



Azure Fundamentals (AZ-900)

Lecture Slides

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Good luck on your exam!

What is Cloud Computing?

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cloud com·put·ing

noun

the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.



On-Premise

- You own the servers
- You hire the IT people
- You pay or rent the real-estate
- You take all the risk

Cloud Providers

- Someone else owns the servers
- Someone else hires the IT people
- Someone else pays or rents the real-estate
- You are responsible for your configuring cloud services and code, someone else takes care of the rest.

What is Cloud Computing?

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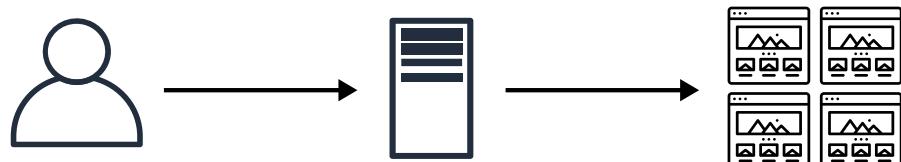


Dedicated Server

One physical machine dedicated to single a business.

Runs a single web-app/site.

Very Expensive, High Maintenance, High Security*

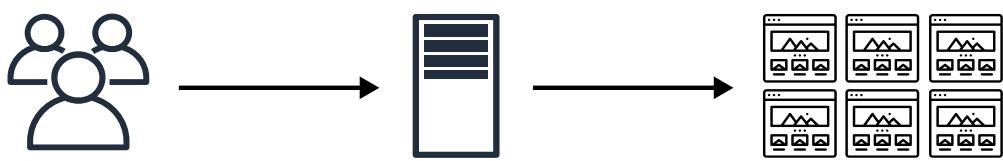


Virtual Private Server

One physical machine dedicated to a single business.

The physical machine is virtualized **into sub-machines**

Runs multiple web-apps/sites

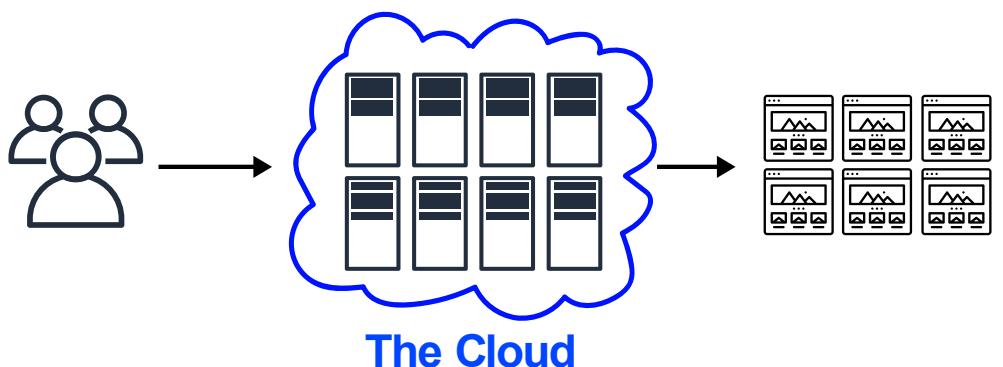


Shared Hosting

One physical machine, shared by hundred of businesses

Relies on most tenants under-utilizing their resources.

Very Cheap, Very Limited.



Cloud Hosting

Multiple physical machines that act as one system.

The system is abstracted into multiple **cloud services**

Flexible, Scalable, Secure, Cost-Effective, High Configurability

Common Cloud Services

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A cloud provider **can have hundreds of cloud services** that are grouped various types of services.
The four most common types of cloud services for Infrastructure as a Service (IaaS) would be:



Compute

Imagine having a virtual computer that can run application, programs and code.



Networking

Imagine having the a virtual network being able to define internet connections or network isolations



Storage

Imagine having a virtual hard-drive that can store files



Databases

Imagine a virtual database for storing reporting data or a database for general purpose web-application

The term “Cloud Computing” can be used to refer to all categories, even though it has “compute” in the name.

What is Microsoft?

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Microsoft

An American multinational computer technology corporation headquartered **in Redmond, Washington**

Microsoft makes software, phones, tablets, game consoles, **cloud services**, a search engine and more!

Microsoft has been around since the late 1970s and is well known for their **Operation System**.



What is Azure?

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Microsoft calls their cloud provider service

Microsoft Azure

Commonly referred to just **Azure**



Azure literally means "**bright blue color of the cloudless sky**"

Cloud Service Providers can be initialized as **CSPs**



Benefits of Cloud Computing

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Cost-effective	You pay for what you consume , no up-front cost . Pay-as-you-go (PAYG) thousands of customers sharing the cost of the resources
Global	Launch workloads anywhere in the world , Just choose a region
Secure	Cloud provider takes care of physical security. Cloud services can be secure by default or you have the ability to configure access down to granular level.
Reliable	data backup, disaster recovery, and data replication, and fault tolerance
Scalable	Increase or decrease resources and services based on demand
Elastic	Automate scaling during spikes and drop in demand
Current	The underlying hardware and managed software is patched, upgraded and replaced by the cloud provider without interruption to you.

Types of Cloud Computing

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SaaS Software as a Service **For Customers**

A product that is run and managed by the service provider
*Don't worry about how the service is maintained.
It just works and remains available.*

PaaS Platform as a Service **For Developers**

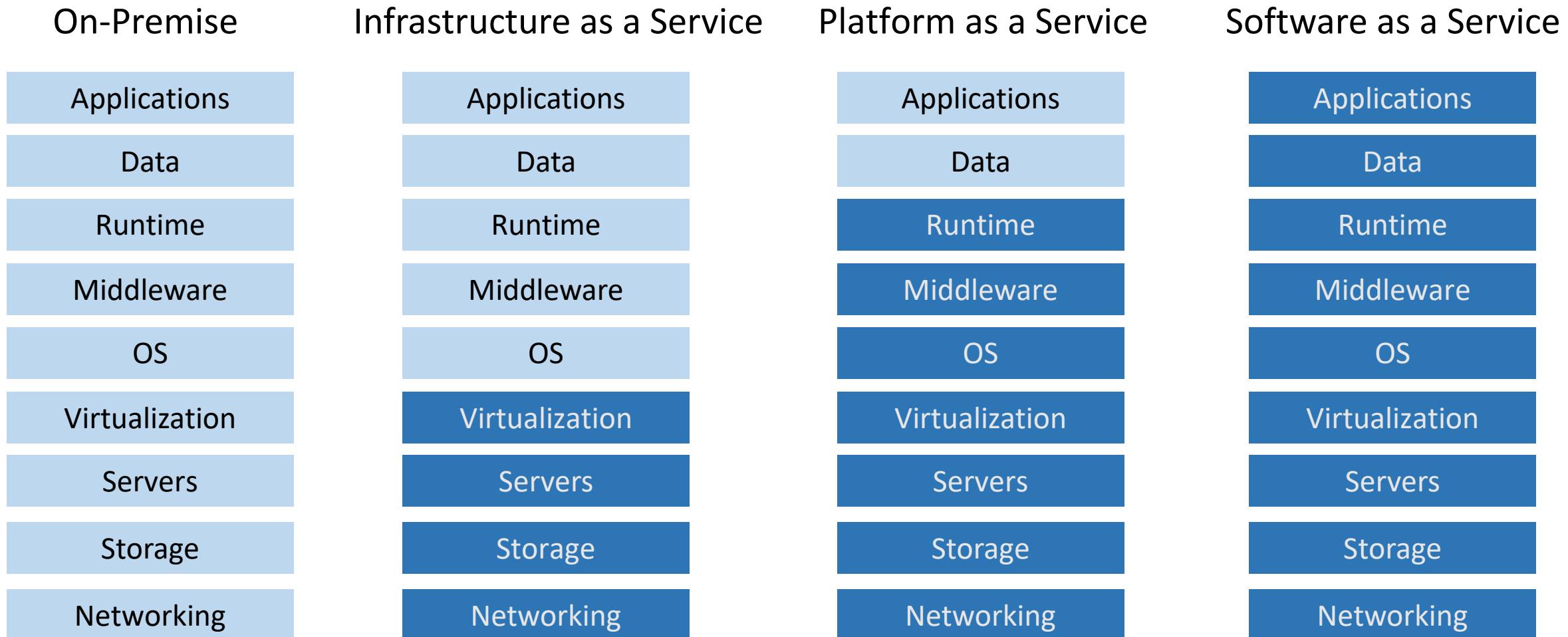
Focus on the deployment and management of your apps.
Don't worry about, provisioning, configuring or understanding the hardware or OS.

IaaS Infrastructure as a Service **For Admins**

The basic building blocks for cloud IT. Provides access to networking features, computers and data storage space.
Don't worry about IT staff, data centers and hardware.

Types of Cloud Computing Responsibilities

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Legend:

Customer is Responsible

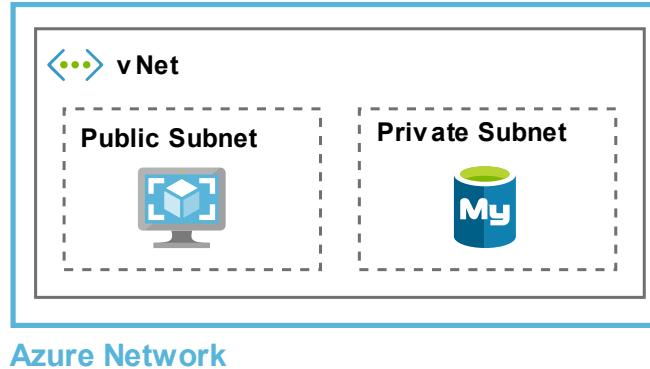
CSP is Responsible

Azure's Deployment Models

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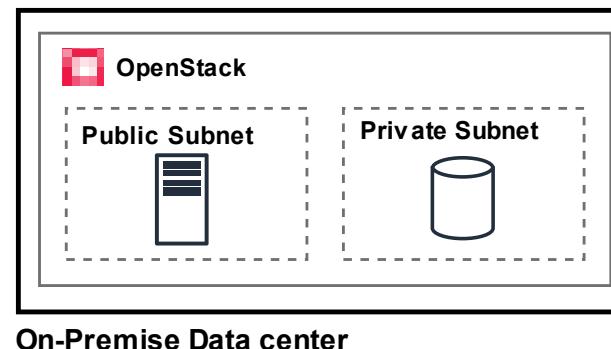
Public Cloud

Everything built on the Cloud Provider
Also known as: Cloud-Native



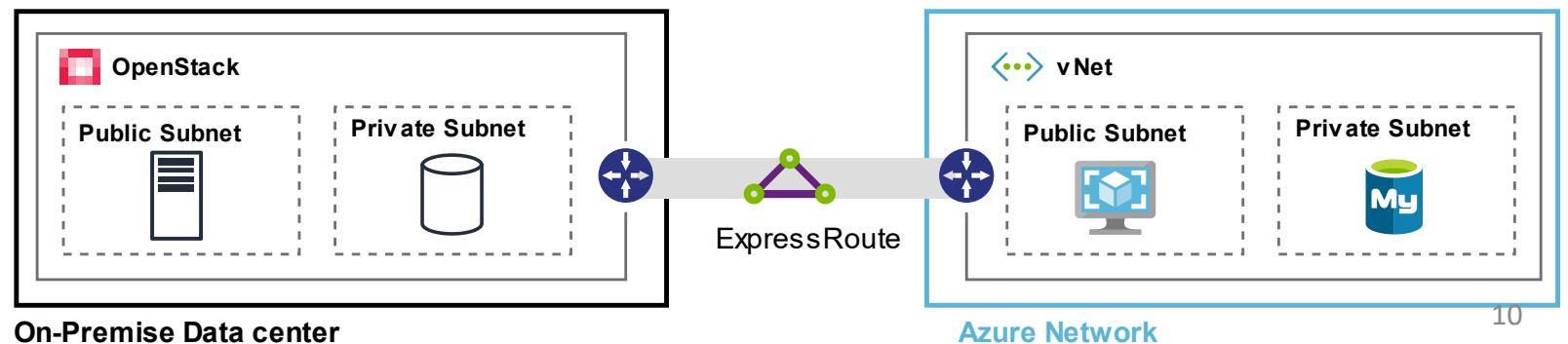
Private Cloud

Everything built on company's datacenters
Also known as **On-Premise**
The cloud could be **OpenStack**



Hybrid

Using both **On-Premise** and
A **Cloud Service Provider**



Azure's Deployment Models

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	Cost	Security	Level of Configuration	Technical Knowledge
Public Cloud	 Most cost-effective	 Security Controls by Default  Might not meet security requirements	 Limited based on what the Cloud Service Provider exposes to you.	 You don't need in-depth knowledge of underlying infrastructure
Private Cloud	 Most expensive	 no guarantee its secure  can meet any security compliance requirement if you put in the work.	 You can configure the infrastructure however you like.	 You need to know in-depth how to configure all levels of your infrastructure
Hybrid	  Could be more cost-effective based on what you offload to the cloud.	 you now have to secure your connection to the cloud  can meet all security requirements	 You get the best of both worlds.	 You need to know in-depth how to configure all levels of your infrastructure and know the CSPs services.

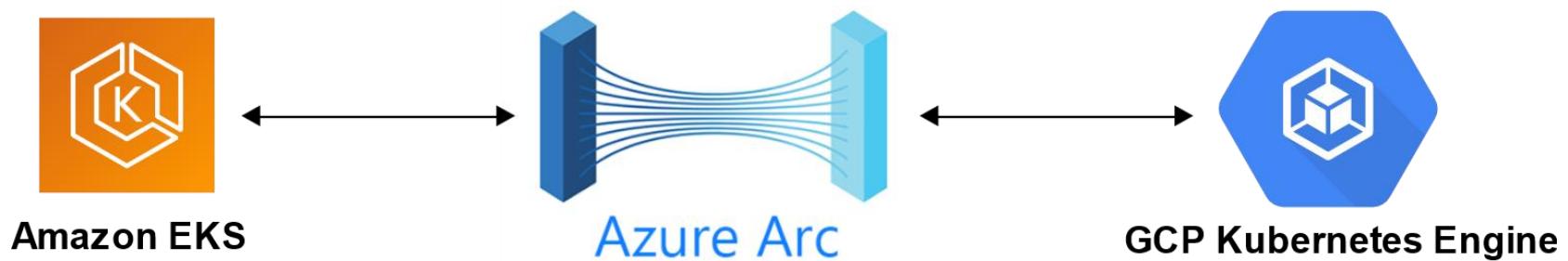
Deployment Models

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Cross-Cloud

Using **Multiple Cloud Providers**

Aka multi-cloud, hybrid-cloud

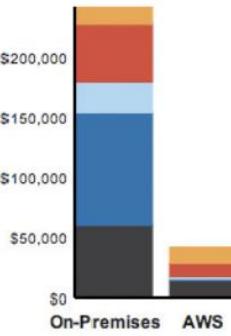


Total Cost of Ownership (TCO)

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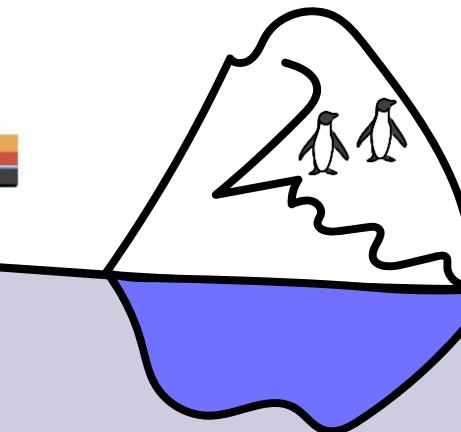
CAPEX On-Premise

Software license Fees



OPEX Azure

Subscription Fees

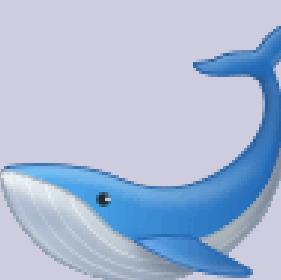


- Implementation
- Configuration
- Training
- **Physical Security**
- Hardware
- IT Personal
- Maintenance



Azure's Responsibility

75% Savings



- Implementation
- Configuration
- Training

Capital vs Operational Expenditure

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Capital Expenditure (CAPEX)

Spending money upfront on **physical infrastructure**

Deducting that expense from your tax bill over time.

- Server Costs (computers)
- Storage Costs (hard drives)
- Network Costs (Routers, Cables, Switches)
- Backup and Archive Costs
- Disaster Recovery Costs
- Datacenter Costs (Rent, Cooling, Physical Security)
- Technical Personal

With Capital Expenses **you have to guess upfront** what you plan to spend

Operational Expenditure (OPEX)

The costs associated with an on-premises datacenter that has shifted the cost to the service provider. The customer only has to be concerned with non-physical costs.

- Leasing Software and Customizing features
- Training Employees in Cloud Services
- Paying for Cloud Support
- Billing based on cloud metrics eg.
 - compute usage
 - storage usage

With Operation Expenses you can try a product or service **without investing in equipment**

Cloud Architecture Terminologies

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Availability - Your ability to maintain service accessibility, often measured by uptime. **Highly Available (HA)** ensures continuous service.

Scalability – Your ability to adjust resources to handle changing workloads. It supports rapid growth without performance issues.

Elasticity – Your ability to dynamically allocate or de-allocate resources based on demand, optimizing cost-efficiency.

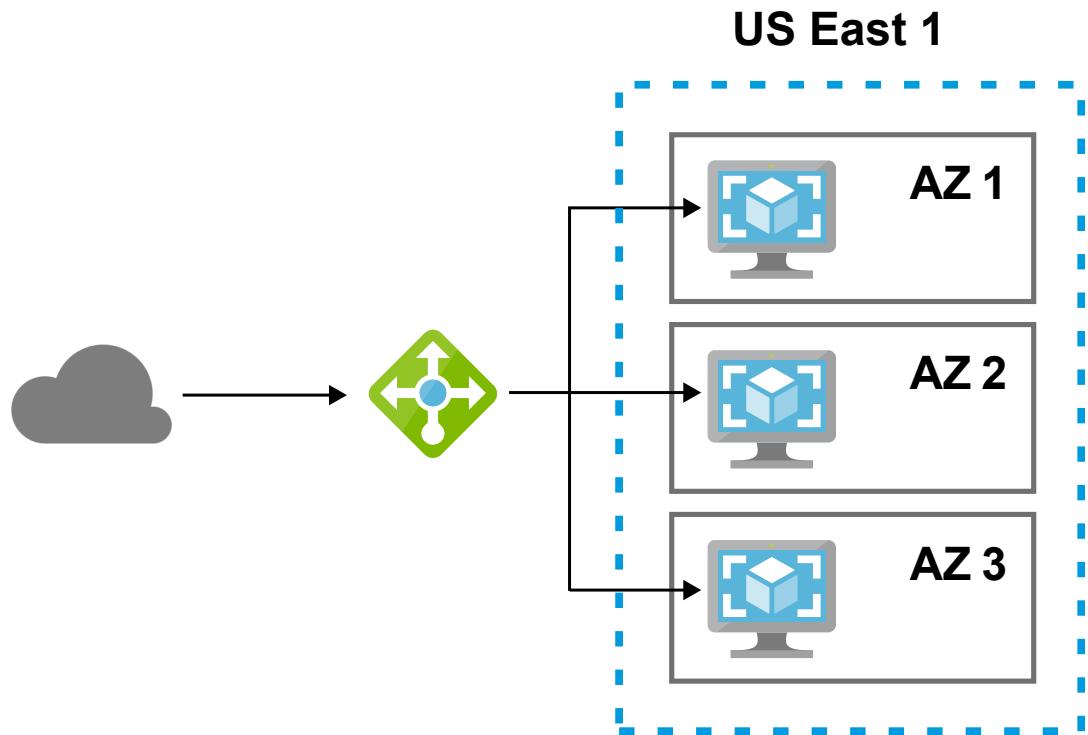
Fault Tolerance – Your ability to sustain functionality despite failures in hardware or software.

Disaster Recovery (DR) - Your ability to recover from major outages, ensuring data integrity and availability even in catastrophic events.

High Availability

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Your ability for your service to **remain available** by ensuring there is
***no single point of failure** and/or ensure a certain level of performance



Azure Load Balancer

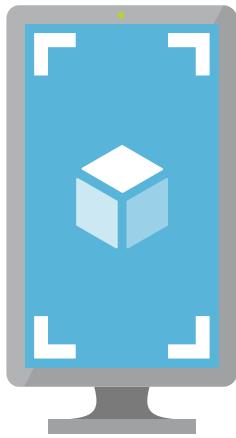
A load balancer allows you to evenly distribute traffic to multiple servers in one or more datacenter. If a datacenter or server becomes unavailable (unhealthy) the load balancer will route the traffic to only available datacenters with servers.

Running your workload across multiple **Availability Zones** ensures that if 1 or 2 AZs become unavailable your service / applications remains available.

High Scalability

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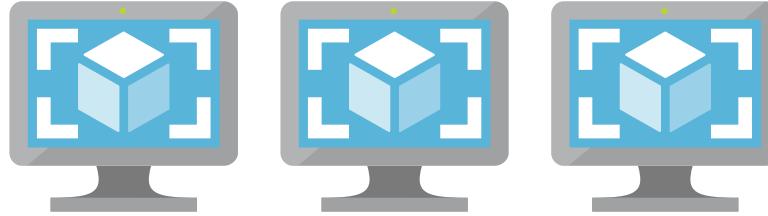
Your ability to **increase your capacity** based on the increasing demand of traffic, memory and computing power



Vertical Scaling

Scaling **Up**

Upgrade to a bigger server



Horizontal Scaling

Scaling **Out**

Add more servers of the same size

High Elasticity

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Your ability to **automatically** increase or decrease your capacity based on the current demand of traffic, memory and computing power



Azure VM Scale Sets

Automatically increase or decrease in response to demand or a defined schedule.

SQL Server Stretch Database

Dynamically stretch warm and cold transactional data from Microsoft SQL Server 2016 to Microsoft Azure

Horizontal Scaling

Scaling **Out** — Add more servers of the same size

Scaling **In** — Removing more servers of the same size

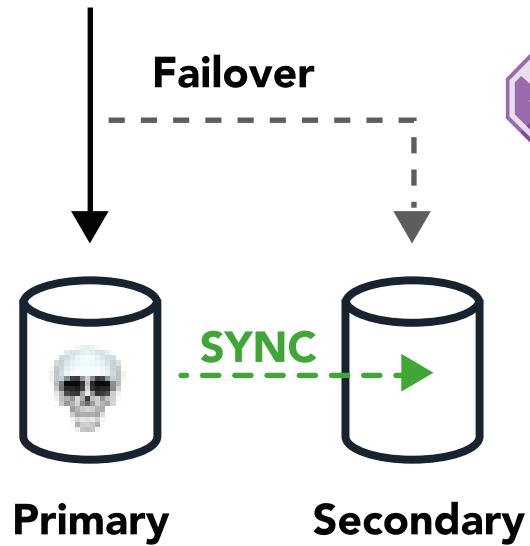
Vertical Scaling is generally hard for traditional architecture so you'll usually only see horizontal scaling described with Elasticity.

Highly Fault Tolerant

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The ability to **withstand and recover** from **unexpected failures**, errors, or disruptions in a system or application, ensuring uninterrupted operation and minimal downtime

Failover involves shifting traffic from a primary system to a redundant system when issues occur



Azure Traffic Manager is a DNS-based traffic load balancer. It does not directly initiate failovers. It's primarily used for load distribution and routing traffic to healthy endpoints

A common use case is secondary replicas taking over in the event of a primary system failure. This process is typically managed through database-specific failover mechanisms.

High Durability

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Your ability to **recover** from a disaster and to prevent **the loss** of data
Solutions that recover from a disaster is known as **Disaster Recovery (DR)**

- Do you have a backup?
- How fast can you restore that backup?
- Does your backup still work?
- How do you ensure current live data is not corrupt?

The Evolution of Computing

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*Dedicated



VMs



Containers



Functions

Wasted Space

App

App

App

Host Operation System

physical server

- A physical server **wholly utilized by a single customer**.
- You have to guess your capacity, you'll overpay for an underutilized server
- Upgrading beyond your capacity will be slow and expensive
- You are limited by your Operating System
- Multiple apps can result in conflicts in resource sharing
- You have a ***guarantee of security, privacy and full utility of underlying resources**

The Evolution of Computing

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*Dedicated



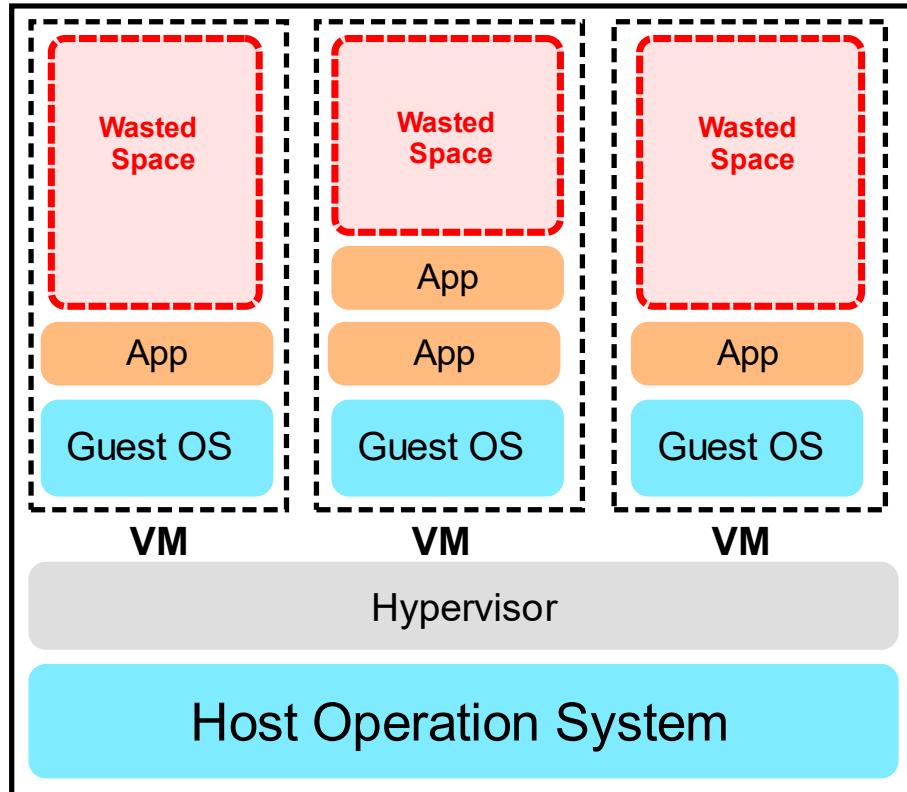
VMs



Containers



Functions



- You can run **multiple Virtual Machines on one machine**.
- **Hypervisor** is the software layer that lets you the VMs
- A physical server shared by multiple customers
- You are pay for a fraction of the server
- You'll overpay for an underutilized Virtual Machine
- You are limited by your Guest Operating System
- Multiple apps on a single Virtual Machine can result in conflicts in resource sharing

The Evolution of Computing

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*Dedicated

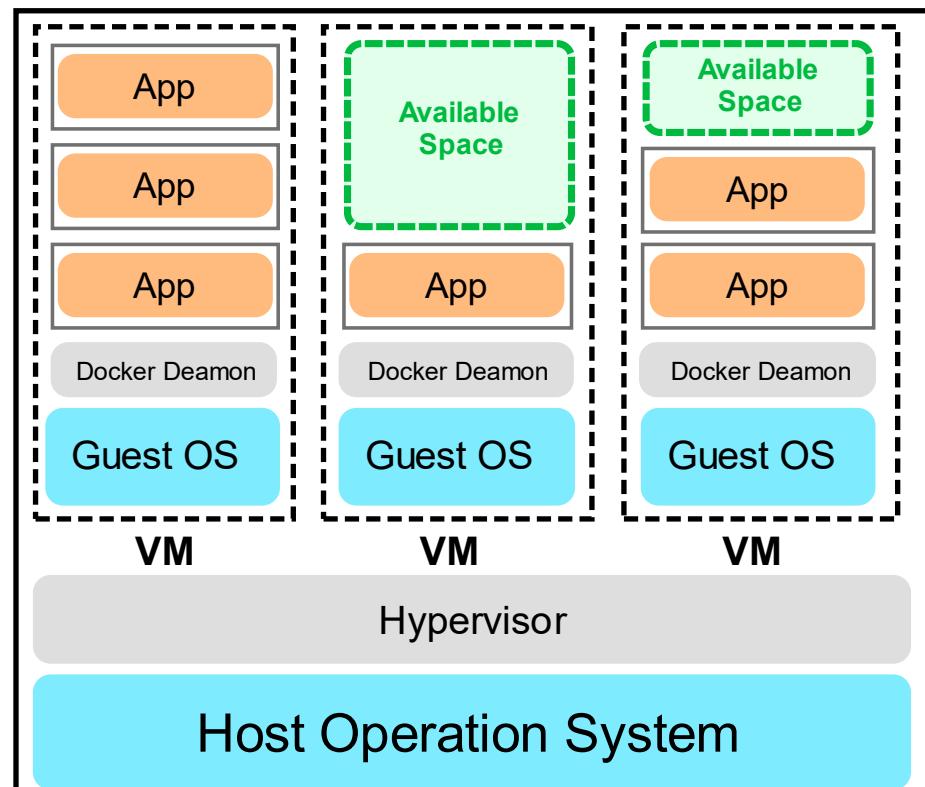


VMs

Containers



Functions



- Virtual Machine running multiple containers
- **Docker Deamon** is the name of the software layer that lets you run multiple containers.
- You can maximum the utilize the available capacity which is more cost-effective
- Your containers share the same underlying OS so containers are more efficient than multiple VMs
- Multiple apps can run side by side without being limited to the same OS requirements and will not cause conflicts during resource sharing

The Evolution of Computing

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*Dedicated



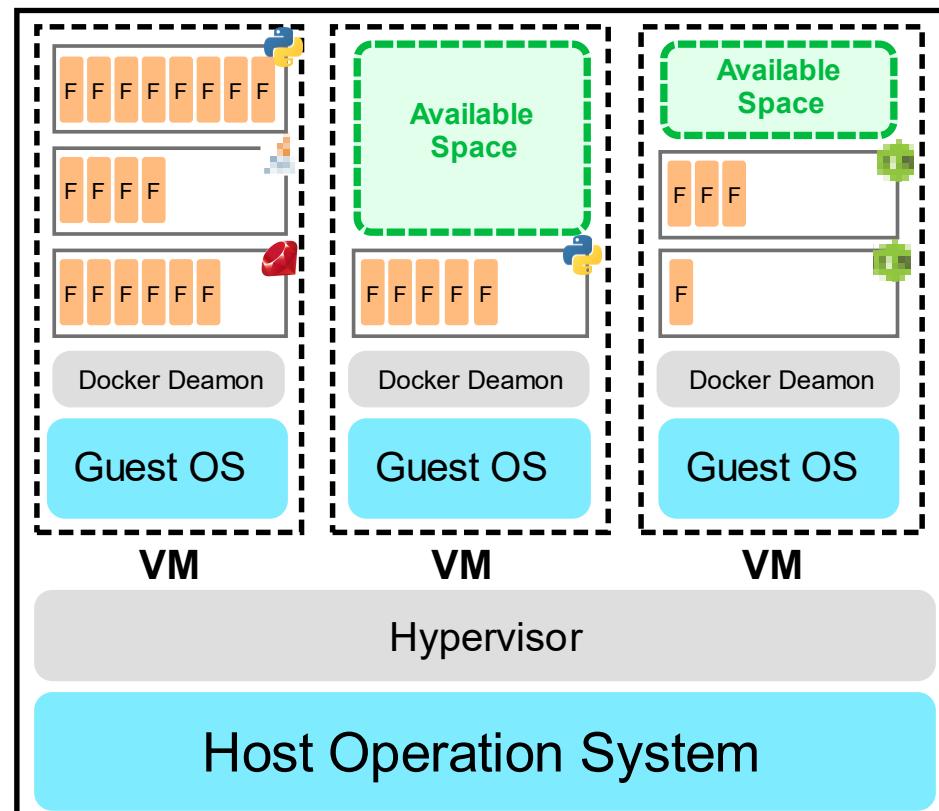
VMs



Containers



Functions



- A managed VMs running managed containers.
- Known as **Serverless Compute**
- You upload a piece of code choose the amount of memory and duration.
- Only responsible for code and data, nothing else
- Very cost-effective, only pay for the time code is running, VMs only run when there is code to be executed
- Cold Starts is a side-effect of this setup

Global Infrastructure – Regions and Geographies

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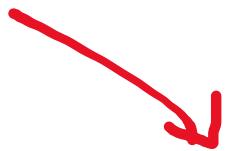
A **region** is a grouping of multiple datacenters (Availability Zones)

Azure has **58 Regions** available across **140 Countries**

A **Geography** is discreet market of two or more regions that preserves **data residency** and **compliance boundaries**.

Azure Geographies

- United States
- Azure Government (US)
- Canada
- Brazil
- Mexico



Imagine you are in Canada and **you want a guarantee that data will remain within Canada**. You would want to use Canada Azure Geographies

Global Infrastructure – Regions and Geographies

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US East 1



(Europe) Norway East



You choose the region when you
launch a new cloud resource

Recommended ⓘ

- (US) East US
- (US) East US 2
- (US) South Central US
- (US) West US 2
- (Asia Pacific) Australia East
- (Asia Pacific) Southeast Asia
- (Europe) North Europe
- (Europe) UK South

(US) East US

Global Infrastructure – Paired Regions

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Each region is paired with another region **300 miles** away.

Only one region is updated at a time to ensure no outages

Some Azure Services rely on Paired Regions for **Disaster Recovery**

Eg. **Azure Geo-redundant Storage (GRS)** replicates data to a secondary region automatically, ensuring that data is durable even in the event that the primary region isn't recoverable.

Canada	Canada Central	Canada East
North America	East US	West US
Germany	Germany Central	Germany Northeast

Global Infrastructure – Region Types and Service Availability

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Not all Azure cloud services are available in every Region.

Recommended region

A region that provides the broadest range of service capabilities and is **designed to support Availability Zones** now, or in the future.

Alternate (other) region

A region that extends Azure's footprint within a data residency boundary where a recommended region also exists. **Not designed to support AZs.**
These Regions are labeled as **Other** in the Azure Portal

General availability (GA) is when a service is considered ready to be used publicly by everyone.

Azure Cloud services are grouped into **three** categories.

Their category determines when cloud services become available:

1. Foundational. When GA, immediately or in 12 months in Recommended and Alternate Regions

2. Mainstream When GA immediately or in 12 months in Recommended Regions

May become available in Alternate Regions based on customer demand

3. Specialized. Available in Recommended or Alternate Region based on customer demand

Global Infrastructure – Special Regions

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Azure has specialized regions to meet **compliance or legal reasons**



- US DoD Central
- US Gov Virginia
- US Gov Iowa

*Three Azure Government secret locations undisclosed



- China East
- China North

* Available through a unique partnership between Microsoft and 21Vianet. Microsoft does not directly maintain the datacenters.

世纪互联®
www.21vianet.com

Global Infrastructure – AZs

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An **Availability Zone** (AZ) is physical location made up of one or more datacenter.

A datacenter is a secured building that contains hundreds of thousands of computers.

A region will ***generally** contain 3 Availability Zones

Datacenters within a region will be isolate from each other (so different buildings). But they will be close enough to provide low-latency.

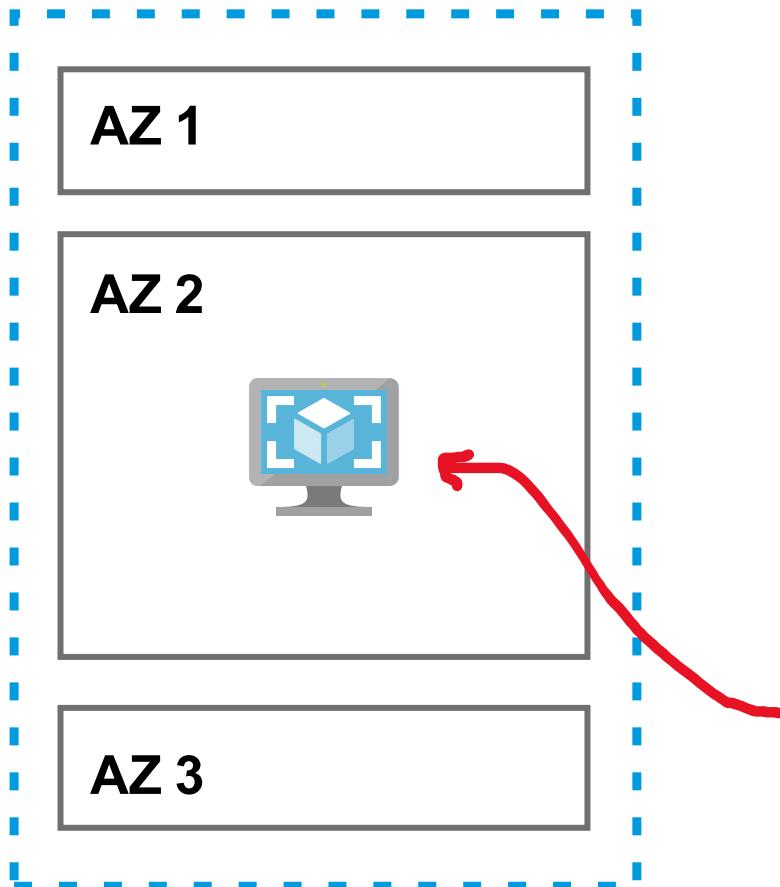
Its common practice to run workloads in at least 3 AZs to ensure services remain available in case one or two datacenters fail. (High Availability)



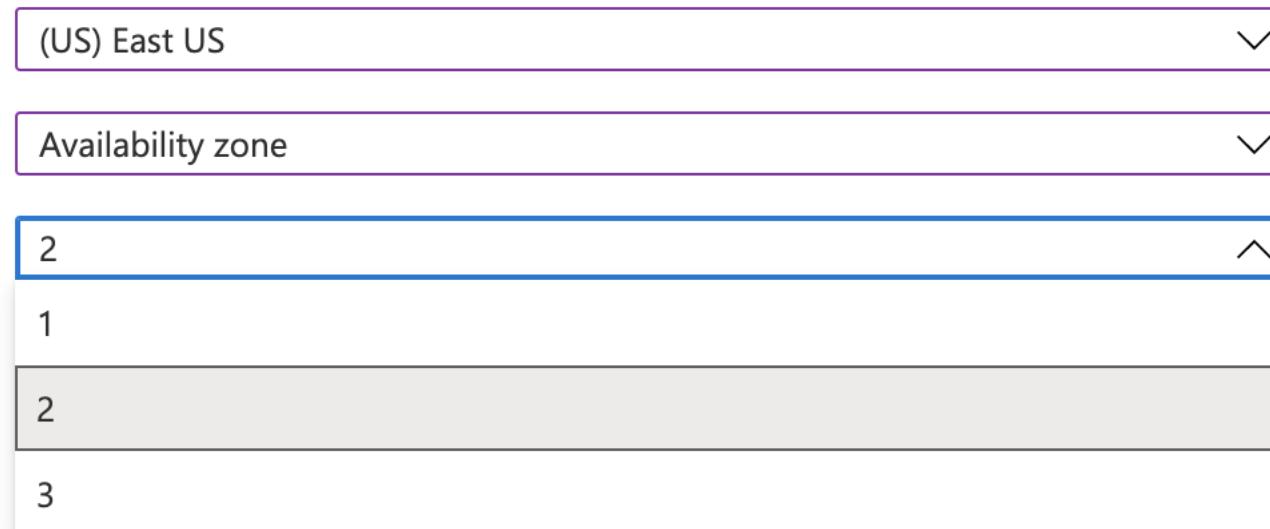
Global Infrastructure – AZs

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US East 1



If you region has multiple AZs you choose a number. Choosing 2 means AZ-2 not that you have chosen a quantity Of 2 AZs.



(US) East US

Availability zone

2

1

2

3

A red curved arrow points from the text "Choosing 2 means AZ-2" to the number 2 in the dropdown menu above.

Global Infrastructure – AZ Supported Regions

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Not Every Region has support for Availability Zones

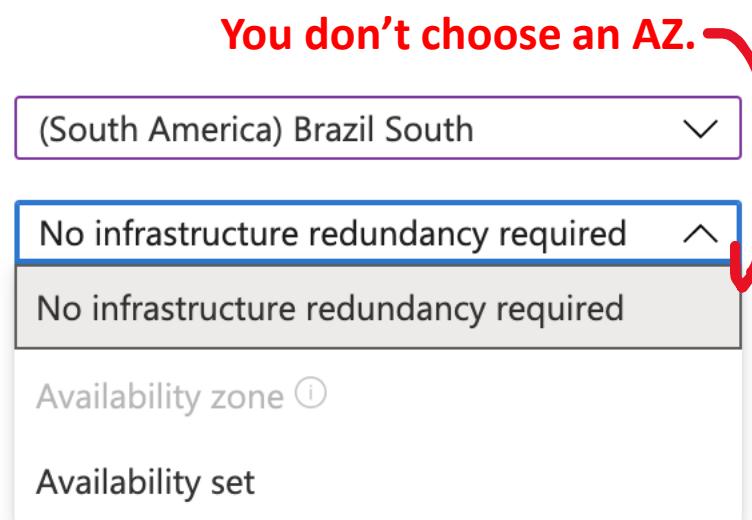
These regions are known as **Alternate** or **Other**

Recommended Regions are suppose to have at least 3 AZs.

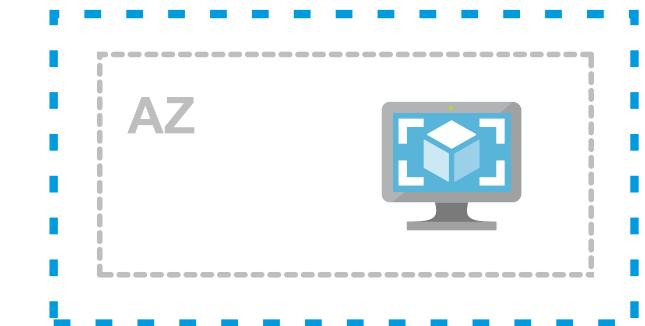
The following Regions

have a minimum of 3 AZs

- Central US
- East US 2
- West US 2
- West Europe
- France Central
- North Europe
- Southeast Asia



(South America) Brazil South



Global Infrastructure – Fault and Update Domains

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An Availability Zone (AZ) in an Azure region is
a combination of a **fault domain** and an **update domain**.

Fault Domain

A logical grouping of hardware to avoid a single point of failure within an AZ.
group of virtual machines that share a common power source and network switch.

Update Domain

Azure may need to apply updates to the underlying hardware and software.
Update domains ensure your resources do not go offline.

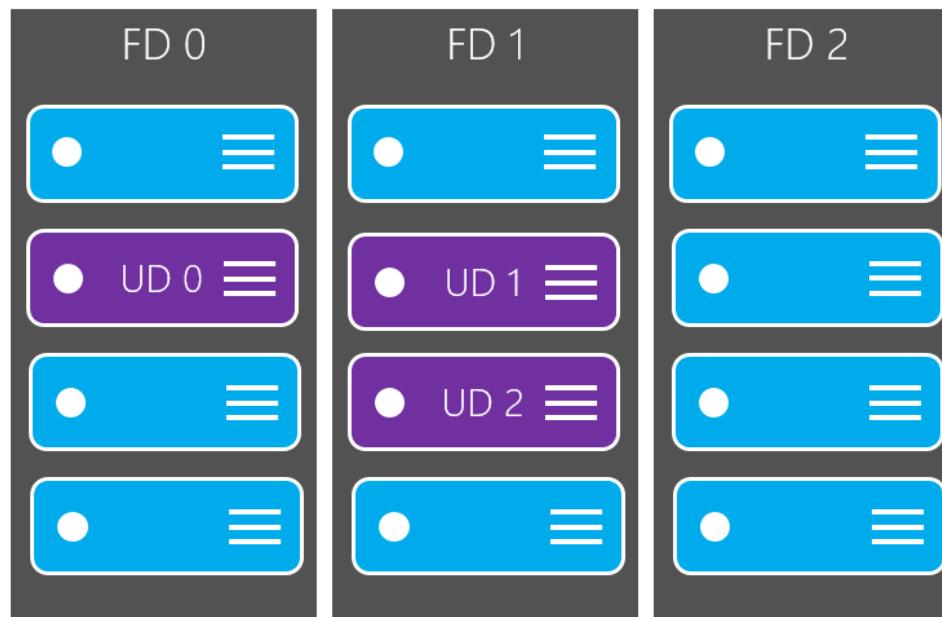
Availability Set

A logical grouping that you can use in Azure to ensure that the VMs you place in the Availability Set are different fault/update domains to avoid downtime.

Global Infrastructure – Fault and Update Domains

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Each Virtual Machine in an Availability Set is assigned a Fault Domain and Update Domain.



**Creating a Availability Set.
Choosing the amount of domains**

Group two or more VMs in an availability set to ensure that at least one is available during planned or unplanned maintenance events. [Learn more](#)

Name *

Fault domains ⓘ

2

Update domains ⓘ

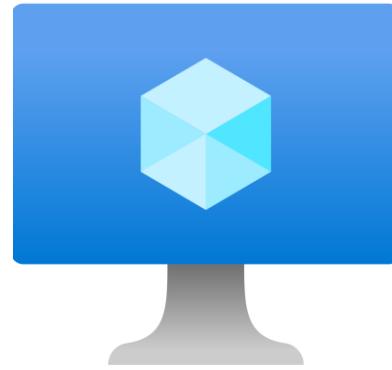
5

Use managed disks ⓘ

No (Classic) Yes (Aligned)



Azure Virtual Machines



Choose an OS, Compute, Memory and Storage
and launch a **server** in minutes



Introduction to Azure VMs

Azure Virtual Machines (VMs) is a highly configurable server. Virtualization let you run a server ***without having to buy and maintain the physical hardware*** that runs it



- Virtual Machines still require maintenance such as:
 - applying OS system patches
 - Installing and configuring packages

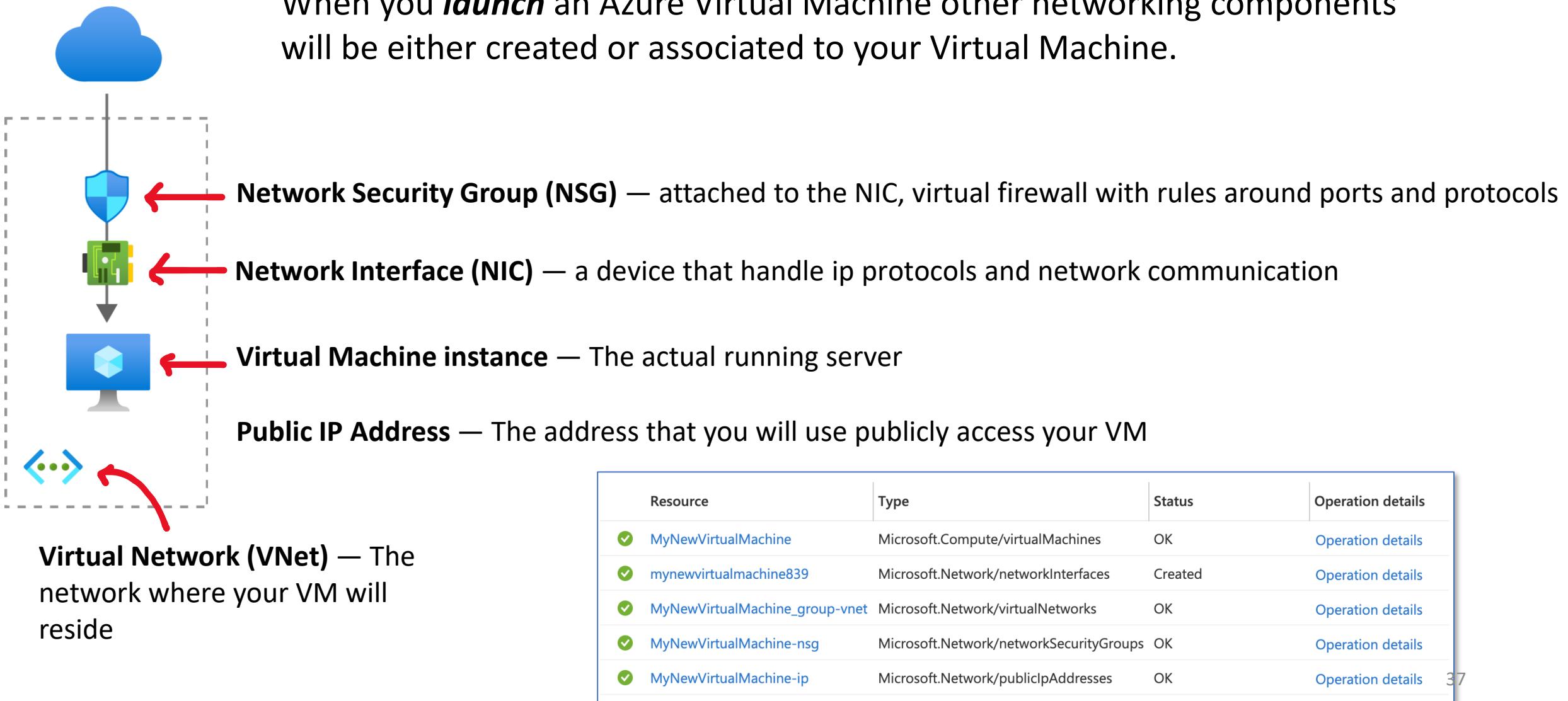
Some things you should know:

- The **size** of the virtual machine is determined by the Image
 - The image defines the combination of vCPUs, Memory and Storage Capacity
- The current limit on a per subscription basis is **25000 VMs per region**.
- Azure VMs are billed at an **hourly rate**
- A single instance VMs has an availability of 99.9% (when all storage disks are premium)
- Two instances deployed in Availability Set will give you 99.95% availability
- You can attach multiple Managed Disk to your Azure VMs



Introduction to Azure VMs

When you **launch** an Azure Virtual Machine other networking components will be either created or associated to your Virtual Machine.



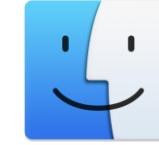


Azure VMs – Operation Systems

What is an Operation System (OS)?

The OS is the program that manages all other programs in a computer.

The most commonly known operations systems are Windows ,macOS, and Linux



When you launch a Virtual Machine you need to choose an Image which has a specific Operation System.

Microsoft works closely with partners to ensure the images available are updated and optimized for an Azure runtime. Most of these images can be found in the **Azure Marketplace**

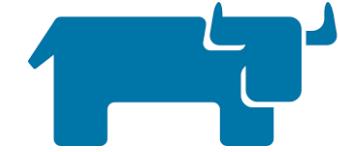


- SUSE Linux Enterprise Server
- Red Hat Enterprise Linux
- Ubuntu Server
- Debian
- FreeBSD
- Azure Marketplace - Flatcar Container Linux
- RancherOS
- Bitnami Library for Azure
- Mesosphere DC/OS on Azure
- Docker images
- CloudBees Jenkins Platform



You can **Bring Your Own Linux** by creating a Linux Virtual Hard Disk (VHD)

(Hyper-V virtual hard disk (VHDX) format isn't supported in Azure, only fixed VHD)

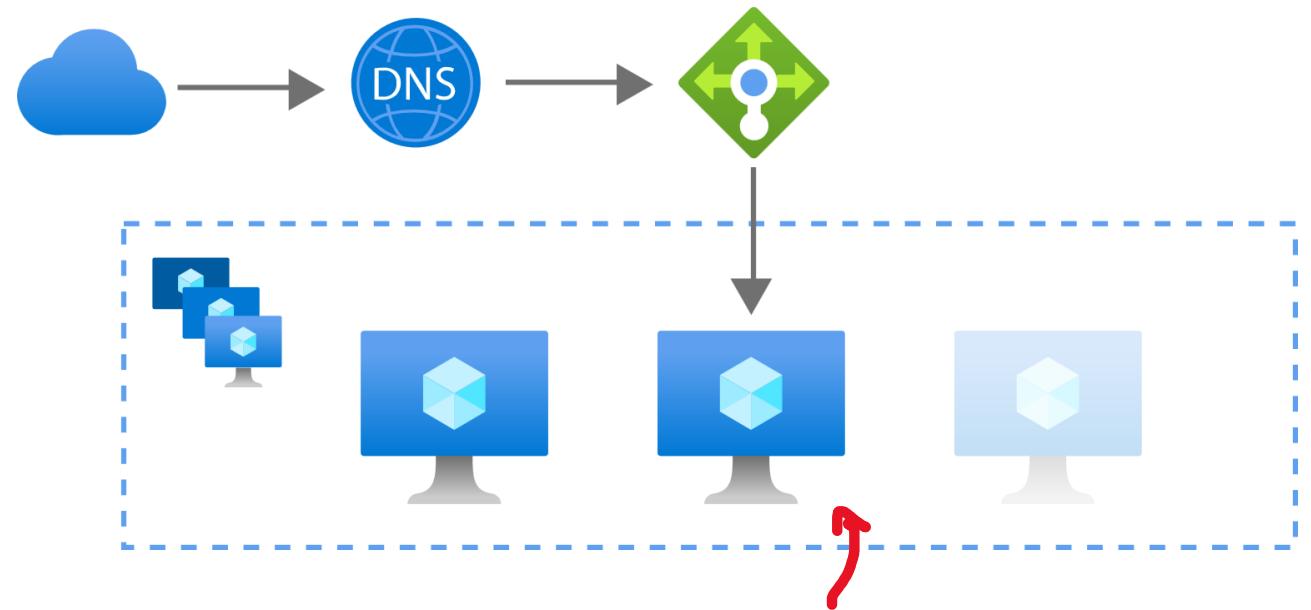




Azure Scale Sets

Azure Scale Sets allows you to **automatically increase or decrease** your VM capacity.

- Create Scaling Policies to automatically add or remove based on Host Metrics
- Create Health checks and set a Repair Policy to replace unhealthy instances
- Associate A Load Balancer to distribute VMs across AZs
- You can scale to 100s or even 1000s of VMs using scale sets



A Scale Set is a group of **identical VMs** (same Image and size)



Azure Scale Sets – Load Balancer

A Load Balancer can be **associated** with a Scale Set.

This will allow you to:

- evenly distribute your VMs across multiple Availability Zones to make your application Highly Available.
- Use Load Balancer probe checks for more robust Health checks

Use a load balancer 

Yes No

Azure load balancer 

(new) TestScaleSet-lb 
[Create new](#)

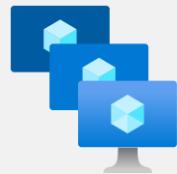
Select a load balancer * 

Select a backend pool * 

(new) bepool 
[Create new](#)

You have the choice between 2 different load balancers:

1. **Application Gateway** is an **HTTP/HTTPS** web traffic load balancer with URL-based routing, SSL termination, session persistence, and web application firewall.
2. **Azure Load Balancer** supports all **TCP/UDP** network traffic, port-forwarding, and outbound flows.



Azure Scale Sets - Health Monitoring

Health monitoring can be enabled to determine if your server is **healthy** or **unhealthy**.

There are 2 modes of health monitoring:

1. Application health extension

- Ping an HTTP request to a specific path and expect a status 200

2. Load Balancer Probe

- Allow you to check based on TCP, UDP or HTTP requests.

Health

Monitor application health (i) Disabled Enabled

Application health monitor * (i) Application health extension ▼

Protocol * (i) HTTP ▼

Port number * (i) 80

Path * (i) /

Monitor application health (i) Disabled Enabled

Application health monitor * (i) Load balancer probe ▼

Load balancer health probe (new) healthProbe3b8ed99b-(▼

[Create new](#)

Automatic repair policy

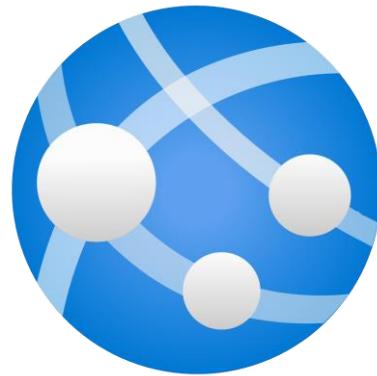
If an instance is found to be unhealthy the delete it and launch a new instance

Automatic repair policy

Automatic repairs (i) On Off

Grace period (min) * (i) 30 ✓

Azure App Service



Quickly **deploy and manage Web apps** on Azure
without worrying about the underlying infrastructure

Platform as a Service



Introduction to Azure App Service

Azure App Service is an **HTTP-based service** for hosting web applications, REST APIs, and mobile back ends.

You can choose your **programming language** and either a **Windows** and **Linux** environment

It is a Platform as Service, so it's the **Heroku equivalent for Azure**.

Azure App Service takes care of the following underlying infrastructure

- Security patches for OS and languages
- Load balancing
- Autoscaling
- Automated manager

When you create your app you have to choose a unique name since it becomes a fully qualified domain

deep-space-nine



.azurewebsites.net

Azure App Service makes it easy to implement common Integrations and features such as:

- Azure DevOps (For deployments)
- Github Integration
- Docker Hub Integration
- Package Management
- Easy to setup staging environments
- Custom Domains
- Attaching TLS/SSL Certificates

You pay based on an Azure App Service Plan:

Shared Tier — Free, Shared (Linux not supported)

Dedicated Tier — Basic, Standard, Premium, PremiumV2, PremiumV3

Isolated Tier

Azure App Services can also run docker single or multi-containers



Azure App Service – Runtimes

What is a Runtime Environment?

A runtime software/instructions that are executed *while* your program is running.

A runtime generally means what **programming language** and **libraries** and **framework** you are using.

A runtime for Azure App Services will be a pre-defined **container** that has your programming language and commonly used library for that language installed.

With Azure App Services you choose a runtime.

- .NET
- .NET Core
- Java
- Ruby
- Node.js
- PHP
- Python

Azure App Services will have generally multiple latest versions of a programming language eg. Ruby 2.6, 2.7

Its common to for a cloud provider to stop supporting older versions so you keep current and forces customer to keep good security practices by having latest patches

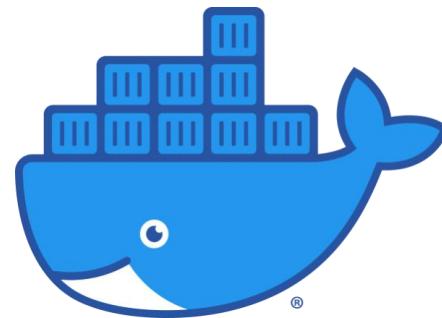




Azure App Service – Custom Container

Azure App Service allows you defined **custom containers** for **Windows or Linux**

You might want to create your own custom container to use a different runtime or bundle in a packages or software



Create your own **Docker** Container
on your local environment



Push the Docker container to
Azure Container Registry



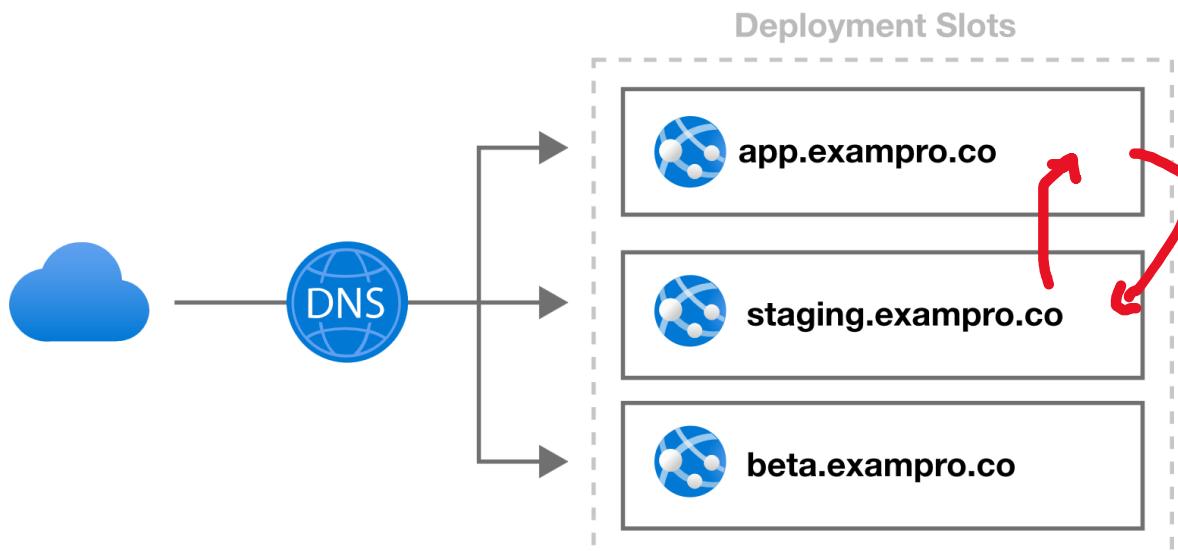
Deploy your Container
Image to **App Service**



Azure App Service – Deployment Slots

Deployment Slots allow you to create **different environments** of your web-application associated to a different hostname. This is useful when need a staging, or QA environment.

Think of it as a way to quickly clone your production environment for other uses.



You can also **Swap environments** This could be how you perform a Blue/Green deploy.

You can promote our staging to production by swapping, if something goes wrong you could swap them back.



Azure App Service – App Service Environment

App Service Environment (ASE) is an Azure App Service feature that provides a **fully isolated and dedicated environment** for securely running App Service apps at high scale

This allow you to host:

- Windows web apps
- Linux web apps
- Docker containers
- Mobile apps
- Functions

App Service environments (ASEs) are appropriate for application workloads that require:

- Very high scale
- Isolation and secure network access.
- High memory utilization

Customers can create multiple ASEs within a single Azure region or across multiple Azure regions making ASEs ideal for **horizontally scaling stateless application tiers** in support of **high requests per second (RPS) workloads**.

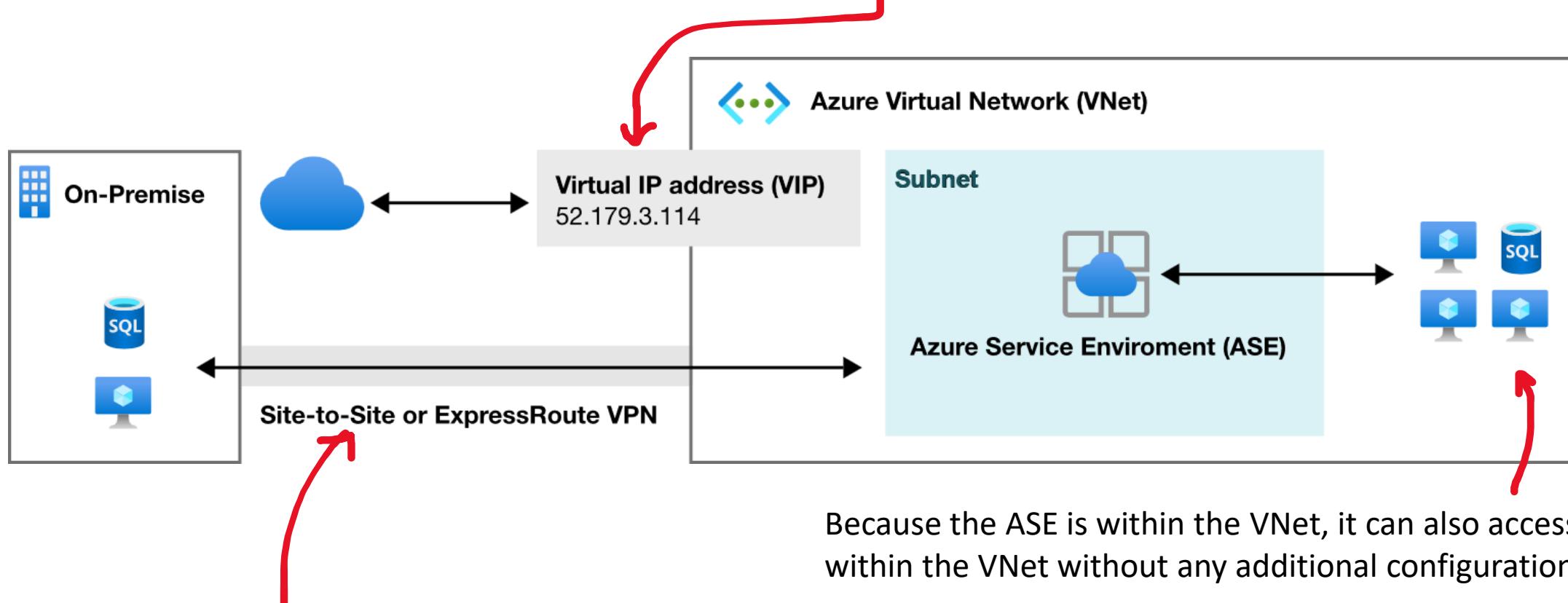
- ASE comes with its own pricing tier (Isolated Tier)
- ASEs can be used to configure security architecture
- Apps running on ASEs can have their access gated by upstream devices, such as web application firewalls (WAFs)
- App Service Environments can be deployed into Availability Zones (AZ) using zone pinning.

There are **2 deployment types** for an App Service environment (ASE):

1. External ASE
2. ILB ASE

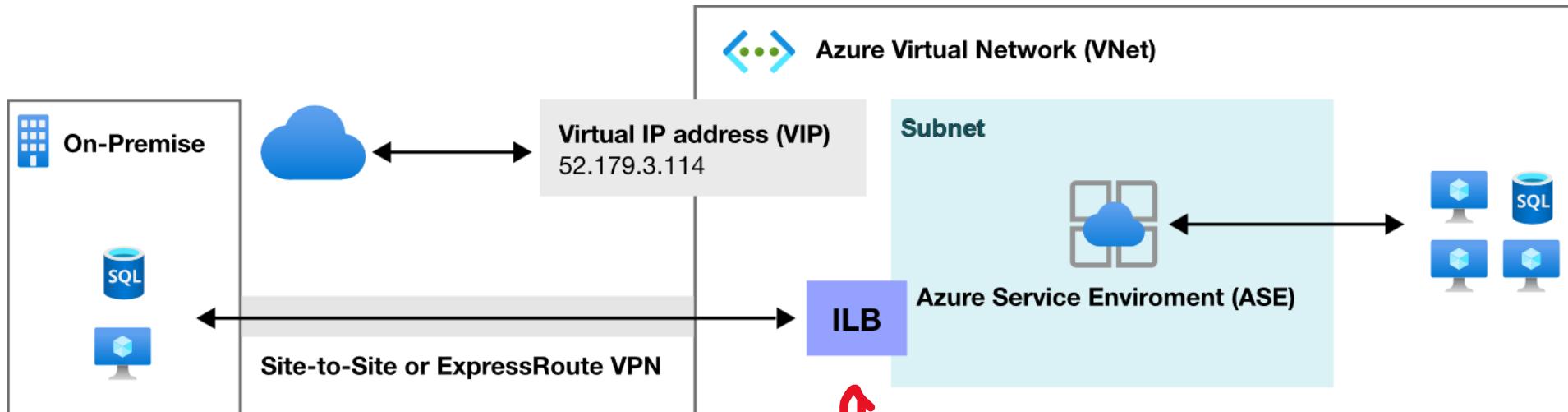
Azure App Service – App Service Environment

External ASE exposes the ASE-hosted apps on an **internet-accessible IP address**.



If the VNet is connected to your on-premises network, apps in your ASE also have access to resources there without additional configuration.

Azure App Service – App Service Environment



ILB ASE exposes the ASE-hosted apps on an IP address inside your VNet.
The internal endpoint is an **internal load balancer (ILB)**



Azure App Service Plan

Azure App Service Plan defines **how you pay and what resources are available** to you.
There are **3 pricing tiers** for App Service Plan:

Shared Tiers

There are **2 shared**: Free, Shared

Free Tier provides:

- 1 GB of disk space
- up to 10 apps on a single shared instance
- No SLA for availability
- Each app has a compute quota of 60 minutes per day

Shared Tier provides

- up to 100 apps on a single shared instance
- No SLA for availability
- Each app has a compute quota of 240 minutes per day

Shared Tiers does not support Linux-based instances



The first Basic (B1) core for Linux is free for the first 30 days!

Recommended pricing tiers

Tier	Memory	Compute	Cost
F1	1 GB memory	60 minutes/day compute	Free
B1	100 total ACU	1.75 GB memory A-Series compute equivalent	16.82 CAD/Month (Estimated)

See additional options

Included hardware

Every instance of your App Service plan will include the following hardware configuration:

Memory	Memory available to run applications deployed and running in the App Service plan.
Storage	1 GB disk storage shared by all apps deployed in the App Service plan.



Azure App Service Plan

Azure App Service Plan defines **how you pay and what resources are available** to you.
There are **3 pricing tiers** for App Service Plan:

Dedicated Tiers

Basic, Standard, Premium, PremiumV2, PremiumV3

Basic

- More disk space
- Unlimited apps
- 3 levels in this tier that offer varying amounts of compute power, memory, and disk storage

The screenshot shows the Azure App Service Plan configuration page. At the top, there are three tabs: 'Dev / Test' (for less demanding workloads), 'Production' (for most production workloads), and 'Isolated' (advanced networking and scale). A note says 'The first Basic (B1) core for Linux is free for the first 30 days!'. Below this, under 'Recommended pricing tiers', there are three boxes: F1 (orange), B1 (green, highlighted with a blue border), and B2 (green). A red arrow points from the 'Basic' section above to the B1 box. A link 'See only recommended options' is shown. Under 'Additional pricing tiers', there are two more boxes: B2 (green) and B3 (green). The 'Included features' section lists 'Custom domains / SSL' and 'Manual scale'. The 'Included hardware' section lists 'Azure Compute Units (ACU)', 'Memory', and 'Storage'. The ACU box includes a note about dedicated compute resources and a 'Learn more' link.

Tier	Compute Power	Memory	Storage	Cost
F1	1 GB memory 60 minutes/day compute	1.75 GB memory A-Series compute equivalent	100 total ACU 16.82 CAD/Month (Estimated)	Free
B1	100 total ACU 1.75 GB memory A-Series compute equivalent	100 total ACU 1.75 GB memory A-Series compute equivalent	100 total ACU 1.75 GB memory A-Series compute equivalent	16.82 CAD/Month (Estimated)
B2	200 total ACU 3.5 GB memory A-Series compute equivalent	200 total ACU 3.5 GB memory A-Series compute equivalent	200 total ACU 3.5 GB memory A-Series compute equivalent	32.70 CAD/Month (Estimated)
B3	400 total ACU 7 GB memory A-Series compute equivalent	400 total ACU 7 GB memory A-Series compute equivalent	400 total ACU 7 GB memory A-Series compute equivalent	65.41 CAD/Month (Estimated)

Included features
Every app hosted on this App Service plan will have access to these features:

- Custom domains / SSL
- Manual scale

Included hardware
Every instance of your App Service plan will include the following hardware configuration:

- Azure Compute Units (ACU)
- Memory
- Storage



Azure App Service Plan

Azure App Service Plan defines **how you pay and what resources are available** to you.
There are **3 pricing tiers** for App Service Plan:

Dedicated Tiers

Basic, Standard, Premium, PremiumV2, PremiumV3

Basic

- More disk space
- Unlimited apps
- 3 levels in this tier that offer varying amounts of compute power, memory, and disk storage

Standard

- scale out to three dedicated instances
- SLA of 99.95% availability
- 3 levels in this tier that offer varying amounts of compute power, memory, and disk storage



The screenshot shows the Azure App Service Plan configuration page. At the top, there are three main categories: Dev / Test (For less demanding workloads), Production (For most production workloads), and Isolated (Advanced networking and scale). A note states: "The first Basic (B1) core for Linux is free for the first 30 days!"

Recommended pricing tiers:

Tier	Total ACU	Memory	Compute Equivalent	Price (CAD/Month)
P1V2	210	3.5 GB	Dv2-Series	103.72 (Estimated)
P2V2	420	7 GB	Dv2-Series	206.50 (Estimated)
P3V2	840	14 GB	Dv2-Series	413.00 (Estimated)
P1V3	195	8 GB	vCPU	158.85 (Estimated)
P2V3	195	16 GB	vCPU	317.70 (Estimated)
P3V3	195	32 GB	vCPU	635.39 (Estimated)

[See only recommended options](#)

Additional pricing tiers:

Tier	Total ACU	Memory	Compute Equivalent	Price (CAD/Month)
S1	100	1.75 GB	A-Series	88.77 (Estimated)
S2	200	3.5 GB	A-Series	177.54 (Estimated)
S3	400	7 GB	A-Series	355.07 (Estimated)

Included features: Every app hosted on this App Service plan will have access to these features:

- Custom domains / SSL
- Auto scale
- Staging slots
- Daily backups
- Traffic manager

Included hardware: Every instance of your App Service plan will include the following hardware configuration:

- Azure Compute Units (ACU)
- Memory
- Storage



Azure App Service Plan

Azure App Service Plan defines **how you pay and what resources are available** to you.
There are **3 pricing tiers** for App Service Plan:

Dedicated Tiers

Basic, Standard, Premium, PremiumV2, PremiumV3

Basic

- More disk space
- Unlimited apps
- 3 levels in this tier that offer varying amounts of compute power, memory, and disk storage

Standard

- scale out to three dedicated instances
- SLA of 99.95% availability
- 3 levels in this tier that offer varying amounts of compute power, memory, and disk storage

Premium

- scale to 10 dedicated instances
- availability SLA of 99.95%
- multiple levels of hardware



Dev / Test	Production	Isolated
<p>The first Basic (B1) core for Linux is free for the first 30 days!</p>		
Recommended pricing tiers		
P1V2 210 total ACU 3.5 GB memory Dv2-Series compute equivalent 103.72 CAD/Month (Estimated)	P2V2 420 total ACU 7 GB memory Dv2-Series compute equivalent 206.50 CAD/Month (Estimated)	P3V2 840 total ACU 14 GB memory Dv2-Series compute equivalent 413.00 CAD/Month (Estimated)
P1V3 195 minimum ACU/vCPU 8 GB memory 2 vCPU 158.85 CAD/Month (Estimated)	P2V3 195 minimum ACU/vCPU 16 GB memory 4 vCPU 317.70 CAD/Month (Estimated)	P3V3 195 minimum ACU/vCPU 32 GB memory 8 vCPU 635.39 CAD/Month (Estimated)
<p>See only recommended options</p>		
Additional pricing tiers		
S1 100 total ACU 1.75 GB memory A-Series compute equivalent 88.77 CAD/Month (Estimated)	S2 200 total ACU 3.5 GB memory A-Series compute equivalent 177.54 CAD/Month (Estimated)	S3 400 total ACU 7 GB memory A-Series compute equivalent 355.07 CAD/Month (Estimated)
Included features Every app hosted on this App Service plan will have access to these features:		
Custom domains / SSL Configure and purchase custom domains with SNI and IP SSL bindings	Azure Compute Units (ACU) Dedicated compute resources used to run applications deployed in the App Service Plan. Learn more	
Auto scale Up to 20 instances. Subject to availability.	Memory Memory per instance available to run applications deployed and running in the App Service plan.	
Staging slots Up to 20 staging slots to use for testing and deployments before swapping them into production.	Storage 250 GB disk storage shared by all apps deployed in the App Service plan.	
Daily backups Backup your app 50 times daily.		
Traffic manager Improve performance and availability by routing traffic between multiple instances of your app.		



Azure App Service Plan

Azure App Service Plan defines **how you pay and what resources are available** to you.
There are **3 pricing tiers** for App Service Plan:

Isolated Tier

- dedicated Azure virtual network
- Full network and compute isolation
- scale out to 100 instances
- availability SLA of 99.95%

tier	ACU	Memory	Compute Equivalent	Price (CAD/Month)
I1	210	3.5 GB	Dv2-Series	355.07 (Estimated)
I2	420	7 GB	Dv2-Series	710.14 (Estimated)
I3	840	14 GB	Dv2-Series	1420.29 (Estimated)

Recommended pricing tiers

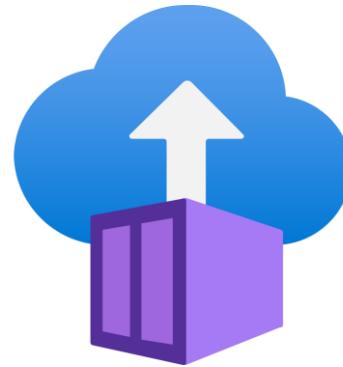
Included features
Every app hosted on this App Service plan will have access to these features:

- Single tenant system
- Isolated network
- Private app access
- Scale to a large number of instances
- Traffic manager

Included hardware
Every instance of your App Service plan will include the following hardware configuration:

- Azure Compute Units (ACU)
- Memory
- Storage

Azure Container Instances (ACI)



package, deploy, and manage cloud applications using **containers**
Fully Managed Docker as a Service



Introduction to ACI

Azure Container Instances (ACIs) allow you to **launch containers** without the need to worry about configuring or managing the underlying virtual machine

Azure Container Instances is designed for isolate containers:

- simple applications
- task automation
- build jobs

- Containers can be provisioned **within seconds** where VMs can take several minutes
- Containers are **billed per second** where VMs are billed per hour (greater savings)
- Containers have **granular and custom sizing of vCPUs, Memory and GPUs** where VMs sizes are predetermined
- ACI can deploy both **Windows** and **Linux** containers
- You can **persist storage with Azure Files** for your ACI containers
- ACIs are accessed via a fully qualified domain name (FQDN) eg *customlabel.azureregion.azurecontainer.io.*

Azure provides Quickstart images to start launching example applications but you can also **source** containers from:

- Azure Container Registry
- Docker Hub
- Privately Hosted Container Registry

Image source * ⓘ

Quickstart images

Azure Container Registry

Docker Hub or other registry





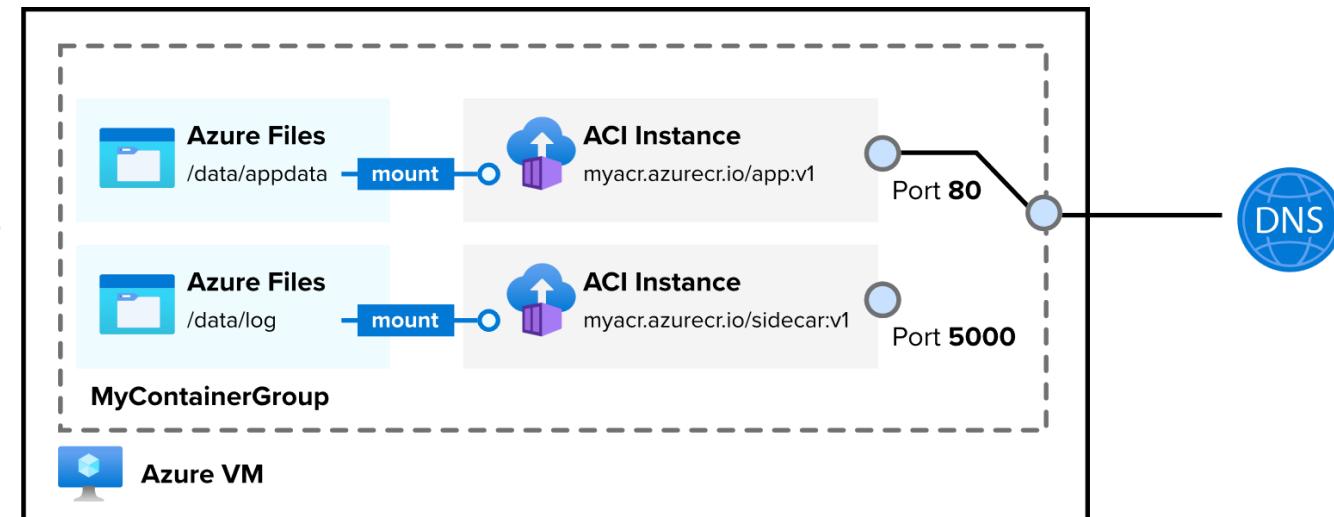
Introduction to ACI

Container Groups are collection of containers that get scheduled on the same host machine.

The containers in a container group share:

- lifecycle
- Resources
- local network
- storage volumes

Container Groups are similar to a Kubernetes pod



*Multi-container groups **currently support only** Linux containers.*

There are two ways to deploy a multi-container group:

- **Resource Manager Template (ARM template)** — when you need to deploy additional Azure service resources
- **YAML File** — when your deployment includes only container instances.



Container Restart Policies

A **container restart policy** specifies what a container should do when their process has completed. Azure Container Instances has 3 restart-policy options:

- **Always** (default) Containers are **always restarted**. Suited for long running tasks eg. **web-servers**
- **Never** Containers **run one time only**. Suited for one off tasks. eg. **background jobs**
- **OnFailure** Containers that encounter an error

The screenshot shows the 'Advanced' tab of the Azure Container Instances configuration interface. The 'Restart policy' dropdown is set to 'On failure'. A red arrow points from the 'OnFailure' option in the list below to the dropdown field.

Restart policy
On failure
Always
Never



Container Environment Variables

Environment variables (Env Vars) allow you to pass configuration details to your containers.

Environment variables can be set via the **Azure Portal**, CLI or PowerShell

Environment variables		
Key	Value	
STRIPE_SECRET_KEY	pk_test_Y3n003t2BPOHD6JHNB7L1eE	
ENV	production	
fruit		

Secured Environment Variables

By default Environment Variables are stored in plaintext.

If you need to secure your environment variables you can use the **--secure-environment-variables** flag

```
az container create \
--resource-group aci-resource-group \
--name aci-demo-secure \
--image exampro/rails:backend \
--ip-address Public \
--location eastus \
--secure-environment-variables \
STRIPE_SECRET_KEY=$STRIPE_SECRET_KEY
```



Container Persistent Storage

Azure Containers are **stateless** by default.

When a container crashes or stops all state is lost.

To persist state you need to **mount** an external volume

You can mount **the following external volumes**:

- Azure Files (file share)
- Secret volume
- Empty Directory
- Cloud git repo

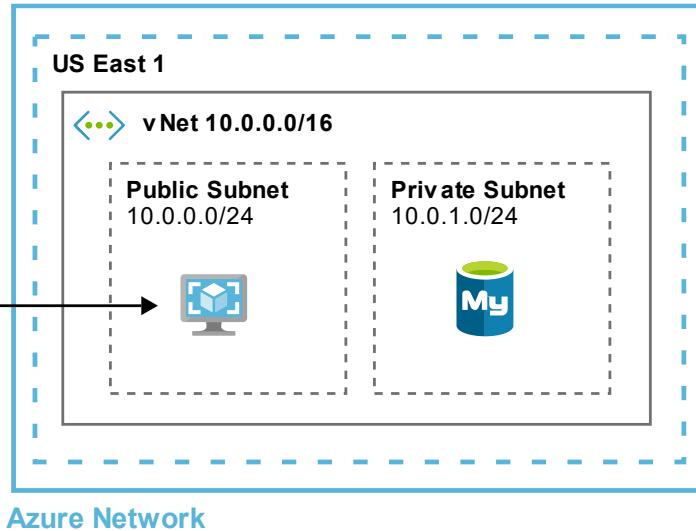
To mount a file volume you need do this via PowerShell or CLI and specify the **details** to mount the drive

```
az container create \
--resource-group exampro-resource-group \
--name my-app \
--image exampro/web-app \
--location eastus \
--ports 80 \
--ip-address Public \
--azure-file-volume-account-name $STORAGE_ACCOUNT_NAME \
--azure-file-volume-account-key $STORAGE_KEY \
--azure-file-volume-share-name my-fileshare \
--azure-file-volume-mount-path /aci/logs/
```



Azure Virtual Network (VNet)

Virtual Network (vNet) is a logically isolated section of the Azure Network where you launch your Azure resources.



Azure DNS — manage your own DNS domain

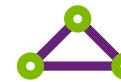


Virtual Network (vNET) — logically isolated section of Azure network

- Address spaces
- Route Tables
- Subnets



Network Security Groups A virtual firewall at the subnet or NIC level



ExpressRoute A 50 Mbps-10 Gbps connection between on-premise to VNET



Virtual WAN a centralized network to route different network connections



Virtual Network Gateway - A site-to-site VPN connection between an VNet and local networks

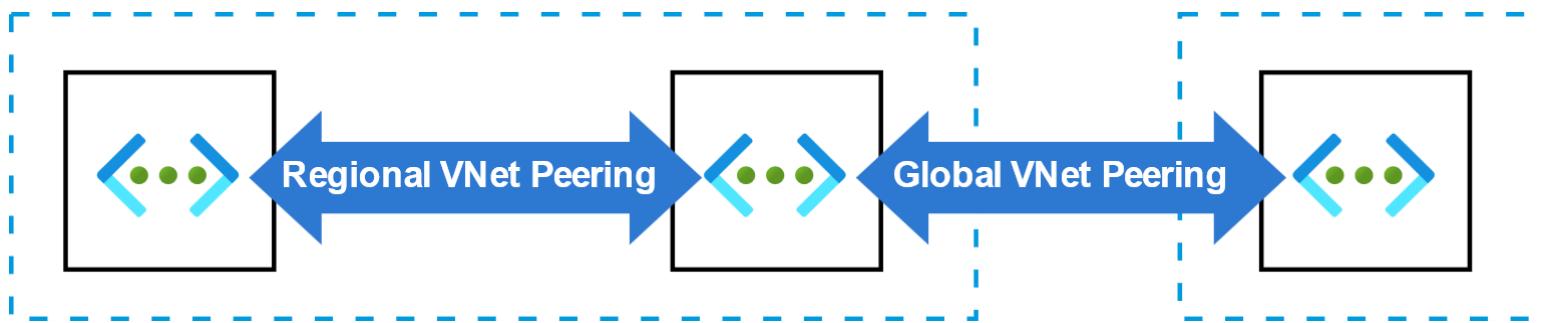


Network Interfaces virtual network device to allow your VMs to communicate using IP protocols



VNet Peering

VNET peering is when you connect multiple VNet so they act as one network.



There are 2 types of VNet Peering:

- 1. Regional VNet Peering** When you peer two VNets from the same region
- 2. Global VNet peering** When you peer two VNets from two different regions



Network Interfaces

What is a Network Interface?

Software or hardware interface between two pieces of equipment or protocol layers in a computer network.

A Network Interface Controller (NIC)

A **computer hardware component** that connects a computer to a computer network.

Also known as:

- network interface card
- network adapter
- LAN adapter
- physical network interface

NICs communicate using **Internet Protocol (IP)**

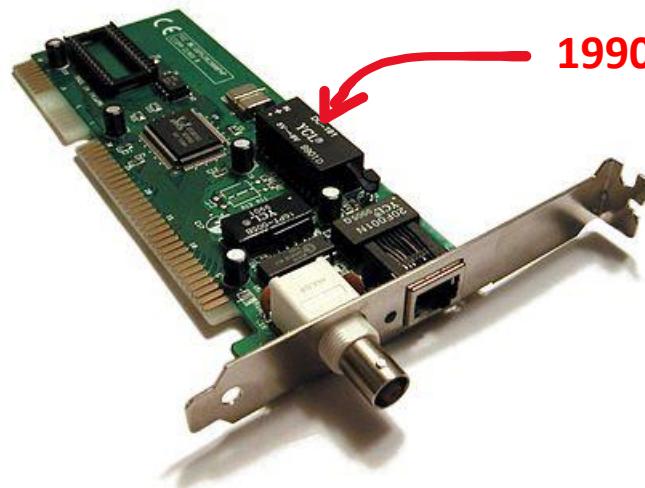


Azure Network Interfaces (NICs)

Azure Network Interfaces are attached to Azure VM instance.

Without an NIC, An Azure VM instance would have no way to communicate.

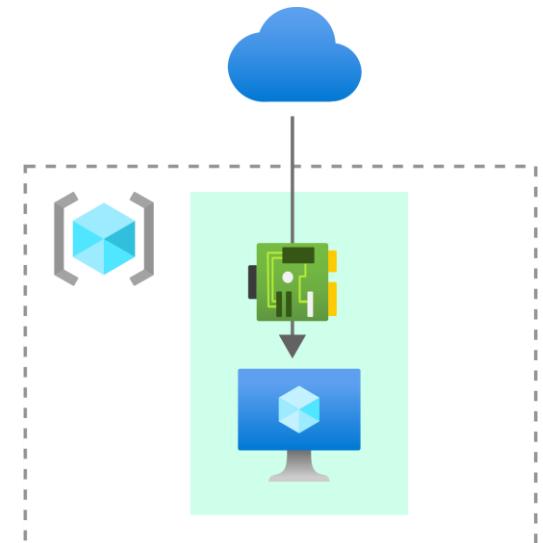
An Azure VM instance has to have an NIC and can have multiple NICs.



1990s Ethernet Interface Controller card

NICs are devices for both the:

- Data Link Layer (Layer 2)
- Physical Layer (Layer 1)





VNeT – Subnets

What is a Subnet?

A subnet is **a logical division of an address space**. Subnets help you **define different kinds of workloads** and allows you to apply virtual isolation within your network. When you launch an Azure resource you choose the subnet you want to launch within and an IP from that subnet is assigned to your resource

Associating a Route Table

A subnet needs a Route Table so it can access

Public vs Private Subnet

Public and Private subnet describes whether a subnet is reachable from the internet or not.

Azure **has no concept of private and public subnets** and its up to you to configure our subnets to have ensure they do no reach the internet by ensuring they have no route via the their route table to the Internet Gateway

Associating Network Security Gateways (NSG)

You can associate an NSG to protect traffic entering and leaving your subnet by applying security rules that can Allow or deny access based on IP address, port and protocol.

Gateway Subnet

Azure has a special type of Gateway Subnet that is used by **Azure Virtual Network Gateway** and that service Launches specialized VMs into that subnet.

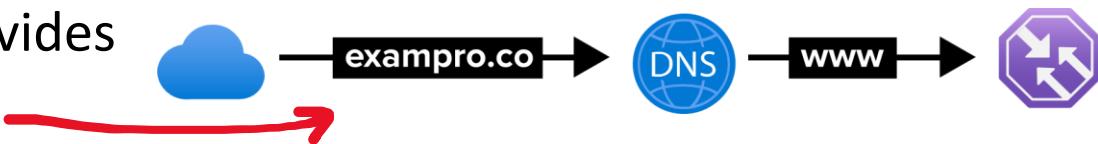


Azure DNS

What is a Domain Name System (DNS)?

It is a service that is responsible for **translating (or resolving) a service name** to its IP address.

Azure DNS is a **hosting service** for **DNS domains** that provides name resolution by using Microsoft Azure infrastructure



Public DNS Internet-facing

- Allows you to manage domains for internet accessible domains
 - Pointing your domain to your website
 - Setting records to prove you own the domain
 - Records to connect your domain to your email server

Private DNS Internal-facing

- Allow you to use your own custom domains instead of the Azure provided domains
 - Many Azure Services use fully qualified domain name (FQDN) to identify services on the network.
 - eg. Azure Storage Accounts FQDN: <http://storageaccount.file.core.windows.net/>

You **can't use** Azure DNS **to buy a domain** name.

You can purchase a domain in App Services or a third-party provider and have Azure DNS manage



Virtual Network Gateways

What is a (Virtual Private Network) VPN?

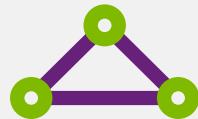
A VPN **extends a private network across a public network** and enables users **to send and receive data across shared or public networks** as if their computing devices were directly connected to the private network.

What is a Virtual Network Gateway?

- A **virtual network gateway** is the software **VPN** device for your Azure virtual network.
- When you deploy a virtual network gateway it will deploy two or specialized VMs in specific subnet you need to create called a “gateway subnet”
- These deployed VMs contain routing tables and run specific gateway services.
- You will choose a **Gateway Type** and that will determine if it's a VPN Gateway or an ExpressRoute Gateway

Gateway type * (i)

VPN ExpressRoute



Azure ExpressRoute

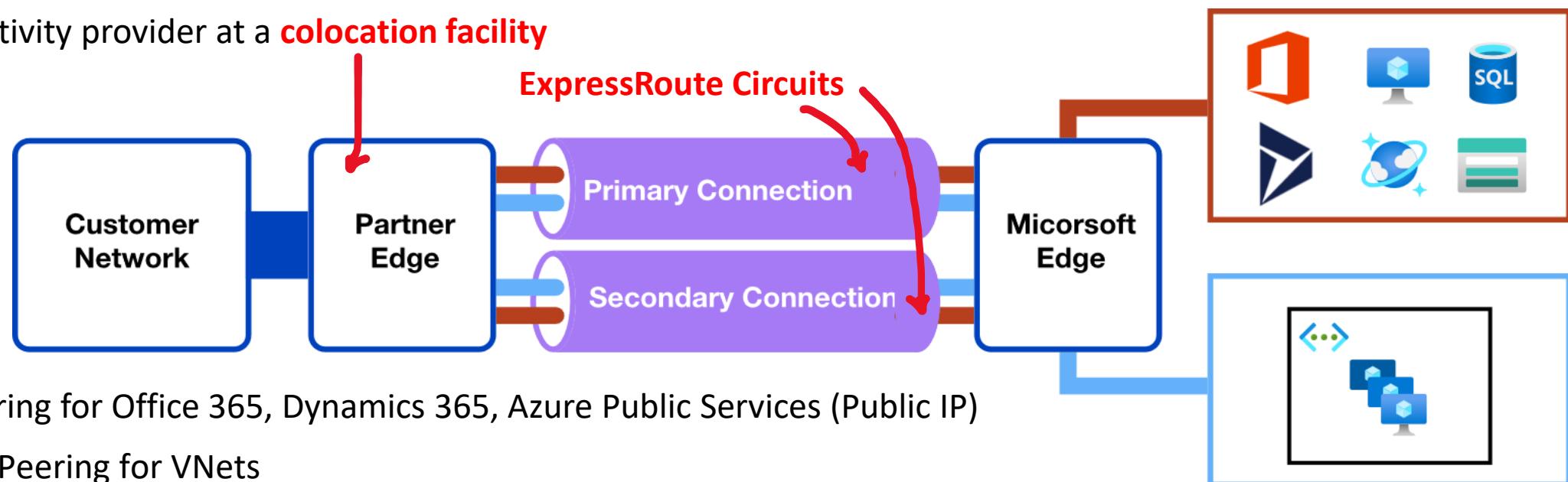
Azure ExpressRoutes creates **private connections** between Azure datacenters and infrastructure on your premises or in a colocation environment

Connectivity options include:

- any-to-any (IP VPN) networks
- point-to-point Ethernet networks
- virtual cross-connection

through a connectivity provider at a **colocation facility**

ExpressRoute connections don't traverse the public Internet, ensuring **enhanced reliability, faster speeds, consistent latencies, and heightened security** compared to traditional internet connections.



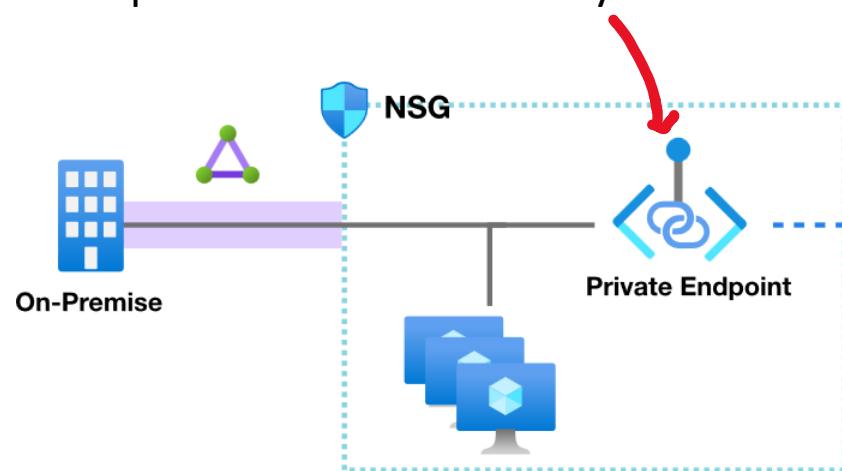
ExpressRoute Direct allows for **greater bandwidth connections** from 50 Mbps to 10 Gbps. Ideal where for hybrid solutions with massive amounts of data or where latency matters.



Private Links

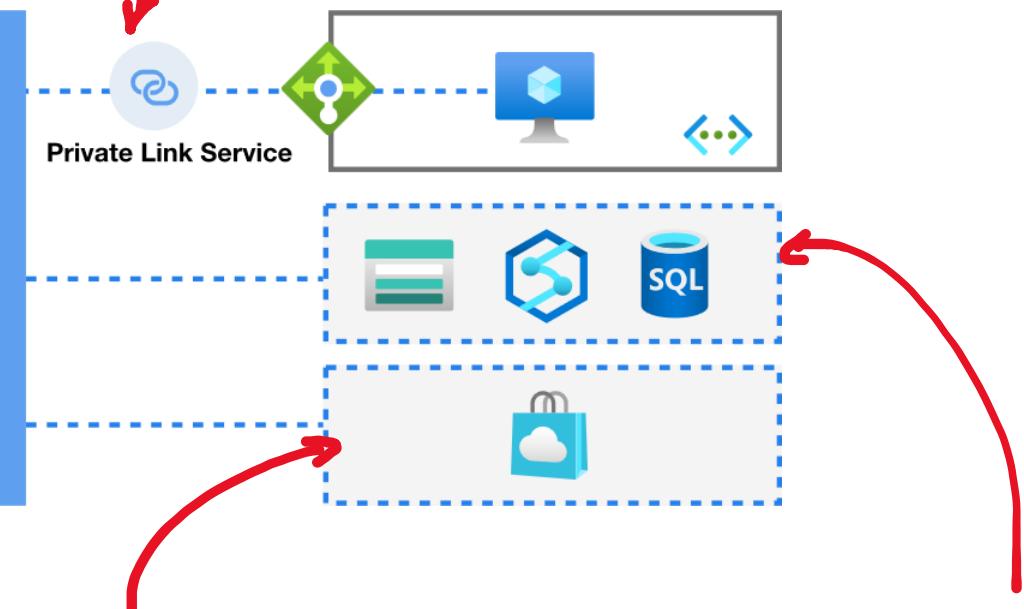
Azure Private Links allows you to **establish secure connections** between Azure resources so traffic **remains within the Azure Network**

Private Link Endpoint is an **Network Interface** that connects you privately and securely to a service powered by Azure Private Link. Private Endpoint uses a private IP address from your VNet



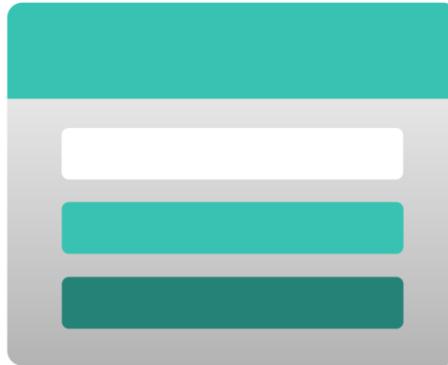
Third-Party providers can be powered by Private Link

Private Link Service allows you to connect your own workload to Private Link. You need an **Azure Standard Internal Load Balancer** and associate it with the Link Service



Many Azure services by default work with Private Link eg. Azure Storage, CosmosDB, SQL

Azure Storage Accounts



Contains all of your Azure Storage data objects:
blobs, files, queues, tables, and disks



Introduction to Storage Accounts

Azure Storage offers **several types of storage** accounts.

Each with **different features** and **their own pricing models**

- General-purpose v1 (legacy)
- General-purpose v2
- BlobStorage (legacy)
- BlockBlobStorage
- FileStorage

Storage accounts vary with the following features:

Supported Services (What can I put in this storage account?)

Blob, File, Queue, Table, **Disk**, and Data Lake Gen2

Performance Tiers (how fast will my read and writes be?)

Standard and Premium

Access Tiers (how often do I need quick access to files?)

Hot, Cool, Archive

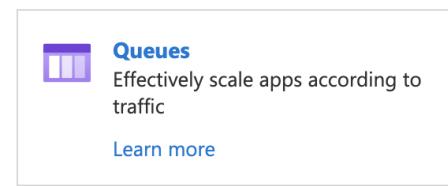
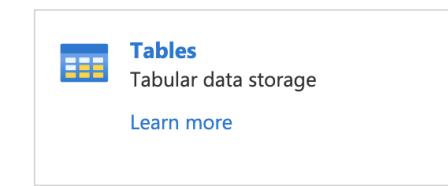
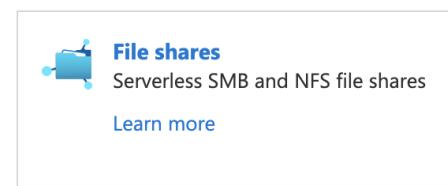
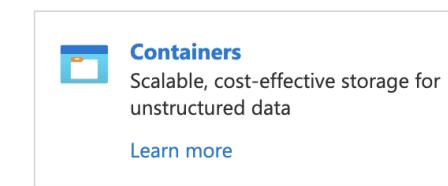
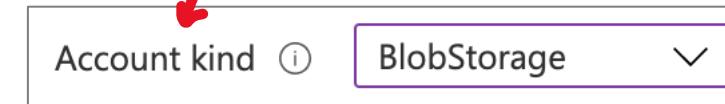
Replication (How many redundant copies should be made and where?)

LRS, GRS, RA-GRS, ZRS, GZRS, RA-GZRS

Deployment model (Who should deploy the supported services?)

Resource Manager, Classic

Storage type and **Account Kind** means the same thing





Introduction to Storage Accounts

Type	Service	Performance Tiers	Access Tiers	Replication	Deployment Models
General-purpose V2	Blob, File, Queue, Table, Disk, Data Lake Gen 2	Standard, Premium	Hot, Cool, Archive	LRS, GRS, RA-GRS, ZRS, GZRS, RA-GZRS	Resource Manager
General-purpose V1	Blob, File, Queue, Table, Disk	Standard, Premium	N/A	LRS, GRS, RA-GRS	Resource Manager Classic
BlockBlobStorage	Blob (block, append)	Premium	N/A	LRS, ZRS	Resource Manager
FileStorage	File	Premium	N/A	LRS, ZRS	Resource Manager
BlobStorage	Blob (Block, append)	Standard	Hot, Cool, Archive	LRS, GRS, RA-GRS	Resource Manager



Core Storage Services

Azure has **5 core storage** services

blob

Services

Storage accounts



Azure Blob

A massively scalable **object store** for text and binary data.
Also includes support for big data analytics through Data Lake Storage Gen2



Azure Files

Managed **file shares** for cloud or on-premises deployments



Azure Queues

A **messaging store** for reliable messaging between application components



Azure Tables

A **NoSQL store** for schemaless storage of structured data.

disk

Services

Disks

Disk Accesses

Disks (classic)



Azure Disks

Block-level storage volumes for Azure VMs



Performance Tiers (Blob Storage)

There are **2 types** of performance tiers for storage accounts: Standard and Premium



Performance ⓘ Standard Premium

IOPS stands for Input/Output Operations Per Second

The higher the IOPS the faster a drive can read and write

Premium Performance

- Stored on Solid State Drives (**SSDs**)
- Optimize for low-latency
- Higher throughput
- Use cases:
 - Interactive workloads
 - Analytics
 - AI or ML
 - Data transformation



An SSD **has no moving parts** and data is distributed randomly. This is why it can read and write so fast.

Standard Performance

- Stored on Hard Disk Drives (**HDDs**)
- Varied performance based on access tier (Hot, Cool, Archive)

Use cases:

- Backup and disaster recovery
- Media content
- Bulk data processing

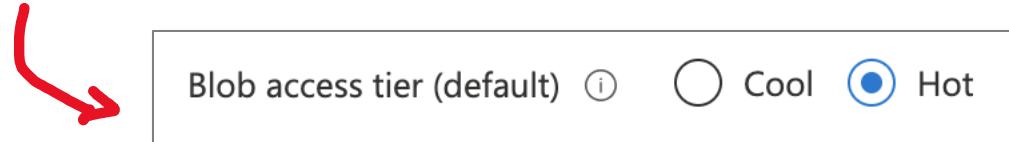


An HDD **has moving parts**, an arm that needs to read and write data sequential to a disk. It is very good at writing or reading large amounts of data that is close together



Access Tiers (Blob Storage)

There are **3 types** of access tiers for **Standard storage**: Cool, Hot and Archive



Hot

- Data that's accessed frequently.
- Highest storage cost, lowest access cost

Use Case

- Data that's in active use or expected to be accessed frequently.
- Data that's staged for processing and eventual migration to the cool access tier

Cool

- Data that's infrequently accessed and stored for at least 30 days.
- Lower storage cost, higher access cost

Use Case

- Short-term backup and disaster recovery datasets
- Older media content not viewed frequently anymore but is expected to be available immediately when accessed
- Large data sets that need to be stored cost effectively while more data is being gathered for future processing.

Archive

- Data that's rarely accessed and stored for at least 180 days
- Lowest storage cost, highest access cost

Use Case

- Long-term backup, secondary backup, and archival datasets
- Original (raw) data that must be preserved, even after it has been processed into final usable form.
- Compliance and archival data that needs to be stored for a long time and is hardly ever accessed.



Access Tiers (Blob Storage)

Account Level Tiering

Any blob that doesn't have an explicitly assigned tier infers the tier from the Storage Account access tier setting.

Blob-Level Tiering

You can upload a blob to the tier of your choice.

Changing tiers happens instantly with the exception from moving out of archive

Rehydrating a Blob

When moving a blob out of archive into another tier it can take several hours. This is known as “[rehydrating](#)”

Blob Lifecycle Management

You can create role-based policies to transition data to different tiers

Eg. After 30 days move to cool storage

The diagram shows a screenshot of a Microsoft Azure Blob Lifecycle Management policy configuration interface. A red curved arrow points from the explanatory text above to the 'Move to cool storage' option in the 'Then' section of the policy rule.

More than (days ago) *
30

Then

- Move to cool storage**
- Move to cool storage**
This is the most reliable option if cost is not a concern.
- Move to archive storage**
Archive storage does not fully delete the blob.
- Delete the blob**
This is the most efficient option if backing up is not a concern.



Access Tiers (Blob Storage)

When a blob is uploaded or moved to another tier
It's charged at the new tier's rate **immediately** upon tier change.



When moving from a **cooler tier**:

The operation is billed as a **write operation** to the destination tier.

Where the write operation (per 10,000) and data write (per GB) charges of the destination tier apply.



When moving from a **hotter tier**

The operation is billed as a read from the source tier

Where the **read operation** (per 10,000) and data retrieval (per GB) charges of the source tier apply

Early deletion charges for any blob moved out of the cool or archive tier may apply as well

Cool and archive early deletion

Any blob that is moved into the cool tier (GPv2 accounts only) is subject to a cool early deletion period of 30 days.

Any blob that is moved into the archive tier is subject to an archive early deletion period of 180 days. This charge is prorated.



Replication and Data Redundancy

When you create a Storage Account you need to choose a **Replication Type**

Replication ⓘ

Geo-redundant storage (GRS) ▾

The greater level of redundancy the more expensive the cost of replication



Replication stores multiple copies of your data so that it is **protected from:**

- planned events
- transient hardware failures
- network or power outages
- massive natural disasters

Primary Region Redundancy

- Locally Redundant Storage (LRS)
- Zone-redundant storage (ZRS)

Disaster Recovery and Failovers

Secondary Region Redundancy

- Geo redundant storage (GRS)
- Geo-zone-redundant storage (GZRS)

Disaster Recovery and Failovers

Secondary Region Redundancy with Read Access

- Read-access geo-redundant storage (RA- GRS)
- Read-access geo-redundant storage (RA-GZRS)

Read Replicas



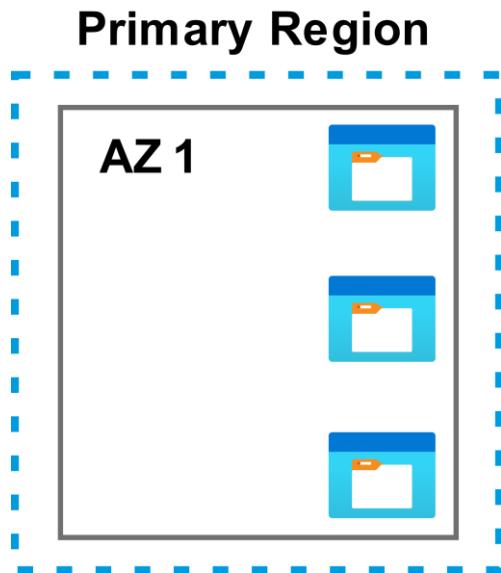
Replication and Data Redundancy

Redundancy in the Primary Region

- Data is replicated **3 times** in the primary region
- There are **two options** for storing in the primary region

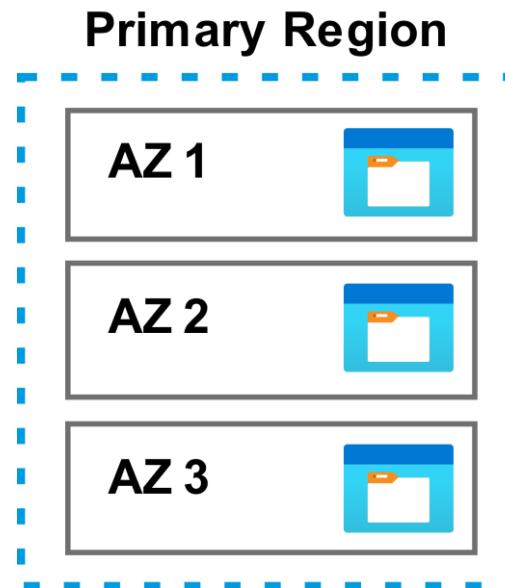
Locally Redundant Storage (LRS)

- Copies data **synchronously** in primary region
- 99.99999999% (11 nines) durability
- **Cheapest option**



Zone-redundant storage (ZRS)

- Copies data **synchronously across 3 AZs** in primary region
- 99.999999999% (12 9's) durability





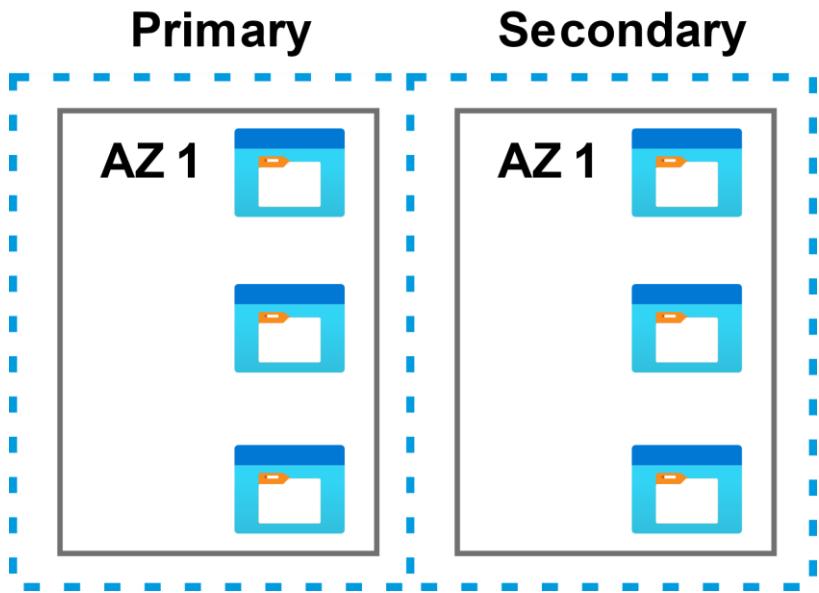
Replication and Data Redundancy

Redundancy in the Secondary Region

- Replicate to a secondary region in case of primary regional disaster
- The secondary region is determined based on your primary's pair region
- Secondary region isn't available for read or write access (except in event of failover)

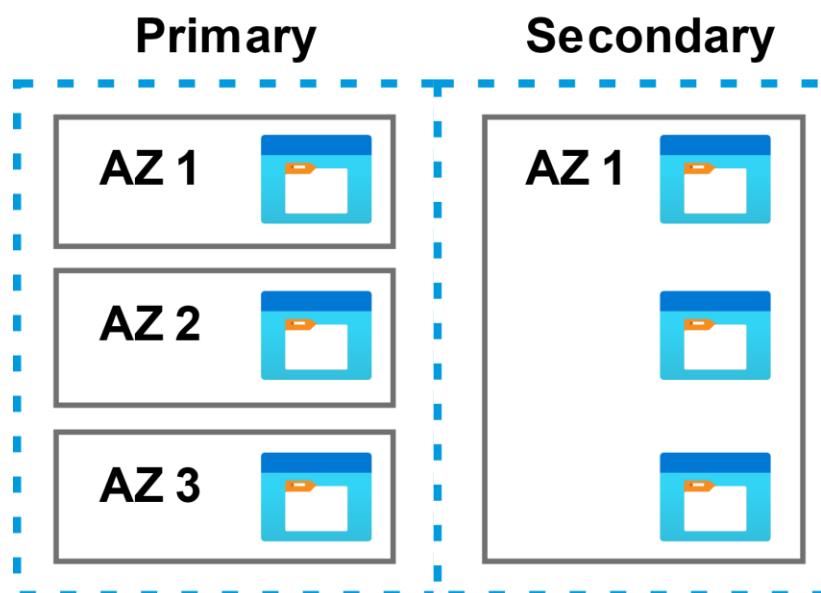
Geo Redundant Storage (GRS)

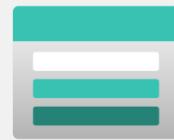
- Copies data **synchronously** in primary region
- Copies data **asynchronously** to another region
- 99.999999999999% (16 9's) of durability



Geo-Zone-redundant storage (GZRS)

- Copies data **synchronously** across 3 AZs in a physical region
- Copies data **asynchronously** to another region
- 99.999999999999% (16 9's) of durability





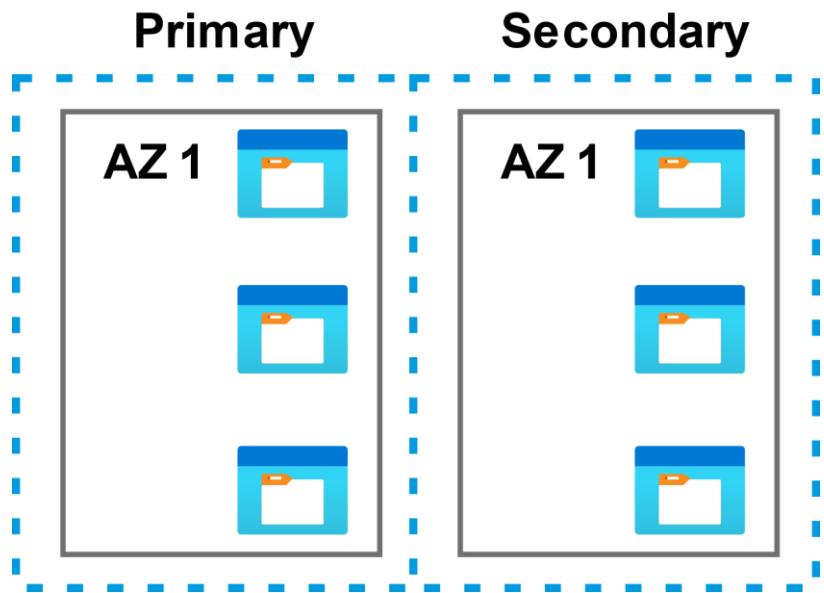
Replication and Data Redundancy

Redundancy in the Secondary Region with Read Access

- Data is replicated **synchronously** to primary region
- Your data will be “in-sync” with your primary and you’ll have **read access**.

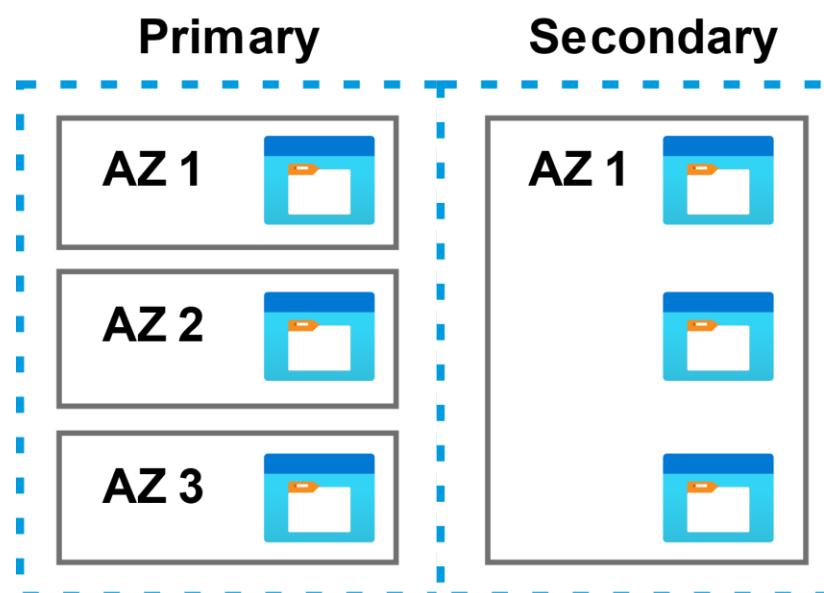
Read-Access Geo Redundant Storage (RA-GRS)

- Copies data **synchronously** in primary region
- Copies data **synchronously** to another region
- 99.999999999999% (16 9's) of durability



Read-Access Geo-Zone-redundant storage (RA-GZRS)

- Copies data **synchronously** across 3 AZs in a physical region
- Copies data **synchronously** to another region
- 99.999999999999% (16 9's) of durability



AZCopy

AZCopy is a **command-line utility** that you can use to copy blobs or files to or from a storage account.

1. Its an **executable** file you download

Download AzCopy

First, download the AzCopy V10 executable file, so there's nothing to install.

- Windows 64-bit (zip)
- Windows 32-bit (zip)
- Linux x86-64 (tar)
- macOS (zip)

2. You will need to have the level of authorization via attached roles:

To download

- Storage Blob Data Reader

To upload:

- Storage Blob Data Contributor
- Storage Blob Data Owner

3. You gain access either via:

1. Azure Active Directory (AD)
2. Shared Access Signature (SAS)

```
~: azcopy login  
To sign in, use a web browser to open the page https://microsoft.com/devicelogin and enter the code E9B7JJK6P to authenticate.
```



Enter code

Enter the code displayed on your app or device.

E9B7JJK6P

Next

4. Use the Copy command to **upload** and **download**

```
azcopy copy \  
'C:\StarTrek\jodri.txt' \  
'https://enterprise.blob.core.windows.net/mycontainer/jodri.txt'
```

```
azcopy copy \  
'https://enterprise.blob.core.windows.net/mycontainer/jodri.txt' \  
'C:\StarTrek\jodri.txt'
```



Azure Storage Explorer

A **standalone app** that makes it easy to work with Azure Storage data on Windows, macOS, and Linux.

You can create Blob containers, upload files, create snapshots of Disk, and more!

The screenshot shows the Microsoft Azure Storage Explorer application window. On the left is the Explorer sidebar with icons for Local & Attached, Storage Accounts, Cosmos DB Accounts (Deprecated), Data Lake Storage Gen1 (Preview), and Azure subscription 1 (andrew@example.com). Under Storage Accounts, there is a folder named 'exampro32klidssfdslk' containing a 'myfiles' blob container. The main pane displays a table of blobs in the 'myfiles' container, with one item selected: 'choose-carefully.png'. The table columns include Name, Access Tier, Access Tier Last Modified, Last Modified, Blob Type, Content Type, Size, Status, Remaining Days, and Deleted Time. A red arrow points from the text 'You can create Blob containers, upload files, create snapshots of Disk, and more!' to the 'myfiles' blob container in the Explorer sidebar.

Name	Access Tier	Access Tier Last Modified	Last Modified	Blob Type	Content Type	Size	Status	Remaining Days	Deleted Time
choose-carefully.png	Hot (inferred)		11/7/2020, 9:47:07 PM	Block Blob	image/png	415.6 KB	Active		

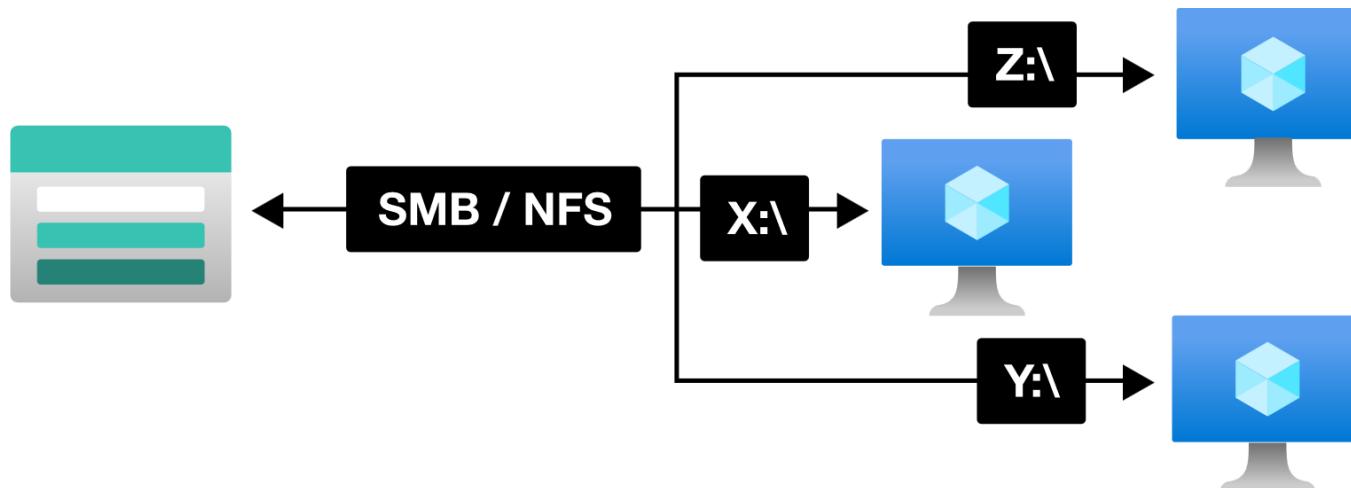


Azure Files

Azure Files is a fully managed **file share** in the cloud.

A file share is a **centralized server for storage** that allows **multiple connections**.

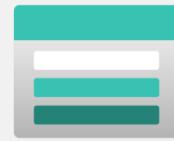
It like having one big shared drive that everyone (Virtual Machines) can work on at the same time.



To connect to the file share a **network protocol** is used:

- Server Message Block (SMB)
- Network File System (NFS)

When a connection is established the file share's filesystem will be accessible in the specific directory within your own directory tree. This is known as **mounting**



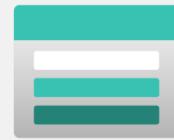
Azure Files – Use Cases

Use Cases

- Completely **replace or supplement** on-premises file servers Network Attach Storage (NAS) devices
- **Lift-and-Shift** your on-premise storage to the cloud via Classic Lift or Hybrid Lift
 - “Lift-and-Shift” means when you move workloads without rearchitecting, eg. importing local VMs to the cloud
 - Classic Lift — where both the application and its data are moved to Azure
 - Hybrid Lift — where the application data is moved to Azure Files, and the application continues to run on-premises
- **Simplify cloud development**
 - Shared application settings — Multiple VMs and developer workstations need to access the same config files.
 - Diagnostic share — All VMs log to the file share, developers can mount and debug all logs in a centralized place
 - Dev/Test/Debug — Quickly share tools for developer needed for local environments
- **Containerization**
 - You can use Azure Files to persist volumes for stateful containers

Why use Azure files instead of setting up your own File Share server?

- **Shared Access** — Already setup to work with standard networking protocols SMB and NFS
- **Fully managed** — Its kept up to date with security patches, designed to scale
- **Scripting and Tooling** — You can automate the management and creation of file shared with Azure API and PowerShell
- **Resiliency** — Built to be durable and always working



Azure Files

Backups

You can backup your file share with **shared snapshots**

- They are read-only
- Incremental (they only contain as much data as has changed since the previous snapshot)
- You can have up to **200 snapshots** per file share
- You can retain backups for **up to 10 years**
- Backups are stored within your file share (if you delete your file share you will delete your backups)

Soft Delete

You can prevent accidental deletion by turning on Soft Delete (Storage will be marked for deletion and retained for a period of time before final delete occurs)

Advanced Threat Protection (ATP)

An additional layer of security intelligence that provides alerts when it detects anomalous activity on your storage account

Store Tiers:

- **Premium** — Store on SSD with single-digit milliseconds for most IO operation
- **Transaction optimized** — Store on HDD with transaction heavy workloads that don't need the latency offered by premium file shares (historically this tier has been called **standard**)
- **Hot** — optimized for general purpose file sharing scenarios such as **team shares** and **Azure File Sync**.
- **Cool** — Stored on HDD for cost-efficient storage optimized for online archive storage scenario



Azure Files

Types of Storage

- **General purpose version 2 (GPv2)** — deployed on to HDD
- **FileStorage** — deployed onto SSD

Identity

- **On-Premise:** — Azure Storage can be joined to an on-premise Active Directory Domain Service
- **Managed** — Azure Storage can be joined to Microsoft managed Active Directory Domain Service
- **Store Account Key** — A username (storage account name) and password (account key) can be used to mount

Networking

- Azure Files are accessible inside or outside your AWS Account from anywhere via storage account **public endpoint**.
- SMB connects to **port 445**, your organization may need to unblock this port so you can mount your file share

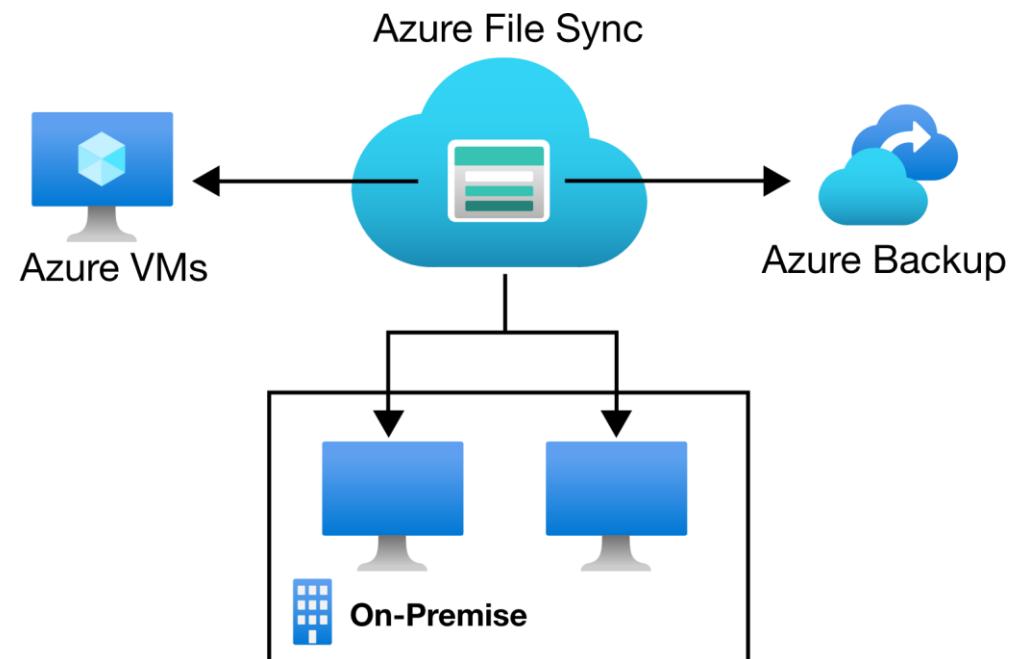
Encryption

- Azure Files is **encrypted-at-rest** using Azure Storage Service Encryption (SSE)
- Azure Files is **encrypted-in-transit** with SMB 3.0+ with encryption or HTTPS



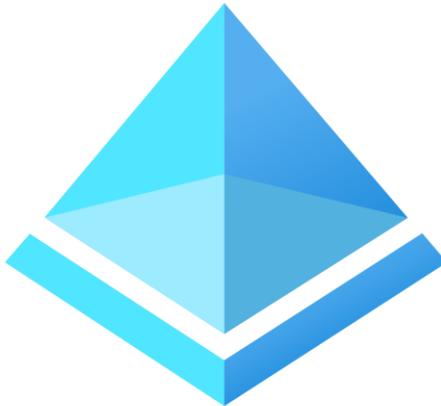
Azure File Sync

Azure File Sync is a service that allows you to **cache** Azure file shares on an **on-premises Windows Server** or **cloud VM**.



- You can use any protocol that's available on Windows Server to access your data locally, including SMB, NFS, and FTPS
- You can have as many caches as you need across the world.

Azure Active Directory (AD)



cloud-based **identity and access management** service
Manage users, Sign-Ins and access to AD-related resources



Introduction to Azure AD

Azure Active Directory (Azure AD) is Microsoft's cloud-based **identity and access management service**, which helps your employees sign in and access resources

External Resources

- Microsoft Office 365
- Azure Portal
- SaaS applications

Internal Resources

- Applications within your internal networking
- Access to workstations on-premise

Use Azure AD to implement **Single-Sign On (SSO)**

Azure Active Directory comes in four editions

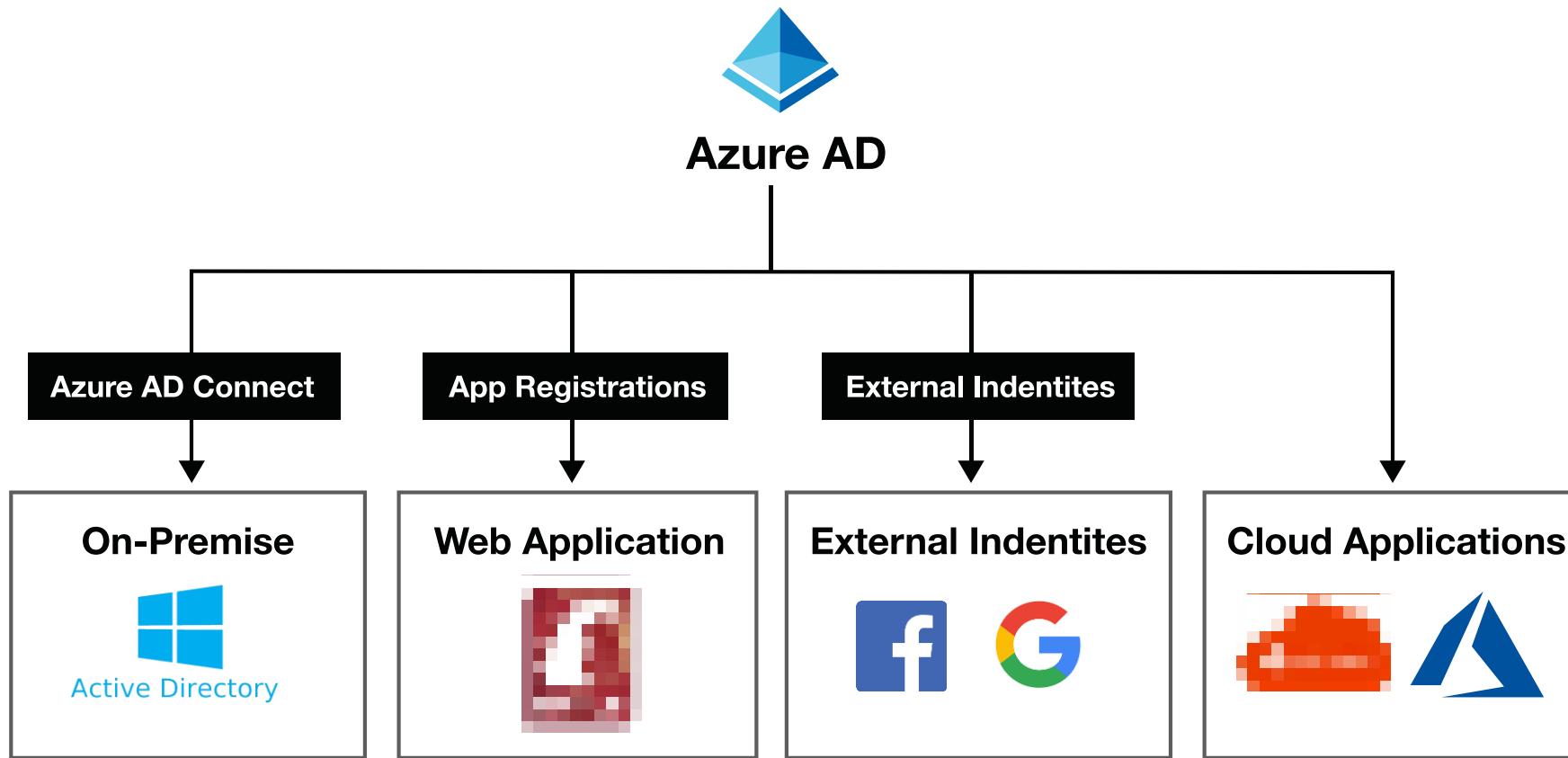
1. **Free** MFA, SSO, Basic Security and Usage Reports, User Management
2. **Office 365 Apps** Company Branding, SLA, Two-Sync between On-Premise and Cloud
3. **Premium 1** Hybrid Architecture, Advanced Group Access, Conditional Access
4. **Premium 2** Identity Protection, Identity Governance



Azure AD – Use Case

Azure AD can **authorize** and **authenticate** to multiple sources.

- To your on-premise AD
- To your web-application
- Allow users to login with their IdP eg. Facebook or Google
- To Office 365 or **Azure Microsoft**





Active Directory vs Azure Active Directory



Microsoft introduced **Active Directory** Domain Services in **Windows 2000** to give organizations the ability to manage multiple on-premises infrastructure components and systems using a single identity per user.

Azure AD takes this approach to the next level by providing organizations with an **Identity as a Service (IDaaS)** solution for all their apps **across cloud and on-premises**.

Both versions are still used today



Active Directory
The **on-premise** version



Azure AD
The **cloud** version

Active Directory Terminology

Domain

A domain is an area of a network organized by a single authentication database

An Active Directory domain is a **logical grouping** of AD objects on a network

Domain Controller (DC)

A domain controller is a server that **authenticates** user identities and **authorizes** their access to resources.

Domain Computer

A computer that is registered with a central authentication database A domain computer would be an AD Object

AD Object

An AD Object is the basic element of Active Directory such as:

Users, Groups, Printers, Computers, Shared folders

Group Policy Object (GPO)

A virtual collection of policy settings. It controls what AD Objects have access to

Organization Units (OU)

A subdivision within an Active Directory into which you can place users, groups, computers, and other organizational units

Directory Service

A directory service, such as **Active Directory Domain Services (AD DS)**, provides the methods for storing directory data and making this data available to network users and administrators. A Directory service runs on a Domain Controller



Azure Active Directory Domain Services (AD DS)

In some cases you'll need to setup your own domain controller(s).

When doing a *lift-and-shift from on-premise* to Microsoft Azure and migrating Active Directory, Azure AD does not support some **domain services**.

Azure Active Directory Domain Services (AD DS) provides **managed domain service** such as:

- Domain joins
- Group policies
- Lightweight directory access protocol (LDAP)
- and Kerberos / NTLM authentication.

You can use these domain services without the need to:
deploy, manage, and patch domain controllers (DCs) in the cloud

Azure AD – External Identities

External Identities in Azure AD, allow people outside your organization to access your apps and resources, while letting them sign in using whatever identity they prefer.

Your partners, distributors, suppliers, vendors, and other guest users can **"bring their own identities"**.

Supports Logins from **Google** and **Facebook**



- Share apps with external users (**B2B collaboration**).
- Develop apps intended for other Azure AD tenants (**single-tenant or multi-tenant**)
- Develop white-labeled apps for consumers and customers (**Azure AD B2C**)

Computing Services

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Azure Virtual Machines

Windows or Linux virtual machines (VMs). The most common type of compute.

You choose your OS, Memory, CPU, Storage. You share hardware with other customers



Azure Container Instances

Docker as a Service Run containerized apps on Azure without provisioning servers or VMs



Azure Kubernetes Service (AKS)

Kubernetes as a Service. Easy to deploy, manage and scale containerized applications.



Uses the open source Kubernetes (K8) software.



Azure Service Fabric

Tier-1 Enterprise Containers as a Service

Distributed systems platform. Runs in Azure or on-premises.

Easy to package, deploy, and manage scalable and reliable **microservices**.



Azure Functions

Event-driven, serverless compute (functions) run code without provisioning or managing servers.

You pay only for the compute time you consume.



Azure Batch

Plans, schedules and executes your batch computer workloads across running 100+ jobs in parallel.

Use Spot VMs to save money (previously used Low-priority VMs to save on compute)

Storage Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Blob Storage

Object Serverless Storage. Store very large files and large amounts of unstructured files.

Pay for what you store, unlimited storage, no-resizing volumes, no filesystem protocols.



Azure Disk Storage

A virtual volume. Choose SSD or HDD, encryption by default, attach volume to VMs



Azure File Storage

A shared volume that you can access and manage like a file server. eg SMB



*Azure Queue Storage

Messaging Queue A data store for queuing and reliably delivering messages between applications



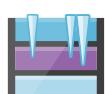
*Azure Table Storage

Wide-Column NoSQL Database A NoSQL store that hosts unstructured data independent of any schema



Azure Data Box / Azure Databox Heavy

A rugged briefcase computer and storage designed to move terabytes or petabytes of data



Azure Archive Storage

Long term cold storage for when you need to hold onto files for years on the cheapest storage options



Azure Data Lake Storage

A centralized repository that allows you to store all your structured and unstructured data at any scale.

Database Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Cosmos DB

A fully managed **NoSQL databases**. Designed for scale with guarantee of 99.999% availability



Azure SQL Database

Fully managed MS SQL database with auto-scale, integral intelligence, and robust security



Azure Database for MySQL / PSQL / MariaDB

Fully managed and scalable **MySQL / PostgreSQL / MariaDB database** with high availability and security



SQL Server on VMs

Host enterprise SQL Server apps in the cloud. Lift-and-shift MS SQL servers from on-premise to Azure Cloud.



Azure Synapse Analytics (Azure SQL Data Warehouse)

Fully managed **data warehouse** with integral security at every level of scale at no extra cost



Azure Database Migration Service

Migrates your databases to the cloud with no application code changes



Azure Cache for Redis

Caches frequently used and static data to reduce data and application latency



*Azure Table Storage

Wide-Column NoSQL Database A NoSQL store that hosts unstructured data independent of any schema

Application Integration Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Notifications Hub

Pub/Sub Send push notifications to any platform from any back end



Azure API Apps

API Gateway Quickly build and consume APIs in the cloud. Route APIs to Azure Services



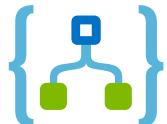
Azure Service Bus

Service Bus Reliable cloud messaging as a service (MaaS) and simple hybrid integration



Azure Stream Analytics

Serverless **real-time analytics**, from the cloud to the edge



Azure Logic Apps

Schedule, automate and orchestrate tasks, businesses processes and workflows.

Integration with Enterprise SaaS and Enterprise applications.



Azure API Management

Hybrid, multi-cloud management platform for APIs across all environments.

Put in-front of existing APIs to add additional functionality.



*Azure Queue Storage

Messaging Queue A data store for queuing and reliably delivering messages between applications

Developer and Mobile Tools

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure SignalR Service

Real-Time Messaging Easily add real-time web functionality to applications

Think of it like the Pusher for Azure



Azure App Service

Easy to use service for deploying and scaling web-applications with .Net, Node.js Java, Python and PHP
Developer focus on building their web-apps, and not worry about the underlying infrastructure

Think of it like Heroku for Azure



Visual Studio (Microsoft-owned)

Code Editor The integrated development environment (IDE) designed for creating powerful, scalable applications for Azure



Xamarin (Microsoft-owned)

Mobile-App Framework Create powerful and scalable native mobile apps with .NET and Azure

Azure DevOps Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure DevOps

Plan smarter, collaborate , and ship faster with a set of modern dev services.



Azure Boards

Kanban Deliver value to your users faster using proven agile tools to plan, track, and discuss work across your teams.



Azure Pipelines

Build, test, and deploy with **CI/CD** that works with any language, platform, and cloud. Connect to GitHub or any other Git provider and deploy continuously.



Azure Repos

Get unlimited, cloud-hosted private **Git repos** and collaborate to build better code with pull requests and advanced file management.



Azure Test Plans

Test and ship with confidence using **manual and exploratory testing tools**.



Azure Artifacts

Create, host, and share packages with your team, and add artifacts to CI/CD pipelines with a single click.



Azure DevTest Labs

Fast, easy, and lean dev-test environments

Azure Resource Manager

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is Infrastructure as code (IaC)?

The process of managing and provisioning computer data centers through machine-readable definition files, rather than physical hardware configuration or interactive configuration tools.



Azure Resource Manager (ARM) allows you to programmatically create Azure resources via JSON template.



Launch VM



```
{  
  "$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#",  
  "resources": [  
    {  
      "type": "Microsoft.Compute/virtualMachines",  
      "name": "MyServer",  
      "properties": {  
        "hardwareProfile": {  
          "vmSize": "Standard_A4"  
        }  
      }  
    }  
  ]  
}
```

Azure QuickStart Templates

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

Azure QuickStart is a library of a **pre-made ARM templates** provided by the community and partners to help you quickly launch new projects for a variety of stack scenarios:

Deploy a Django app

This template uses the Azure Linux CustomScript extension to deploy an application. This example creates an Ubuntu VM, does a silent install of Python, Django...



by [Madhan Arumugam Ramakrishnan](#),

Last updated: 5/2/2019

Deploy an Ubuntu VM with Docker Engine

This template allows you to deploy an Ubuntu VM with Docker (using the Docker Extension). You can later SSH into the VM and run Docker containers.



by [Corey Sanders](#),

Last updated: 12/11/2019

CI/CD & Containerized App Deploy Docker Enterprise & Jenkins

This quick start launches a stack that allows you to Build, Run & Ship Containerized Applications using Docker Enterprise Edition and CloudBees Jenkins. This integrated sta...



by [Mazhar Hussain Warsi](#),

Last updated: 12/6/2019

Web App on Linux with PostgreSQL

This template provides a easy way to deploy Web App on Linux with Azure database for PostgreSQL.



by [Sunitha Muthukrishna](#),

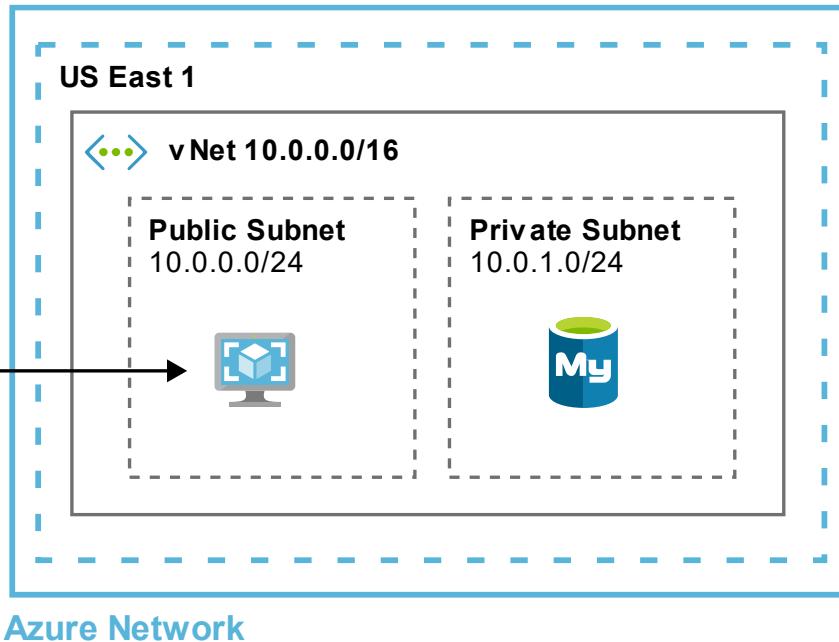
Last updated: 5/5/2020

Azure Virtual Network (vNet) and Subnets

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

Virtual Network (vNet) is a logically isolated section of the Azure Network where you launch your Azure resources. You choose a **range of IPs using CIDR Range**

CIDR Range of **10.0.0.0/16 = 65,536** IP Addresses



Subnets a logical partition of an IP network into multiple smaller network segments. **You are breaking up your IP range for VNet** into smaller networks.

Subnets **need to have a smaller CIDR range than to the vNet** represent their portion.
eg Subnet CIDR Range $10.0.0.0/24 = 256$ IP Addresses

A Public Subnet is one that can reach the internet

A Private Subnet is one that cannot reach the internet

Cloud-Native Networking Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure DNS

Provides ultra-fast DNS responses and ultra-high domain availability



Azure Virtual Network (vNET)

A logical isolated section of the Azure network for customers to launch Azure resources within.



Azure Load Balancer

OSI Level 4 (Transport) Load Balancer



Azure Application Gateway

OSI Level 7 (HTTP) Load Balancer, can apply a Web Application Firewall



Network Security Groups

A virtual firewall at the subnet level

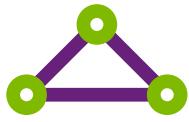
Enterprise/Hybrid Networking Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Front Door

Scalable and secure entry point for fast delivery of your global applications



Azure Express Route

A connection between your on-premise to Azure cloud from 50 Mbps to 10 Gbps



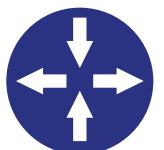
Virtual WAN

a networking service that brings many networking, security, and routing functionalities together to provide a single operational interface



Azure Connection

A VPN connection securely connects two Azure local network via (IPsec).



Virtual Network Gateway

A site-to-site VPN connection between an Azure virtual network and your local network

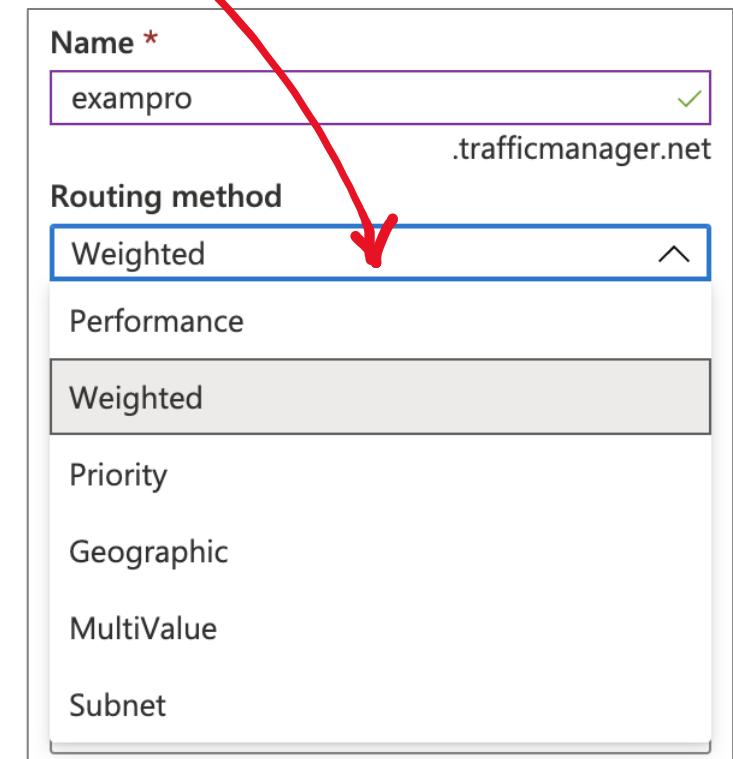
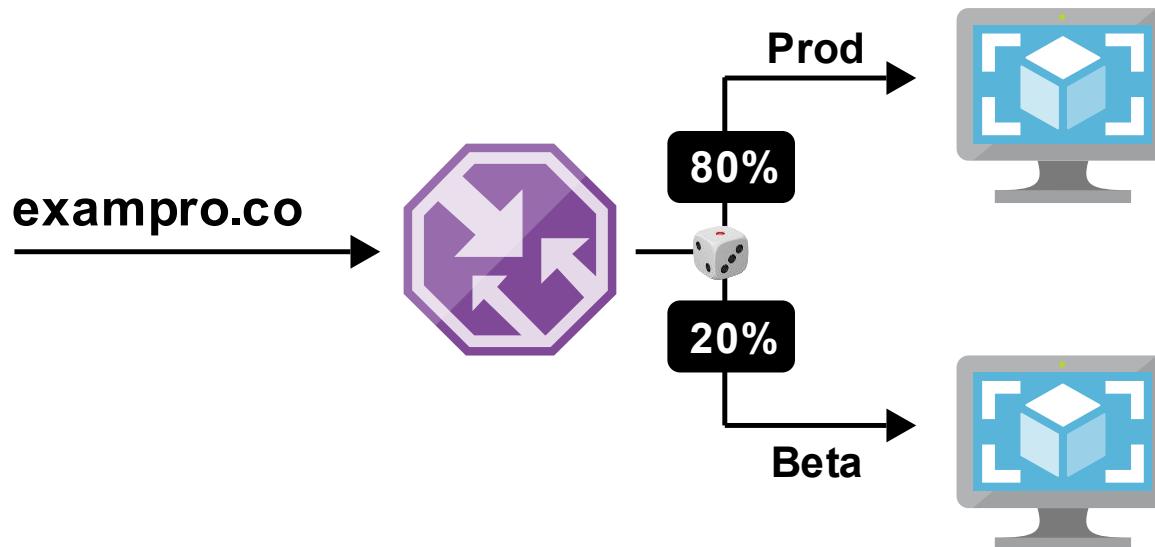
Azure Traffic Manager

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Traffic Manager operates at the **DNS layer** to quickly and efficiently direct incoming DNS requests based on the **routing method of your choice**.

- Route traffic to servers the geographically near by to reduce latency
- Fail-over to redundant systems in-case primary systems become unhealthy.
- Route to random VM to simulate A/B testing



Azure DNS

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure DNS allows you to host your domains names on Azure.
You can create DNS Zones and **manage your DNS records.**

Azure DNS **does not allow you to purchase domains.**
Only the ability to manage DNS records.

Search record sets			
Name	Type	TTL	Value
@	NS	172800	ns1-08.azure-dns.com. ns2-08.azure-dns.net. ns3-08.azure-dns.org. ns4-08.azure-dns.info.
@	SOA	3600	Email: azuredns-host... Host: ns1-08.azure-d... Refresh: 3600 Retry: 300 Expire: 2419200 Minimum TTL: 300 Serial number: 1

Red arrows point from the 'Manage your DNS records' text in the first slide to the 'Add record set' dialog and from the table in the first slide to the 'Value' field in the dialog.

Add record set

exampro.co

Name: beta .exampro.co

Type: A

Alias record set: Yes

Alias type: Azure resource

Choose a subscription: Free Trial

Azure resource: exampro

Azure Load Balancer

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

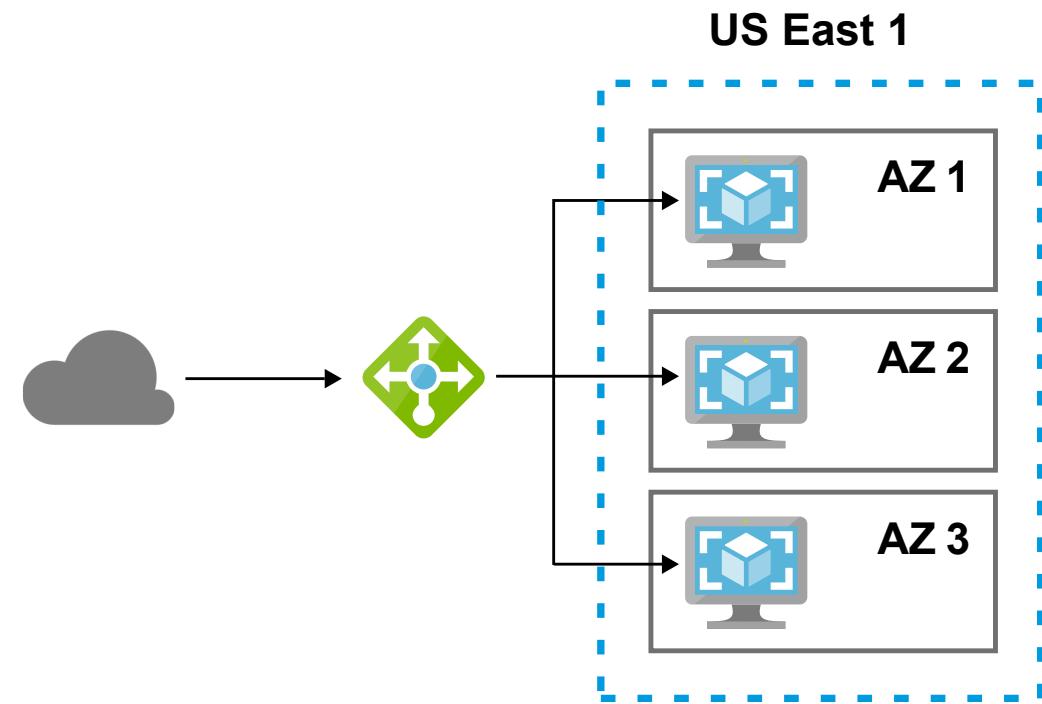


Azure Load Balancer is used for evenly distributing incoming network traffic across a group of backend resources or servers.

Azure Load Balancer operates on **OSI Layer 4 (Transport)**

You can create a:

- **Public Load Balancer** incoming traffic from the internet **to public-facing servers** (Public IPs)
- **Internal (Private) Load Balancer** incoming internal network traffic to **private-facing servers** (Private IPs)

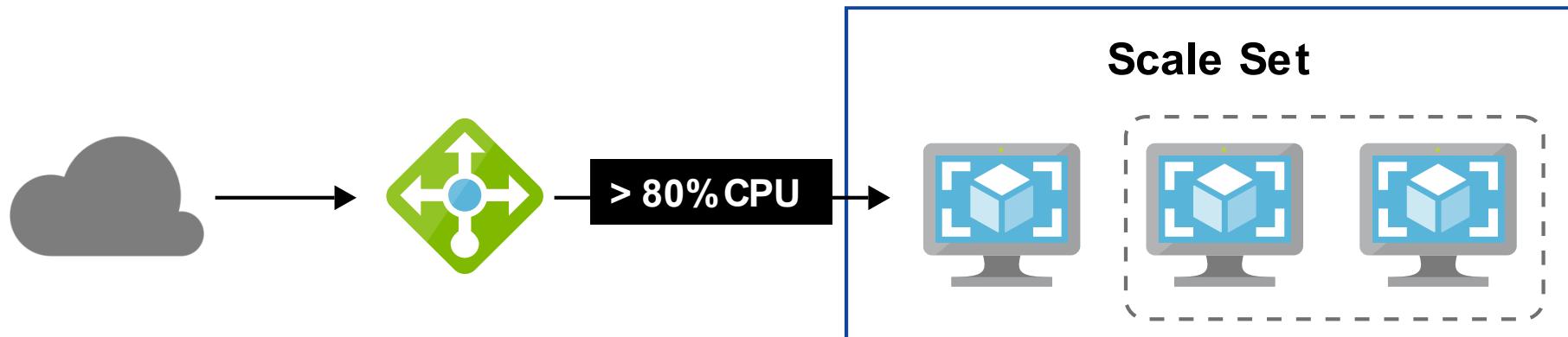


Scale Sets

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

Allows you group together identical Virtual Machines (VMs) and **automatically increase or decrease the amount of servers** based on:

- change in CPU, memory, disk, and network performance
- On a predefined schedule



IoT Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is Internet of Things (IoTs)?

A network of Internet connected objects (usually hardware) able to collect and exchange data.



- Smart Bulbs
- Smart Fridges
- Smart Light Switches
- Narrowband vs Wideband hardware
- Security Cameras
- Voice Command Speakers
- Temperature, Pressure or Humidity Sensors
- Drones
- Phones
- Buttons

IoT Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



IoT Central

Connects your IoT devices to the cloud



IoT Hub

Enable highly secure and reliable communication between your IoT application and the devices it manages



IoT Edge

A fully managed service built on Azure IoT Hub. It allows data processing and analysis nearest the IoT devices. Edge computing is when you offload compute from the cloud to local computing hardware such as IoT devices, phones or home computers

Azure IoT Edge strengthens privacy protection and security by enabling localized data processing. This approach minimizes the need to transmit sensitive data to remote servers, reducing the risk of data exposure during transit. With IoT Edge, you can implement robust security measures and enforce data access controls at the device level, ensuring sensitive information remains safeguarded, even in challenging or disconnected environments.



Windows 10 IoT Core Services

A cloud services subscription that provides the essential **services** needed to commercialize a device on **Windows 10 IoT Core**. Long-term OS support and services to manage device updates and assess device health

Big Data and Analytics Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is BigData?

A term used to describe **massive volumes of structured/unstructured data** that is so large it is difficult to **move and process** using traditional database and software techniques.



Azure Synapse Analytics (*formally known as SQL Data Warehouse*)

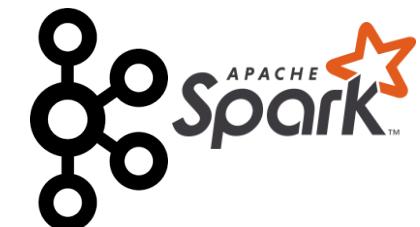
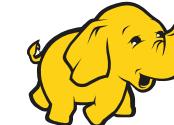
Enterprise **data warehousing and Big Data analytics**.

Intended to **run SQL queries** against large databases for things such as reporting.



HDInsight

Run **open-source analytics software** such as Hadoop, Kafka and Spark



Azure Databricks

An Apache Spark-based analytics platform optimized for the Microsoft Azure cloud services platform.

Third-Party Databricks cloud services supported within Azure.



Data Lake Analytics

An on-demand analytics job service that simplifies big data.

A **data lake** is a storage repository that holds a vast amount of raw **data** in its native format until it is needed.

AI/ML Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is Artificial Intelligence (AI)?

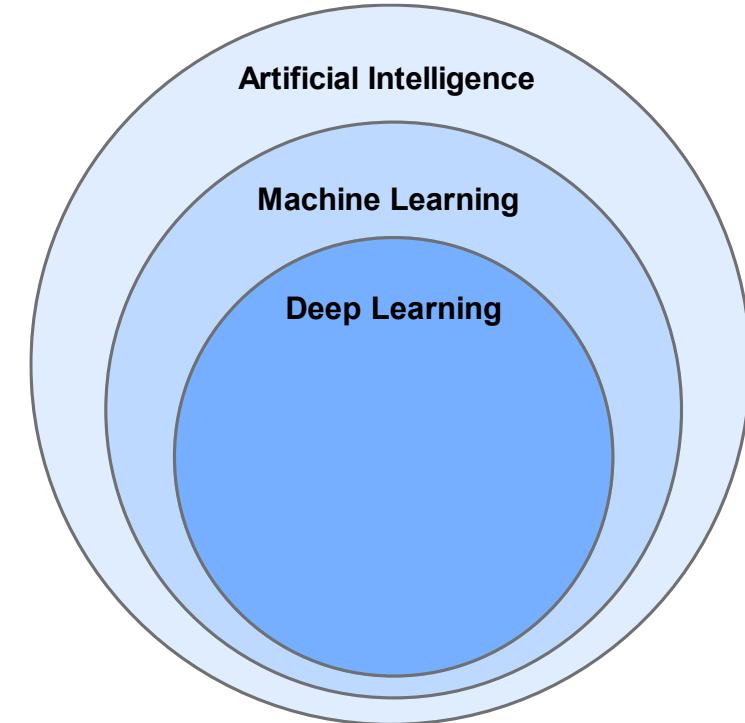
Machines that perform jobs that mimic human behavior

What is Machine Learning (ML)?

Machines that get better at a task without explicit programming

What is Deep Learning (DL)?

Machines that have an artificial neural network inspired by the human brain to solve complex problems.



Azure Machine Learning Service

A service for that simplifies running AI/ML related workloads allowing you to build flexible Pipelines to automate workflow. Use Python an R, Run DL workloads such as Tensorflow

Azure Machine Learning Studio (classic)

An older service that manages AI/ML workloads. Does not have a pipeline and other limitations. Workloads are not easily transferable to from classic to the new service.

AI/ML Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Personalizer Deliver rich, personalised experiences for every user.



Translator Add real-time, multi-language text translation to your apps, website and tools.



Anomaly detector Detect anomalies in data to quickly identify and troubleshoot issues.



Azure Bot Service Intelligent, serverless bot service that scales on demand



Form Recogniser Automate the extraction of text, key/value pairs and tables from your documents.



Computer Vision Easily customise computer vision models for your unique use case.



Language Understanding Build natural language understanding into apps, bots and IoT devices.

AI/ML Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



QnA Maker Create a conversational question-and-answer bot from your existing content.



Text Analytics Extract information such as sentiment, key phrases, named entities and language from your text.



Content moderator Moderate text and images to provide a safer, more positive user experience.



Face Detect and identify people and emotions in images.



Ink Recogniser Recognise digital ink content, such as handwriting, shapes and document layout.

Serverless Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is Serverless?

When the underlying servers, infrastructure and OS is taken care of by the Cloud Service Provider (CSP) It will generally be highly available, scalable and cost-effective.

Event-Driven Scale

A serverless function can be triggered or trigger other events allowing you to compose complex applications and it scales.

Abstraction of Servers

Servers are abstracted away. Your code is described as functions. These functions can be running on different compute instances.

Micro-Billing

Serverless compute could run for a fraction of a second.

Billing into micro-seconds will save you money.

Serverless Services

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



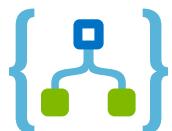
Azure Functions

Run small amounts of code known as serverless functions in your favorite language: C#, Java, JavaScript, Python and PowerShell



Blob Storage

Serverless Object Storage. Just upload files, don't think about the underlying file-systems, resizing



Logic Apps

Allows you to build serverless workflows composed of Azure Functions
Building a state machines for serverless compute.



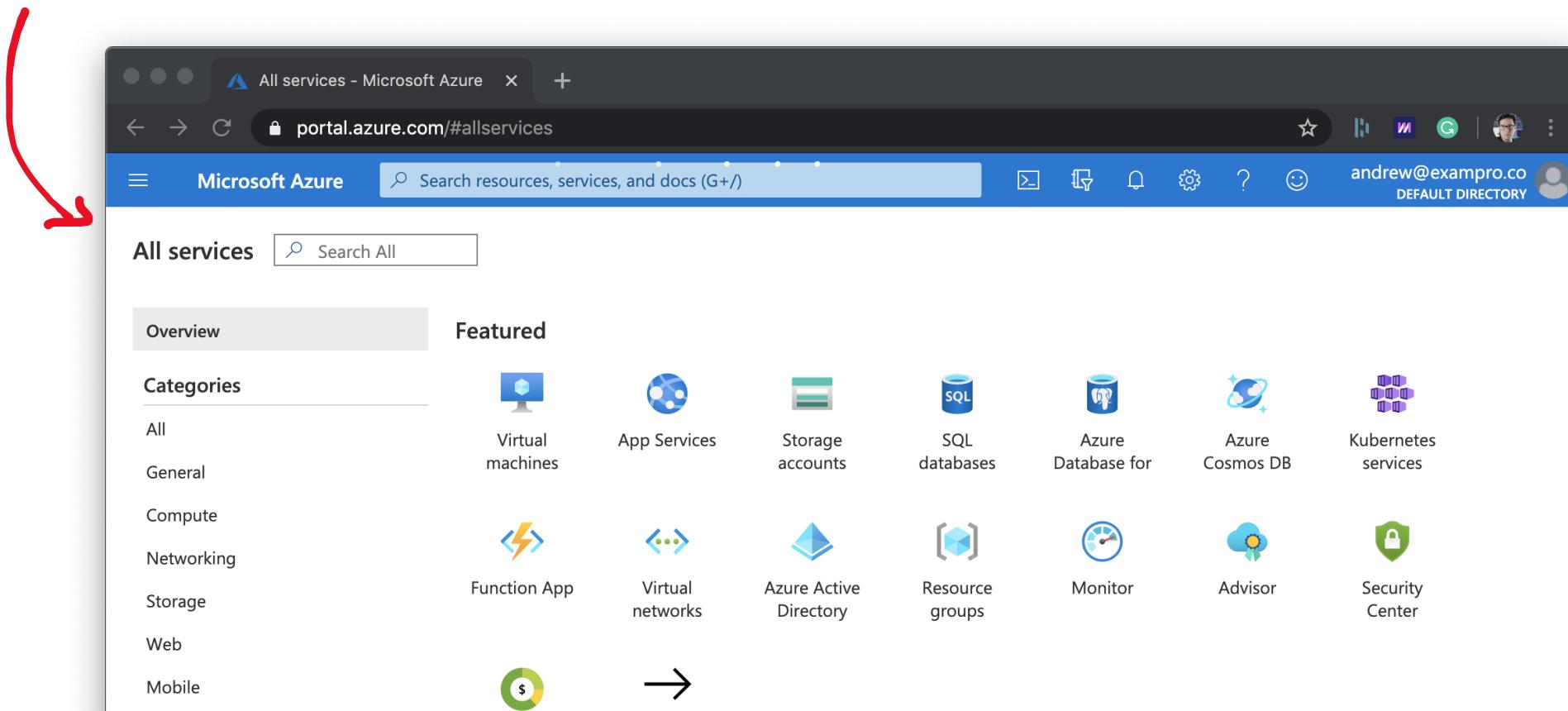
Event Grid

Uses Pub/Sub messaging system to allow you react to events and trigger other Azure cloud services such as Azure Functions.

Azure Portal

Cheat sheets, Practice Exams and Flash cards www.exampro.co/az-900

The Azure portal is **a web-based, unified console** that provides an alternative to command-line tools. You can manage your Azure subscription with the Azure portal. Build, manage, and monitor everything from simple web apps to complex cloud deployments.



Azure Preview Portal

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

You can utilize new features that are in

- **Preview**
- **Beta**
- **Other pre-release**

- If you want to **test preview features** should use **preview.portal.azure.com**
- if you **stable-release and production-ready** features you should use **portal.azure.com**

Azure PowerShell

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is PowerShell?

PowerShell is a task automation and configuration management framework.

A **command-line shell** and a **scripting language**.

Unlike most shells, which accept and return text, PowerShell is built on top of the .NET Common Language Runtime (CLR), and accepts and returns .NET objects.



Azure PowerShell

A set of cmdlets for managing Azure resources directly from the PowerShell command line



```
Windows PowerShell
Link-local IPv6 Address . . . . . : fe80::541f:9e31:7df6:9847%22
IPv4 Address . . . . . : 10.0.75.1
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . :

Ethernet adapter vEthernet (New Virtual Switch):

Connection-specific DNS Suffix . :
Link-local IPv6 Address . . . . . : fe80::2c0d:8306:9bcf:8247%14
IPv4 Address . . . . . : 10.0.0.100
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 10.0.0.254

Unknown adapter Local Area Connection:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Ethernet adapter Ethernet 4:

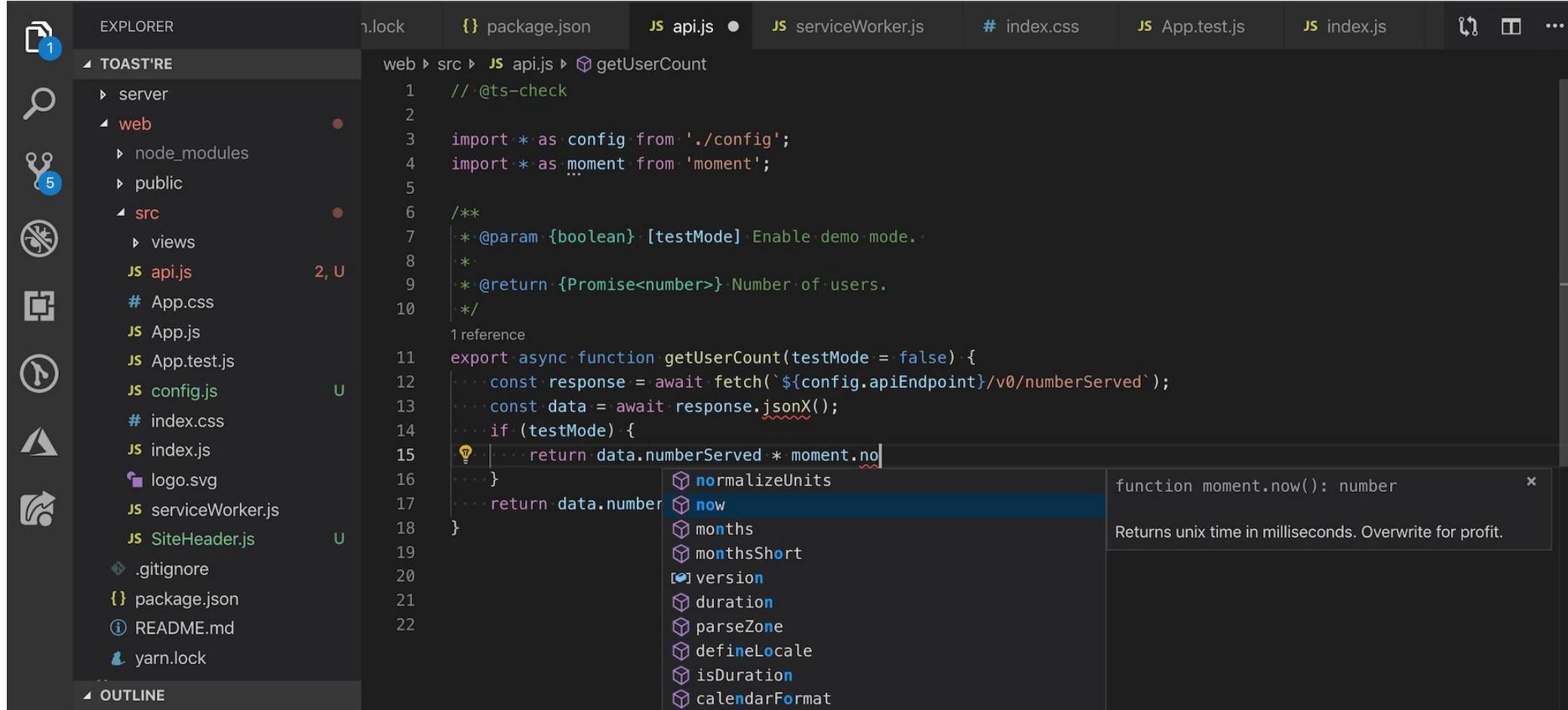
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
PS C:\Users\Andrew>
```

Visual Studio Code

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Visual Studio Code is a free source-code editor made by Microsoft for Windows, Linux and macOS.



The screenshot shows the Visual Studio Code interface with the following details:

- EXPLORER** pane on the left: Shows a file tree with a folder named "TOAST'RE". Inside "TOAST'RE" are "server", "web", "node_modules", "public", and "src" folders. "src" contains "views", "api.js", "App.css", "App.js", "App.test.js", "config.js", "index.css", "index.js", "logo.svg", "serviceWorker.js", and "SiteHeader.js". There are also ".gitignore", "package.json", "README.md", and "yarn.lock" files at the root level. A status bar indicates there are 1 file with 1 change, 5 files with 5 changes, and 2 files with 2 updates.
- EDITOR** pane: Displays a code editor window for "api.js". The code is a TypeScript function for getting user counts, using the "moment" library. The cursor is on the line `return data.numberServed * moment.now();` which is highlighted in yellow. A tooltip for "now" shows the documentation: "function moment.now(): number" and "Returns unix time in milliseconds. Overwrite for profit."
- SEARCH** pane: Shows a search result for "getUserCount" in the "src/api.js" file.
- STATUS BAR**: Shows the file count (1), changes (5), and updates (2).
- NAVIGATION**: Includes icons for back, forward, and search.

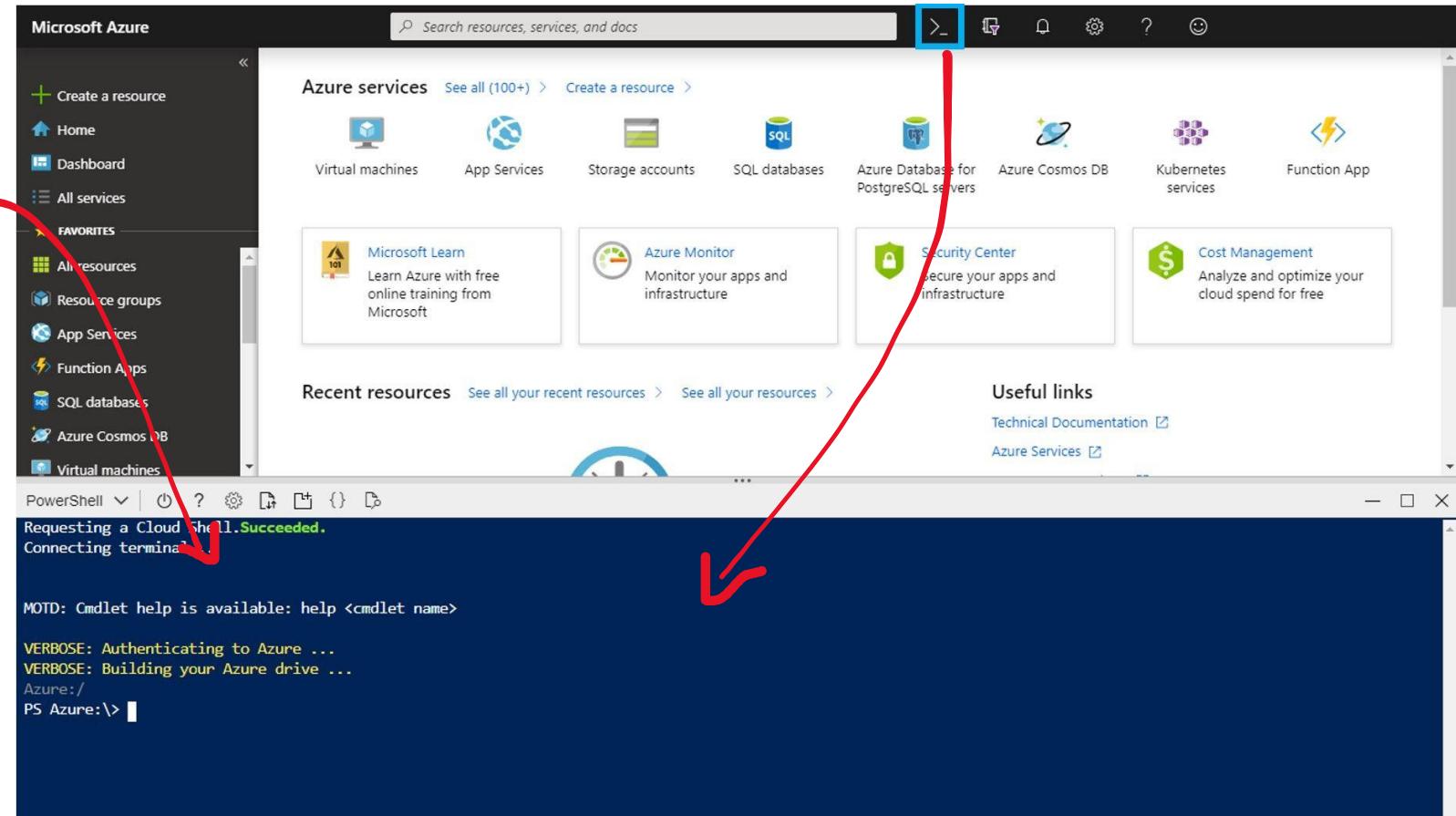
Azure Cloud Shell

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Azure Cloud Shell is an interactive, authenticated, **browser-accessible shell** for managing Azure resources.

It provides the flexibility of choosing the shell experience that best suits the way you work, either **Bash** or **PowerShell**.



Azure CLI

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What is a CLI?

A Command Line Interface (CLI) **processes commands to a computer program in the form of lines of text.** Operating systems implement a command-line interface in a shell or terminal

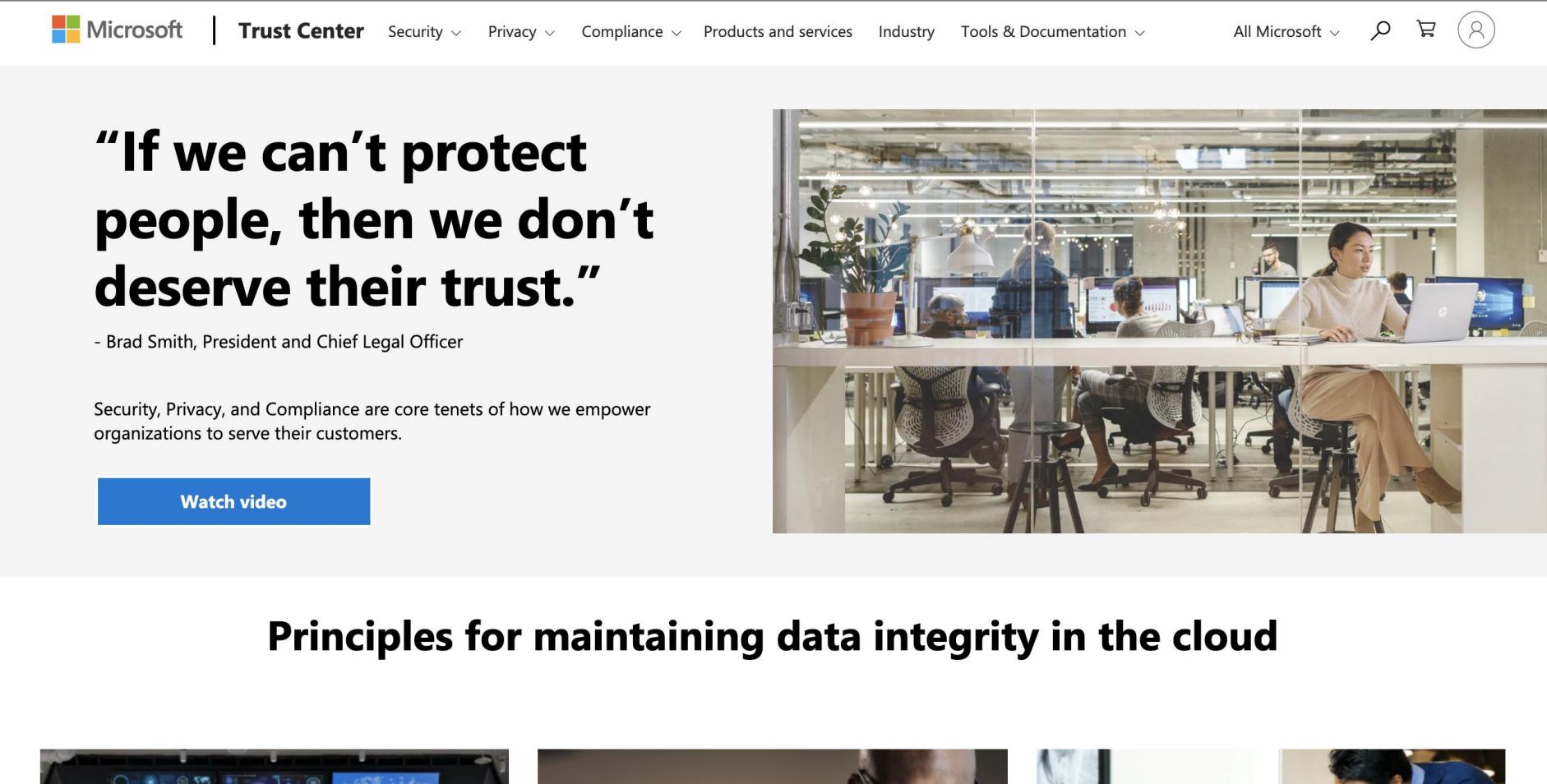
The Azure CLI can be installed on Windows, Mac and Linux. Once installed you can type **az** followed by other commands to create, update, delete, view and manage Azure resources.

```
#!/bin/bash
# Create a resource group.
az group create --name myResourceGroup --location westeurope
# Create a new virtual machine, this creates SSH keys if not present.
az vm create --resource-group myResourceGroup --name myVM --image UbuntuLTS --generate-ssh-keys
```

Azure Trust Center

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

A public-facing website portal providing easy access to
privacy and **security** and **regulatory compliance** information.



The screenshot shows the Microsoft Trust Center homepage. At the top, there's a navigation bar with the Microsoft logo, a search bar, and links for Security, Privacy, Compliance, Products and services, Industry, Tools & Documentation, All Microsoft, a shopping cart icon, and a user profile icon. Below the navigation, a large quote by Brad Smith is displayed: "If we can't protect people, then we don't deserve their trust." followed by "- Brad Smith, President and Chief Legal Officer". A paragraph below the quote states: "Security, Privacy, and Compliance are core tenets of how we empower organizations to serve their customers." A blue "Watch video" button is located at the bottom left of this section. To the right of the quote is a photograph of a modern office environment with several people working at desks with multiple monitors. At the bottom of the page, the text "Principles for maintaining data integrity in the cloud" is visible, along with three small thumbnail images.

Microsoft | Trust Center Security ▾ Privacy ▾ Compliance ▾ Products and services Industry Tools & Documentation ▾ All Microsoft ▾   

"If we can't protect people, then we don't deserve their trust."

- Brad Smith, President and Chief Legal Officer

Security, Privacy, and Compliance are core tenets of how we empower organizations to serve their customers.

Watch video

Principles for maintaining data integrity in the cloud

Azure Security – Compliance Programs

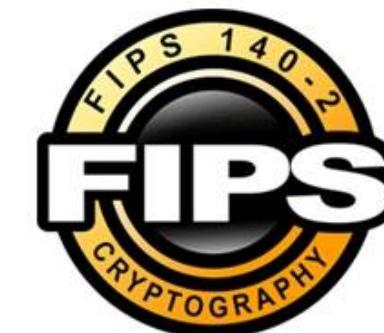
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Enterprise Companies WILL NOT BUY your software solutions unless its  **secure**.

How are you going **to meet their security compliance requirements?**

We'll only do business with you if you are...

- **NIST 800-53**
- **PIPEDA Compliant**
- **HIPPA Compliant**
- **FIPS-140-2 Compliant**



Azure Security – Compliance Programs

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Criminal Justice Information Services (CJIS)

Any US state or local agency that wants to access the FBI's CJIS database is required to adhere to the CJIS Security Policy.



Cloud Security Alliance (CSA) STAR Certification

Independent third-party assessment of a cloud provider's security posture



General Data Protection Regulation (GDPR)

A European privacy law. Imposes new rules on companies, government agencies, non-profits, and other organizations that offer goods and services to people in the European Union (EU), or that collect and analyze data tied to EU residents.



EU Model Clauses

Contractual guarantees around transfers of personal data outside of the EU

Azure Security – Compliance Programs

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Health Insurance Portability and Accountability Act (HIPAA).
US federal law that regulates patient Protected Health Information



International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) 27018.
Code of practice, covering the processing of personal information by cloud service providers.



Multi-Tier Cloud Security (MTCS) Singapore.

Operational Singapore security management Standard. A common standard that cloud service providers (CSPs) can apply to address customer concerns about the security and confidentiality of data in the cloud, and the impact on businesses of using cloud services.



Service Organization Controls (SOC) 1, 2, and 3.

independent third-party examination reports that demonstrate how the company achieves key compliance controls and objectives

Azure Security – Compliance Programs

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



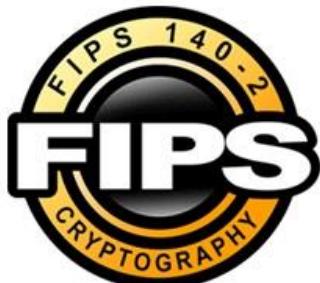
National Institute of Standards and Technology (NIST) Cybersecurity Framework (CSF)

Voluntary Framework that consists of standards, guidelines, and best practices to manage cybersecurity-related risks.



UK Government G-Cloud.

Cloud computing certification for services used by government entities in the United Kingdom



Federal Information Processing Standard (FIPS) 140-2

US and Canadian government standard that specifies the security requirements for cryptographic modules that protect sensitive information.

Azure Active Directory

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

Azure Active Directory (Azure AD) is Microsoft's cloud-based **identity and access management service**, which helps your employees sign in and access resources

External Resources

- Microsoft Office 365
- Azure Portal
- SaaS applications

Internal Resources

- Applications within your internal networking
Access to workstations on-premise

Use Azure AD to implement **Single-Sign On (SSO)**

Azure Active Directory comes in four editions

1. **Free** MFA, SSO, Basic Security and Usage Reports, User Management
2. **Office 365 Apps** Company Branding, SLA, Two-Sync between On-Premise and Cloud
3. **Premium 1** Hybrid Architecture, Advanced Group Access, Conditional Access
4. **Premium 2** Identity Protection, Identity Governance

Multi-Factor Authentication

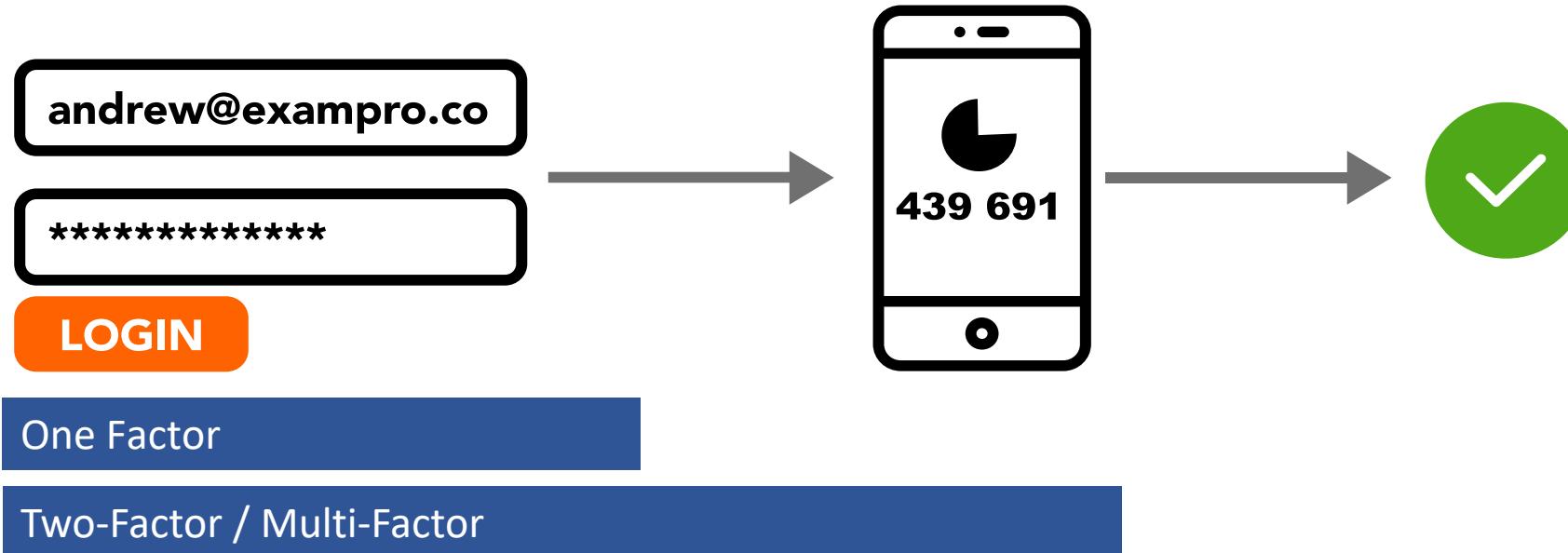
Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

What is Multi-Factor Authentication (MFA)?

A security control where after you fill in your username/email and password **you have to use a second device** such as a phone to confirm that its you logging in.

MFA **protects** against people who have stolen your password.

MFA is an option in most cloud providers and even social media websites such as Facebook.



Azure Security Center

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Security Center is a **unified infrastructure security management system**. It strengthens the security posture of your data centers, and provides advanced threat protection across your hybrid workloads in the cloud.

Home > Security Center - Overview

Security Center - Overview
Showing subscription 'ASC DEMO'

Documentation X

Search (Ctrl+ /) Subscriptions What's new

GENERAL

- Overview
- Getting started
- Events
- Search

POLICY & COMPLIANCE

- Coverage
- Secure score
- Regulatory compliance
- Security policy

RESOURCE SECURITY HYGIENE

- Recommendations
- Compute & apps
- Networking
- IoT hubs & resources (Preview)
- Data & storage

Policy & compliance

Secure score: 497 OF 940

Secure score impact changed. Learn more >

Review your secure score >

Regulatory compliance

- SOC TSP: 0 of 13 passed controls
- PCI DSS 3.2: 2 of 33 passed controls
- ISO 27001: 2 of 22 passed controls

Subscription coverage

Fully covered: 1
Partially covered: 0
Not covered: 0
108 Covered resources

Regulatory compliance

View your compliance posture relative to the standards and regulations that are important to you. Remediate assessments to watch your compliance posture improve.

Learn more >

Resource security hygiene

Recommendations

High Severity: 17
Medium Severity: 8
Low Severity: 10
79 Unhealthy resources

Resource health monitoring

- Compute & apps: 39
- Networking: 20
- Data & storage: 45
- Identity & access: 4

Review and improve your secure score

Review and resolve security vulnerabilities to improve your secure score and secure your workload

Learn more >

131

Key Vault

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900



Azure Key Vault helps you **safeguard cryptographic keys and other secrets** used by cloud apps and services.

Secrets Management

store and tightly control access to **tokens, passwords, certificates, API keys, and other secrets**

Key Management

create and control the **encryption keys** used to encrypt your data

Certificate Management

easily provision, manage, and deploy public and private **SSL certificates** for use with Azure and internal connected resources.

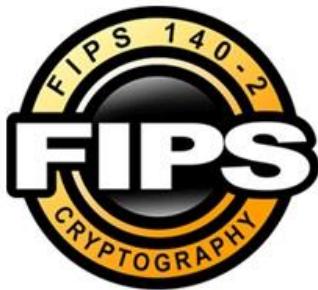
Hardware Security Module

secrets and keys can be protected either by software or **FIPS 140-2 Level 2** validated HSMs

Key Vault

Cheat sheets, Practice Exams and Flash cards ➡ www.exampro.co/az-900

An HSM is a **Hardware Security Module**.
Its a piece of hardware designed to store
encryption keys.



Federal Information Processing Standard (FIPS) 140-2

US and Canadian government standard that specifies the security requirements for cryptographic modules that protect sensitive information.

HSM's that are **multi-tenant** are **FIPS 140-2 Compliant**
(multiple customers virtually isolated on an HSM)

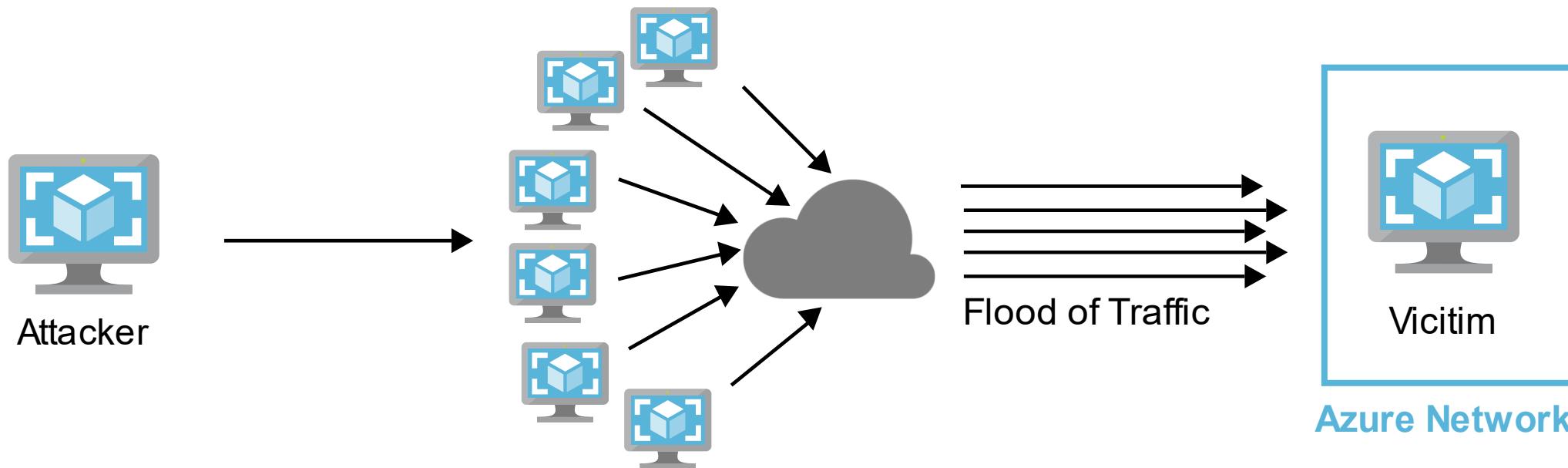
HSM's that are **single-tenant** are **FIPS 140-3 Compliant**
(single customer on a dedicated HSM)

Azure DDoS Protection

Cheat sheets, Practice Exams and Flash cards ➡ www.exampro.co/az-900

What is a DDoS (Distributed Denial of Service) Attack?

A malicious attempt to disrupt normal traffic by flooding a website with large amounts of fake traffic.



Azure DDoS Protection

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Azure offers **two tiers** of DDoS Protection

DDoS IP Protection

- **Pricing Model:** Charged per protected IP
- **Key Features:**
 - Active Traffic Monitoring and Detection
 - Application-based Mitigation Policies
 - Metric, Alerts, and Mitigation Reports
 - Integration with Azure Services
 - Public IP Standard Tier Protection

DDoS Network Protection

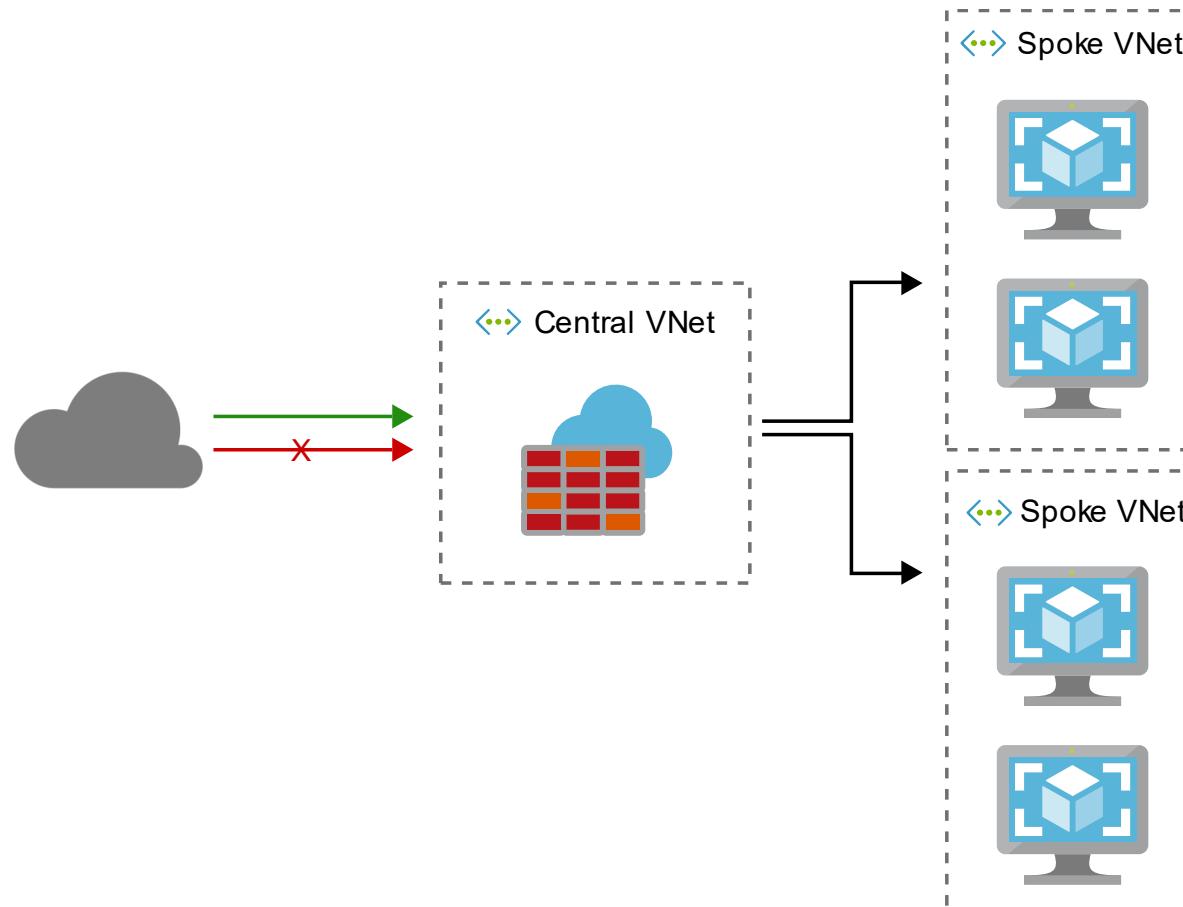
- **Pricing Model:** Charged per 100 protected IP addresses
- **Key Features:**
 - All Features of IP Protection
 - DDoS Rapid Response Support
 - Cost Protection
 - WAF Discount
 - Protection Across Subscriptions

Azure Firewall

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Azure Firewall is a managed, **cloud-based network security service** that protects your Azure Virtual Network resources.



Azure Firewall

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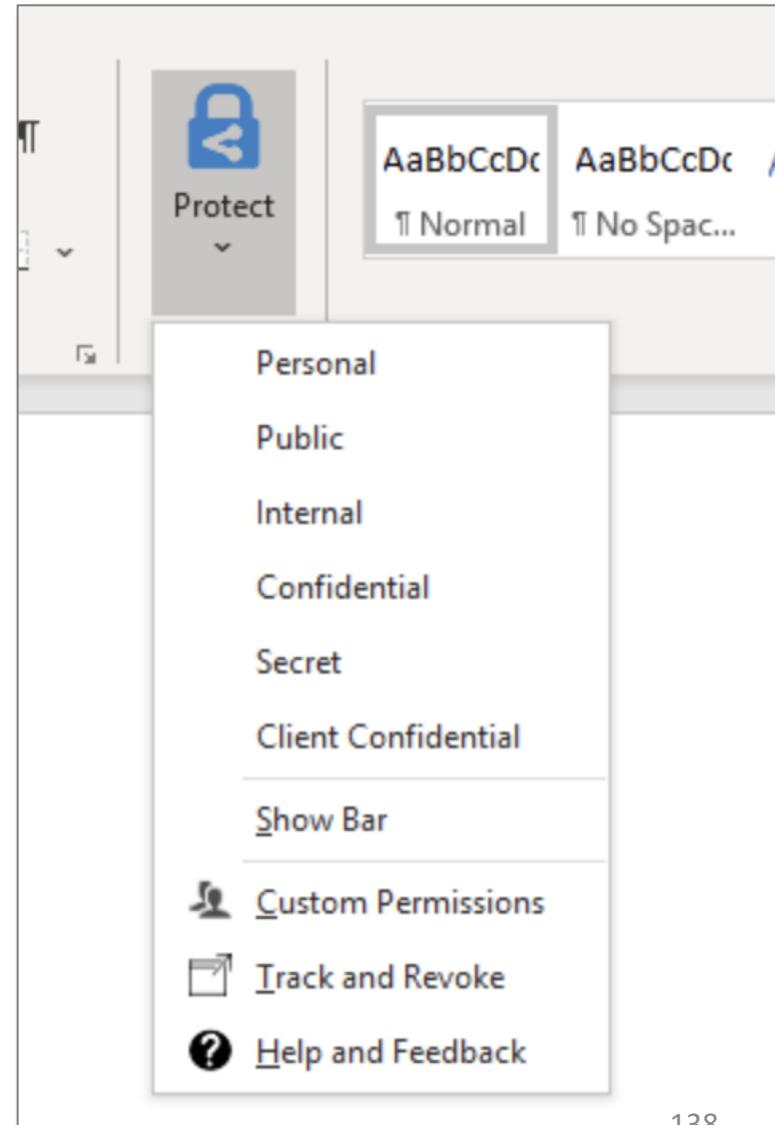
Azure Firewall Features

- Centrally create, enforce, and log application and network connectivity policies **across subscriptions** and virtual networks.
- Uses a **static public IP address** for your virtual network resources allowing outside firewalls to identify traffic originating from your virtual network
- High availability is built in, **no additional load balancers are required**
- Can configure during deployment to **span multiple AZs for increased availability**.
- There's **no additional cost** for a firewall deployed in an Availability Zone (AZ)
- There are **additional costs for inbound and outbound data transfers** associated with AZs

Azure Information Protection (AIP)

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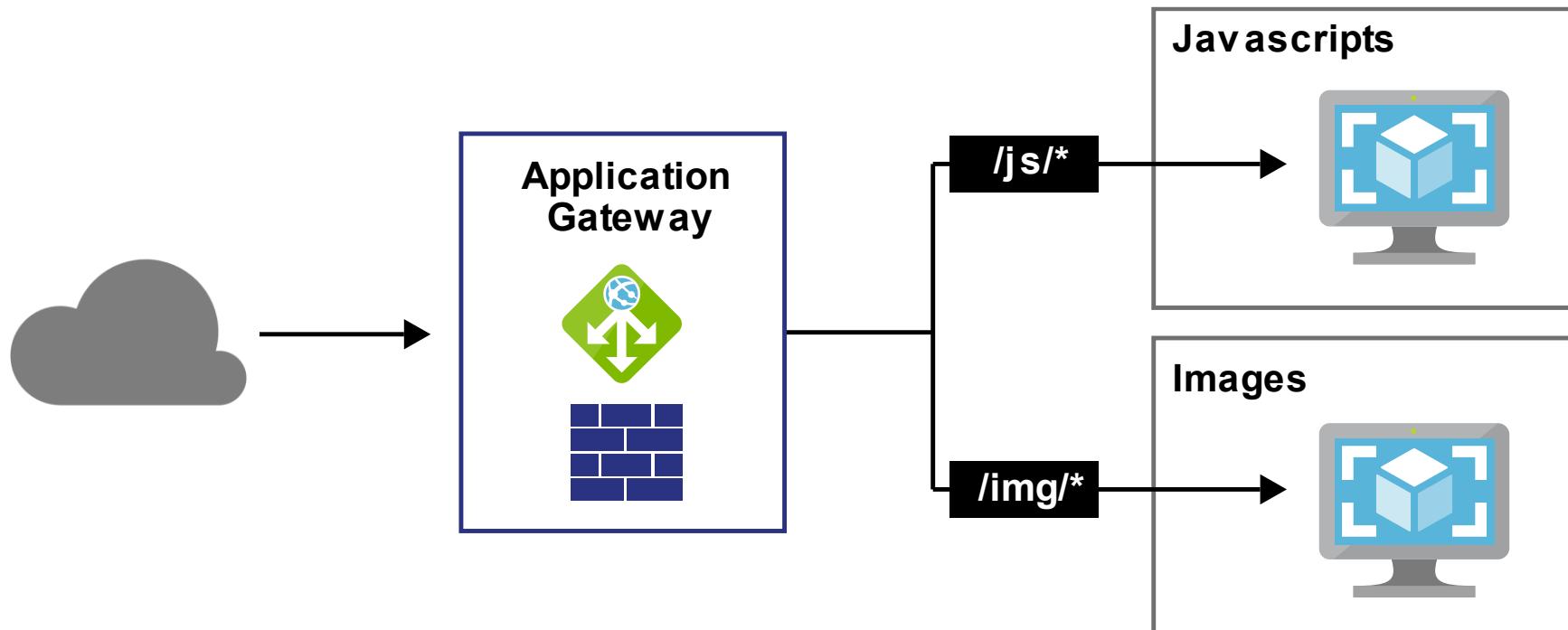
Protects sensitive information such as emails and documents with encryption, restricted access and rights, and integrated security in Office apps



Azure Application Gateway

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Application Gateway is a **web-traffic load balancer** (Layer 7 HTTP) that re-route traffic based on a set of rules. A Web Application Firewall (WAF) can be attached for additional protection on OSI Layer 7.



Azure Advanced Threat Protection (ATP)

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What is IDS/IPS?

Intrusion Detection System and Intrusion Protection System

A device or software application that monitors a network or systems for malicious activity or policy violations.



Azure Advanced Threat Protection (ATP) is a cloud-based security solution that **leverages your on-premises Active Directory signals to identify, detect, and investigate advanced threats, compromised identities, and malicious** insider actions directed at your organization.

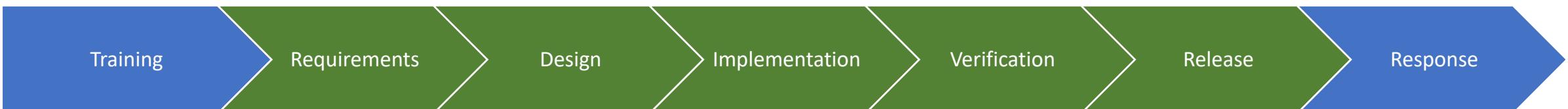
Microsoft Security Development Lifecycle (SDL)

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**Microsoft Security Development Lifecycle (SDL) is
an industry-leading software security assurance process.**

A Microsoft-wide initiative and a mandatory policy since 2004, the SDL has played a critical role in embedding security and privacy in Microsoft software and culture.

Building security into each **SDL phase** of the development lifecycle helps you catch issues early, and it helps you reduce your development costs.



Azure Security – Policies

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Azure Policy is a service you can use to create, assign, and manage policies. A policy allows you to enforce or control the properties of a resource

Azure Policy evaluates resources in Azure by comparing the properties of those resources to business rules. These business rules, described in **JSON** format, are known as **Policy Definitions**.

Azure Role-Based Access Control (RBAC)

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Azure role-based access control (Azure RBAC) helps you manage **who has access to Azure resources**, what they can do with those resources, and what areas they have access to.

Role Assignments the way you control access to resources

A Role Assignment is consist of these three elements

1. security principal
2. role definition
3. scope

Azure Role-Based Access Control (RBAC)

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A Security Principal represents the identities requesting access to an Azure resource such as:

User An individual who has a profile in Azure Active Directory

Group A set of users created in Azure Active Directory.

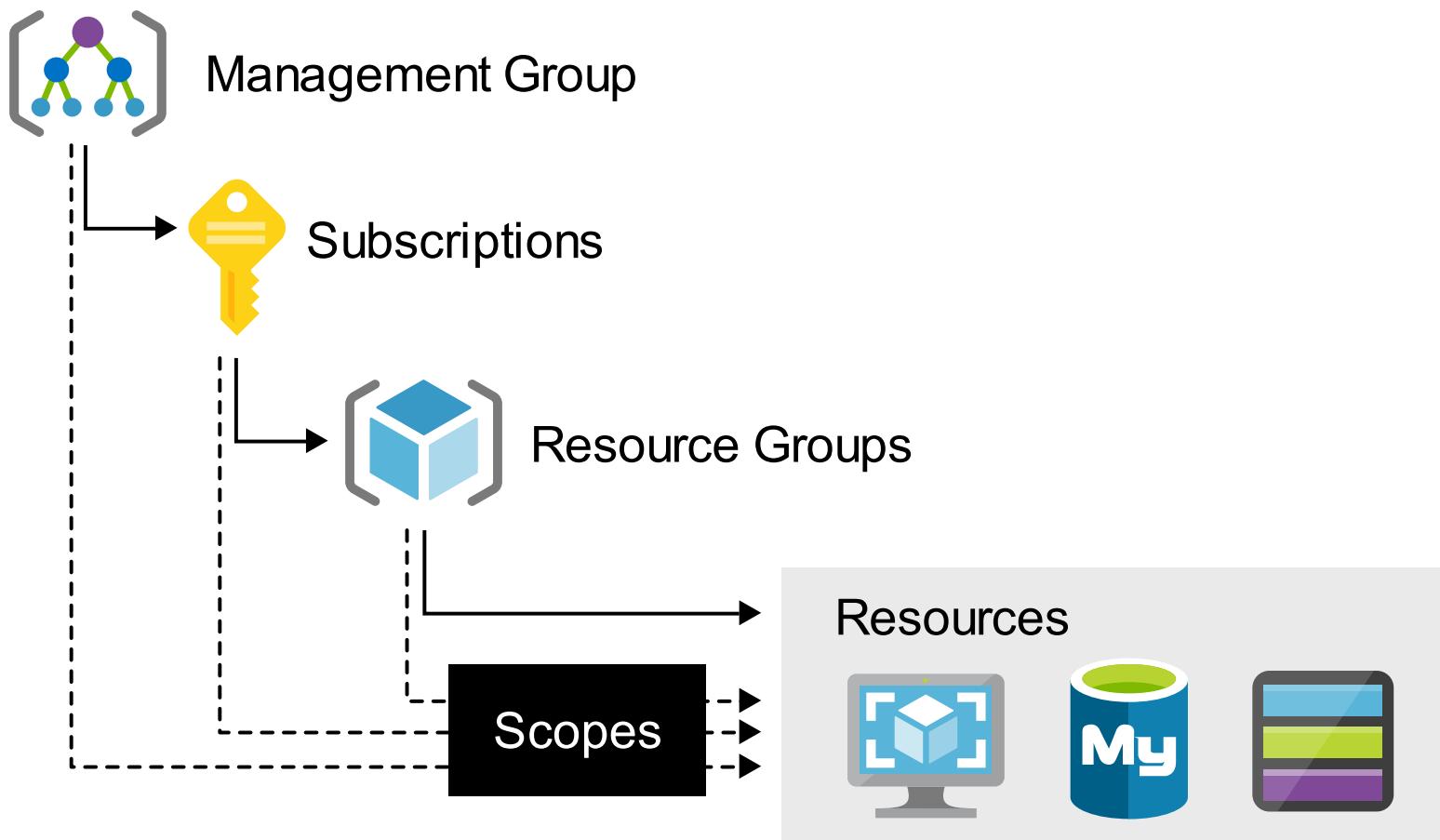
Service Principal A security identity used by applications or services to access specific Azure resources.

Managed identity An identity in Azure Active Directory that is automatically managed by Azure.

Azure Role-Based Access Control (RBAC)

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Scope is the **set of resources** that access for the Role Assignment applies to.
Scope Access Controls at the Management, Subscription or Resource Group level.



Azure Role-Based Access Control (RBAC)

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A Role Definition is a collection of permissions.

A role definition lists the operations that can be performed, such as **read, write, and delete**.
Roles can be high-level, like owner, or specific, like virtual machine reader.

Azure has **built-in roles** and you can define **custom roles**



	Read	Grant	Create, Update, Delete
Owner			
Contributor			
Reader			
User Access Administrator			

These are the four fundamental built-in role

Lock resources

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As an admin, you may need to **lock a subscription, resource group, or resource** to **prevent other users from accidentally deleting or modifying critical resources.**

In the **Azure Portal** you can set the following lock levels.

CanNotDelete (Delete)

authorized users can still read and modify a resource, but they can't delete the resource.

ReadOnly (Read-only)

authorized users can read a resource, but they can't delete or update the resource



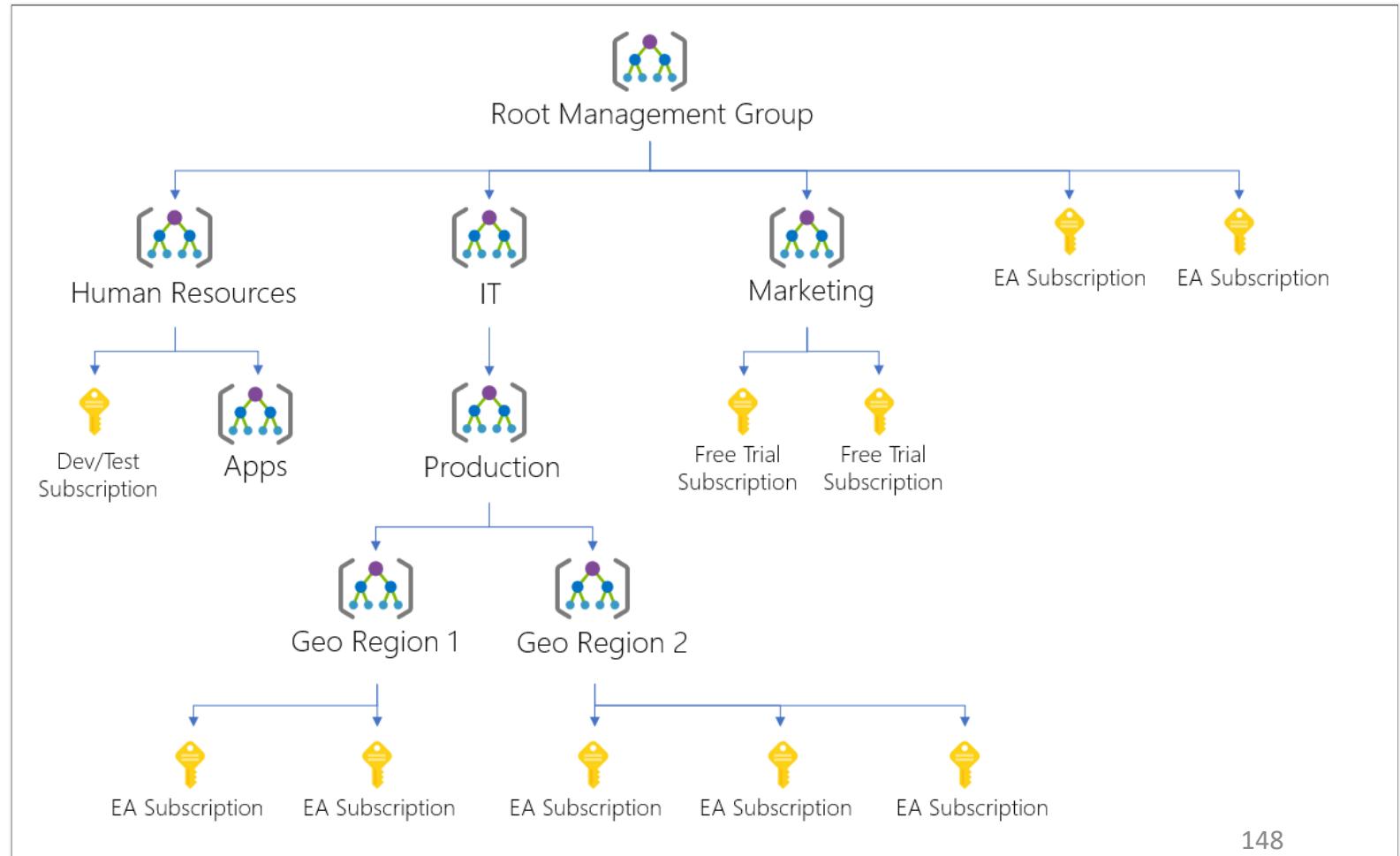
Azure Management Groups

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Managing multiple subscriptions (accounts) into a hierachal structure.

Each directory is given a single top-level management group called the "Root" management group.

All subscriptions within a management group automatically inherit the conditions applied to the management group.



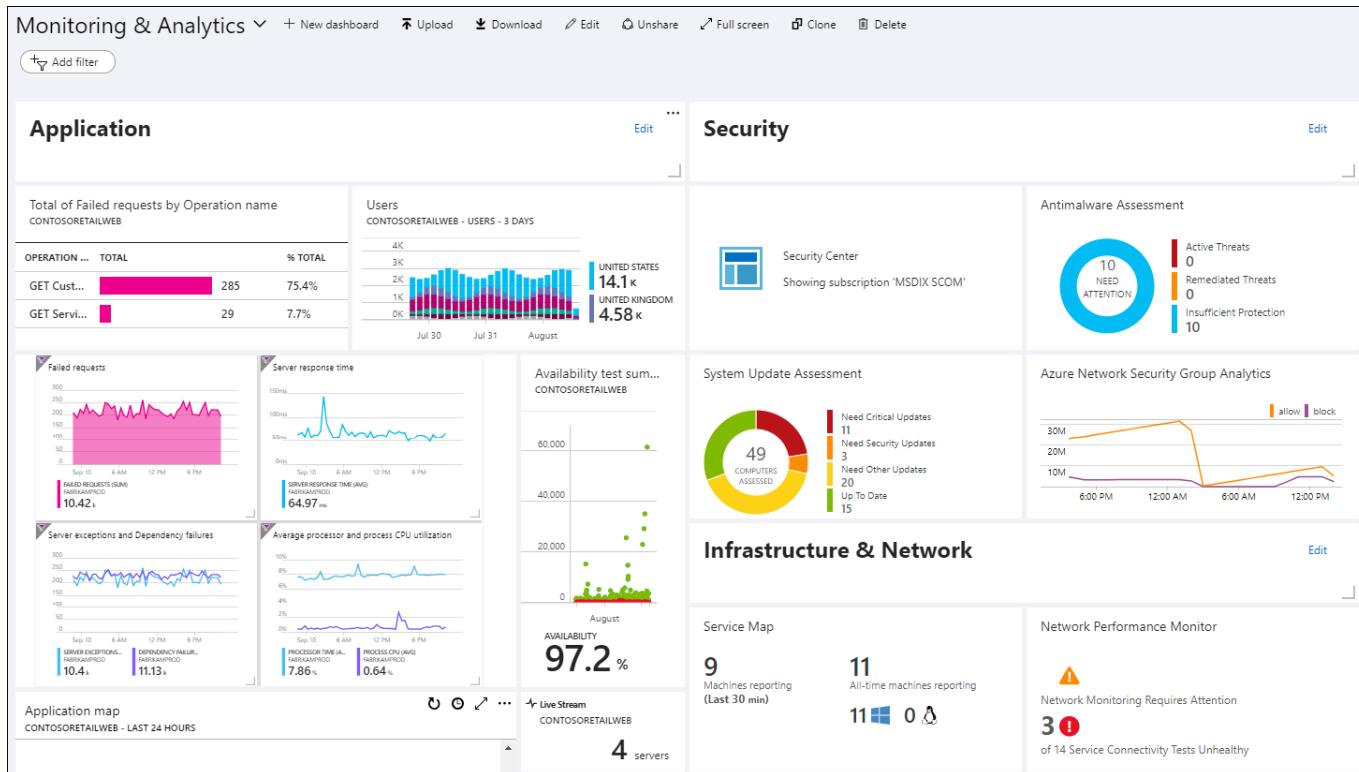
Azure Monitor

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Azure Monitor comprehensive solution **for collecting, analyzing, and acting on telemetry** from your cloud and on-premises environments

-  Overview
-  Activity log
-  Alerts
-  Metrics
-  Logs
-  Service Health
-  Workbooks



- Create Visual Dashboards
- Smart Alerts
- Automated Actions
- Log Monitoring

Azure Service Health

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Information about **current and upcoming issues** such as:

- service impacting events
- planned maintenance
- and other changes that may affect your availability.

1. **Azure Status** informs you of service outages in Azure
2. **Azure service health** a personalized view of the health of the Azure services and regions you're using.
3. **Azure resource health** information about the health of your individual cloud resources eg. VM

Azure Advisor

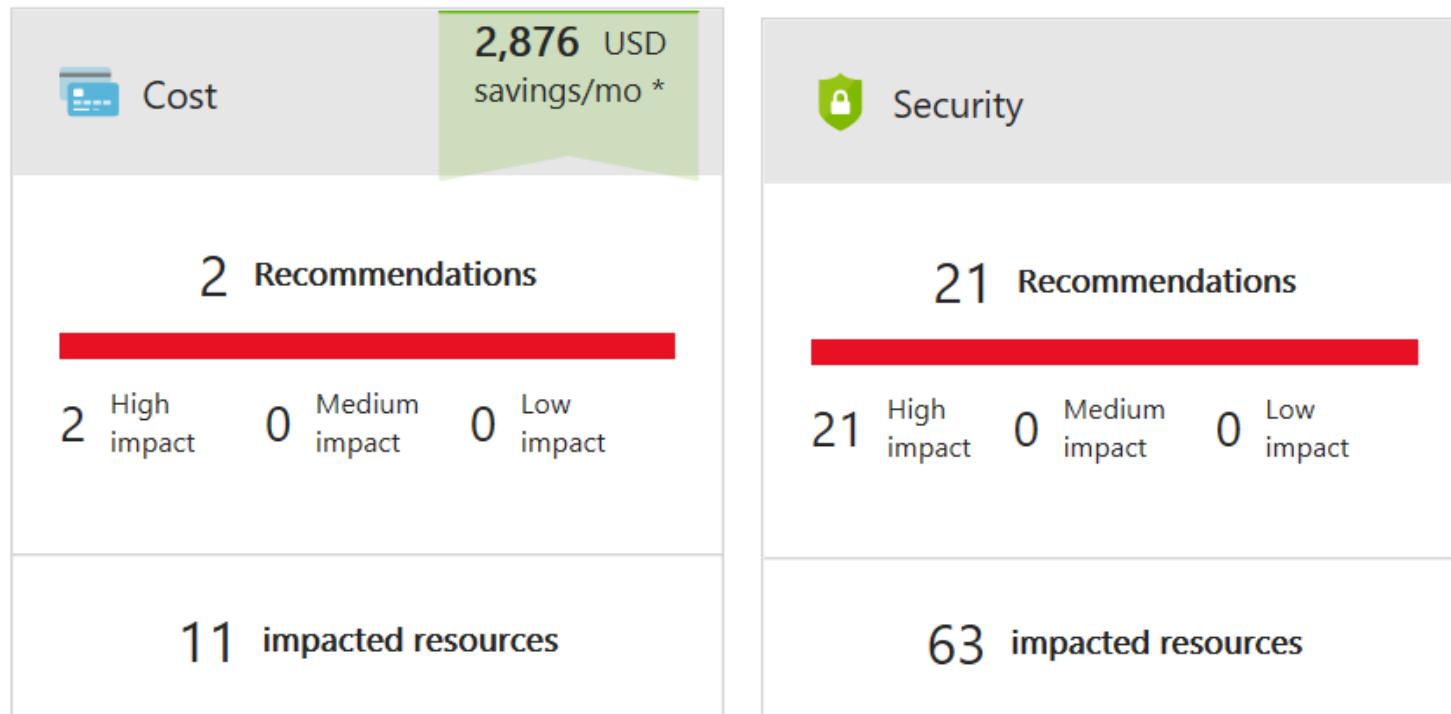
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Azure Advisor is a personalized cloud consultant that helps you follow best practices to optimize your Azure deployments.

The Advisor dashboard displays personalized recommendations for all your subscriptions for the following 5 categories:

1. High Availability
2. Security
3. Performance
4. Cost
5. Operational Excellence



Pricing and Support – SLAs

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Service Level Agreement (SLA) describes Azure's commitments for **uptime** and **connectivity**

SLA's are individualized per Azure service

Uptime and connectivity is described as **Performance Targets**

A Performance Target is represented as a **percentage %**.

- 99% (two nines)
- 99.9% (three nines)
- 99.999% (five nines)
- 99.999999% (nine nines)

Azure does not provide SLAs for Free Tier or the shared tiers.

Pricing and Support – Service Credits

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Service Credits

customers may **have a discount applied to their Azure bill, as compensation for an under-performing Azure product or service** based on the SLA.



Azure Virtual Machine Service Credit Calculation

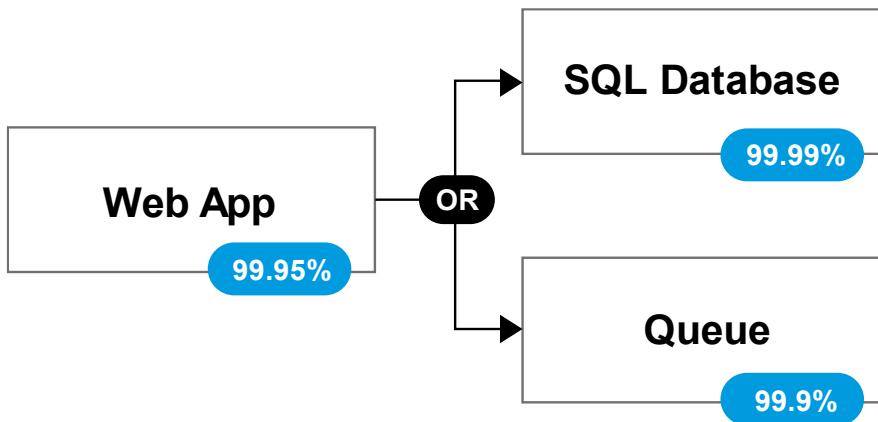
Monthly Uptime %	Service Credit %
< 99.9	10
< 99	25
< 95	100

Pricing and Support – Composite SLA

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Different services have different SLAs.

A **Composite SLA** is when you **combine** SLAs across different service offerings.



The real SLA for a Web-App + SQL Database would be:
 $99.95\% \times 99.99\% = 99.94\%$.

Fallback systems will improve overall SLA.

Imagine SQL Database was down but you had a queue
Saving transactions attempts from Web App to Queue to write to DB.
 $\text{Web app and (database or queue)} = 99.95\% \times 99.99999\% = \sim 99.95\%$

Pricing and Support – TCO Calculator

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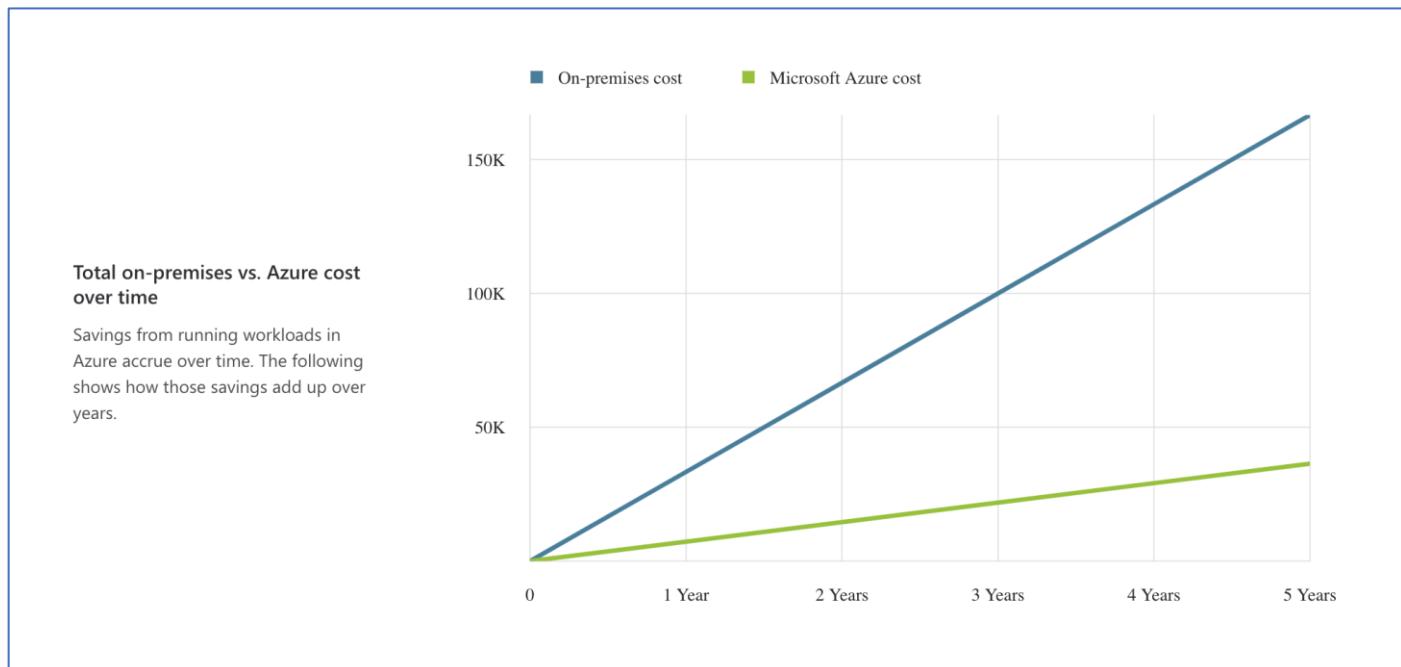
Estimate the cost savings you can realize by migrating your workloads to Azure

Generate out a detailed report and export as a PDF to send to decision makers.

azure.microsoft.com/pricing/calculator

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

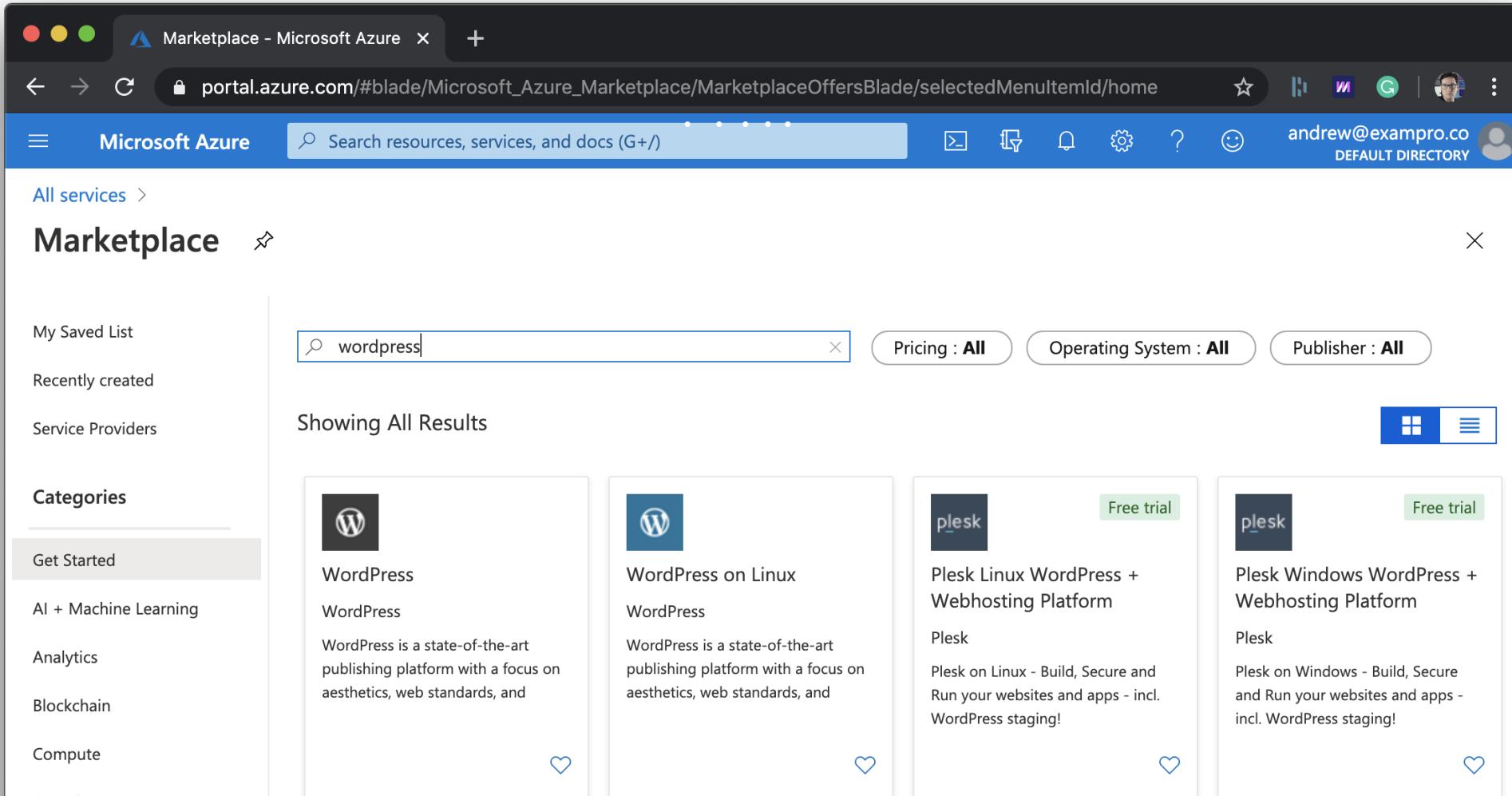
much as **\$130,191**



Azure Marketplace

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Azure Marketplace are **apps and services** made available by **third-party publishers** to quickly get started. The available apps and services can be Free, Free-Trial, Pay-As-You-Go, Bring-Your-Own-License (BYOL)



The screenshot shows the Microsoft Azure Marketplace interface. The search bar at the top contains the text "wordpress". Below the search bar, there are three filter buttons: "Pricing : All", "Operating System : All", and "Publisher : All". The main area displays four search results:

Offer	Publisher	Status	Description
WordPress	WordPress		WordPress is a state-of-the-art publishing platform with a focus on aesthetics, web standards, and
WordPress on Linux	WordPress		WordPress is a state-of-the-art publishing platform with a focus on aesthetics, web standards, and
Plesk Linux WordPress + Webhosting Platform	Plesk	Free trial	Plesk on Linux - Build, Secure and Run your websites and apps - incl. WordPress staging!
Plesk Windows WordPress + Webhosting Platform	Plesk	Free trial	Plesk on Windows - Build, Secure and Run your websites and apps - incl. WordPress staging!

On the left sidebar, under "Categories", "Get Started" is selected. Other categories listed include AI + Machine Learning, Analytics, Blockchain, Compute, and Containers.

Azure Support Plans

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Basic

Email Support only
For Billing and Account

Developer



Email Tech Support

Reply during Business Hours

Standard



24/7 Phone Support

Professional Direct

Third Party Software Support

Minimal business impact (Sev C)

< 8 hours

(Sev C)

< 4 hours

Moderate (Sev B)

< 4 hours

(Sev B)

< 2 hours

Critical business impact (Sev A)

< 1 hour

Azure Advisor, Azure Health Status, Community Support, Azure Documentation

Architecture General Guidance



Architecture, Operational Support and Proactive Guidance by pool **ProDirect** delivery managers



Webinars led by Azure Engineers

\$0 USD / month

\$29 USD / month

\$100 USD / month

\$1000 USD / month

157

Azure Licensing – Azure Hybrid Benefit

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Many customers have invested in **Windows Server licenses** and would like to **repurpose this investment** on Azure.



Azure Hybrid Use Benefit (HUB)

Gives customers the right to use these licenses for virtual machines on Azure.

- Windows Servers
 - SQL Servers
-
- HUB can be turned on and off at anytime for existing VMs
 - HUB can be applied at deployment time for new VMs

Bring your own license (BYOL)

Azure Subscriptions

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An Azure Subscription is the same as saying our Azure Account.

There are **4 tiers** of Azure Subscriptions:



Free Subscription

- Credit Card Required
- \$200 USD credits free for 30 days
- Certain Azure products free for 12 months



Pay-As-You-Go (PAYG) Subscription

- Credit Card Required
- Charged end at the end of the month based on consumed cloud resources



Enterprise Agreement

- An Enterprise and Azure agree on receiving discounted price for licenses and cloud services



Student Subscription

- No Credit Card Required
- \$100 USD credits for 12 months
- Requires valid student email

Azure Pricing Calculator

Cheat sheets, Practice Exams and Flash cards  www.exampro.co/az-900

Configure and estimate the costs for Azure products. No Sign-in required.
Download an **Excel spreadsheet** and share with your boss.

azure.microsoft.com/pricing/calculator

Virtual Machines

REGION: West US OPERATING SYSTEM: Windows TYPE: (OS Only) TIER: Standard

INSTANCE: D2 v3: 2 vCPU(s), 8 GB RAM, 50 GB Temporary storage, US\$0.209/hour VIRTUAL MACHINES: 1 x 730 Hours

Savings Options

Save up to 72% on pay-as-you-go prices with 1-year or 3-year Reserved Virtual Machine Instances. Reserved Instances are great for applications with steady-state usage and applications that require reserved capacity. [Learn more about Reserved VM Instances pricing.](#)

Compute (D2 v3)	OS (Windows)	
<input checked="" type="radio"/> Pay as you go	<input checked="" type="radio"/> License included	= US\$152.57
<input type="radio"/> 1 year reserved (~62% discount)	<input type="radio"/> Azure Hybrid Benefit	Average per month (US\$0.00 charged upfront)
<input type="radio"/> 3 year reserved (~76% discount)		
US\$85.41	US\$67.16	
Average per month (US\$0.00 charged upfront)	Average per month (US\$0.00 charged upfront)	
<input type="checkbox"/> Managed Disks		US\$0.00
<input type="checkbox"/> Storage transactions		US\$0.05
		Upfront cost US\$0.00
		Monthly cost US\$152.62

Azure Cost Management

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Perform **cost-analysis**, visualize the spending of your Azure cloud resources
Create **budgets**, set a budget threshold be alerted when approaching or exceeded

