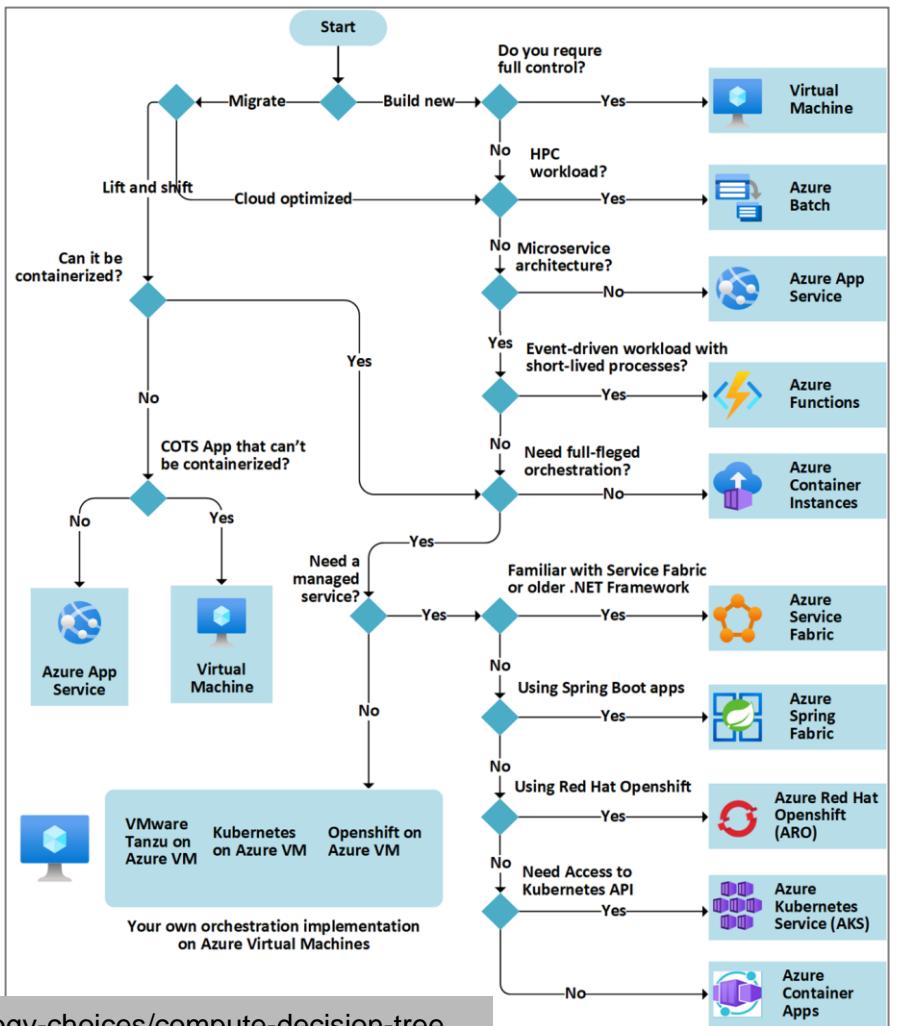


# Azure Container Instances (ACI)

Azure Container Instances offer a simple way to run a Docker-based container in Azure. No need to manage any VMs.



- Azure App Services
- Azure Container Instances (ACI)
- Azure Functions
- Azure Virtual Machines (VMs)
- Azure Container Apps
- Azure Kubernetes Services
- Azure Spring Apps
- Azure Batch



# Application Hosting Options

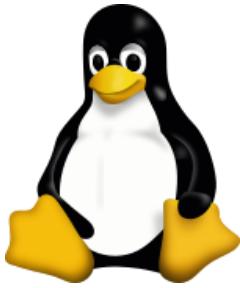
# Azure App Services

Azure App Service is an HTTP-based service for hosting web applications, REST APIs, and mobile back ends. It can host .NET, .NET Core, Java, Ruby, Node.js, PHP, or Python code.



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# Azure App Services Operating System



Linux



Windows

<https://docs.microsoft.com/en-us/azure/app-service/overview>



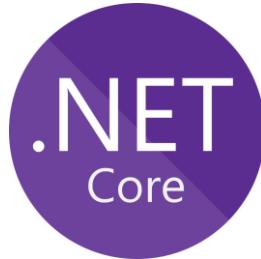
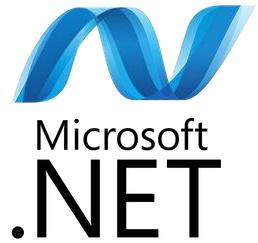
# Azure App Services

- A PaaS service. You don't manage the service OS
- You can control security, autoscaling, configuration settings
- Supports both Linux and Windows workloads
- Can run Docker containers
- Native integration with other Azure services (VNets, Key Vault, Storage, etc.)
- DevOps integration (Azure DevOps, Github, etc.)
- Rich tooling (VS Code, Visual Studio)



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# App Services Supported Frameworks



<https://docs.microsoft.com/en-us/azure/app-service/overview>



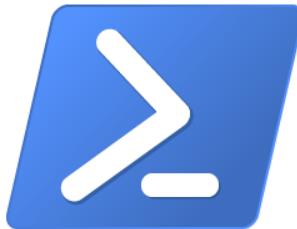
# Azure Functions

- A serverless offering
- Use it only for APIs, microservices, and isolated code
- No UI, no Web App frontends
- You can create multiple functions within a single Function App
- Unlike App Services, you can use the pay-as-you-go model



---

# Function Apps Supported Frameworks



<https://docs.microsoft.com/en-us/azure/azure-functions/supported-languages#languages-by-runtime-version>



# VM Options in Azure

# Azure Virtual Machines

Run a virtual machine in Azure using Azure VMs. Like other VMs, you need to maintain the virtual machine by configuring, patching, and installing the software that runs on it.



# Before Creating a Virtual Machine

- Decide on the VM size (SKU) and its cost
- Not all Azure locations support all VM types
- The number of VMs that can be created in a subscription
- How many vCPUs you want to use in which regions
- The OS for the virtual machine (Linux, Windows, etc.)
- The configuration of the virtual machine after it starts
- The related resources that the virtual machine needs

<https://docs.microsoft.com/en-us/azure/virtual-machines/overview#what-do-i-need-to-think-about-before-creating-a-virtual-machine>  
<https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/azure-subscription-service-limits>



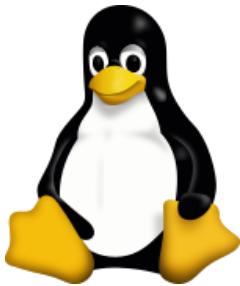
# Virtual Machine Available Sizes (SKUs)

Type	Sizes	Description
General purpose	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2, Dv4, Dsv4, Ddv4, Ddsv4, Dv5, Dsv5, Ddv5, Ddsv5, Dasv5, Dadsv5	Balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute optimized	F, Fs, Fsv2, FX	High CPU-to-memory ratio. Good for medium traffic web servers, network appliances, batch processes, and application servers.
Memory optimized	Esv3, Ev3, Easv4, Eav4, Ebdsv5, Ebsv5, Ev4, Esv4, Edv4, Edsv4, Ev5, Esv5, Edv5, Edsv5, Easv5, Eadsv5, Mv2, M, DSv2, Dv2	High memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage optimized	Lsv2, Lsv3, Lasv3	High disk throughput and IO ideal for Big Data, SQL, NoSQL databases, data warehousing and large transactional databases.
GPU	NC, NCv2, NCv3, NCasT4_v3, ND, NDv2, NV, NVv3, NVv4, NDsrA100_v4, NDm_A100_v4	Specialized virtual machines targeted for heavy graphic rendering and video editing, as well as model training and inferencing (ND) with deep learning. Available with single or multiple GPUs.
High performance compute	HB, HBv2, HBv3, HC, H	Our fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA).

<https://docs.microsoft.com/en-us/azure/virtual-machines/sizes>



# Virtual Machine Operating System



Linux



Windows

<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/quick-create-portal>  
<https://docs.microsoft.com/en-us/azure/virtual-machines/windows/quick-create-portal>



# Virtual Machine Limits

## Virtual Machines limits - Azure Resource Manager

The following limits apply when you use Azure Resource Manager and Azure resource groups.

Resource	Limit
VMs per subscription <sup>3</sup>	25,000 <sup>1</sup> per region.
VM total cores per subscription <sup>3</sup>	20 <sup>1</sup> per region. Contact support to increase limit.
Azure Spot VM total cores per subscription <sup>3</sup>	20 <sup>1</sup> per region. Contact support to increase limit.
VM per series, such as Dv2 and F, cores per subscription <sup>3</sup>	20 <sup>1</sup> per region. Contact support to increase limit.
Availability sets per subscription	2,500 per region.
Virtual machines per availability set	200
Proximity placement groups per resource group	800
Certificates per availability set	199 <sup>2</sup>

<https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/azure-subscription-service-limits#virtual-machines-limits---azure-resource-manager>



# Virtual Machine Quotas

Let's use vCPU quotas as an example. To request a quota increase with support for vCPUs, you must decide how many vCPUs you want to use in which regions. You then request an increase in vCPU quotas for the amounts and regions that you want. If you need to use 30 vCPUs in West Europe to run your application there, you specifically request 30 vCPUs in West Europe. Your vCPU quota isn't increased in any other region--only West Europe has the 30-vCPU quota.

As a result, decide what your quotas must be for your workload in any one region. Then request that amount in each region into which you want to deploy. For help in how to determine your current quotas for specific regions, see [Resolve errors for resource quotas](#).



# Azure Container Instances (ACI)

Azure Container Instances offer a simple way to run a Docker-based container in Azure. No need to manage any VMs.

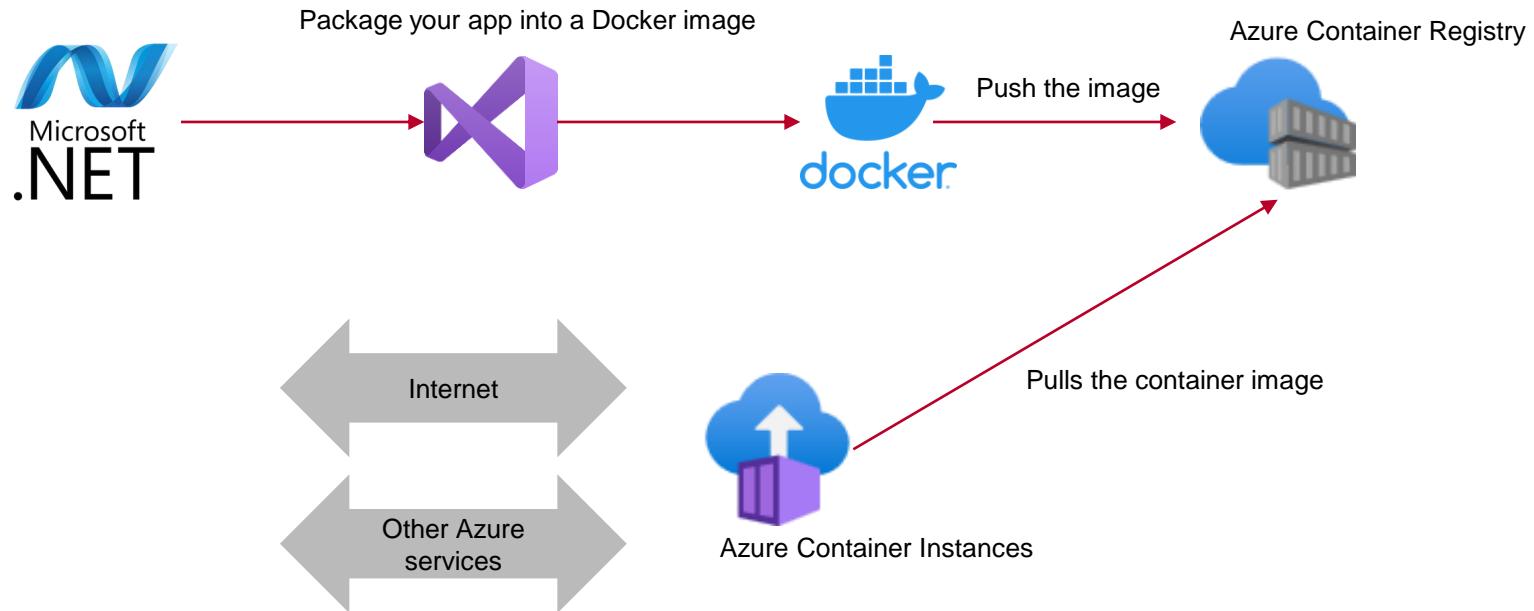


# Azure Container Instances (ACI)

- An IaaS service
- Expose your container to internet with an IP address
- Host websites, APIs, microservices, and any other application
- Linux and Windows containers are supported
- Each ACI instance only hosts a single container



# Host Your Code in ACI

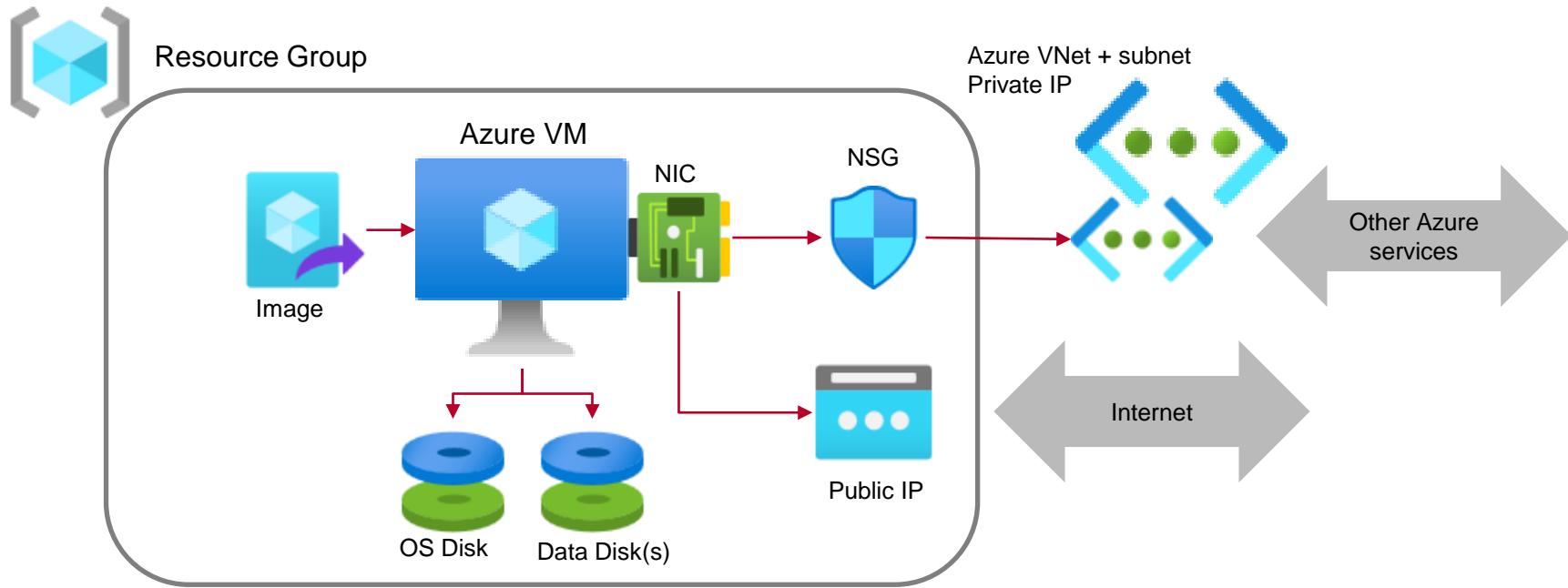


<https://docs.microsoft.com/en-us/azure/container-instances/container-instances-overview>



# Resources Required for an Azure VM

# Resources Required for an Azure VM



<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/quick-create-portal>

<https://docs.microsoft.com/en-us/azure/virtual-machines/windows/quick-create-portal>



# Azure Virtual Networks

# Azure Virtual Networks (VNet)

Azure's implementation of computer networks. VNets are the foundation of your private network in Azure.



# Azure Virtual Networks (VNet)

- Enables Azure resources to securely communicate with each other, the internet, and on-premises networks
- Like your local computer networks
- Filter network traffic using NSGs and/or Azure Firewall
- Native integration for several Azure services
- Scoped to a single region/location
- VNet is scoped to a subscription



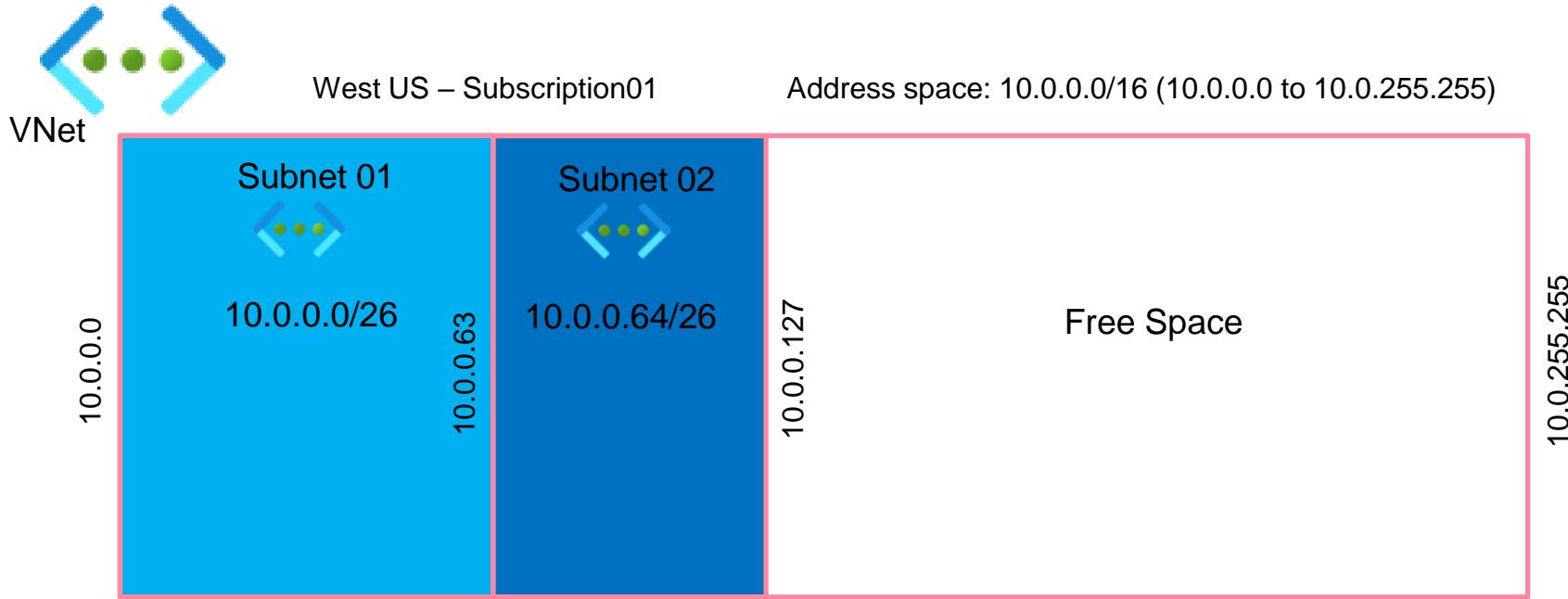
# Virtual Network Limits Per Subscription

Resource	Limit
Virtual networks	1,000
Subnets per virtual network	3,000
Virtual network peerings per virtual network	500
Virtual network gateways (VPN gateways) per virtual network	1
Virtual network gateways (ExpressRoute gateways) per virtual network	1
DNS servers per virtual network	20
Private IP addresses per virtual network	65,536
Total Private Addresses for a group of Peered Virtual networks	128,000
Private IP addresses per network interface	256
Private IP addresses per virtual machine	256

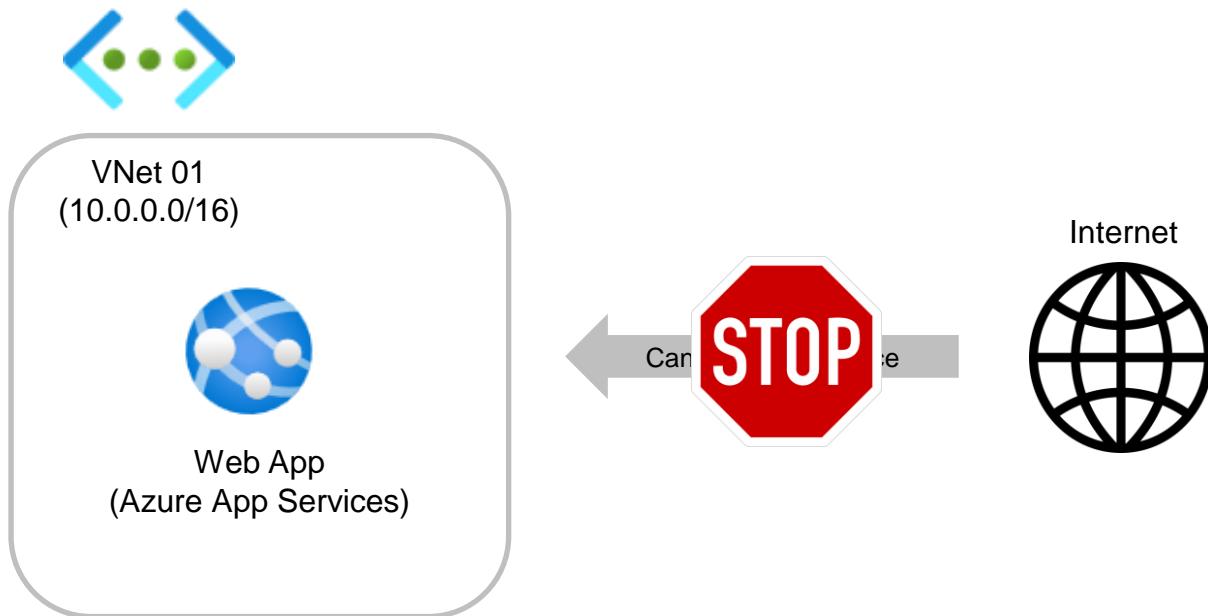
<https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/azure-subscription-service-limits#networking-limits>



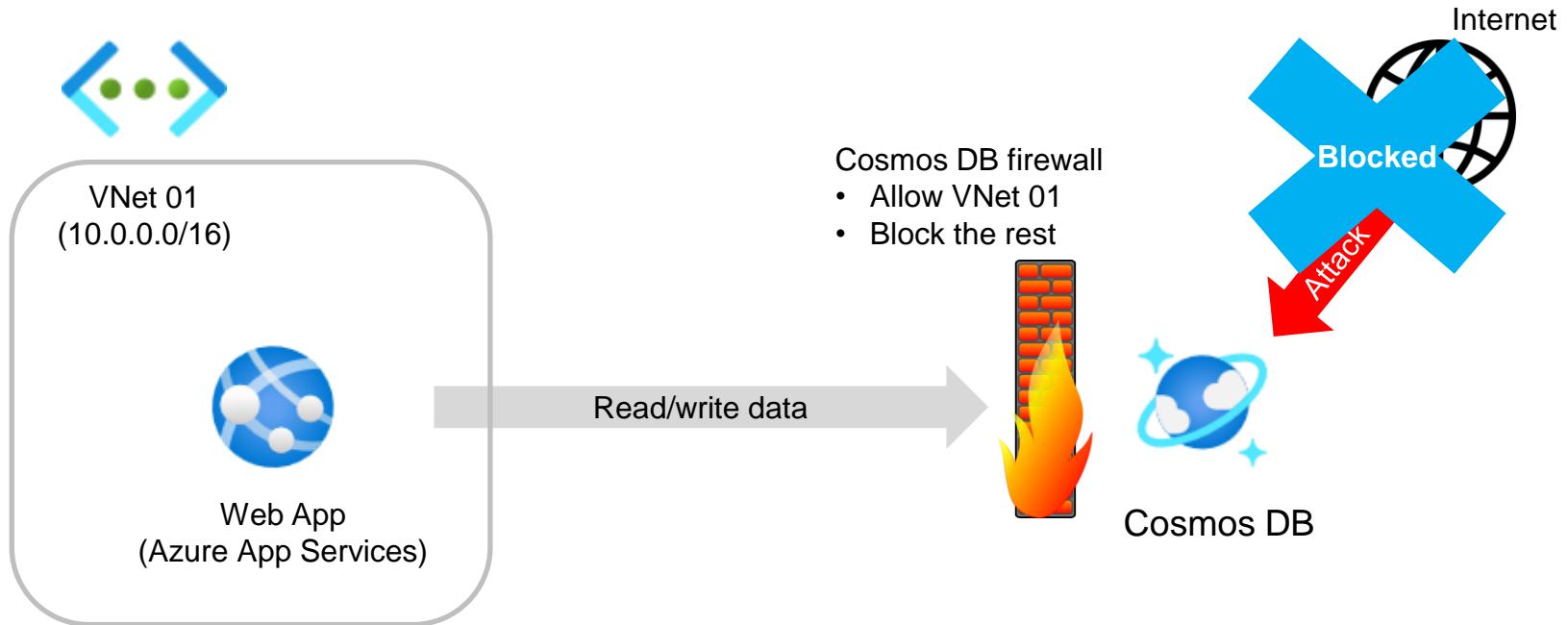
# Azure VNet Concepts



# Azure VNet Purpose



# Azure VNet Purpose



# Azure VNet Security

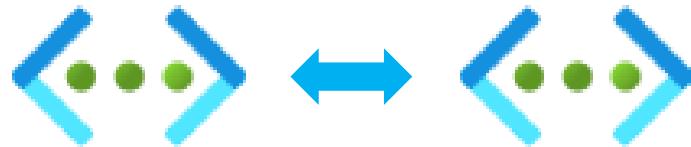


You must secure your VNet traffic using services such as NSGs and/or Azure Firewall.

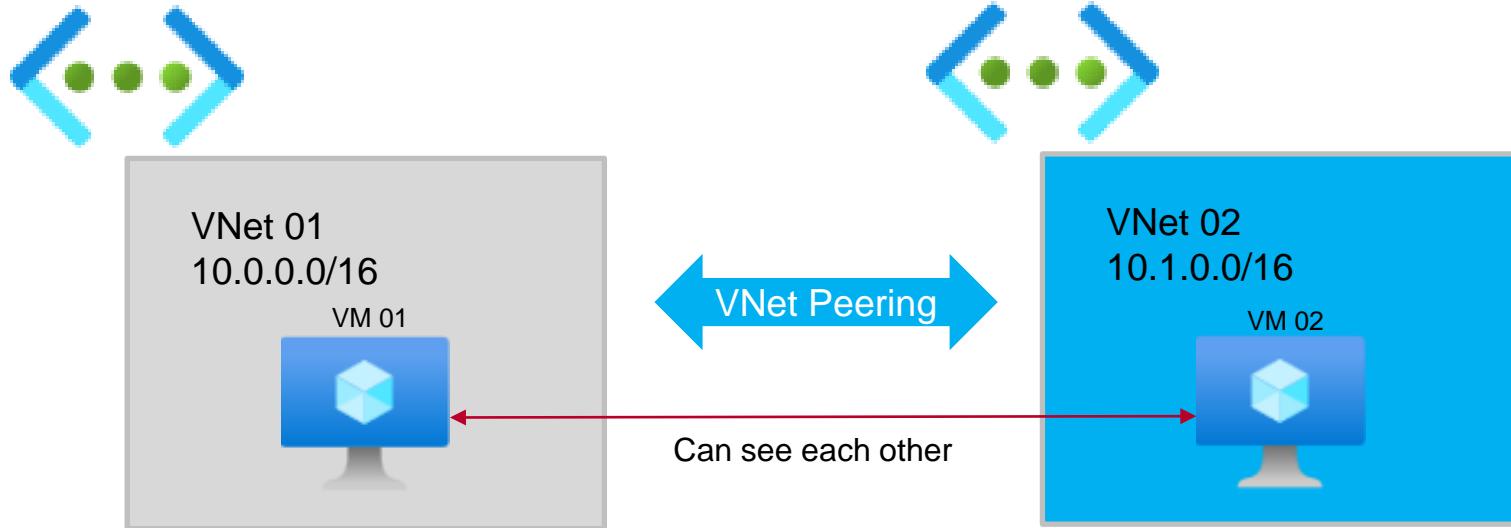
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# Azure Virtual Networks Peering

Connect two or more Azure Virtual Networks using VNet Peering.



# Azure Virtual Networks Peering



<https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-peering-overview>



---

# Azure Virtual Networks Peering



Before peering, make sure your VNets don't  
have any overlapping IP addresses!



# VPN Gateway Option



You can also use VPN Gateway to connect two  
Azure VNets.

<https://docs.microsoft.com/en-us/azure/vpn-gateway/design#V2V>



# Azure DNS

# Azure DNS

Performs a domain name resolution to a target IP, using Azure infrastructure.



<https://docs.microsoft.com/en-us/azure/dns/dns-overview>



# Azure DNS

- You can NOT buy a domain using Azure DNS
- Buy your domain from App Service Domains or a 3<sup>rd</sup> party provider
- Host that domain name in the Azure DNS for record management
- Use a DNS Zone to host DNS records for the domain
- Each DNS record has a name and a type
- Supports all common DNS record types: A, AAAA, CAA, CNAME, MX, NS, PTR, SOA, SRV, and TX



# Azure DNS



<https://docs.microsoft.com/en-us/azure/dns/dns-zones-records>



# Azure DNS

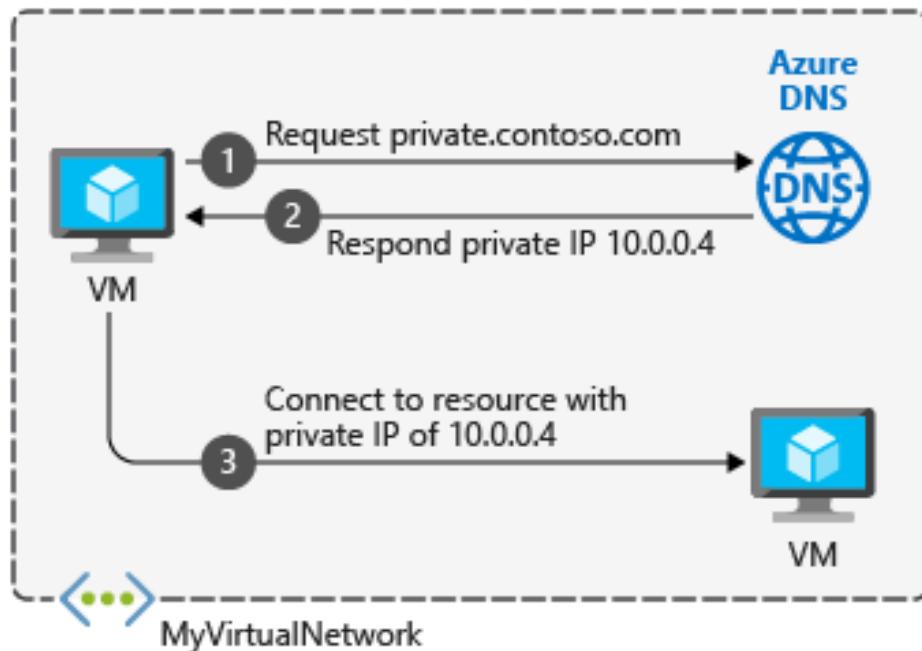
dns				
www.contoso.com.	3600	IN	A	134.170.185.46
www.contoso.com.	3600	IN	A	134.170.188.221

Domain name	TTL	Record type	Target IP/FQDN
-------------	-----	-------------	----------------



# Azure Private DNS

A DNS service for your private virtual network



<https://docs.microsoft.com/en-us/azure/dns/private-dns-overview>



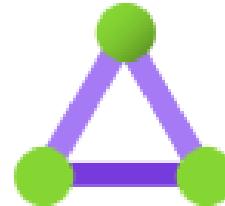
# Connecting Other Networks to Azure

# Connecting Other Networks to Azure

Microsoft allows you to connect your on-premises networks to Azure using a few options.



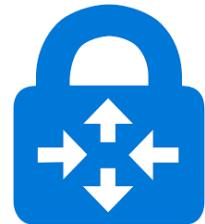
VPN gateway



ExpressRoute

# Azure VPN Gateway

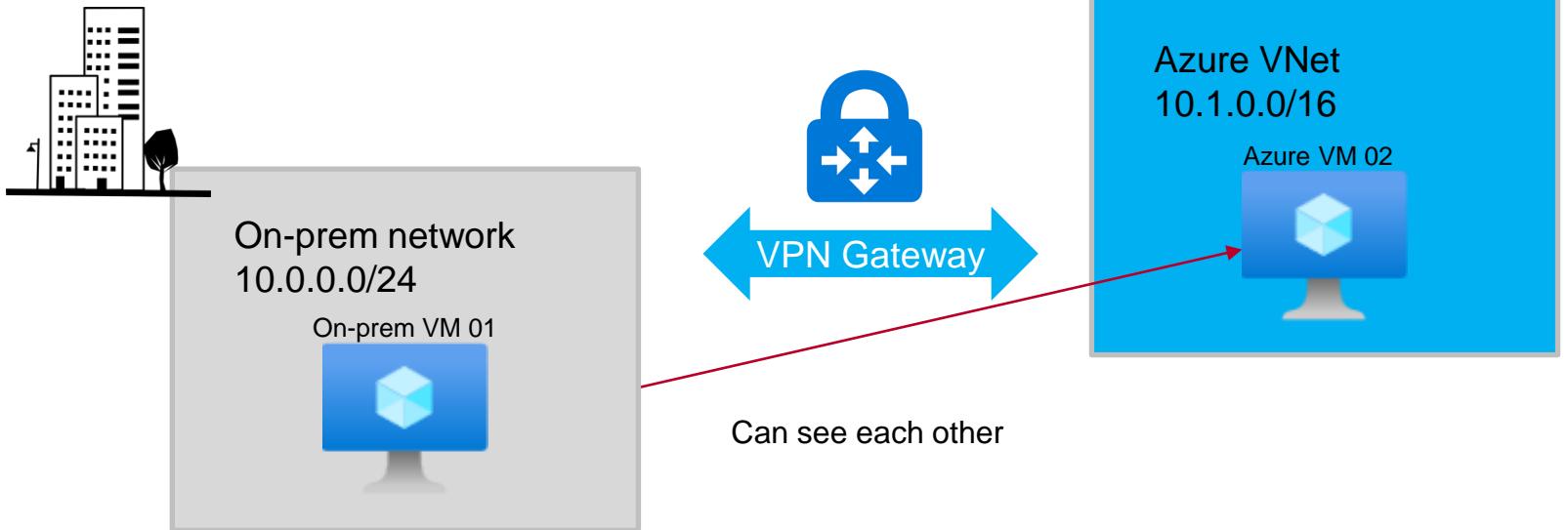
- A virtual network gateway that sends encrypted traffic between an Azure virtual network (VNet) and an on-premises network
- The encrypted traffic goes over the public Internet.



<https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-vpngateways>



# Azure VPN Gateway



<https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-vpngateways>



# VPN Connection Types

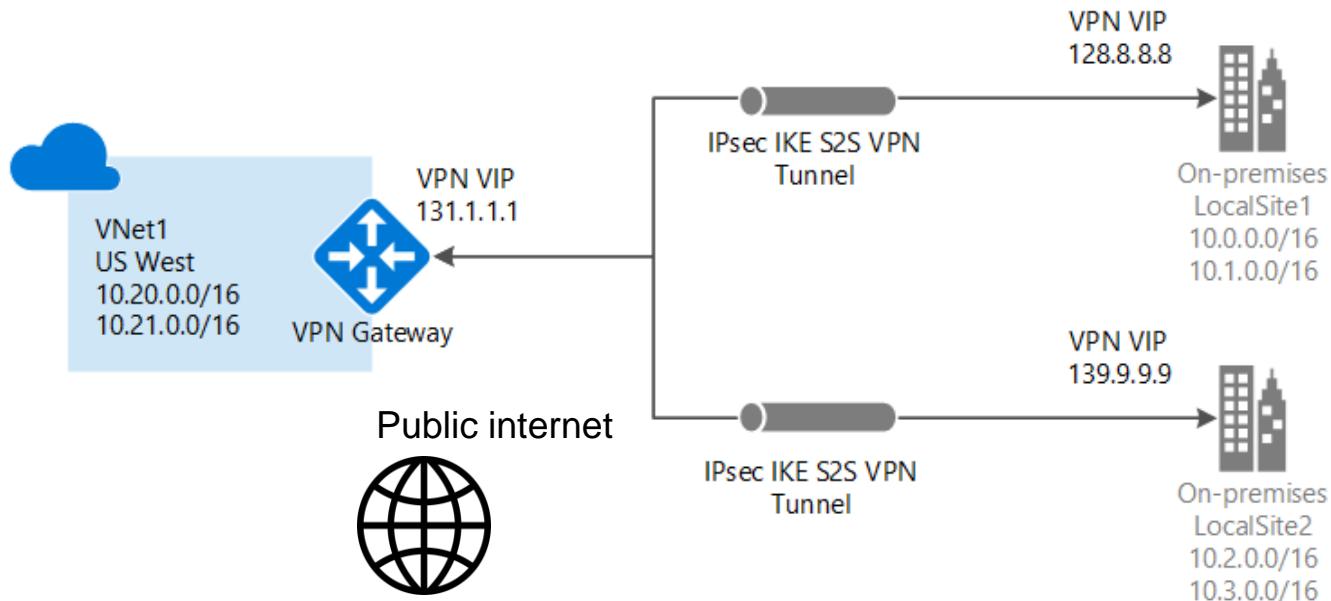


Point-to-Site  
VPN



Site-to-Site  
VPN

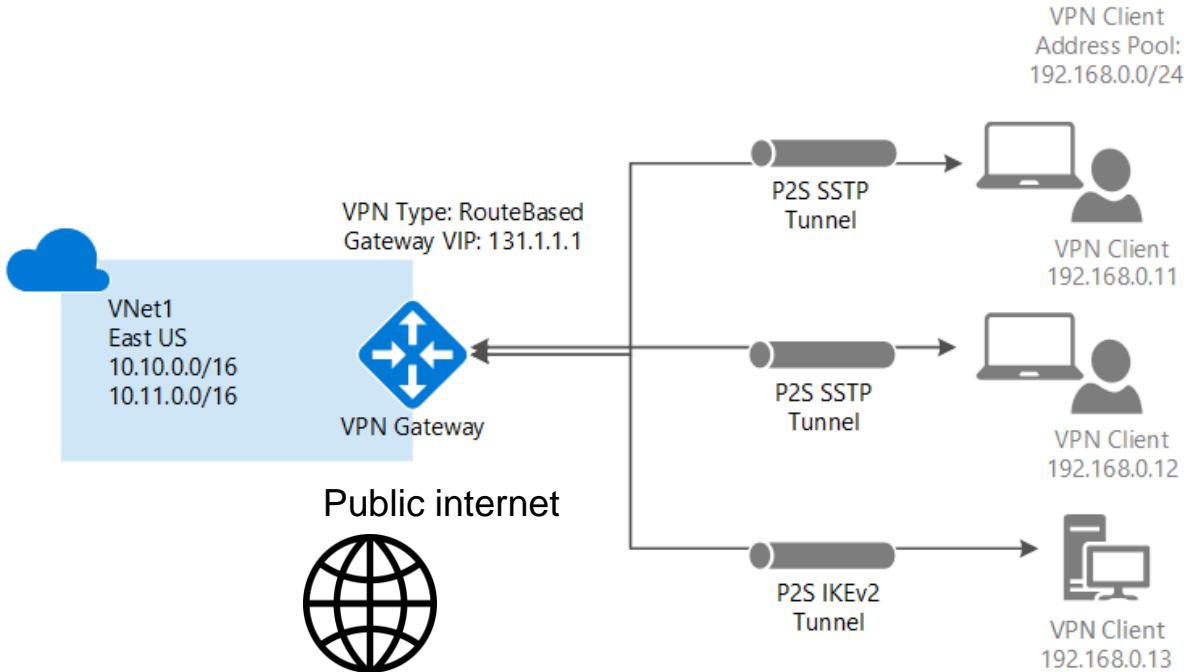
# Site-to-Site VPN



<https://docs.microsoft.com/en-us/azure/vpn-gateway/design#s2smulti>



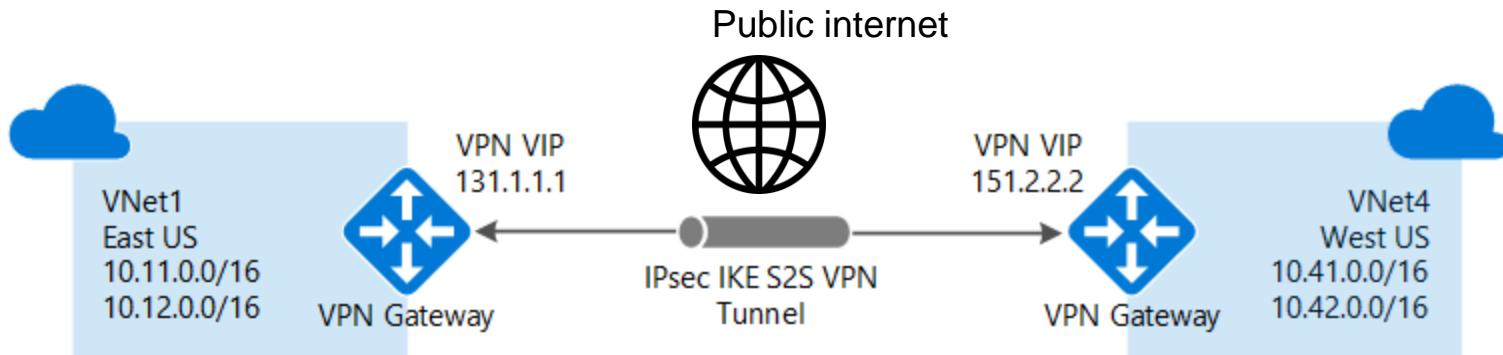
# Point-to-Site VPN



<https://docs.microsoft.com/en-us/azure/vpn-gateway/design#P2S>

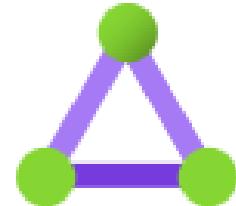


# VNet-to-VNet Connections



# Azure ExpressRoute

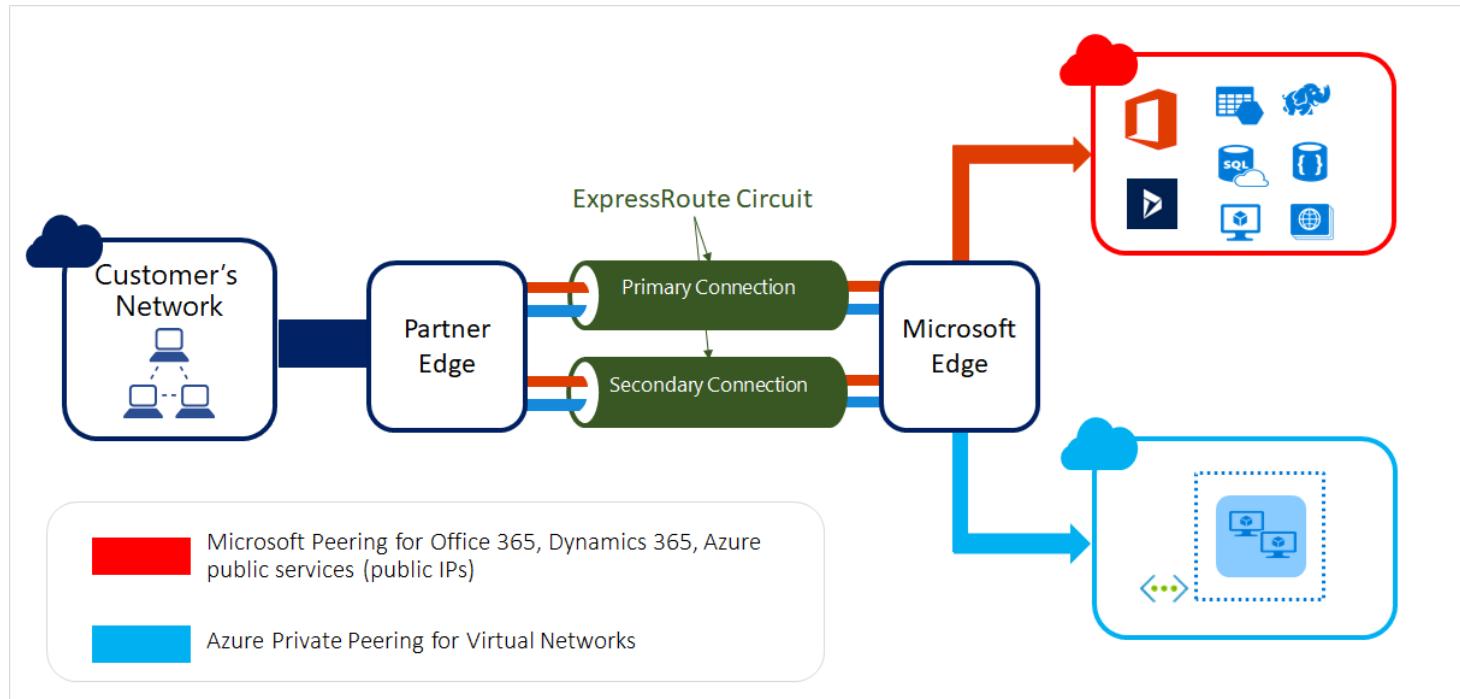
- Enables you to extend your on-premises networks into Azure.
- The connection is private (not going over public internet)
- The help of a connectivity provider is required



<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-introduction>



# Azure ExpressRoute



<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-introduction>  
<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-locations>



# Public and Private Endpoints

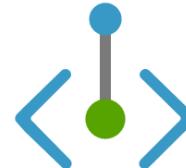
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# Service Endpoints

Allows clients and users to reach out to an Azure service



Public Endpoint



Private Endpoint

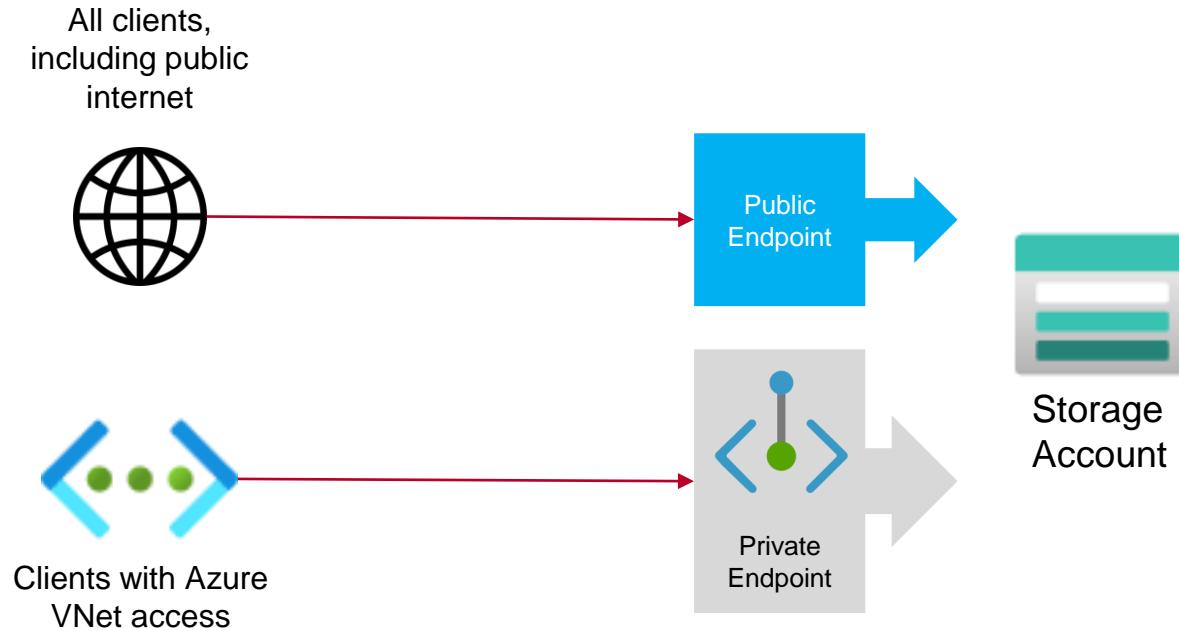


# Azure Private Endpoint

- A network interface that uses a private IP address from your VNet
- Brings your service to an Azure virtual network (VNet)
- Public clients will not see your resource anymore
- The traffic goes over Microsoft private backbone network



# Service Endpoints



# Azure Private Endpoint Support

Azure App Configuration	Azure Database for PostgreSQL - Single server	Azure Machine Learning	Azure File Sync
Azure Automation	Azure Device Provisioning Service	Azure Migrate	Azure Synapse
Azure Cosmos DB	Azure IoT Hub	Application Gateway	Azure Synapse Analytics
Azure Batch	Azure IoT Central	Private Link service (your own service)	Azure App Service
Azure Cache for Redis	Azure Digital Twins	Power BI	Azure App Service
Azure Cache for Redis Enterprise	Azure Event Grid	Microsoft Purview	Azure Static Web Apps
Azure Cognitive Services	Azure Event Grid	Microsoft Purview	Azure Media Services
Azure Managed Disks	Azure Event Hub	Azure Backup	
Azure Container Registry	Azure HDInsight	Azure Relay	
Azure Kubernetes Service - Kubernetes API	Azure API for FHIR (Fast Healthcare Interoperability Resources)	Azure Cognitive Search	
Azure Data Factory	Azure Key Vault HSM (hardware security module)	Azure Service Bus	
Azure Data Explorer	Azure Key Vault	Azure SignalR Service	
Azure Database for MariaDB		Azure SignalR Service	
Azure Database for MySQL		Azure SQL Database	
		Azure Storage	

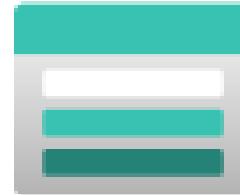
<https://docs.microsoft.com/en-us/azure/private-link/private-endpoint-overview#private-link-resource>



# Azure Storage Services

# Azure Storage Account

Contains all Azure Storage data objects, including blobs, file shares, queues, and tables.



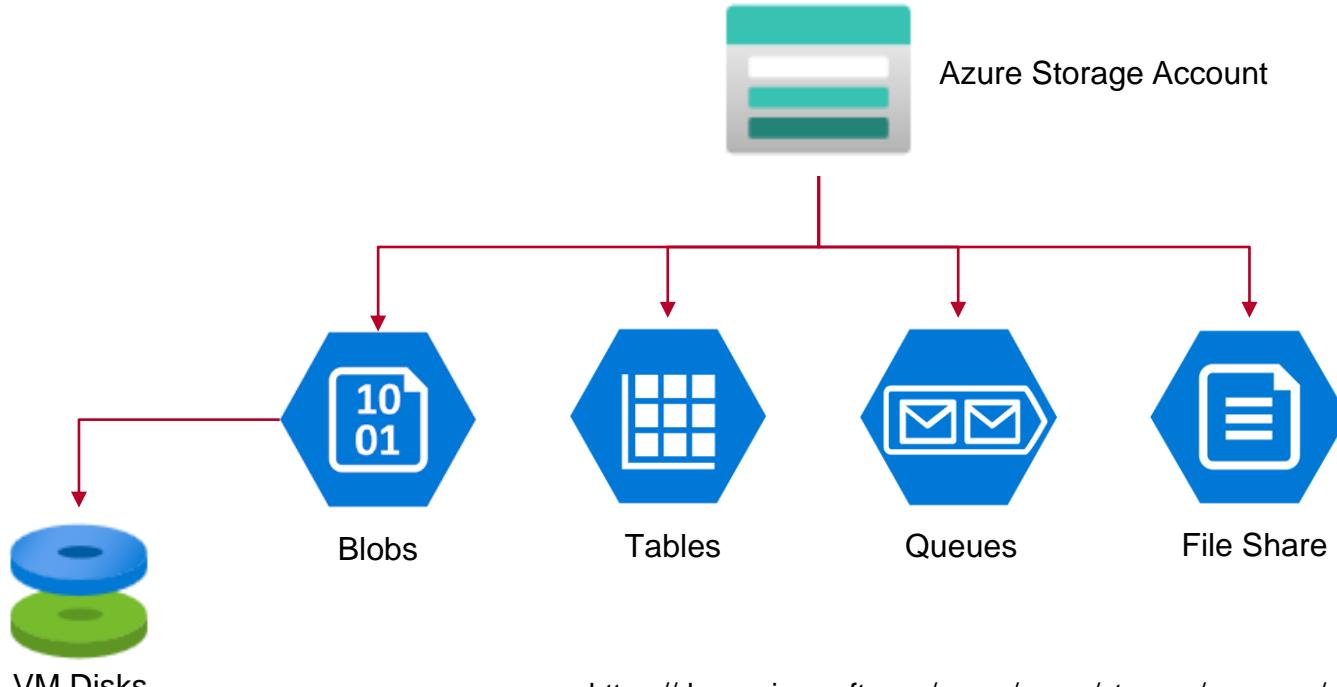
# Azure Storage Account

- Accessible from around the globe over HTTP(S)
- Store blobs, tables, queues, and file shares
- Access via public and private endpoints
- Financially-backed SLA
- Security-in-depth (firewall, in transit, at rest)

<https://docs.microsoft.com/en-us/azure/storage/common/storage-account-overview>



# Azure Storage Services

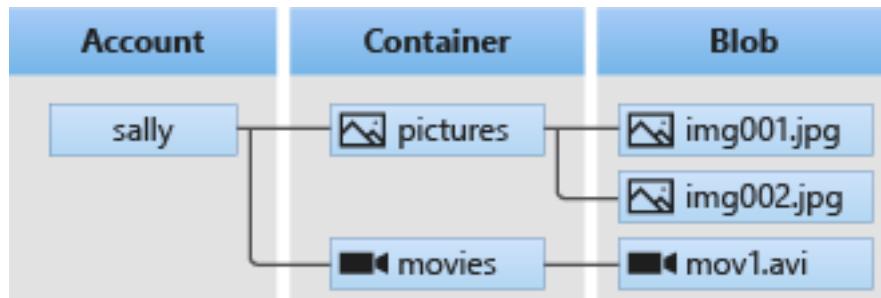


<https://docs.microsoft.com/en-us/azure/storage/common/storage-introduction>



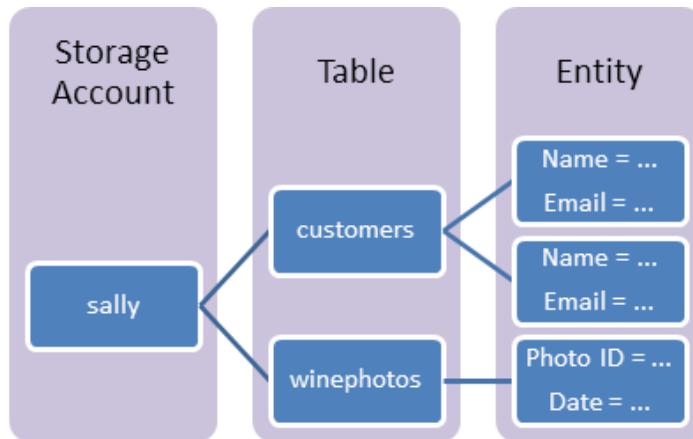
# Azure Storage Account: Blobs

A scalable object store for text/binary files (unstructured data). Also includes support for big data analytics through Data Lake Storage Gen2



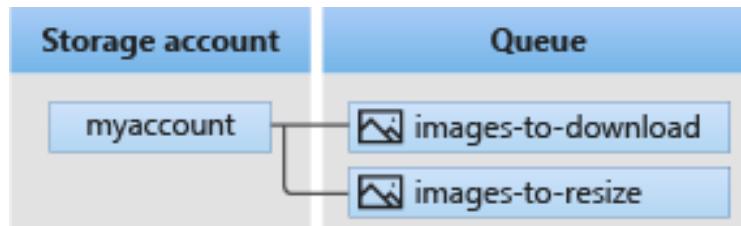
# Azure Storage Account: Tables

Stores non-relational structured data (structured NoSQL) in the cloud, providing a key/attribute store with a schema-less design



# Azure Storage Account: Queues

- Stores a large number of messages in a queue data structure
- A queue message can be up to 64 KB in size (use Service Bus for bigger messages)
- Create a backlog of work to process asynchronously



# Azure Storage Account: Files

- File shares in the cloud that are accessible via the industry standard Server Message Block (SMB) protocol, Network File System (NFS) protocol, and Azure Files REST API



<https://docs.microsoft.com/en-us/azure/storage/files/storage-files-introduction>



# Azure Storage Tiers

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# Azure Storage Pricing

- Storage Account type
- Storage Account access tier
- Storage Account redundancy option
- Usage (storage + access)

<https://azure.microsoft.com/en-ca/pricing/details/storage/blobs/>



# Azure Storage Blob Types

Azure  
Storage  
Blobs



Block Blobs



Page Blobs



Append  
Blobs



# Azure Storage Types

- General Purpose V2
- Premium block blobs
- Premium page blobs
- Premium file shares

Type of storage account	Supported storage services
Standard general-purpose v2	Blob Storage (including Data Lake Storage <sup>1</sup> ), Queue Storage, Table Storage, and Azure Files
Premium block blobs <sup>3</sup>	Blob Storage (including Data Lake Storage <sup>1</sup> )
Premium file shares <sup>3</sup>	Azure Files
Premium page blobs <sup>3</sup>	Page blobs only

<https://docs.microsoft.com/en-us/azure/storage/common/storage-account-overview#types-of-storage-accounts>



# Legacy Storage Account Types



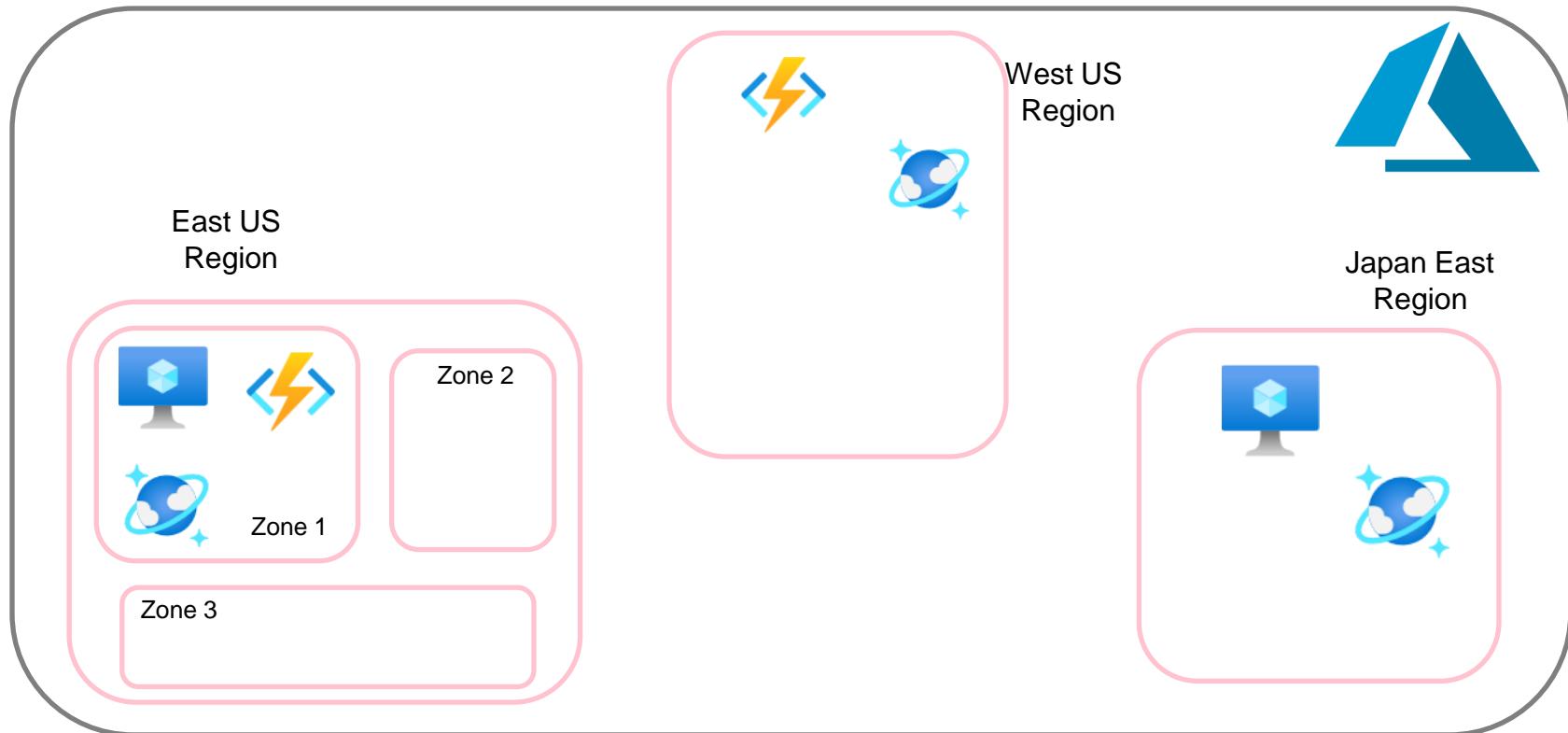
Do NOT use the legacy **General Purpose V1** or  
**Standard Blob Storage** type!

# Azure Blob Access Tiers

- **Hot:** Highest storage costs, lowest access costs
- **Cool:** Lower storage costs, higher access costs compared
- **Archive:** Optimized for storing data that is rarely accessed



# Storage Account Redundancy Option



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# Storage Account Redundancy Option

- Locally redundant storage
- Zone-redundant storage
- Geo-redundant storage
- Geo-zone-redundant storage



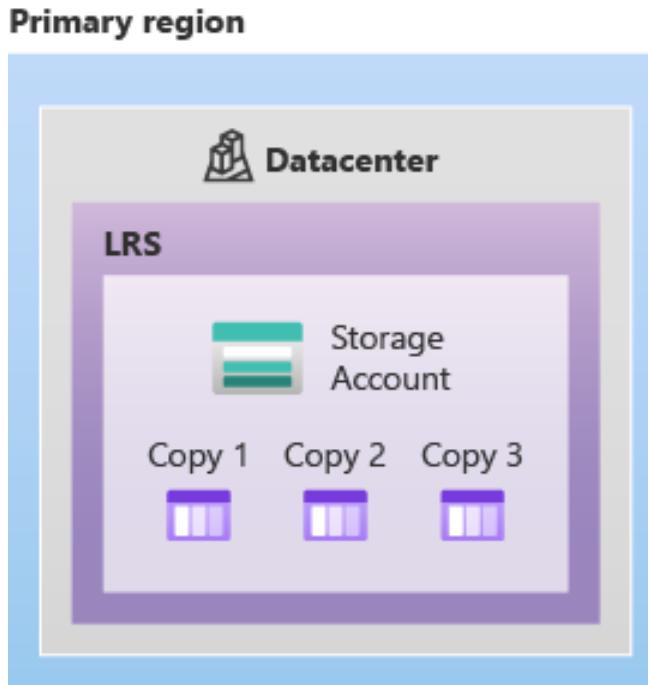
# Storage Account Redundancy Option

Parameter	LRS	ZRS	GRS/RA-GRS	GZRS/RA-GZRS
Percent durability of objects over a given year	at least 99.99999999% (11 9's)	at least 99.999999999% (12 9's)	at least 99.99999999999999% (16 9's)	at least 99.99999999999999% (16 9's)
Availability for read requests	At least 99.9% (99% for Cool or Archive access tiers)	At least 99.9% (99% for Cool or Archive access tiers)	At least 99.9% (99% for Cool or Archive access tiers) for GRS	At least 99.9% (99% for Cool or Archive access tiers) for GZRS At least 99.99% (99.9% for Cool or Archive access tiers) for RA-GZRS
Availability for write requests	At least 99.9% (99% for Cool or Archive access tiers)	At least 99.9% (99% for Cool or Archive access tiers)	At least 99.9% (99% for Cool or Archive access tiers)	At least 99.9% (99% for Cool or Archive access tiers)
Number of copies of data maintained on separate nodes	Three copies within a single region	Three copies across separate availability zones within a single region	Six copies total, including three in the primary region and three in the secondary region	Six copies total, including three across separate availability zones in the primary region and three locally redundant copies in the secondary region

<https://docs.microsoft.com/en-us/azure/storage/common/storage-redundancy#durability-and-availability-parameters>



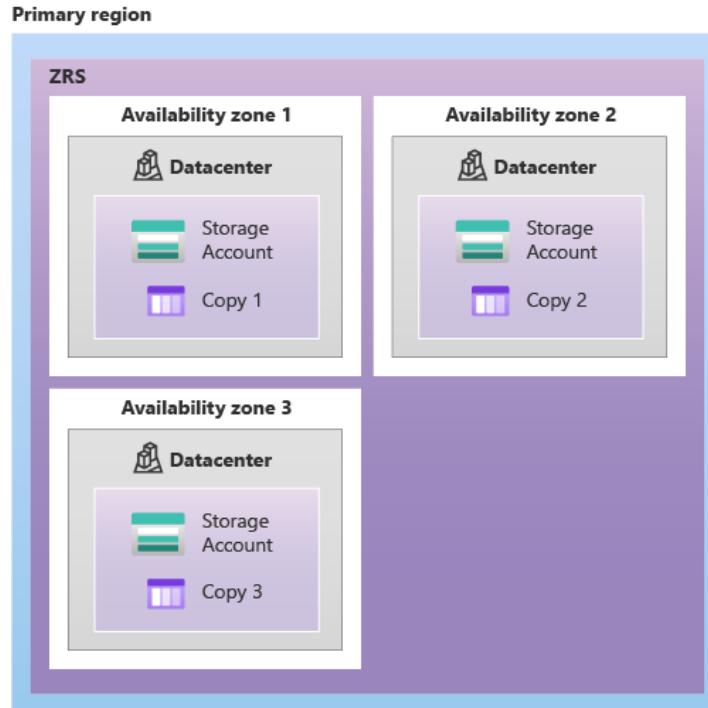
# Locally Redundant Storage (\$)



<https://docs.microsoft.com/en-us/azure/storage/common/storage-redundancy#locally-redundant-storage>



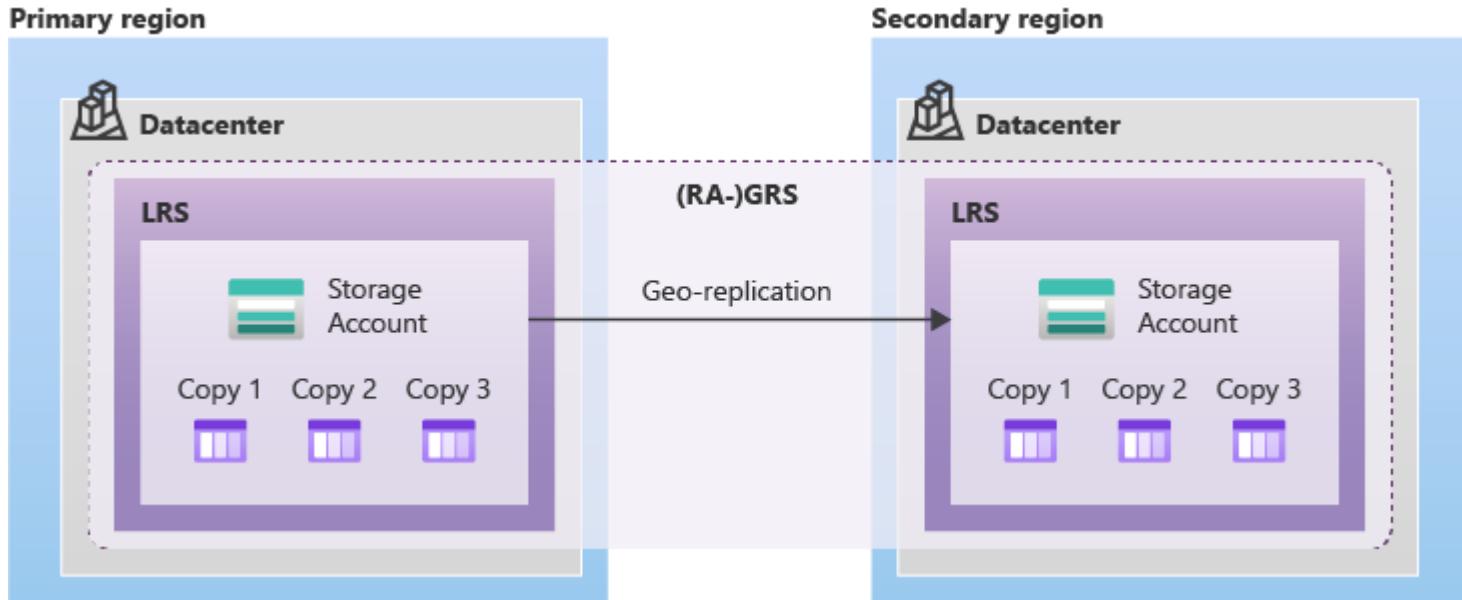
# Zone-redundant Storage (\$\$)



<https://docs.microsoft.com/en-us/azure/storage/common/storage-redundancy#zone-redundant-storage>



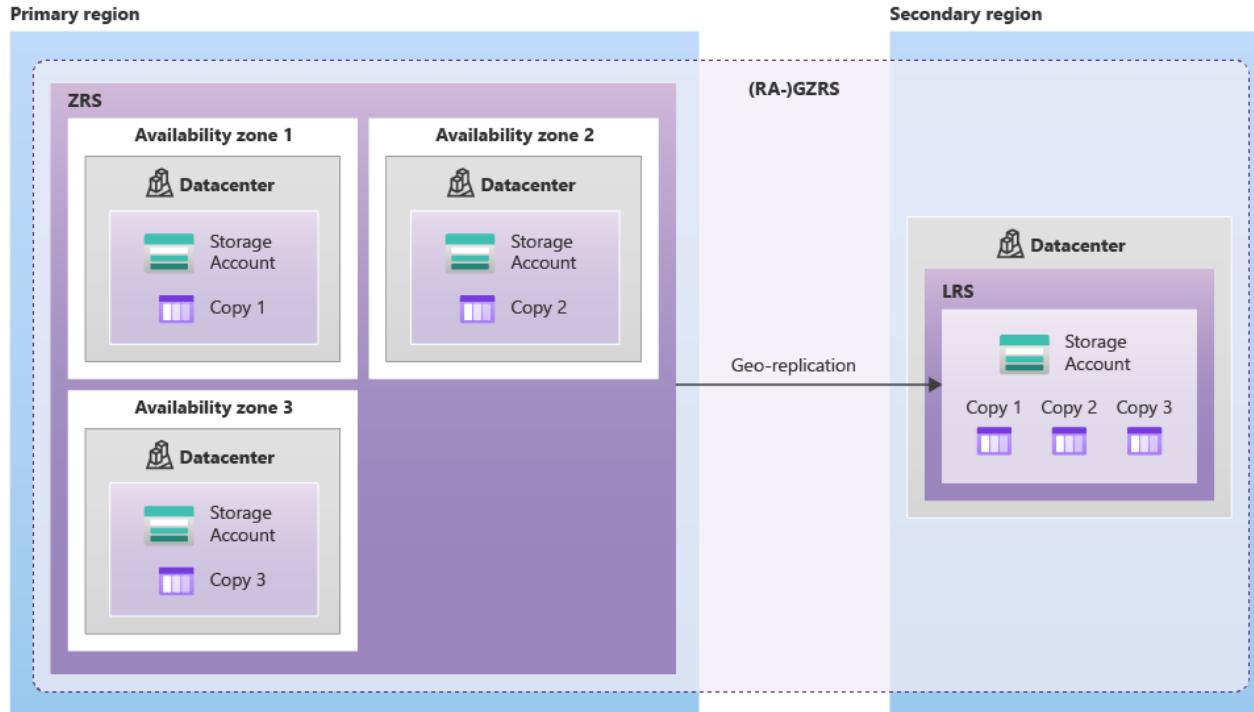
# Geo-redundant storage (\$\$\$)



<https://docs.microsoft.com/en-us/azure/storage/common/storage-redundancy#geo-redundant-storage>



# Geo-zone-redundant storage (\$\$\$\$\$)



<https://docs.microsoft.com/en-us/azure/storage/common/storage-redundancy#geo-zone-redundant-storage>



# Moving Files

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# Copy Files To and From Storage Accounts

- AzCopy
- Azure Storage Explorer
- Azure File Sync



# AzCopy (Blobs and Files Only)

Is a command-line utility enabling you to copy blobs or files to/from a storage account

```
azcopy copy  
    "C:\local\path"  
    "https://mystorageaccount.blob.core.windows.net/imagecontainer/?[SAS Token]"  
    --recursive=true
```

<https://docs.microsoft.com/en-us/azure/storage/common/storage-use-azcopy-v10>



# AzCopy (Blobs and Files Only)

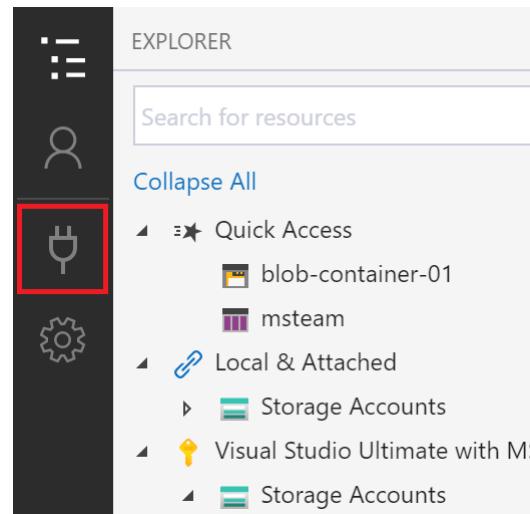
Service	Article
Azure Blob Storage	<a href="#">Upload files to Azure Blob Storage</a>
Azure Blob Storage	<a href="#">Download blobs from Azure Blob Storage</a>
Azure Blob Storage	<a href="#">Copy blobs between Azure storage accounts</a>
Azure Blob Storage	<a href="#">Synchronize with Azure Blob Storage</a>
Azure Files	<a href="#">Transfer data with AzCopy and file storage</a>
Amazon S3	<a href="#">Copy data from Amazon S3 to Azure Storage</a>
Google Cloud Storage	<a href="#">Copy data from Google Cloud Storage to Azure Storage (preview)</a>
Azure Stack storage	<a href="#">Transfer data with AzCopy and Azure Stack storage</a>

<https://docs.microsoft.com/en-us/azure/storage/common/storage-use-azcopy-v10>



# Azure Storage Explorer (All Storage Services)

A standalone app that enables you to work with Azure Storage data on Windows, macOS, and Linux.



<https://docs.microsoft.com/en-us/azure/vs-azure-tools-storage-manage-with-storage-explorer?tabs=windows>



# Azure File Sync (Files Only)

Transforms Windows Server into a quick cache of your Azure file share.

Use SMB, NFS, and FTPS to locally access your data. You can have as many caches as you need across the world.



# Azure File Sync (Files Only)

- Most frequently accessed files are cached local server
- Least frequently accessed files are stored in the cloud
- A local Windows Server for each of your offices
- Azure File Sync is backed by Azure Files
- Centralized backups in the cloud using Azure Backup



# Other Data Moving Options



Other services such as **Azure Data Factory** can be used to move data. This service is beyond the scope of AZ-900 exam.

# Migration Options

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# Data Migration Options

- Azure Migrate and Azure Data Box



<https://docs.microsoft.com/en-us/azure/migrate/migrate-services-overview>



# Azure Migrate

Azure Migrate provides a simplified migration, modernization, and optimization service for Azure.



<https://docs.microsoft.com/en-us/azure/migrate/migrate-services-overview>



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# Azure Migrate

- Unified migration platform
- Range of tools
- Assessment, migration, and modernization



# Azure Migrate Tools

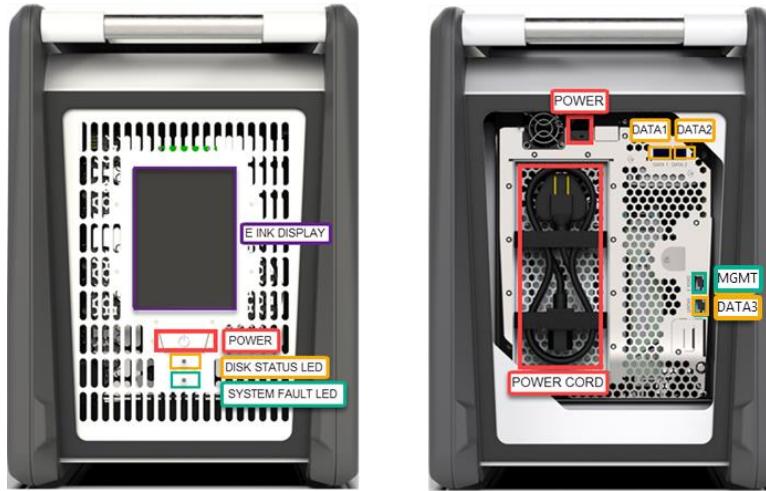
Tool	Assess and migrate	Details
Azure Migrate: Discovery and assessment	Discover and assess servers including SQL and web apps	Discover and assess on-premises servers running on VMware, Hyper-V, and physical servers in preparation for migration to Azure.
Azure Migrate: Server Migration	Migrate servers	Migrate VMware VMs, Hyper-V VMs, physical servers, other virtualized servers, and public cloud VMs to Azure.
Data Migration Assistant	Assess SQL Server databases for migration to Azure SQL Database, Azure SQL Managed Instance, or Azure VMs running SQL Server.	Data Migration Assistant is a stand-alone tool to assess SQL Servers. It helps pinpoint potential problems blocking migration. It identifies unsupported features, new features that can benefit you after migration, and the right path for database migration. <a href="#">Learn more</a> .
Azure Database Migration Service	Migrate on-premises databases to Azure VMs running SQL Server, Azure SQL Database, or SQL Managed Instances	<a href="#">Learn more</a> about Database Migration Service.
Movere	Assess servers	<a href="#">Learn more</a> about Moveure.
Web app migration assistant	Assess on-premises web apps and migrate them to Azure.	Azure App Service Migration Assistant is a standalone tool to assess on-premises websites for migration to Azure App Service.  Use Migration Assistant to migrate .NET and PHP web apps to Azure. <a href="#">Learn more</a> about Azure App Service Migration Assistant.
Azure Data Box	Migrate offline data	Use Azure Data Box products to move large amounts of offline data to Azure. <a href="#">Learn more</a> .

<https://docs.microsoft.com/en-us/azure/migrate/migrate-services-overview#integrated-tools>



# Azure Data Box

Enables you to quickly send terabytes of data into and out of Azure.



Data Box front view (left) and back view (right)

<https://docs.microsoft.com/en-us/azure/databox/data-box-overview>



---

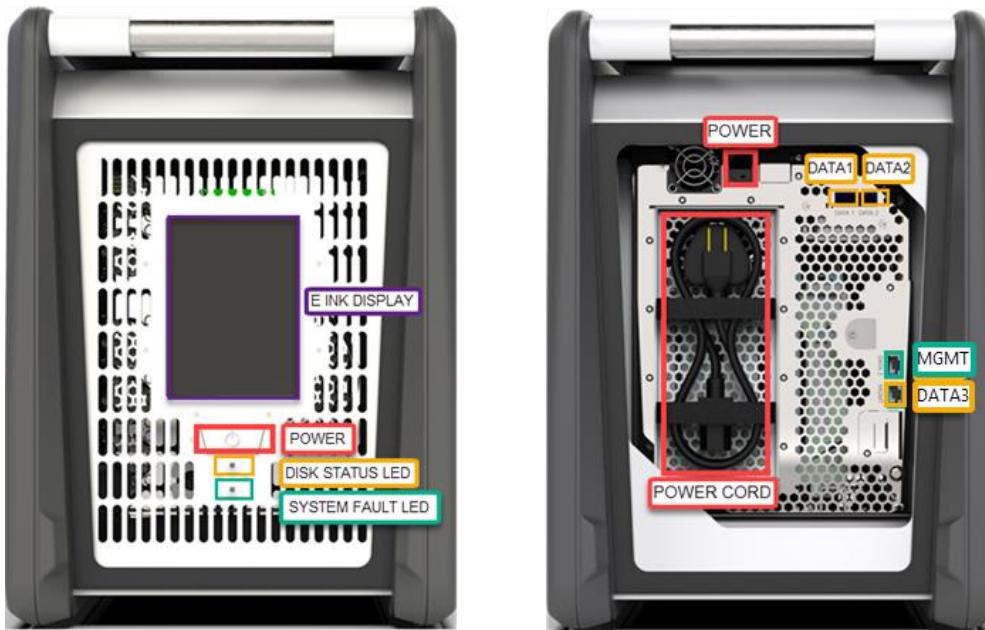
# Data Box Components

- Data Box device
- Local web user interface
- Data Box service

<https://docs.microsoft.com/en-us/azure/databox/data-box-overview#data-box-components>



# Data Box Device (80 TB Usable Storage )



Data Box front view (left) and back view (right)

<https://docs.microsoft.com/en-us/azure/databox/data-box-overview#data-box-components>



# Local Web User Interface (Device)

Microsoft Azure Data Box

Dashboard MyDataBoxOrder

View dashboard Set network interfaces Connect and copy Prepare to ship

MANAGE

Shut down or restart Contact Support

Lock device Refresh Help Settings Sign out

**Set network interfaces**  
Verify or configure network settings.  
[Learn more](#) [Start](#)

**Connect and copy**  
Get share credentials and copy data.  
[Learn more](#)

**Prepare to ship**  
Prepare the device for shipping.  
[Learn more](#) [Start](#)

MGMT 192.168.100.10 Data 3 5.5.7.127

Free Space 80,202 GB Used Space 94 GB

Device Unlocked

<https://docs.microsoft.com/en-us/azure/databox/data-box-overview#data-box-components>



# Data Box Service (Azure)

Microsoft Azure

Report a bug Search resources, services, and docs

john@contoso.com MICROSOFT

Home > All resources > MyDataBox01

MyDataBox01 RESOURCE NAME FOR YOUR ORDER

SEARCH

Clone Download shipping label Schedule pickup Cancel Delete

Subscription (change) <Subscription name> Resource group (change) <Resource group name>

Subscription ID <Subscription ID>

Overview MENU

Activity log Settings Locks

General Quickstart Order details Device details

DEVICE STATUS TRACKING

Current order status: Received on 08/21/2018, 10:59 AM.

We have received the device and will notify you once the data copy starts.



**PROCESSED**  
Azure 08/15/2018, 9:59 AM

**DELIVERED**  
Customer 08/16/2018, 11:09 AM

**RECEIVED**  
Azure 08/21/2018, 10:59 AM

**DATA COPY**  
Azure

<https://docs.microsoft.com/en-us/azure/databox/data-box-overview#data-box-components>

# Managing Identity with Azure Active Directory (Azure AD)

---

# Azure AD vs. Active Directory



Azure Active Directory and Active Directory are  
two different products.

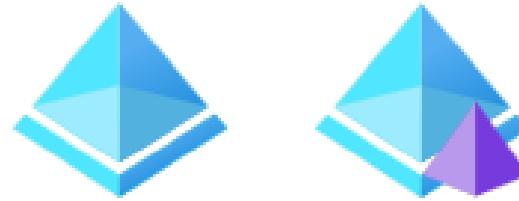
<https://docs.microsoft.com/en-us/azure/active-directory/fundamentals/active-directory-compare-azure-ad-to-ad>



---

# Azure Directory Services

- Azure Active Directory (Azure AD)
- Azure Active Directory Domain Services (Azure AD DS)



---

# Azure Active Directory (Azure AD)

A cloud-based identity and access management service.

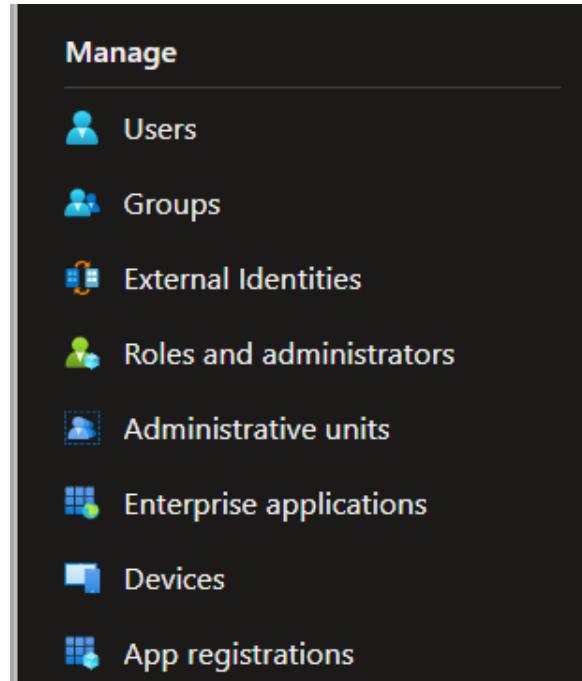


<https://docs.microsoft.com/en-us/azure/active-directory/fundamentals/active-directory-whatis>



# Azure Active Directory (Azure AD, AAD)

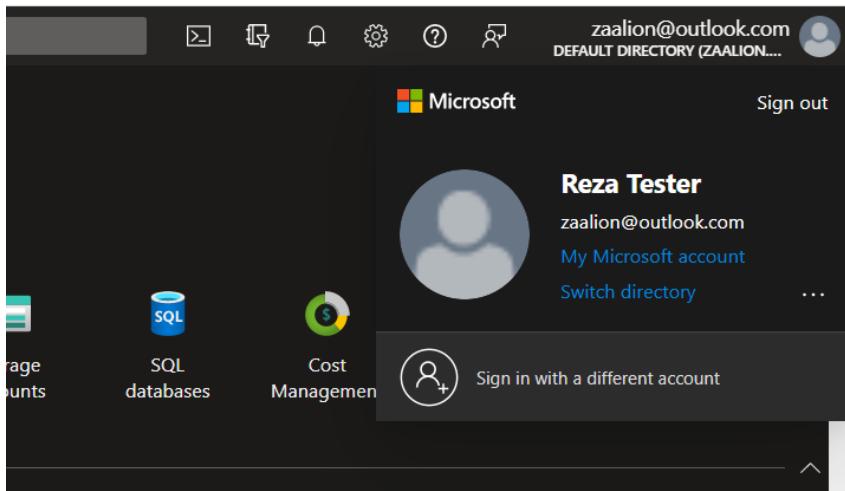
- Users
- Group
- Service Principals
- Managed Identities



<https://docs.microsoft.com/en-us/azure/active-directory/fundamentals/active-directory-whatis>



# Azure Active Directory (Azure AD, AAD)



This screenshot shows the Azure Active Directory (AAD) user management interface. The top navigation bar includes 'All services', 'Default Directory', 'Users', and 'Users'. The main title is 'Reza Tester' with a 'User' icon. Below the title are buttons for 'Edit properties', 'Delete', 'Refresh', 'Reset password', and 'Revo'. A search bar is also present. The left sidebar has sections for 'Overview', 'Audit logs', 'Sign-in logs', 'Diagnose and solve problems', 'Manage', 'Assigned roles', 'Administrative units', and 'Groups'. The 'Overview' section is currently selected. The right panel displays 'Basic info' for 'Reza Tester', including the name, user principal name 'zaalion\_outlook.com#EXT#@zaalionoutlook.onmicrosoft.com', and status 'Member'. There's also a purple circular profile picture with 'RT' initials and a camera icon.



# Azure Active Directory (Azure AD, AAD)

- Access Azure portal
- Access SaaS applications using AAD authentication (Microsoft 365)
- Access internal resources like apps on your corporate intranet network
- Access any cloud apps developed for your organization



# Azure Active Directory Domain Services (Azure AD DS)

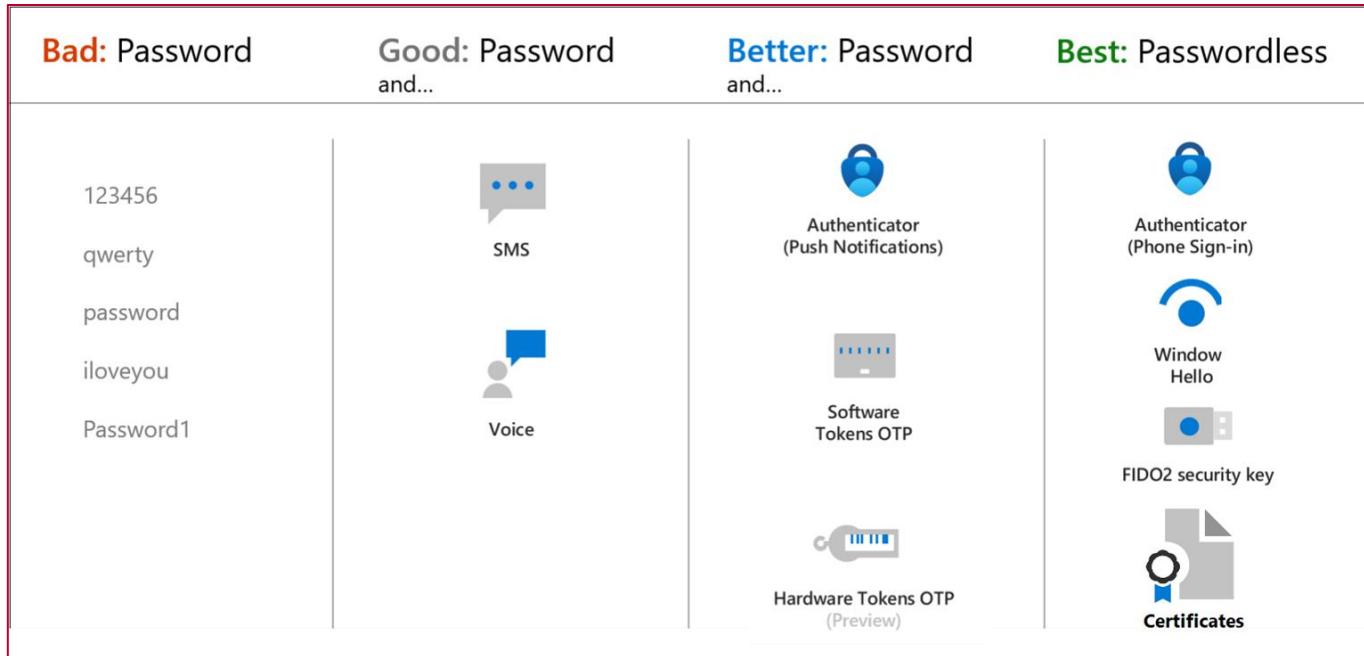
- Provides managed domain services such as domain join, group policy, lightweight directory access protocol (LDAP), and Kerberos/NTLM authentication.
- Use it when decommissioning your local Active Directory



<https://docs.microsoft.com/en-us/azure/active-directory-domain-services/overview>



# Authentication Methods in Azure



<https://docs.microsoft.com/en-us/azure/active-directory/authentication/concept-authentication-methods>



# Authentication Methods in Azure

- Password authentication
- Multifactor (password + SMS/Voice call)
- Multifactor (password + Authenticator App/eTokens)
- Passwordless (biometric, Windows Hello!, Certificates, FIDO2 key)



# Single Sign On (SSO)

- An authentication method that allows users to sign in using **one set of credentials** to multiple independent systems.

<https://docs.microsoft.com/en-us/azure/active-directory/manage-apps/what-is-single-sign-on>





# External Identities in Azure AD

Azure AD External Identities refers to all the ways you can securely interact with users outside of your organization.





# Azure AD Guest Access

Guest users from other tenants can be invited by administrators or by other users.



<https://docs.microsoft.com/en-us/azure/active-directory/governance/manage-guest-access-with-access-reviews>





# External Identities in Azure AD

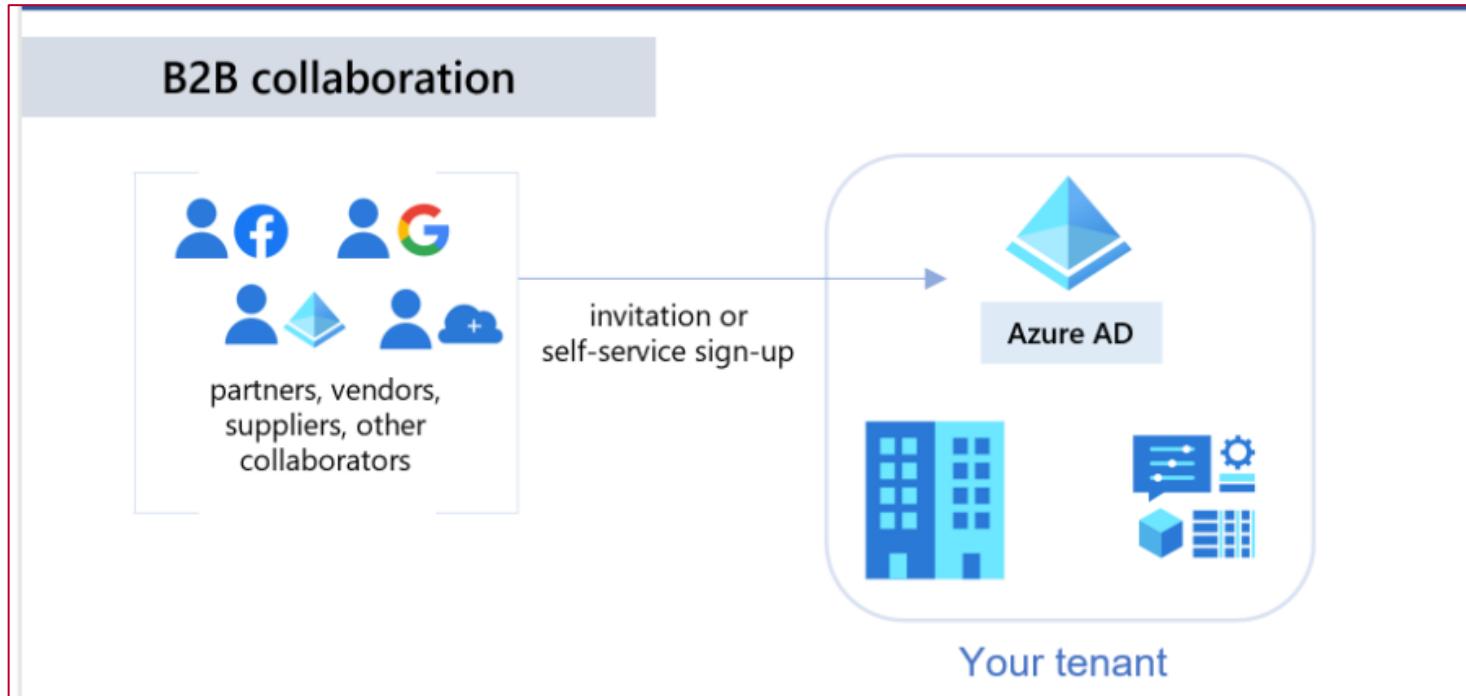
- B2B collaboration
- Azure AD B2C



<https://docs.microsoft.com/en-us/azure/active-directory/external-identities/external-identities-overview>



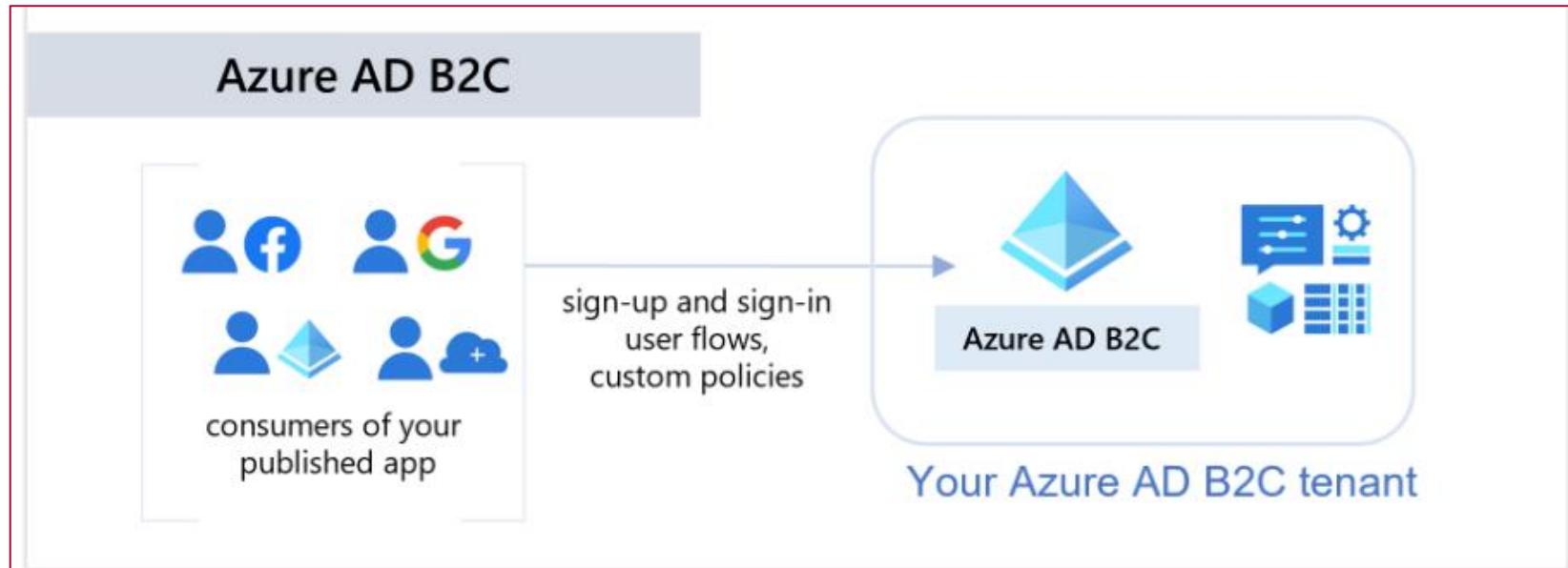
# External Identities in Azure AD



<https://docs.microsoft.com/en-us/azure/active-directory/external-identities/external-identities-overview>



# External Identities in Azure AD



# Azure AD Conditional Access



# Azure AD Conditional Access

With Conditional Access, organizations can use identity-driven signals as part of their access control decisions.



<https://docs.microsoft.com/en-us/azure/active-directory/conditional-access/overview>

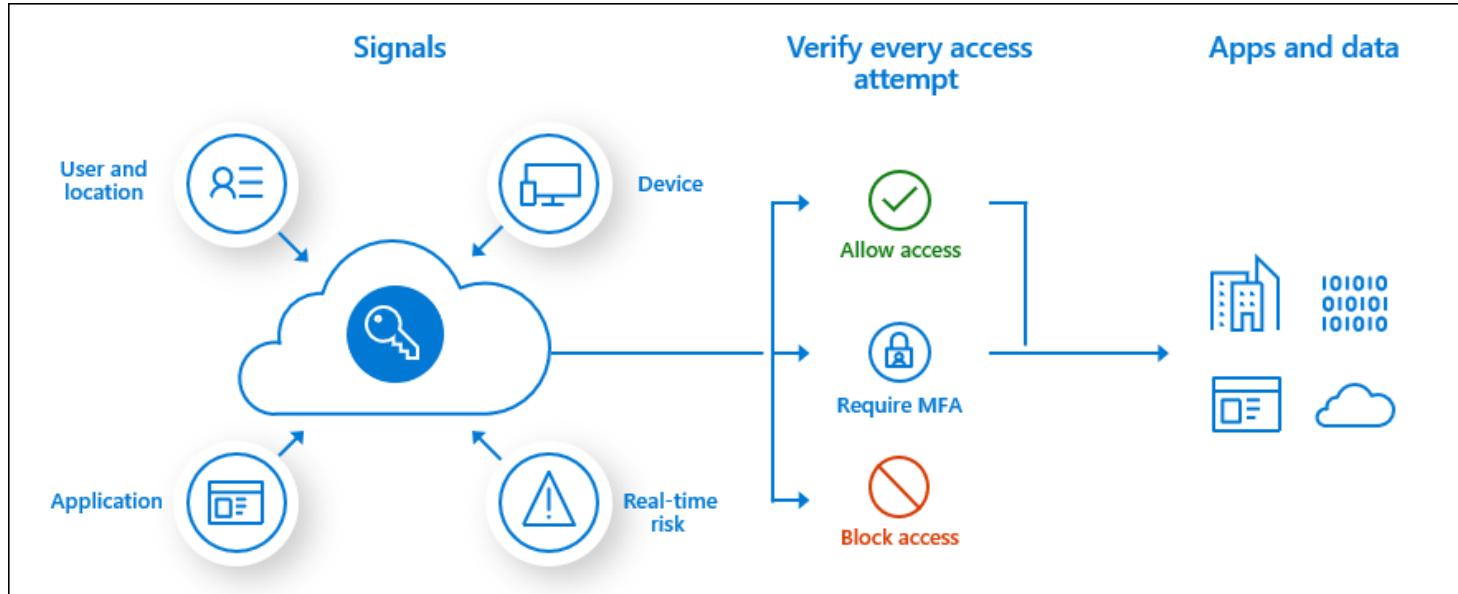


# Azure AD Conditional Access

- Requiring multi-factor authentication for users with administrative roles
- Requiring multi-factor authentication for Azure management tasks
- Blocking sign-ins for users attempting to use legacy auth. protocols
- Requiring trusted locations for Azure AD Multi-Factor Authentication registration
- Blocking or granting access from specific locations



# Azure AD Conditional Access



<https://docs.microsoft.com/en-us/azure/active-directory/conditional-access/overview>



# Conditional Access Signals

- User's group membership
- User IP Location information
- Device the user is using
- Application the user tries to access
- Real-time and calculated risk detection
- Microsoft Defender for Cloud Apps

<https://docs.microsoft.com/en-us/azure/active-directory/conditional-access/overview#common-signals>



---

# Conditional Access Decisions

- Block access
- Allow access
- Allow access after multifactor authentication, etc.



# License Requirements



Using Conditional Access requires an Azure AD Premium P1 or P2 license.



# Azure Role-based Access Control (RBAC)

# Azure Role-based Access Control (RBAC)

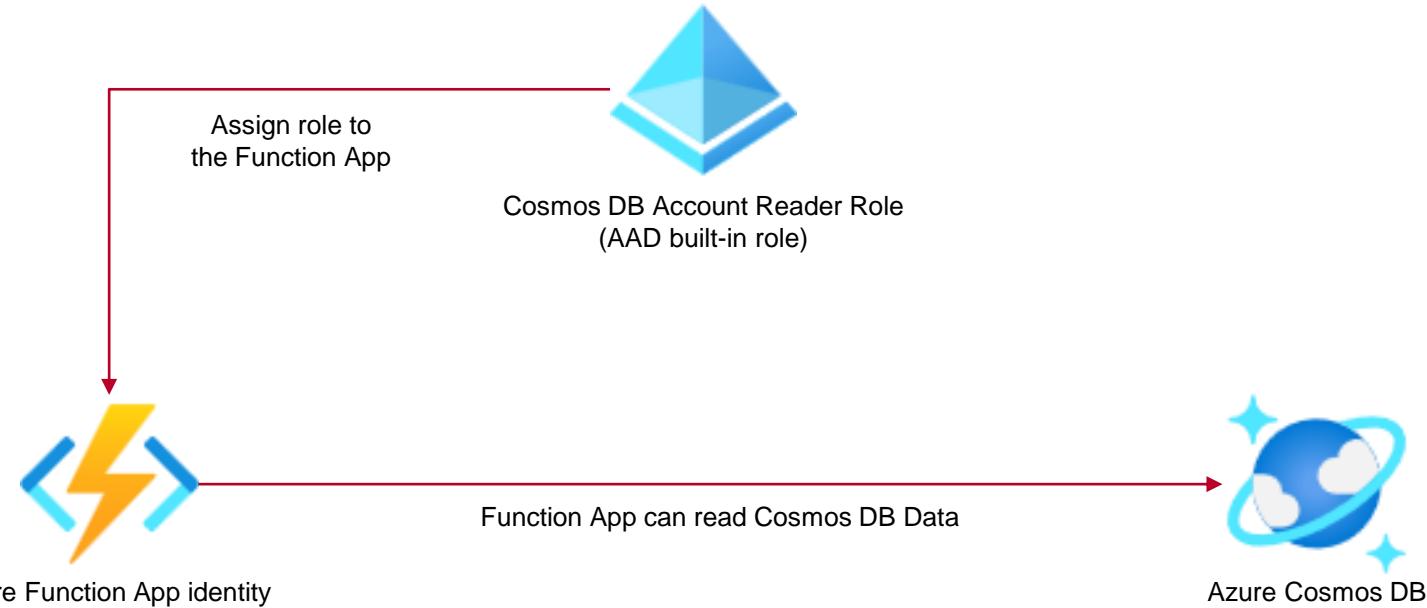
Provides fine-grained access management to Azure resources.



<https://docs.microsoft.com/en-us/azure/role-based-access-control/overview>



# Azure RBAC



---

# Azure RBAC Role

- A role is a group of permissions (actions)
- There are several built-in roles in Azure AD
- You can define a custom role if needed



# Example: Cosmos DB Account Reader Role

```
JSON Copy  
  
{  
    "assignableScopes": [  
        "/"  
    ],  
    "description": "Can read Azure Cosmos DB Accounts data",  
    "id": "/subscriptions/{subscriptionId}/providers/Microsoft.Authorization/roleDefinitions/fbd93bf-df7d-  
    "name": "fbd93bf-df7d-467e-a4d2-9458aa1360c8",  
    "permissions": [  
        {  
            "actions": [  
                "Microsoft.Authorization/*/read",  
                "Microsoft.DocumentDB/*/read",  
                "Microsoft.DocumentDB/databaseAccounts/readonlykeys/action",  
                "Microsoft.Insights/MetricDefinitions/read",  
                "Microsoft.Insights/Metrics/read",  
                "Microsoft.Resources/subscriptions/resourceGroups/read",  
                "Microsoft.Support/*"  
            ],  
            "notActions": [],  
            "dataActions": [],  
            "notDataActions": []  
        }  
    ],  
    "roleName": "Cosmos DB Account Reader Role",  
    "roleType": "BuiltInRole",  
    "type": "Microsoft.Authorization/roleDefinitions"  
}
```



<https://docs.microsoft.com/en-us/azure/role-based-access-control/built-in-roles#cosmos-db-account-reader-role>

# Some Built-in Roles

Check access    Role assignments    **Roles**    Deny assignments    Classic administrators

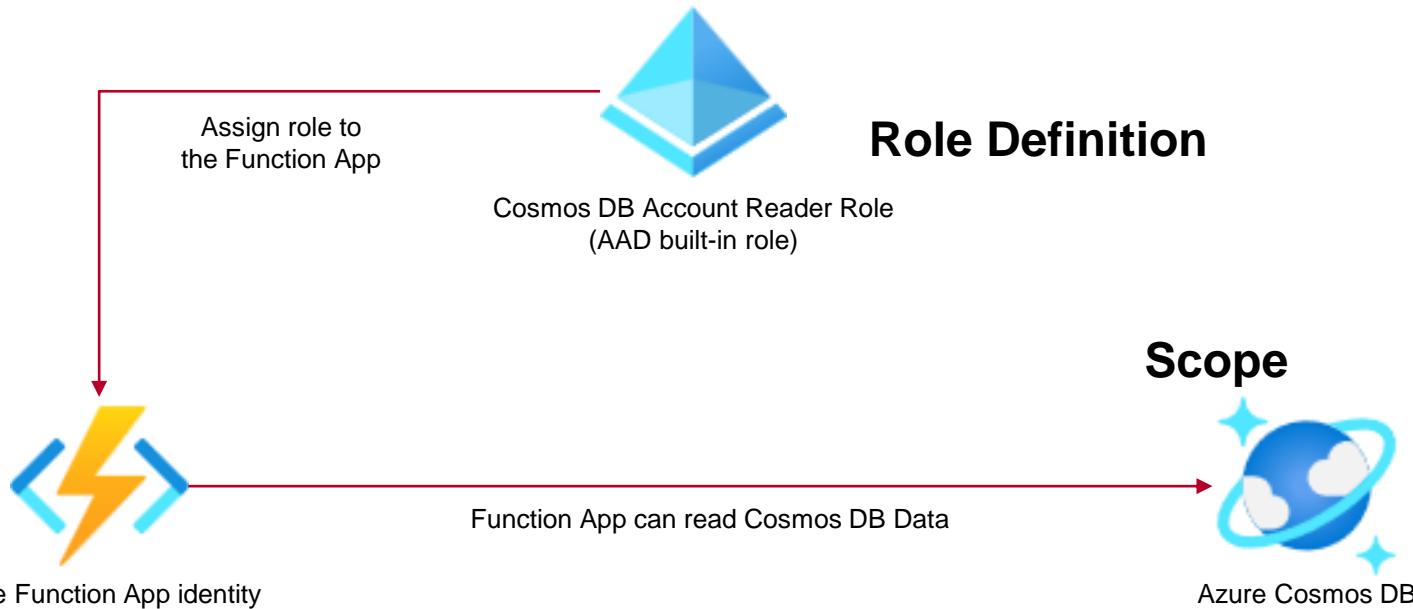
A role definition is a collection of permissions. You can use the built-in roles or you can create your own custom roles. [Learn more](#)

Search by role name or description    Type : All    Category : All

<input type="checkbox"/> Name ↑↓	Description ↑↓	Type ↑↓
<input type="checkbox"/> Owner	Grants full access to manage all resources, including the ability to assign roles in...	BuiltInRole
<input type="checkbox"/> Contributor	Grants full access to manage all resources, but does not allow you to assign role...	BuiltInRole
<input type="checkbox"/> Reader	View all resources, but does not allow you to make any changes.	BuiltInRole
<input type="checkbox"/> Access Review Operator Servic...	Lets you grant Access Review System app permissions to discover and revoke ac...	BuiltInRole
<input type="checkbox"/> AcrDelete	acr delete	BuiltInRole
<input type="checkbox"/> AcrImageSigner	acr image signer	BuiltInRole
<input type="checkbox"/> AcrPull	acr pull	BuiltInRole
<input type="checkbox"/> AcrPush	acr push	BuiltInRole
<input type="checkbox"/> AcrQuarantineReader	acr quarantine data reader	BuiltInRole
<input type="checkbox"/> AcrQuarantineWriter	acr quarantine data writer	BuiltInRole
<input type="checkbox"/> AgFood Platform Sensor Partn...	Provides contribute access to manage sensor related entities in AgFood Platfor...	BuiltInRole



# How Azure RBAC works



## Security Principal

<https://docs.microsoft.com/en-us/azure/role-based-access-control/overview>



# Azure RBAC Roles

## Resource roles

- General (Owner, Contributor, Reader, etc.)
- Resource-specific (Azure Blob Data Reader)

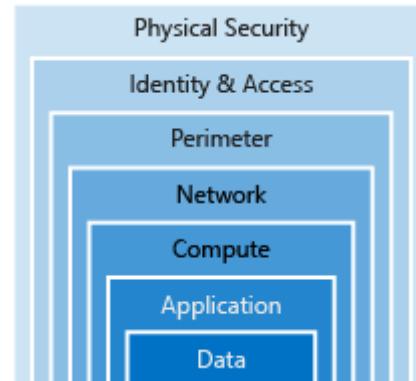
## Azure Active Directory roles (Global Administrator)



# Defense in Depth and Zero Trust

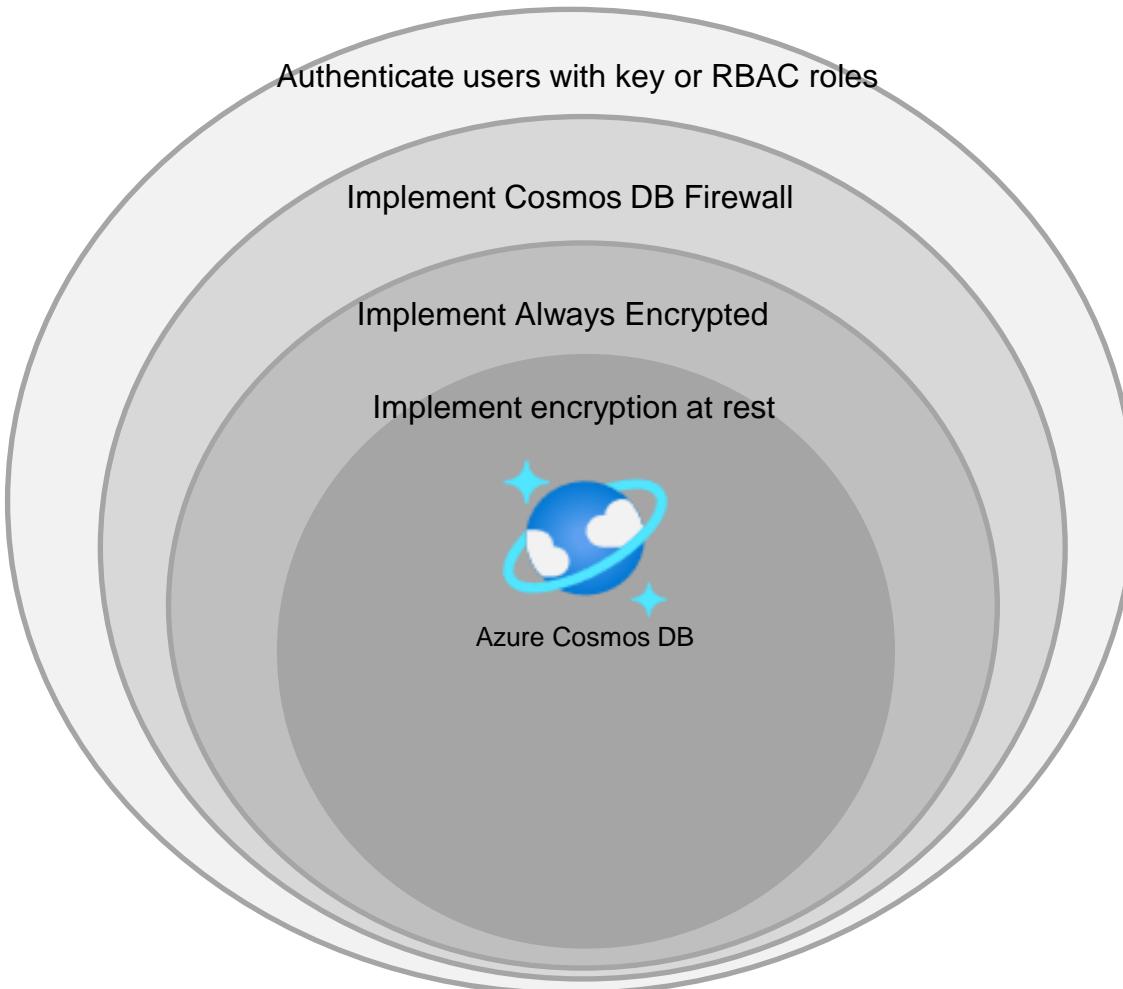
# Defense in Depth

A strategy that employs a series of mechanisms to slow the advance of an attack on a computer system.



<https://docs.microsoft.com/en-us/learn/modules/azure-well-architected-security/2-defense-in-depth>





#	Ring	Example	Principle
1	Data	Data encryption at rest in Azure Blob Storage	Integrity
2	Application	SSL/TLS encrypted sessions	Integrity
3	Compute	Regular application of OS and layered software patches	Availability
4	Network	Network security rules	Confidentiality
5	Perimeter	DDoS protection	Availability
6	Identity and access	Azure Active Directory user authentication	Integrity
7	Physical security	Azure datacenter biometric access controls	Confidentiality

# Zero Trust Model

Zero Trust is a security strategy. It is not a product or a service, but an approach in designing and implementing the following set of security principles:

- Verify explicitly
- Use least privilege access
- Assume breach



# Verify Explicitly

Always authenticate and authorize based on all available data points.



# Use Least Privilege Access

Limit user access with Just-In-Time and Just-Enough-Access (JIT/JEA), risk-based adaptive policies, and data protection.



# Assume Breach

Minimize blast radius and segment access. Verify end-to-end encryption and use analytics to get visibility, drive threat detection, and improve defenses.



# **Microsoft Defender for Cloud**

# Microsoft Defender for Cloud

Microsoft Defender for Cloud is a Cloud Security Posture Management (CSPM) and Cloud Workload Protection Platform (CWPP) for all your Azure, on-premises, and multi-cloud (Amazon AWS and Google GCP) resources.



# Microsoft Defender for Cloud

- Defender for Cloud secure score
- Defender for Cloud recommendations
- Defender for Cloud alerts



# Microsoft Defender for Cloud



## Continuously Assess

Know your security posture.  
Identify and track vulnerabilities.



## Secure

Harden resources and services with  
Azure Security Benchmark and  
AWS Security Best Practices standard



## Defend

Detect and resolve threats to  
resources and services.



# Microsoft Defender for Cloud

Enable Microsoft Defender for Cloud so you:

- Will get reports on security status of your resources
- Get recommendations on resolving issues
- Get alerts when threats are detected
- Resolve threats to resources



All services >



# Microsoft Defender for Cloud | Overview

Showing subscription 'Pay-As-You-Go'

Search (Ctrl+ /)

Subscriptions

What's new

## General

Overview

Getting started

Recommendations

Security alerts

Inventory

Workbooks

Community

Diagnose and solve problems

## Cloud Security

Security posture

Regulatory compliance

Workload protections

Firewall Manager

## Management

Environment settings

Security solutions

1  
Azure subscriptions

13  
Assessed resources

13  
Active recommendations



## Security posture

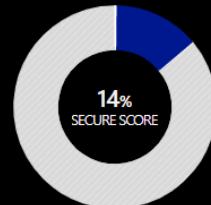
13/13

Unassigned recommendation

0/0

Overdue recommendations

## Secure score



Azure 14%

AWS -

GCP -

Explore your security posture >



# Microsoft Defender for Cloud | Recommendations

Showing subscription 'Pay-As-You-Go'



Download CSV report



Governance report (preview)



## General

Overview

Getting started

Recommendations

Security alerts

Inventory

Workbooks

Community

Diagnose and solve problems

## Cloud Security

Security posture

Regulatory compliance

Workload protections

Firewall Manager

## Management

Environment settings

Security solutions

You may be viewing limited information. To get tenant-wide visibility, click here →

[Secure score recommendations](#)    All recommendations

Secure score



14%

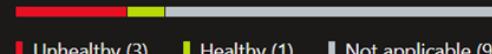
Active items

Controls  
12/14

Recommendations

13/26

Resource health



Governance (preview)

Overdue recommendations

Unassigned recommendations

Search recommendations

Recommendation status == None

Severity == None

Add filter

More (4)

Show my

Name ↑↓	Max score ↑↓	Current score ↑↓	Potential score increase ↑↓	Status ↑↓	Unhealthy resources
---------	--------------	------------------	-----------------------------	-----------	---------------------

Enable MFA	10	0.00	+ 18%	Unassigned	1 of 1 resources
[REDACTED] men...	8	0.00	+ 14%	Unassigned	1 of 1 resources
[REDACTED] dates	6	0.00	+ 11%	Unassigned	1 of 1 resources
[REDACTED] nerab...	6	0.00	+ 11%	Unassigned	1 of 1 resources
[REDACTED] a...	4	0.00	+ 7%	Unassigned	1 of 1 resources

# Factors Affecting Costs in Azure

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# Factors Affecting Costs in Azure

- Resource type
- Resource location/region
- Resource pricing tier/size
- Storage
- Traffic
- Processed Data



# Resource Type: Cosmos DB vs. Azure SQL

**Azure Cosmos DB**

DATABASE OPERATIONS: Standard provisioned throughput (manual) WRITE REGIONS: Single Region Write (Single-Master) ENABLE ALWAYS-FREE QUANTITY ⓘ

**Savings Options**  
Save up to 65% on pay-as-you-go prices with 1 year or 3 year Reserved Capacity options.

Pay as you go  
 1 year reserved capacity  
 3 year reserved capacity

\$23.36  
Average per month  
(\$0.00 charged upfront)

Request units per second (RU/s) ⓘ

400 RU/s × 730 Hours

Write Region: East US Availability Zone

400 × 730 × \$0.008 = \$23.36  
Per 100 RU/s per hour

**Azure SQL Database**

REGION: East US TYPE: Single Database BACKUP STORAGE TIER: ⓘ PURCHASE MODEL: vCore

SERVICE TIER: General Purpose COMPUTE TIER: Provisioned HARDWARE TYPE: Standard-series (Gen 5)

INSTANCE: 4 vCore

**Compute**  
REDUNDANCY: Locally Redundant

1 Databases × 730 Hours

**Savings Options**  
Save up to 73% on pay as you go prices with 1 year or 3 year reserved options.

**Compute**  
 Pay as you go  
 1 year reserved  
 3 year reserved

\$444.47  
Average per month  
(\$0.00 charged upfront)

**SQL License**  
 Pay as you go  
 Azure Hybrid Benefit

\$291.90  
Average per month  
(\$0.00 charged upfront)

= \$736.37  
Average per month  
(\$0.00 charged upfront)

<https://azure.microsoft.com/en-us/pricing/calculator/>



# Resource Location/Region: Cosmos DB

Azure Cosmos DB

DATABASE OPERATIONS: Standard provisioned throughput (manual) WRITE REGIONS: Single Region Write (Single-Master)  ENABLE ALWAYS-FREE QUANTITY ⓘ

Savings Options  
Save up to 65% on pay-as-you-go prices with 1 year or 3 year Reserved Capacity options.

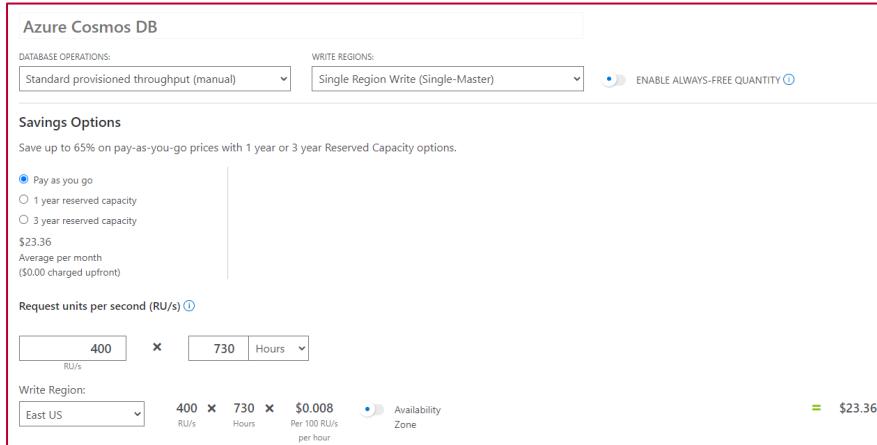
Pay as you go  
 1 year reserved capacity  
 3 year reserved capacity

\$23.36  
Average per month  
(\$0.00 charged upfront)

Request units per second (RU/s) ⓘ

400 × 730 Hours ⏺ RU/s

Write Region: East US RU/s Hours \$0.008 Per 100 RU/s per hour Availability Zone = \$23.36



Azure Cosmos DB

DATABASE OPERATIONS: Standard provisioned throughput (manual) WRITE REGIONS: Single Region Write (Single-Master)  ENABLE ALWAYS-FREE QUANTITY ⓘ

Savings Options  
Save up to 65% on pay-as-you-go prices with 1 year or 3 year Reserved Capacity options.

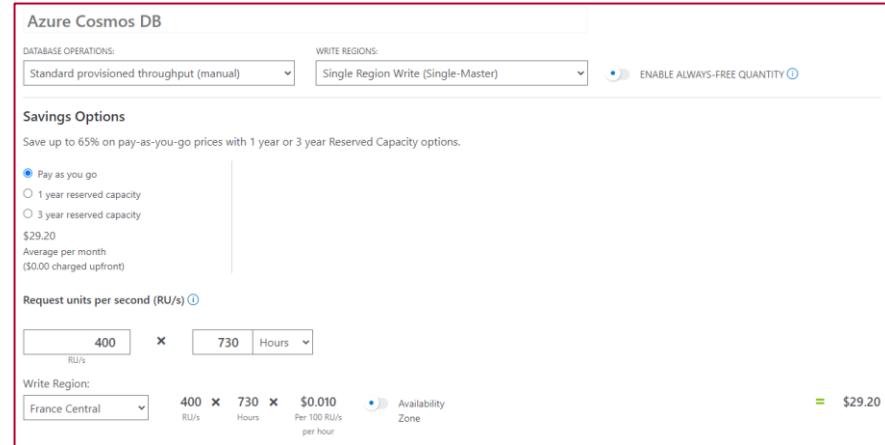
Pay as you go  
 1 year reserved capacity  
 3 year reserved capacity

\$29.20  
Average per month  
(\$0.00 charged upfront)

Request units per second (RU/s) ⓘ

400 × 730 Hours ⏺ RU/s

Write Region: France Central RU/s Hours \$0.010 Per 100 RU/s per hour Availability Zone = \$29.20



<https://azure.microsoft.com/en-us/pricing/calculator/>



# Resource Pricing/Tier/Size: Cosmos DB

Azure Cosmos DB

DATABASE OPERATIONS: Standard provisioned throughput (manual) WRITE REGIONS: Single Region Write (Single-Master)  ENABLE ALWAYS-FREE QUANTITY ⓘ

**Savings Options**  
Save up to 65% on pay-as-you-go prices with 1 year or 3 year Reserved Capacity options.

Pay as you go  
 1 year reserved capacity  
 3 year reserved capacity

\$23.36  
Average per month  
(\$0.00 charged upfront)

Request units per second (RU/s) ⓘ

400 × 730 Hours ⏺ RU/s

Write Region: East US RU/s Hours Per 100 RU/s per hour Availability Zone

= \$23.36

Azure Cosmos DB

DATABASE OPERATIONS: Standard provisioned throughput (manual) WRITE REGIONS: Multiple Region Write (Multi-Master)  ENABLE ALWAYS-FREE QUANTITY ⓘ

**Savings Options**  
Save up to 65% on pay-as-you-go prices with 1 year or 3 year Reserved Capacity options.

Pay as you go  
 1 year reserved capacity  
 3 year reserved capacity

\$46.72  
Average per month  
(\$0.00 charged upfront)

Request units per second (RU/s) ⓘ

400 × 730 Hours ⏺ RU/s

Primary Write Region: East US RU/s Hours Per 100 RU/s per hour Availability Zone

= \$46.72

<https://azure.microsoft.com/en-us/pricing/calculator/>



# Storage: Cosmos DB

Storage

Transactional Storage

1  
GB

= \$0.25

Storage

Transactional Storage

5  
GB

= \$1.25

<https://azure.microsoft.com/en-us/pricing/calculator/>



# Processed Data – Azure Firewall



<https://azure.microsoft.com/en-us/pricing/calculator/>



---

# Cost Saving Options

- Choose the right resource size
- Use Azure Reservations (if applicable)
- View cost optimization recommendations
- VM only:
  - Use Spot Virtual Machines
  - Azure Hybrid Benefit for Windows Server



---

# Azure Reservations

- Azure Reservations help you save money if you commit to one-year or three-year plans.
- “Reduce your resource costs by up to 72% from pay-as-you-go prices.”
- Don't affect the runtime state of your resources



---

# Cost Optimization Recommendations

- Cost Management works with **Azure Advisor** to provide cost optimization recommendations.



# VM Only: Use Spot Virtual Machines

- Take advantage of Azure's unused capacity at a reduced cost.
- The amount of available capacity varies based on size, region, etc.
- You set a maximum price for the Spot VM
- VMs can be evicted based on capacity or the max price you set.
- Do NOT use Spot VMs for Production workloads or processes which can not tolerate start-overs



# VM Only: Azure Hybrid Benefit for Windows Server

- Allows you to use your on-premises Windows Server licenses to run Windows virtual machines on Azure at a reduced cost.

<https://docs.microsoft.com/en-us/azure/virtual-machines/windows/hybrid-use-benefit-licensing>



# Azure Calculators and SLAs

# Azure Calculators

## Pricing calculator

Calculate your estimated hourly or monthly costs for using Azure.



## Total Cost of Ownership (TCO) Calculator

Estimate the cost savings you can realise by migrating your workloads to Azure



## Pricing calculator

Calculate your estimated hourly or monthly costs for using Azure.



- Calculate your estimated hourly or monthly costs for using Azure
- Add multiple resources to the same session
- Export the results to Excel
- Save the results in your account
- Share a link to the calculation session

<https://azure.microsoft.com/en-us/pricing/calculator/>



## Total Cost of Ownership (TCO) Calculator

Estimate the cost savings you can realise by migrating your workloads to Azure

- Estimate the cost savings by migrating your workloads to Azure
- Enter your on-premises workload details
- Get the cost for the same workload in Azure

SAMPLE

Over 5 year(s) with Microsoft Azure, your estimated cost savings could be as

much as **US\$98,315**

<https://azure.microsoft.com/en-ca/pricing/tco/calculator/>



# Azure Service-level Agreements (SLAs)

“Service-level agreements (SLAs) describe Microsoft’s commitments for uptime and connectivity.”

<https://azure.microsoft.com/en-ca/support/legal/sla/>



# SLA for Virtual Machines

Last updated: July 2020

- For all Virtual Machines that have two or more instances deployed across two or more Availability Zones in the same Azure region, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.99% of the time.
- For all Virtual Machines that have two or more instances deployed in the same Availability Set or in the same Dedicated Host Group, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.95% of the time.
- For any Single Instance Virtual Machine using Premium SSD or Ultra Disk for all Operating System Disks and Data Disks, we guarantee you will have Virtual Machine Connectivity of at least 99.9%.
- For any Single Instance Virtual Machine using Standard SSD Managed Disks for Operating System Disk and Data Disks, we guarantee you will have Virtual Machine Connectivity of at least 99.5%.
- For any Single Instance Virtual Machine using Standard HDD Managed Disks for Operating System Disks and Data Disks, we guarantee you will have Virtual Machine Connectivity of at least 95%.

## Introduction

## General Terms

<https://docs.microsoft.com/en-us/azure/cost-management-billing/cost-management-billing-overview>



MONTHLY UPTIME PERCENTAGE	SERVICE CREDIT
< 99.99%	10%
< 99%	25%
< 95%	100%

<https://docs.microsoft.com/en-us/azure/cost-management-billing/cost-management-billing-overview>



# Uptime Number: Allowed Offline Time

- 95% Monthly: 1d 12h 31m 27s
- 99% Monthly: 7h 18m 17s
- 99.5% Monthly: 3h 39m 8s
- 99.9% Monthly: 43m 49s
- 99.95% Monthly: 21m 54s
- 99.99% Monthly: 4m 22s

<https://docs.microsoft.com/en-us/azure/cost-management-billing/cost-management-billing-overview>



# Azure Cost Management and Billing tool

# Azure Cost Management and Billing Tool

- A group of tools to help you analyze, manage, and optimize your workloads costs
- Ensures that your organization is taking advantage of the benefits provided by the cloud

You can think of your Azure workloads like the lights in your home. When you leave to go out for the day, are you leaving the lights on? Could you use different bulbs that are more efficient to help reduce your monthly energy bill? Do you have more lights in one room than are needed? You can use Cost Management + Billing to apply a similar thought process to the workloads used by your organization.



# Azure Cost Management and Billing Tool

- Do billing administrative tasks (e.g. paying your bill)
- Download cost and usage data
- Apply data analysis to your costs
- Set spending thresholds + alerts
- Identify opportunities for workload changes that optimize spending



# Azure Tags (Taxonomy Tags)

# Azure Tags (Taxonomy Tags)

- Tags are metadata elements that you apply to your resources
- Almost all Azure resources support tags
- Tags are key/value pairs: (e.g. **Environment = Dev**)
- You can create cost reports based on resource tags (give me the total monthly cost for the **Dev** environment resources)



# Azure Policy

# Azure Governance

Maintain control over your Azure resources, to enforce company standards, comply with government laws, and uphold security best practices.



Azure Policy

<https://docs.microsoft.com/en-us/azure/governance/>



# Azure Policy

- Azure Policy helps to enforce organizational standards and to assess compliance at-scale.
- Several built-in policy definitions to choose from
- Create your own custom policy definition if needed.



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# Use Azure Policy to

- Limit the resource deployment locations (regions)
- Limit what resource types can get deployed
- Enforce security best practices on your databases
- ...



# Azure Policy Initiative

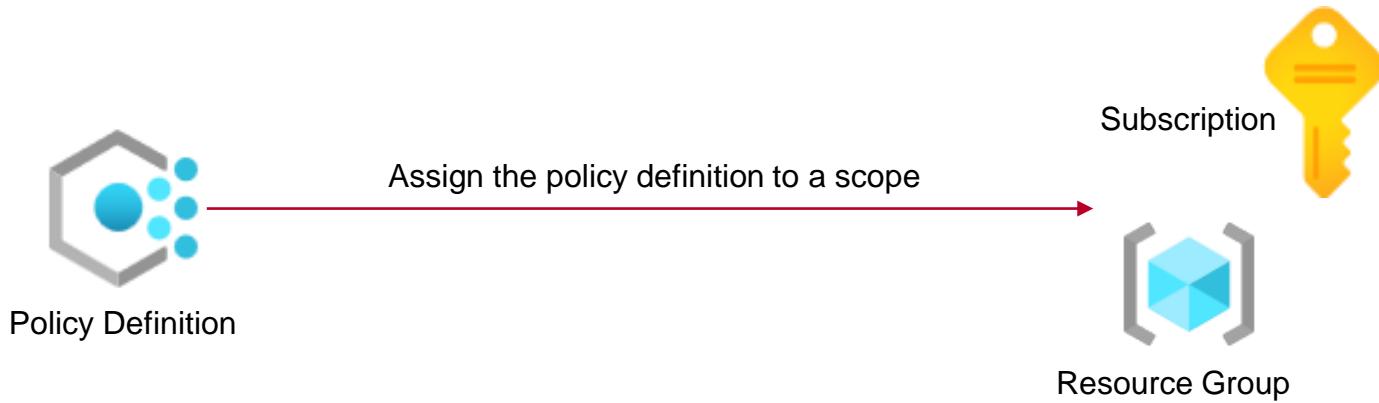
- Groups a collection of policies. You can then assign this collection to your scopes/resources.



<https://docs.microsoft.com/en-us/azure/governance/policy/overview#initiative-definition>



# Azure Policy Assignment



<https://docs.microsoft.com/en-us/azure/governance/policy/concepts/assignment-structure>





## Policy | Definitions



Search (Ctrl+ /)

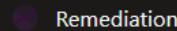
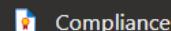
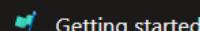
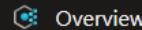


+ Policy definition

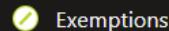
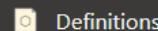
+ Initiative definition

Export definitions

Refresh



## Authoring



## Scope

Pay-As-You-Go



## Definition type

All definition types

## Category

All categories

Now export your definitions and assignments to GitHub and manage them using actions! Click on 'Export def

Name ↑↓	Definition location ↑↓	Policies ↑↓	Type ↑↓
Audit virtual machines w...			BuiltIn
Vulnerability assessment...			BuiltIn
SQL Server Integration S...			BuiltIn
[Preview]: Configure VM...			BuiltIn
Private endpoint connec...			BuiltIn
Azure Backup should be...			BuiltIn
Configure a private DNS ...			BuiltIn



# Policy | Assignments

 Search (Ctrl+ /)[Assign policy](#)[Assign initiative](#)[Refresh](#)[Overview](#)[Getting started](#)[Compliance](#)[Remediation](#)[Events](#)

## Authoring

[Definitions](#)[Assignments](#)[Exemptions](#)

### Scope

Pay-As-You-Go



### Definition type

All definition types

### Search

Filter by name or ID...

Now create custom non-compliance messages for policy assignments. Learn more <https://aka.ms/policyassignmentnoncompliancmessage>

Total Assignments i

1

Initiative Assignments i

1

Policy Assignments i

0

Assignment name ↑↓

Scope ↑↓

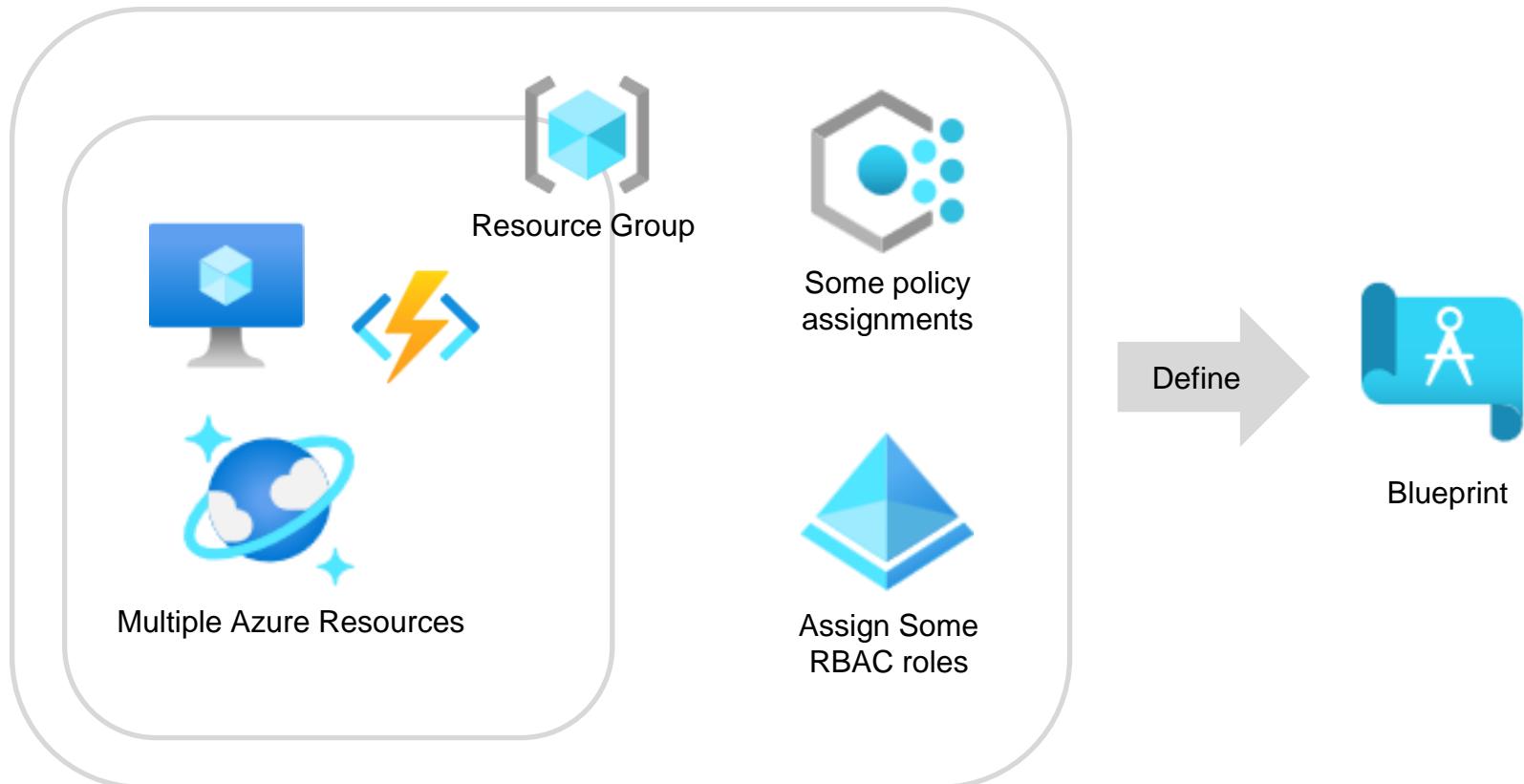
ASC Default (subscription: 19969c81-e8ff-4585-8c2f-3f196b588227)

Pay-As-You-Go



# Azure Blueprints

# Azure Blueprints



# Azure Blueprints

Define a repeatable set of Azure resources complying to your organization's standards, patterns, and requirements.



<https://docs.microsoft.com/en-us/azure/governance/blueprints/overview>



# Azure Blueprints is in PREVIEW



No SLA! Use Azure Blueprint with caution for  
Production workloads!

<https://docs.microsoft.com/en-us/azure/governance/blueprints/overview>



# Resource Locks

# Resource Locks

As an **administrator**, you can lock an Azure subscription, resource group, or resource to protect them from **accidental user deletions and modifications**. The lock **overrides any user permissions**.



# Who Can Create or Delete Locks

Only the **Owner** and the **User Access Administrator** built-in roles can create and delete management locks.



<https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/lock-resources?tabs=json#who-can-create-or-delete-locks>



# Resource Locks

The screenshot shows the 'Locks' blade for a storage account named 'cs21003bffd9676a24a'. The left sidebar includes links for 'Azure search', 'Settings' (Configuration, Data Lake Gen2 upgrade, Resource sharing (CORS), Advisor recommendations, Endpoints, Locks, Monitoring), and a search bar. The main area displays a message: 'This resource has no locks.'

The dialog box is titled 'Add lock'. It contains fields for 'Lock name \*' (with a red asterisk indicating it's required) and 'Lock type \*' (set to 'Read-only'). A note below the name field says 'Lock name is required.' There is also a 'Notes' text area and a 'Delete' link. At the bottom are 'OK' and 'Cancel' buttons.



# Resource Locks Types

- **Delete lock:** authorized users can read and modify a resource, but they can't delete it.
- **ReadOnly lock:** authorized users can read a resource, but they can't delete or update it



# Service Trust Portal

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# Service Trust Portal

- Audit Reports
- Data Protection
- Azure Stack
- Trust Center
- Microsoft Datacenter details
- Security & Compliance center

<https://servicetrust.microsoft.com/>



# Azure Portal

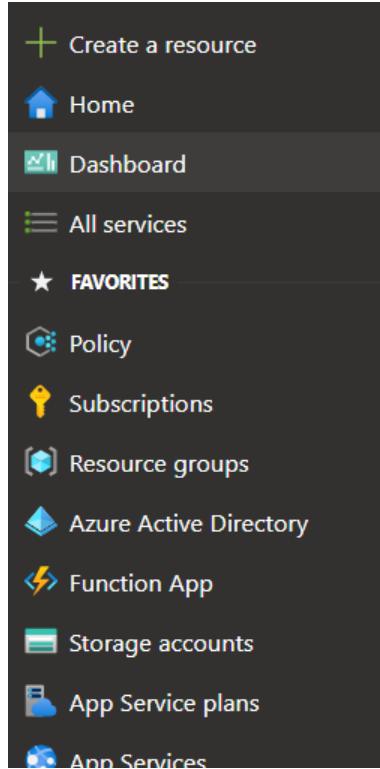
# Azure Portal

- Is a web-based console that provides an alternative to command-line tools.
- Manage your Azure subscription using a graphical user interface.
- Create custom dashboards for an organized view of resources.



# Azure Portal

- Azure Home
- Azure Dashboard
- Resource menu



<https://docs.microsoft.com/en-us/azure/azure-portal/azure-portal-overview>



---

# Azure Portal Recommended Browsers

- Microsoft Edge (latest version)
- Safari (latest version, Mac only)
- Chrome (latest version)
- Firefox (latest version)



# Azure Mobile App

[Home](#) / [Get started](#) / [Azure Portal](#) / [Azure mobile app](#)

## Get the Azure mobile app

Stay connected to your Azure resources—anytime, anywhere.



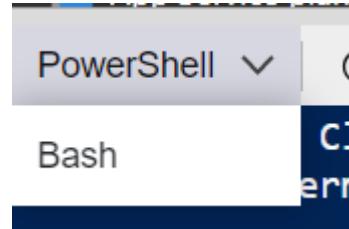
<https://azure.microsoft.com/en-us/get-started/azure-portal/mobile-app/>



# Azure Cloud Shell

# Azure Cloud Shell

- Use Azure Cloud Shell to manage Azure resources.
- Already authenticated
- Browser-accessible shell



<https://docs.microsoft.com/en-us/azure/cloud-shell/overview>



# Access Azure Cloud Shell

- **Direct link:** Open a browser to <https://shell.azure.com>.
- **Azure portal:** Select the Cloud Shell icon on the Azure portal



- **Code snippets:** In the technical documentation, select the Try It button

- **Code snippets:** In Microsoft technical documentation and training resources, select the Try It button that appears with Azure CLI and Azure PowerShell code snippets:A screenshot of a Microsoft technical documentation page. At the top, there's a header with "Azure CLI" and a "Try It" button with a "Copy" link. Below the header, there's a code editor containing the command "az account show".

<https://docs.microsoft.com/en-us/azure/cloud-shell/overview>



PowerShell ▾ | ⌂ ? ⚙ ⌛ ⌜ ⌝ ⌞ ⌘ ⌟

Connecting terminal...

Welcome to Azure Cloud Shell

Type "az" to use Azure CLI

Type "help" to learn about Cloud Shell

MOTD: Download scripts from PowerShell Gallery: Install-Script <script name>

VERBOSE: Authenticating to Azure ...

VERBOSE: Building your Azure drive ...

PS /home/reza> □

Bash ▾ | ⌂ ? ⚙ ⌛ ⌜ ⌝ ⌞ ⌘ ⌟

Requesting a Cloud Shell. **Succeeded.**

Connecting terminal...

reza@Azure:~\$ □



# Working from Your Local Machine



Alternatively, you can install **Azure PowerShell** or **Azure CLI** on your local machine and authenticate to your Azure subscription.



# Azure Resource Manager Templates (ARM)

# Azure Resource Manager Templates (ARM)

- Use ARM templates to implement infrastructure as code for your Azure solutions
- ARM templates are JSON documents that define the infrastructure and configuration for your project.
- Store the ARM templates in the source control
- Use ARM templates to automate your deployments at scale

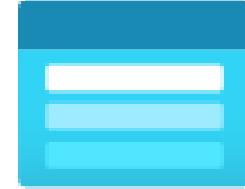


# Azure Resource Manager Templates (ARM)

JSON

```
"resources": [  
    {  
        "type": "Microsoft.Storage/storageAccounts",  
        "apiVersion": "2019-04-01",  
        "name": "mystorageaccount",  
        "location": "westus",  
        "sku": {  
            "name": "Standard_LRS"  
        },  
        "kind": "StorageV2",  
        "properties": {}  
    }  
]
```

Deploy (using CLI, PowerShell,  
Portal, REST APIs)



<https://docs.microsoft.com/en-us/azure/azure-resource-manager/templates/template-tutorial-create-first-template>



# Structure and Syntax of ARM Templates

1. **"\$schema":**
2. **"contentVersion": "",**
3. **"apiProfile": "",**
4. **"parameters": { },**
5. **"variables": { },**
6. **"functions": [ ],**
7. **"resources": [ ],**
8. **"outputs": { }**

JSON

```
{  
  "$schema": "https://schema.management.azure.com/schemas/2015-01-01/deploymentTemplate.json#"  
  "contentVersion": "",  
  "apiProfile": "",  
  "parameters": {},  
  "variables": {},  
  "functions": [],  
  "resources": [],  
  "outputs": {}  
}
```

<https://docs.microsoft.com/en-us/azure/azure-resource-manager/templates/syntax>



# Bicep



## Tip

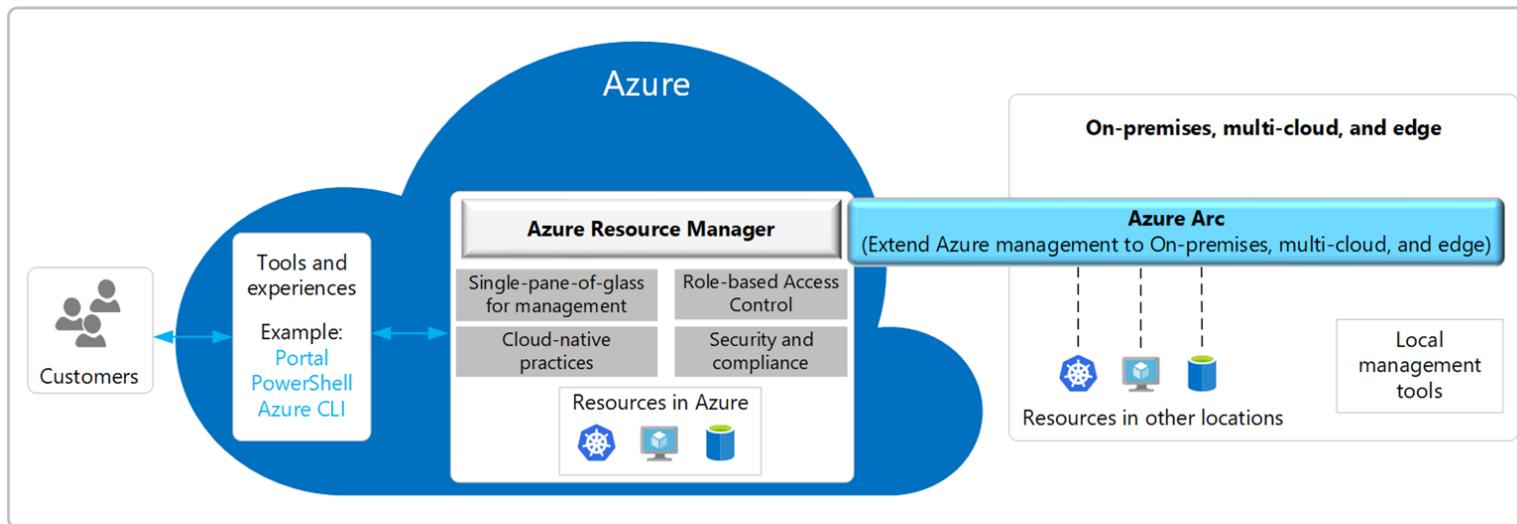
We've introduced a new language named **Bicep** that offers the same capabilities as ARM templates but with a syntax that's easier to use. Each Bicep file is automatically converted to an ARM template during deployment. If you're considering infrastructure as code options, we recommend looking at Bicep. For more information, see [What is Bicep?](#).



# Azure Arc

# Azure Arc

Brings the power of Azure cloud to your on-premises datacenter.



<https://docs.microsoft.com/en-us/azure/azure-arc/overview>



# Azure Arc

- Manage VMs, K8s clusters, and DBs as if they are running in Azure
- Use familiar Azure services and management capabilities
- Project your existing non-Azure and/or on-premises resources into Azure Resource Manager



# Azure Arc Supported Resource Types

- **Servers:** Manage Windows and Linux physical servers and VMs hosted outside of Azure.
- **Kubernetes clusters:** Attach and configure Kubernetes clusters running anywhere, with multiple supported distributions.
- **SQL Server:** Extend Azure services to SQL Server instances hosted outside of Azure.



# Azure Monitor

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# Azure Monitor

Helps you collect, analyze, and act on telemetry from your cloud and on-premises environments.



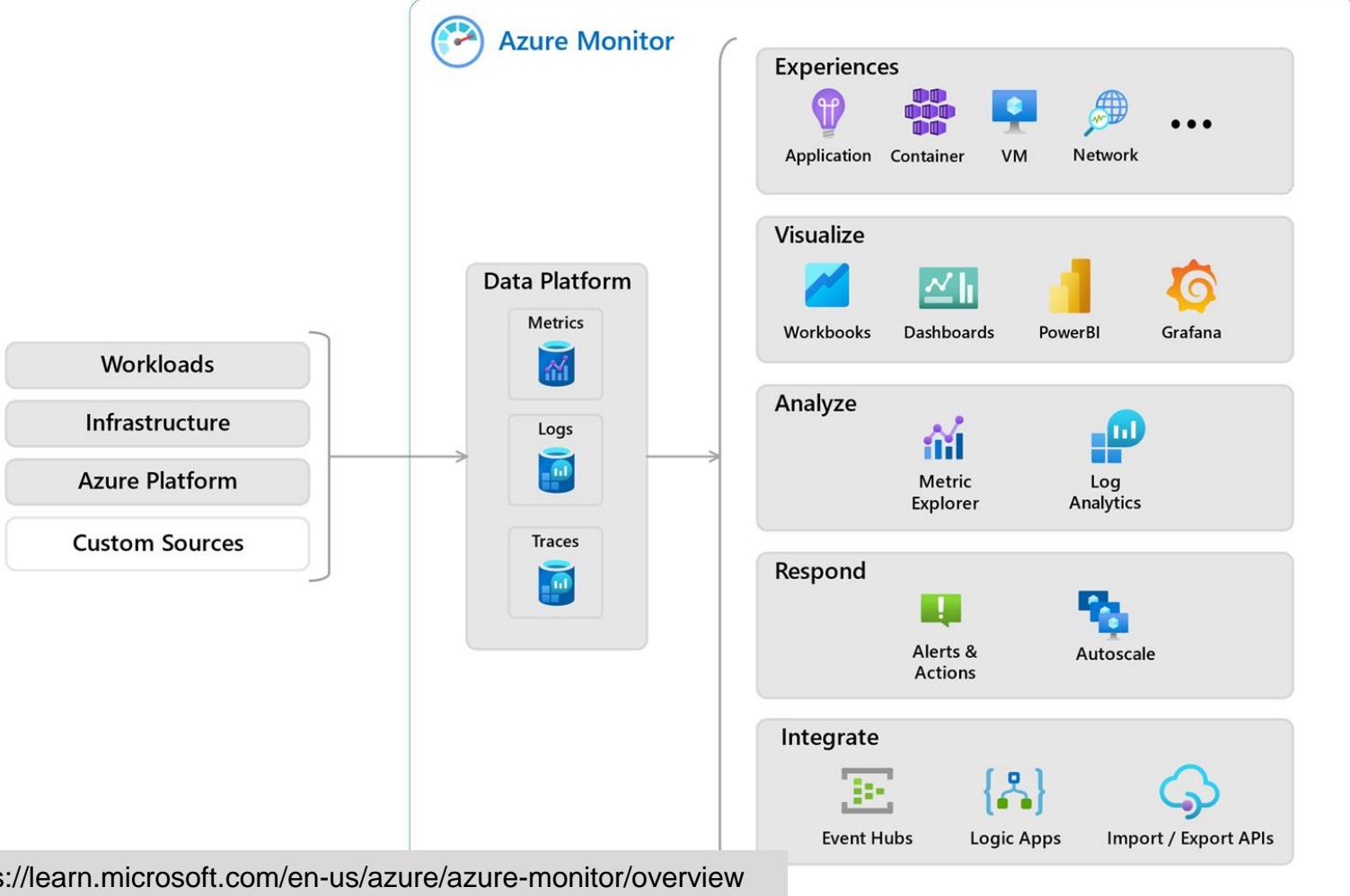
<https://docs.microsoft.com/en-us/azure/azure-monitor/overview>



# Azure Monitor

- Detect and diagnose issues across applications and their dependencies using **Application Insights**.
- Detect and correlate infrastructure issues with **VM insights** and **Container insights**.
- Drill into your monitoring data with **Log Analytics**
- Collect resource performance data using **Azure Monitor Metrics**.





<https://learn.microsoft.com/en-us/azure/azure-monitor/overview>



---

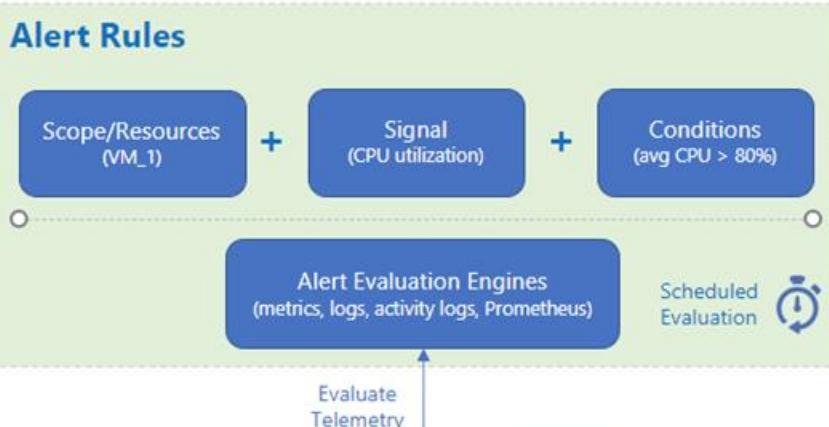
# Azure Monitor Alerts and Actions

- Alerts notify you of possible problems with your resources or infrastructure.
- Actions help you address the issues

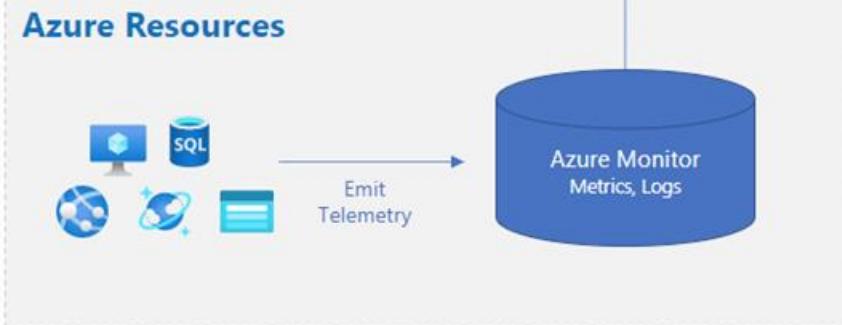
<https://docs.microsoft.com/en-us/azure/azure-monitor/alerts/alerts-overview>



2



1



3



4



Alerts boundary

External boundary

# Azure Monitor Alert Types

- Metric alerts
- Log alerts
- Activity log alerts
- Smart detection alerts (Web application - Application Insights)



# Azure Monitor Alert Actions

Azure Monitor, Azure Service Health, and Azure Advisor use action groups to notify users/administrators about the alert (by sending a voice call, SMS, or email) and take an action.



# Azure Monitor Alert Action Properties

- Type
- Name
- Details

<https://docs.microsoft.com/en-us/azure/azure-monitor/alerts/action-groups>



# Azure Monitor Alert Notifications

- Email Azure Resource Manager Role (email users who are assigned to certain subscription-level roles)
- Email/SMS message/Push/Voice



# Azure Monitor Alert Action Types

- An Azure Automation runbook
- An Azure function
- A notification sent to Azure Event Hubs
- A notification sent to an IT service management (ITSM) tool
- An Azure Logic Apps workflow
- A secure webhook
- A webhook



# Azure Monitor Application Insights

Application Insights is a feature of Azure Monitor that provides extensible application performance management and monitoring for **live web apps**

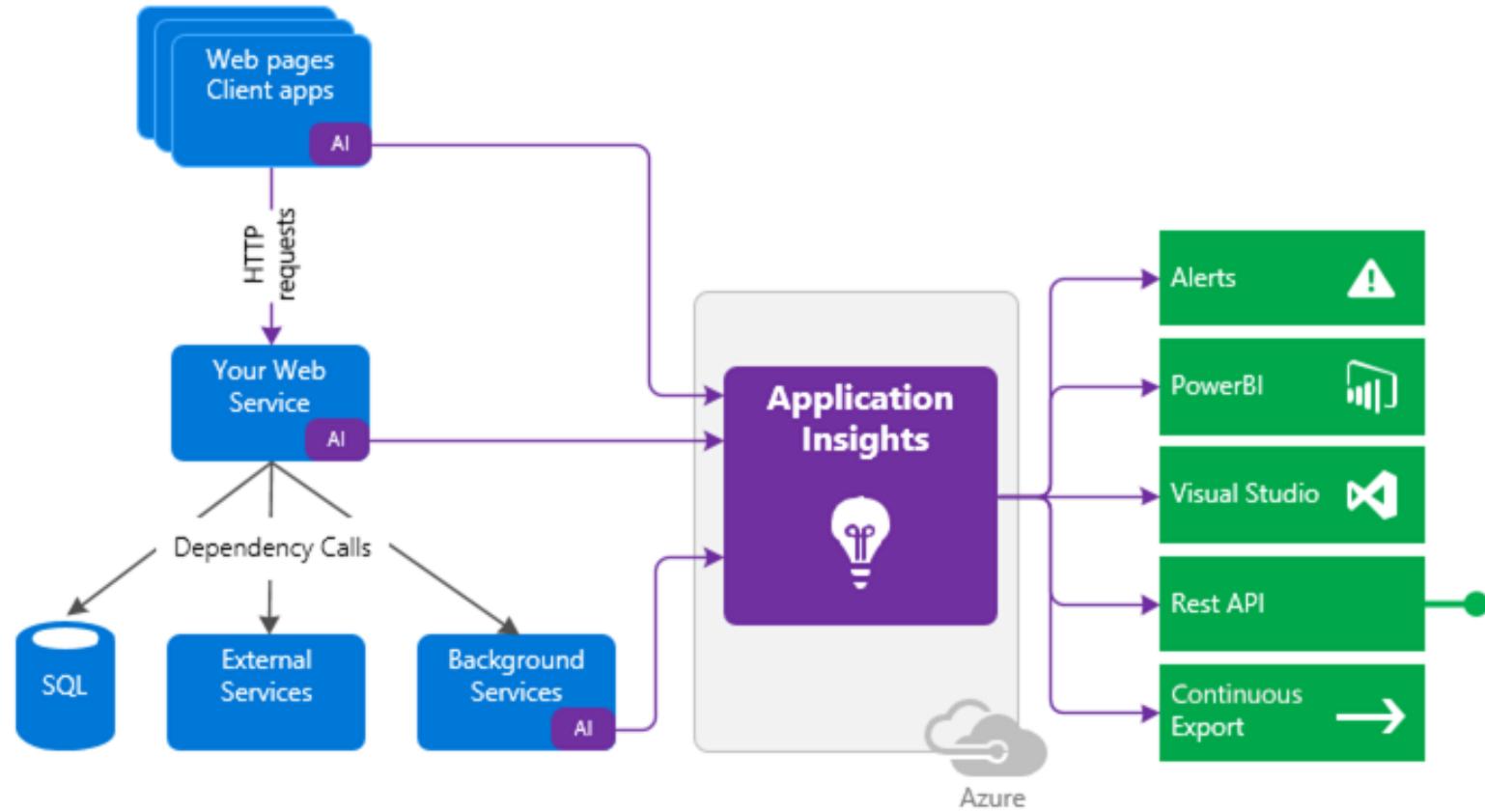
<https://docs.microsoft.com/en-us/azure/azure-monitor/app/app-insights-overview>



# Azure Monitor Application Insights

- Automatically detect performance anomalies
- Help diagnose issues by using analytics tools
- See what users do with apps
- Help to improve app performance and usability
- Supports many platforms, including .NET, Node.js, Java, and Python



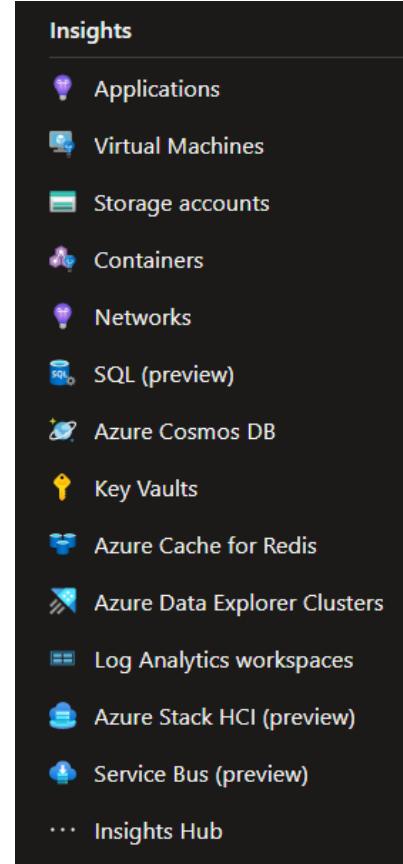


<https://docs.microsoft.com/en-us/azure/azure-monitor/app/app-insights-overview>



# Insights

- Azure Monitor Application Insights
- Azure Data Explorer insights
- Azure Container Insights
- Azure Cosmos DB Insights
- Azure Service Bus Insights
- Azure Storage Insights
- Azure Network Insights
- Azure VM Insights
- Azure Virtual Desktop Insights
- ...



<https://docs.microsoft.com/en-us/azure/azure-monitor/monitor-reference#insights-and-curated-visualizations>



# Azure Advisor

# Azure Advisor

Advisor is a “personalized cloud consultant” that helps you follow best practices to further optimize your Azure infrastructure.



<https://docs.microsoft.com/en-us/azure/advisor/advisor-overview>



# Azure Advisor

- Analyzes your resource configuration and usage telemetry
- Then recommends solutions that can help you improve the cost effectiveness, performance, reliability (formerly called high availability), and security of your Azure resources.
- Proactive, actionable, and personalized best practices recommendations
- Get recommendations with proposed actions inline





## Advisor | Advisor Score (preview)

 Search (Ctrl+ /)[Feedback](#)[Download as CSV](#)[Download as PDF](#)[Overview](#)[Advisor Score \(preview\)](#)Subscription : **all**Recommendation Status : **Active**[Add Filter](#)

No grouping

## Recommendations

[Cost](#)[Security](#)[Reliability](#)[Operational excellence](#)[Performance](#)[All recommendations](#)

## Advisor Score ⓘ

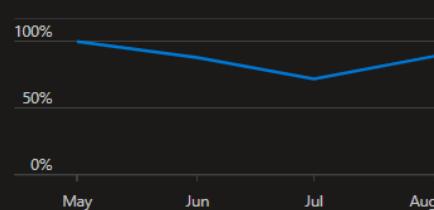
**79%**

Your Advisor Score refreshes every 24 hours.

[Learn more](#)

## Score history

Monthly



## Score by category ⓘ

Cost:

100%

Security:

14%

Reliability:

No data

Operational excellence:

100%

Performance:

100%

## Monitoring

[Alerts \(Preview\)](#)[Recommendation digests](#)

## Settings

[Configuration](#)

Cost



-

Security



-

Reliability



1

Operational excellence



-

Performance



All recommendations



1

# Service Health

---

# Azure Service Health

- Azure status
- Service health
- Resource health

<https://docs.microsoft.com/en-us/azure/service-health/overview>



---

# Azure Status

Provides a global view of the health of Azure services and regions

<https://docs.microsoft.com/en-us/azure/service-health/azure-status-overview>



# Azure status

Updated 33 seconds ago



View other issues that might be impacting your services:

[Go to Azure Service Health >](#)

## HELPFUL LINKS

[Azure status history](#)

[Get notified of outages that impact you](#)

[Building reliable applications on Azure](#)

Refresh every

2 minutes ▾

✓ Good ⓘ Information ⚠ Warning ✖ Critical -- N/A

		Current Impact	Americas		Europe		Asia Pacific		Middle East and Africa		Azure Government		Azure China		Jio <sup>§</sup>	
Products And Services	*Non-Regional ⓘ	East US	East US 2	Central US	North Central US	South Central US	West Central US	West US	West US 2	West US 3	Canada East	Canada Central	Brazil South	Brazil Southeast		
<strong>COMPUTE</strong>																
Azure VMware Solution by CloudSimple	--	✓	--	--	--	✓	--	✓	--	--	--	--	--	--	--	--
Virtual Machines	--	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SAP HANA on Azure Large Instances	--	✓	--	--	--	--	--	✓	✓	--	--	--	--	--	--	--

# Service Health

Provides a view of the health of the Azure services and regions you're using



<https://docs.microsoft.com/en-us/azure/service-health/overview>



# Service Health | Service issues



Search (Ctrl+ /)



Create service health alert Switch To Classic

## ACTIVE EVENTS

Service issues

Planned maintenance

Health advisories

Security advisories

## HISTORY

Health history

## RESOURCE HEALTH

Resource health

## ALERTS

Health alerts

Scope == All

Subscription == All

Region == All

Service == All

Welcome to the new Service Health experience. You can switch back to classic anytime. [Learn more](#)

No active service issues

 Healthy locations  
 Affected locationsTo view Service Health events, users must have the [reader role](#) on a subscription.

Give feedback

# Resource Health

Provides information about the health of an individual resource such as a VM or Storage Account instance





# cs21003bffd9676a24a | Resource health

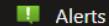
Storage account

Search (Ctrl+ /)



+ Add resource health alert

Diagnose and solve problems



Metrics

Workbooks

Diagnostic settings

Logs

## Monitoring (classic)

Metrics (classic)

Diagnostic settings (classic)

Usage (classic)

## Automation

Tasks (preview)

Export template

## Support + troubleshooting

Resource health

Connectivity check

Recover deleted account

New Support Request

Resource health watches your resource and tells you if it's running as expected. [Learn more](#)



Available

There aren't any known Azure platform problems affecting this storage account.

### What actions can you take?

1. Ensure that your storage account is not approaching [Storage Scalability and Performance Targets](#)
2. [Diagnose and troubleshoot issues using Storage metrics](#)

## Health history

Resource health eve

Date	Description
08/23/2022	Available
08/22/2022	Available
08/21/2022	Available
08/20/2022	Available
08/19/2022	Available

---

# Course Repository

<https://github.com/zaalion/oreilly-az900ondemand>





Thank you!

Reza Salehi

@zaalion

