



Cloud Computing

(an Infrastructure perspective)

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Sr. Solutions Architect & DevOps Engineer

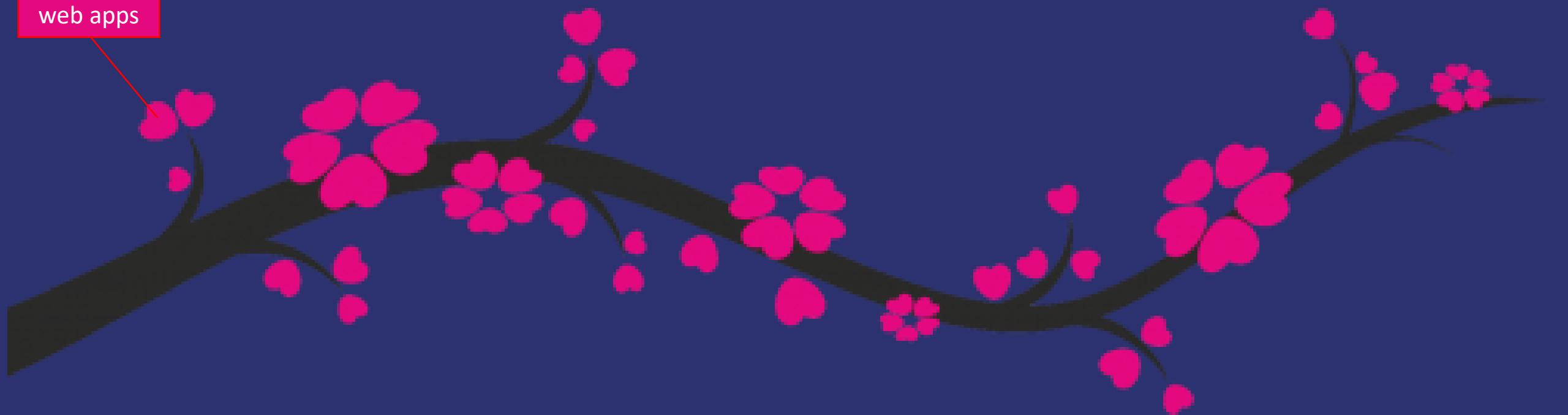


Sr. Solutions Architect
Sr. DevOps Engineer

Esther
Barthel



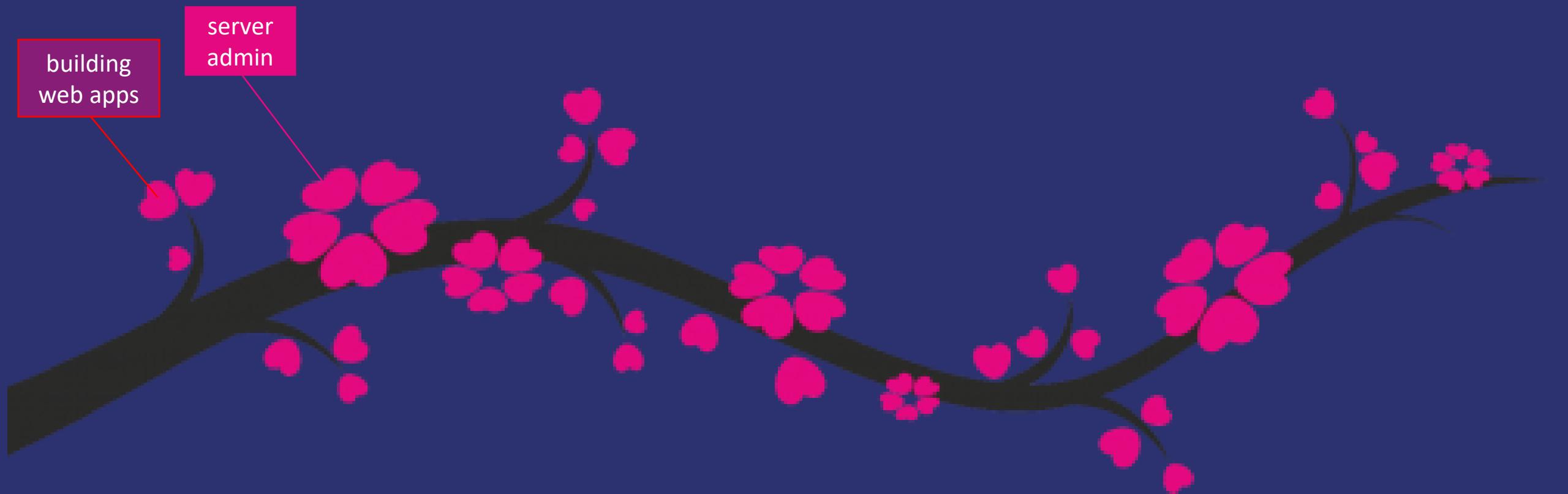
building
web apps





building
web apps

server
admin







End User Computing (EUC)
Solutions Architect

building
web apps

server
admin

Citrix
admin

Automated Infra
deployments & configurations

Sr. DevOps Engineer

IT Process automation

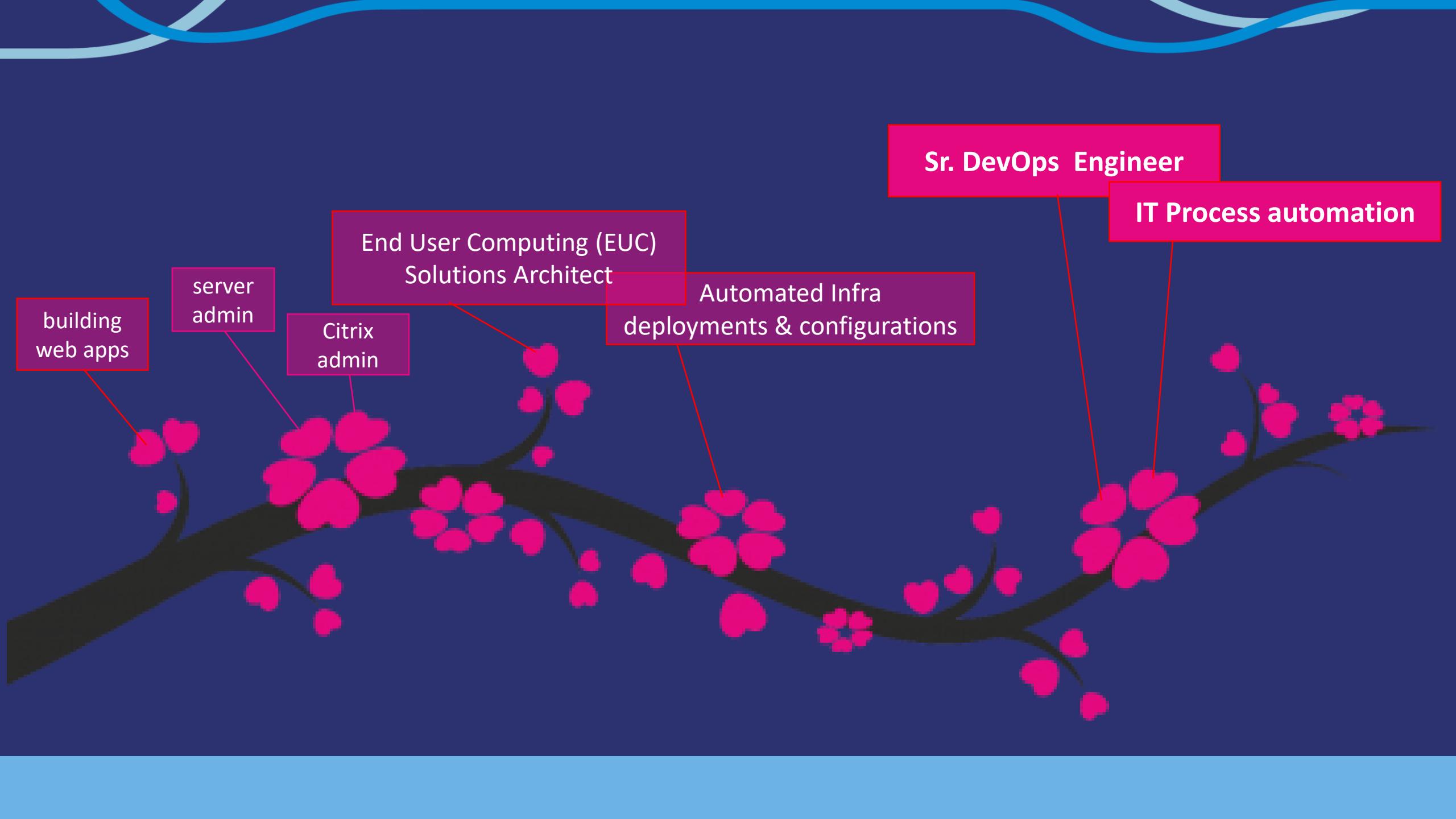
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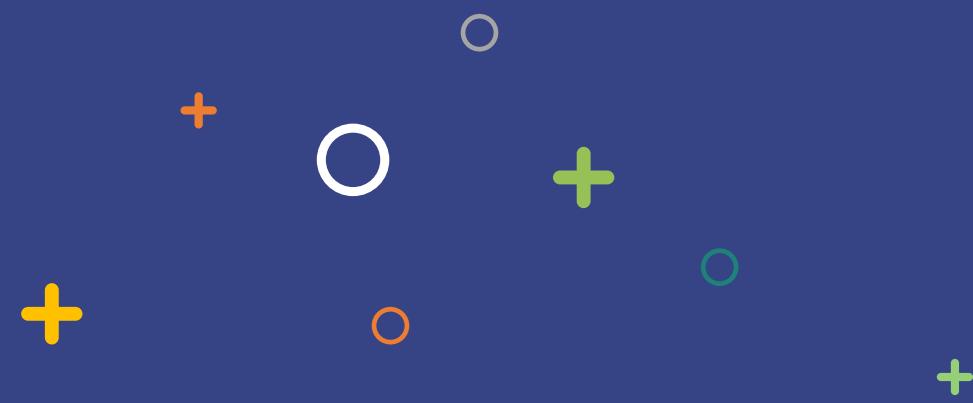


Agenda

- Cloud Computing Fundamentals
 - History of the Internet & Evolution of Cloud Computing
 - Introduction to Cloud Computing
- Cloud Computing Platforms & Tools
 - Introduction to Cloud Platform
- Optimizing Cloud Resources
 - Assessment and Optimization



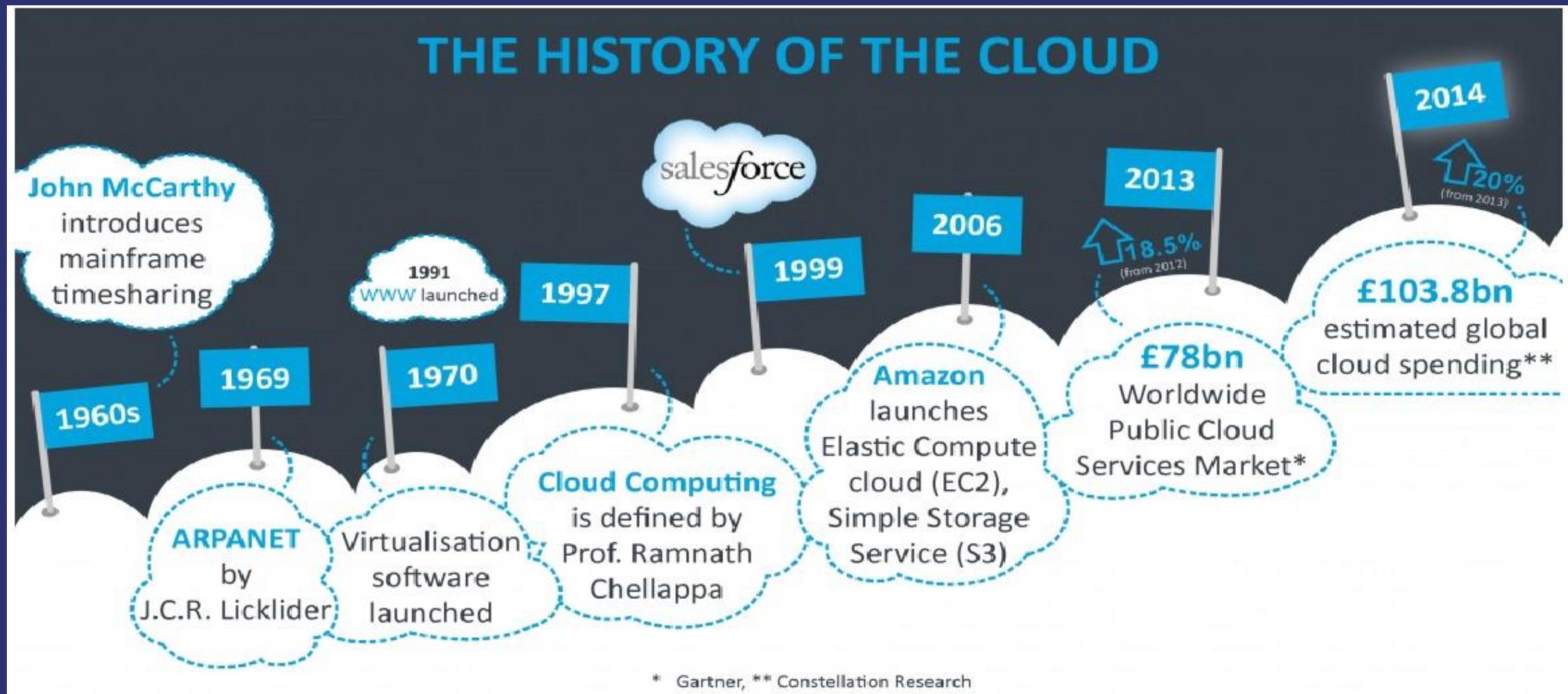
Cloud Computing Fundamentals





Evolution of Cloud Computing

Evolution of Cloud Computing



Evolution of Cloud Computing



Cloud computing timeline

Key points in the evolution and emergence of modern cloud computing.

- **1960s:** Mainframe computers become available for timesharing over telephone networks.
- **1972:** IBM develops the first virtual machine (VM).
- **1991:** The internet and WWW emerge.
- **1993:** The term “cloud” was first used to describe remote applications and services. However, use of the cloud symbol has been noted as early as the late 1970s to represent remote services.
- **1999:** VMware develops x86 systems; incorporation of Salesforce and VMware.
- **2006:** AWS introduces EC2 services.
- **2007:** Release of Google Apps suite.
- **2008:** Launch of Google App Engine.
- **2010:** Microsoft launches Microsoft Azure.
- **2011:** Microsoft launches Office 365 (SaaS).
- **2013:** Release of Docker container technology.
- **2020 and beyond:** Serverless and edge computing are expected to grow with advancements in AI and ML.

Evolution of Cloud Computing

1960-1990s: The Road to the World Wide Web

1960s: John McCarthy introduces **mainframe time-sharing**, first interactive, general-purpose time-sharing system usable for software development.

1969: Launch of **ARPANET**, marking the beginning of networked communication.

1983: Internet Protocol (IP) adoption standardizes **TCP/IP**, laying the groundwork for future internet connectivity.

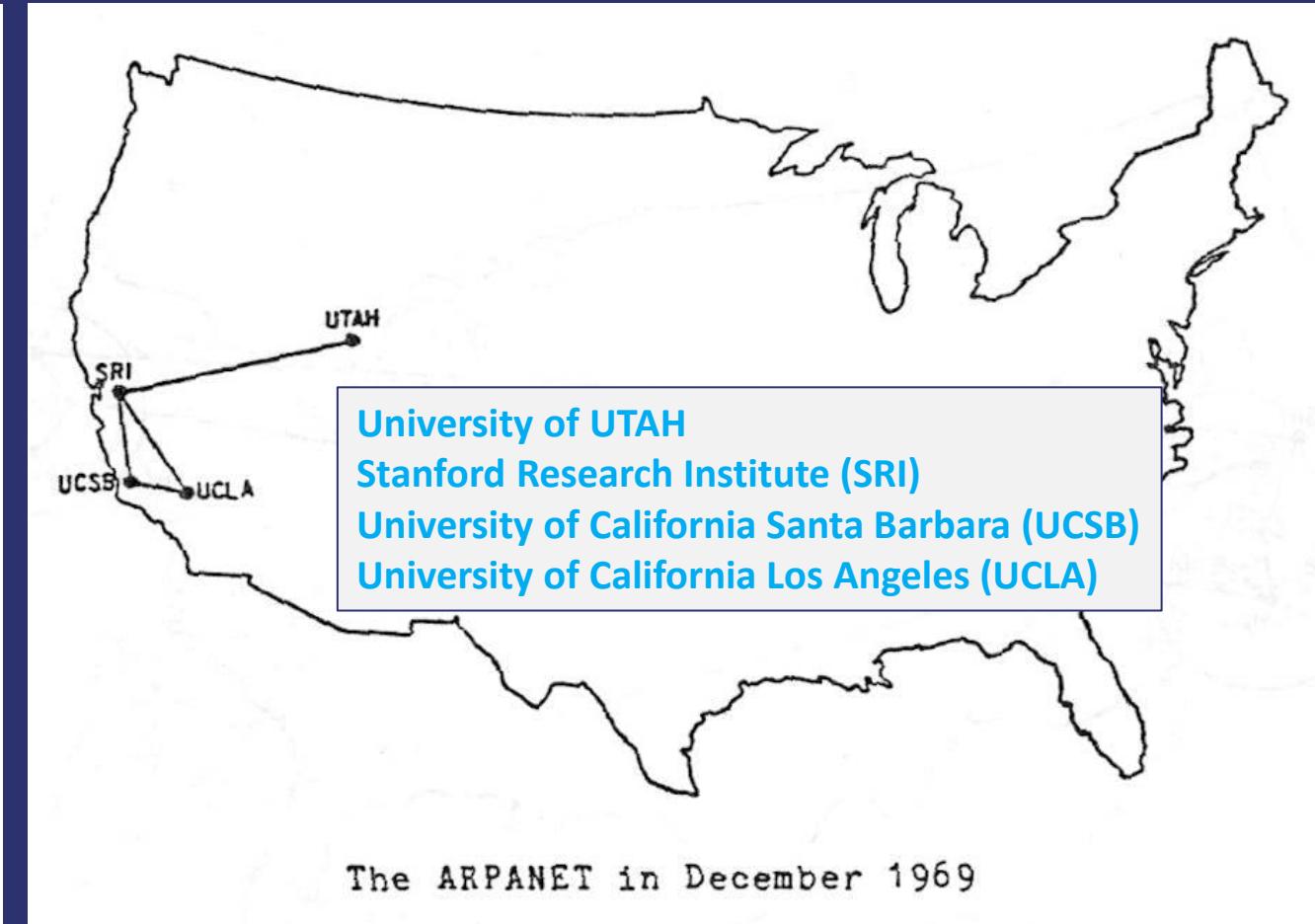
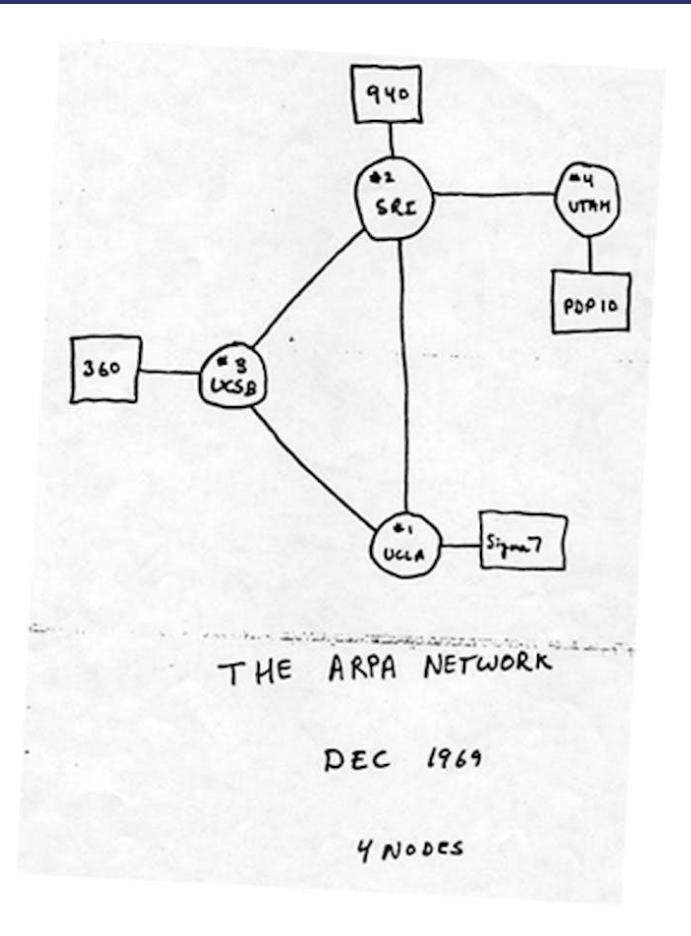
Evolution of Cloud Computing

The Advanced Research Projects Agency Network (ARPANET)

- World's first packet switching network.
- Made by **(Defense) Advanced Research Projects Agency ((D)ARPA)** of the United States Department of Defense (DoD).
- Main network of a set that came to make up the global Internet.

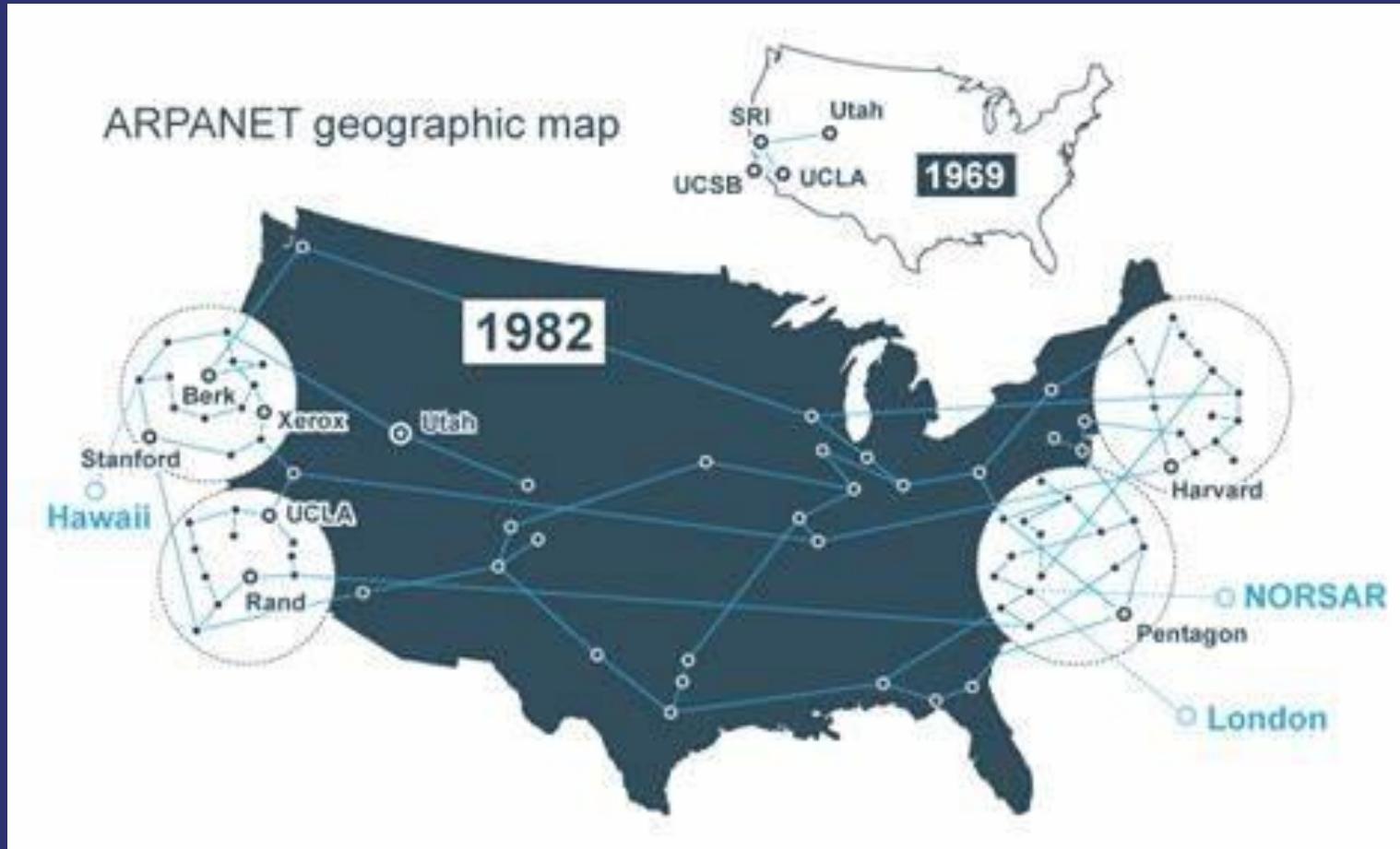
Evolution of Cloud Computing

The Advanced Research Projects Agency Network (ARPANET)



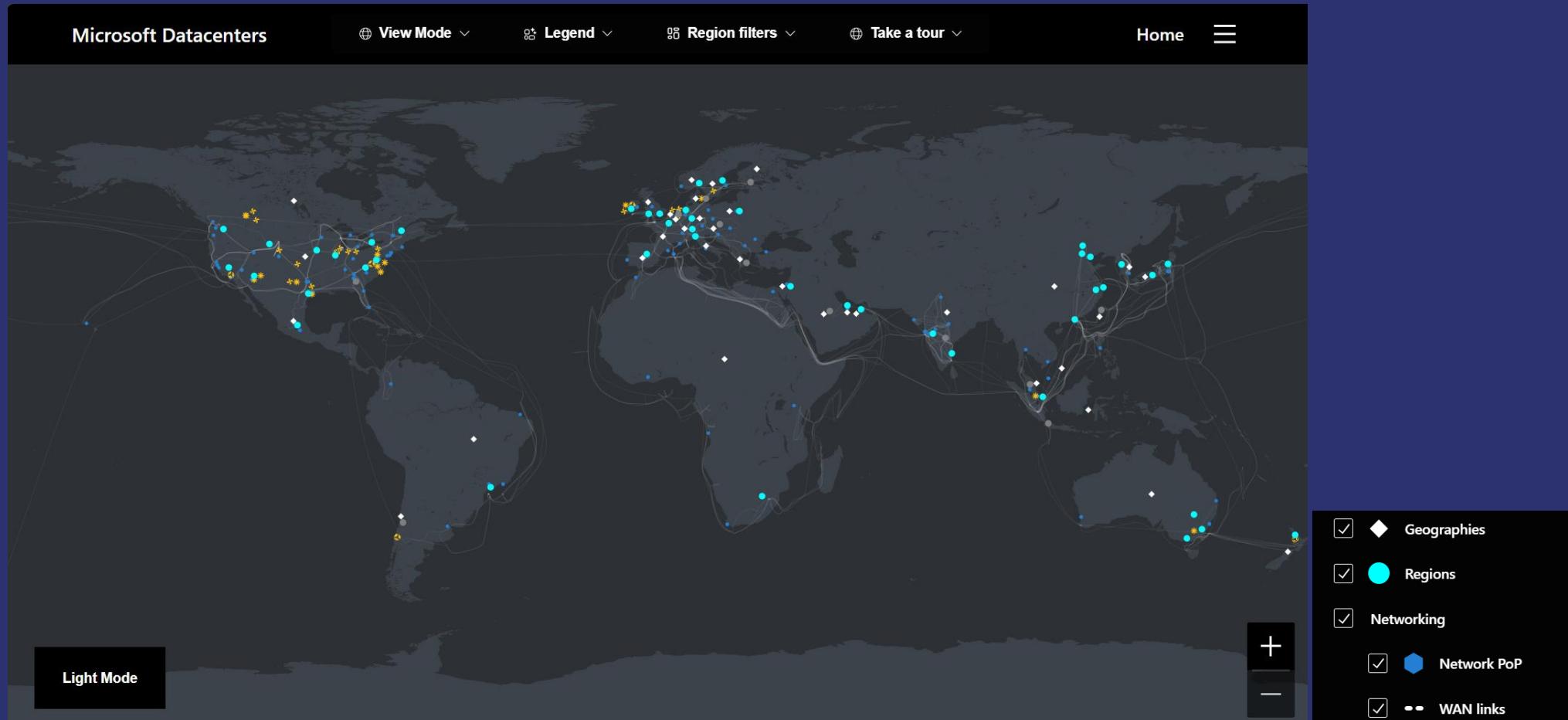
Evolution of Cloud Computing

The Advanced Research Projects Agency Network (ARPANET)



Evolution of Cloud Computing

The Advanced Research Projects Agency Network (ARPANET)



Evolution of Cloud Computing

1990-2000s: The World Wide Web Revolution

1991: The **Internet** and **World Wide Web (WWW)** emerge.

1993: First use of the term "**cloud**".

1999: VMware develops **x86 systems**,
Salesforce builds first **SaaS** application.

Evolution of Cloud Computing

2000-2011: From Niche to Everywhere

- 2002: Amazon launches **Amazon Web Services**, offering foundational cloud services like storage and computation.
- 2006: Amazon introduces **Elastic Compute Cloud (EC2)**, pivotal moment, allowing users to rent virtual computers.
- 2008: Google launches **Google App Engine**, significantly advancing cloud application hosting.
- 2010: Microsoft launches **Microsoft Azure**
- 2011: Microsoft launches **Office 365 (SaaS)**

Evolution of Cloud Computing

2012-2020: Rapid Development of Cloud Computing

2012: Oracle enters cloud services and introduces **Oracle Cloud**, offering a comprehensive suite of servers, storage, and applications.

2016: Google Cloud Platform announces **Google Kubernetes Engine**, pioneering managed container services.

2018: Google unveils **Anthos**, facilitating application management in both cloud and on-premises environments.

Evolution of Cloud Computing

2012-2020: Rapid Development of Cloud Computing

2019: Microsoft Azure introduces **Azure Arc**, further blurring the lines between local and cloud computing environments by enabling services to run across various platforms.

Evolution of Cloud Computing

2021-2025: AI, ML, Green Computing

2021: **Kubernetes** and cloud-native technologies significantly advance, indicating shift towards more agile & scalable cloud infrastructures.

2022: Cloud becomes primary platform for **AI & ML innovations**, providers offering specialized tools for these technologies.

2024: **Sustainability** becomes core focus in cloud computing, major efforts towards using renewable energy and enhancing data center efficiency.

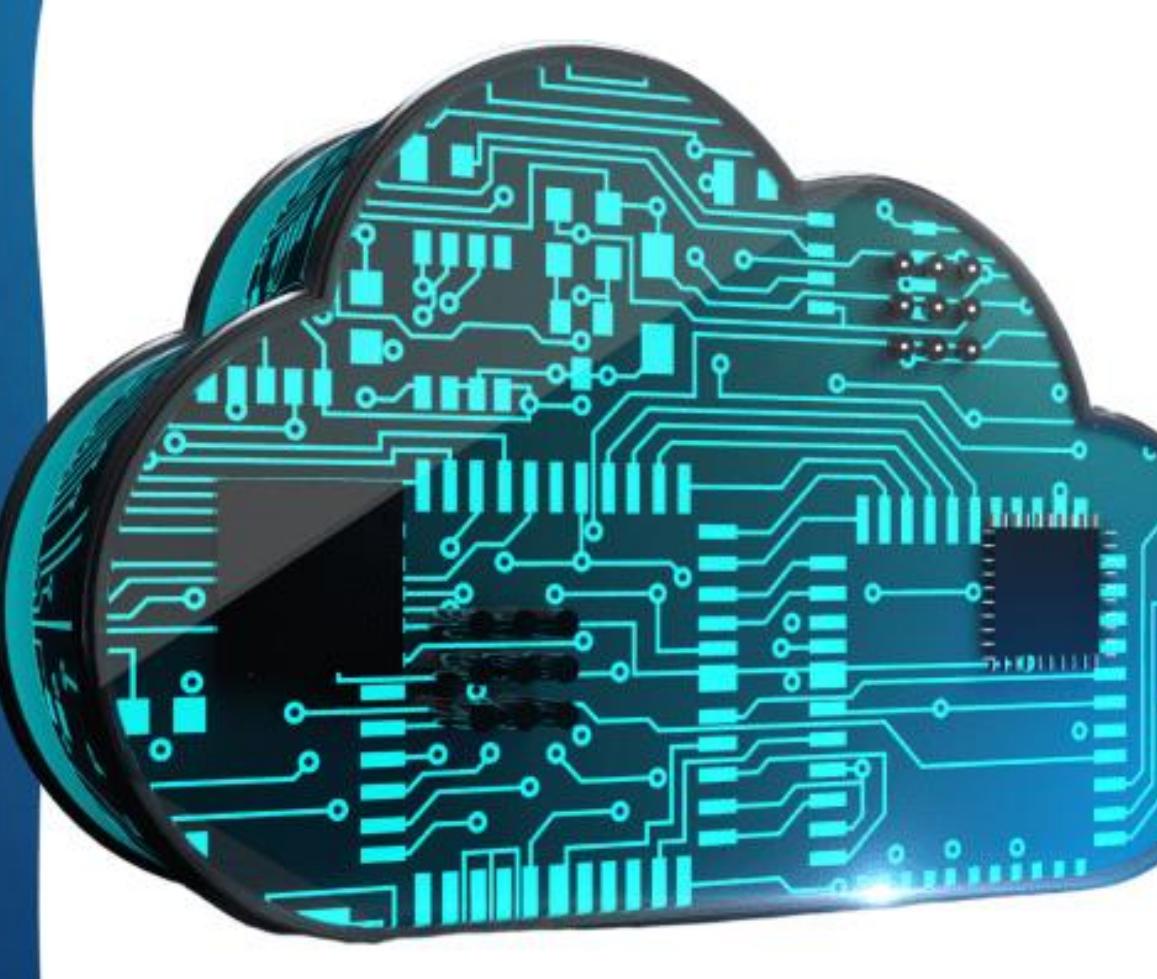


What is Cloud Computing?



What is Cloud Computing?

**THERE IS NO
SUCH THING AS
“THE CLOUD” –
IT’S JUST
SOMEONE
ELSE’S
COMPUTERS**

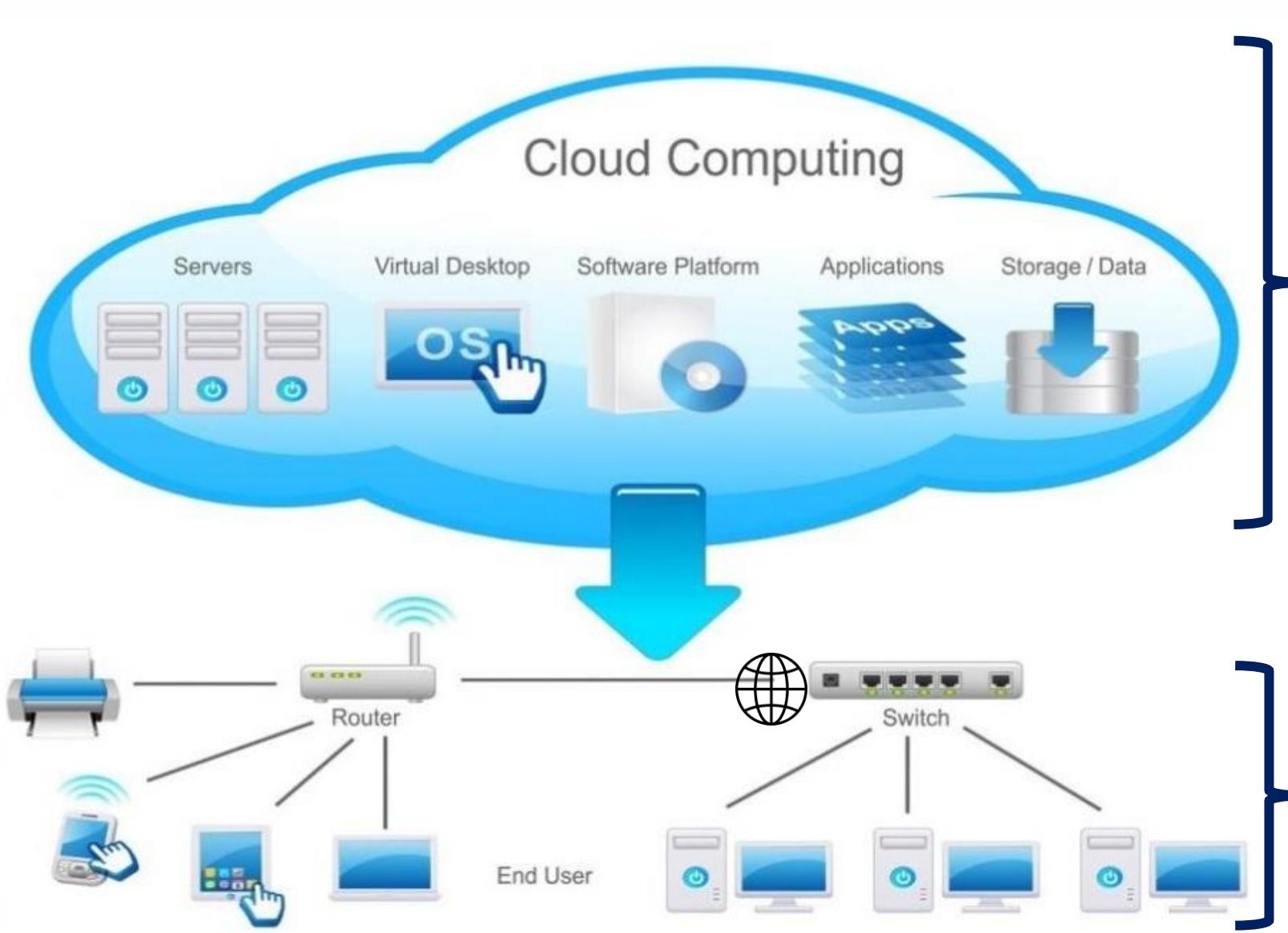


What is Cloud Computing?

*the **delivery** of **computing services** over the **Internet***

-- including servers, storage, databases, networking, software, analytics, and intelligence --

*to offer **faster innovation, flexible resources,**
and **economies of scale.***



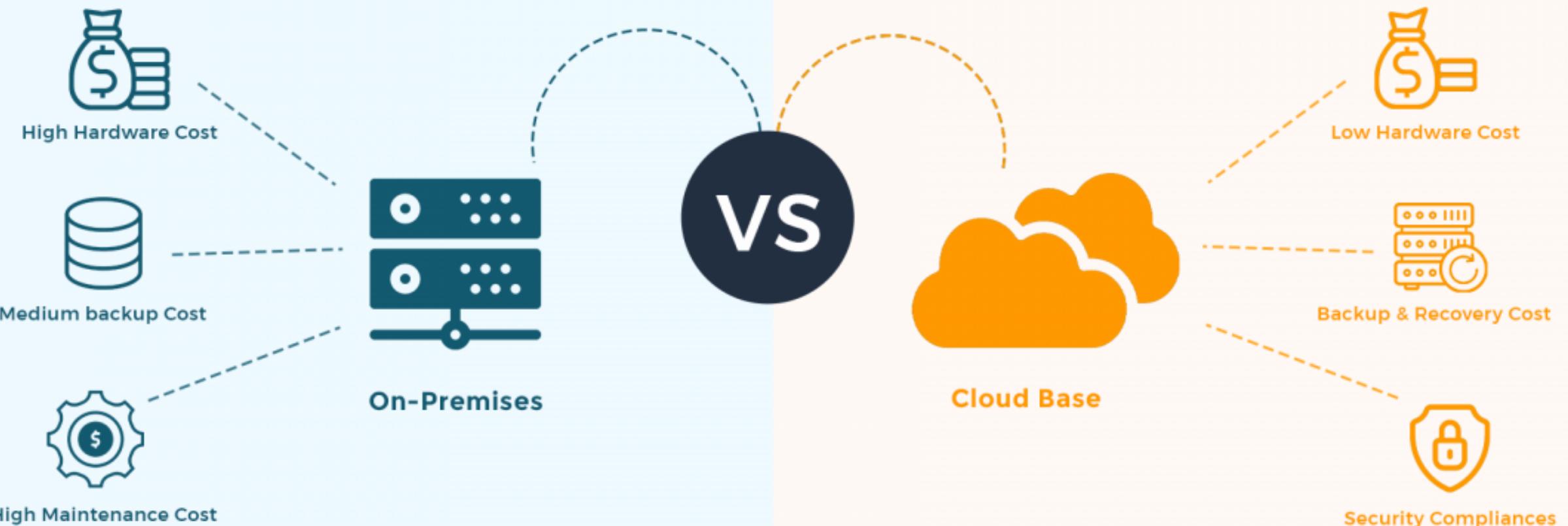
Cloud Service Provider

Client Infrastructure

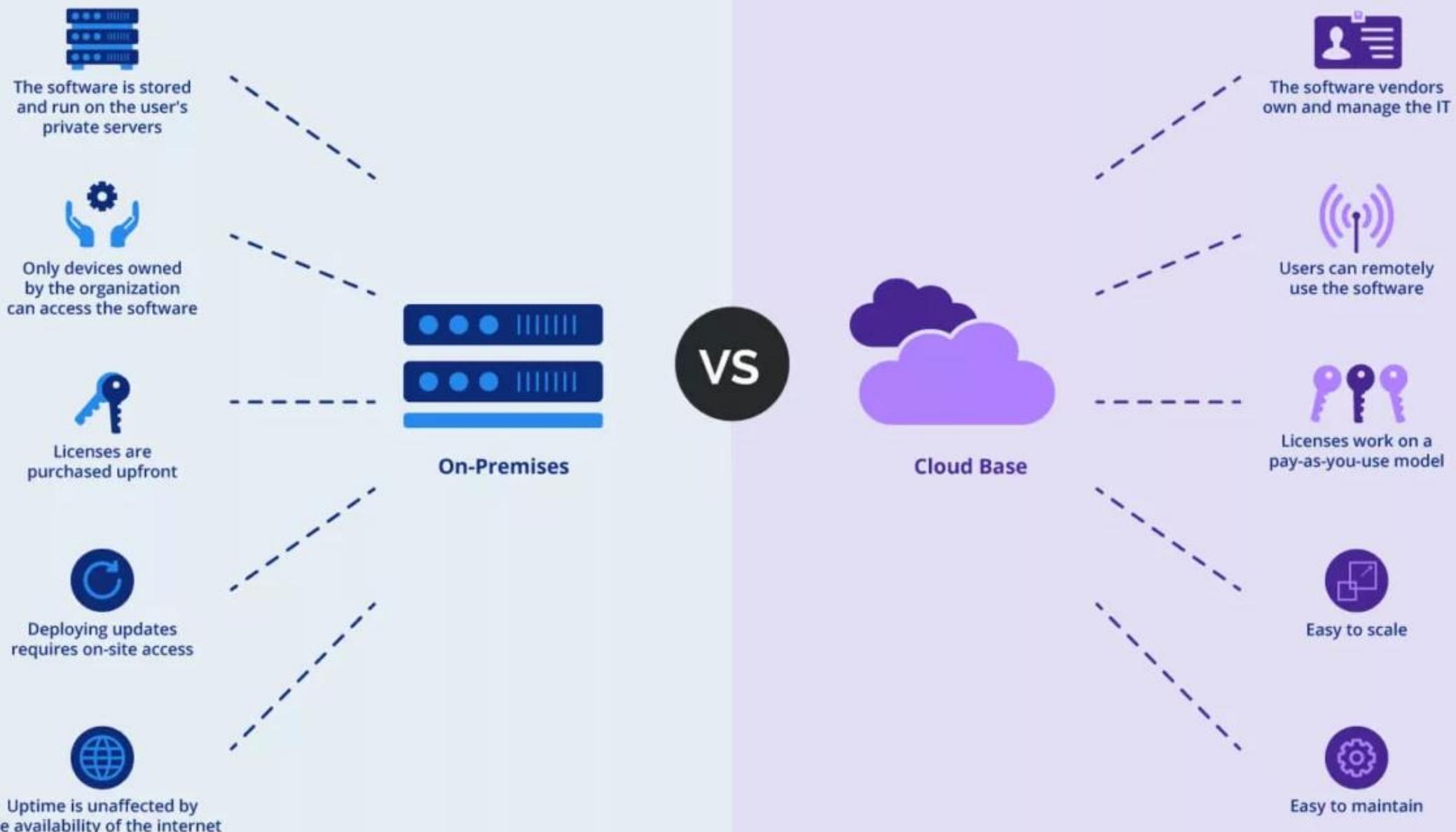


On-premises vs Cloud Computing

On-Premises VS Cloud Base



On-Premises VS Cloud Base



Benefits of Cloud Computing Framework

Scalability and Flexibility

Enhanced Efficiency

Cost Optimization

Improved Security

Simplified Management

Collaboration and Accessibility

Compliance and Regulatory Support

Multi-Cloud and Hybrid Cloud Strategies

Cloud computing benefits

- **Scalability:** scale (on-demand) as business needs change
- **Resilience:** recover quickly from (hardware) failures

Cloud computing - scalability

Ability of a system to handle an **increasing amount of work** by **adding resources** to the system, using either **scaling up** (adding more power to existing resources) or **scaling out** (adding more resources).

Cloud computing - scalability

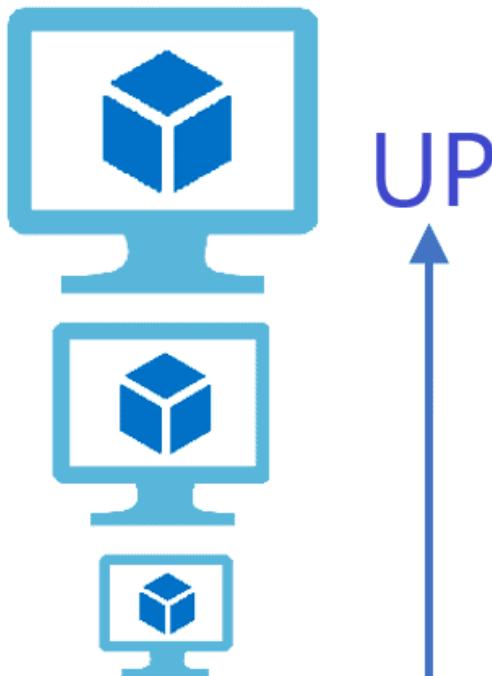
Ability of a system to handle an **increasing amount of work** by **adding resources** to the system, using either **scaling up** (adding more power to existing resources) or **scaling out** (adding more resources).

ensures applications can grow with demand without compromising performance or reliability.

Cloud computing - scalability

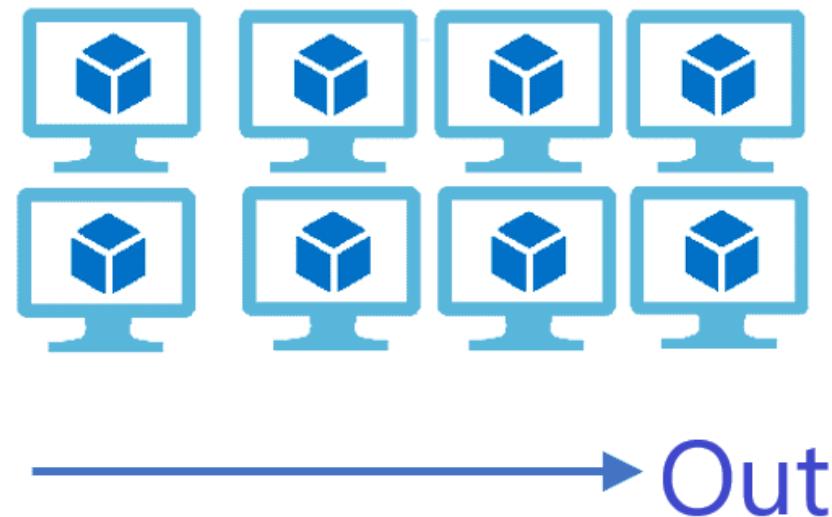
Vertical Scaling

(Increase size of instance (RAM , CPU etc.))



Horizontal Scaling

(Add more instances)



Cloud computing - resilience

Ability of a system to **recover quickly from failures** and continue operating.

It involves implementing strategies and architectures that ensure **continuous availability and reliability** of services, even in the face of disruptions such as hardware failures, network issues, or other unforeseen incidents..

Cloud computing - resilience





Cloud Computing service models

Cloud computing service models

SaaS Software as a service	PaaS Platform as a service	IaaS Infrastructure as a service
A software distribution model in which a third-party provider hosts applications and makes them available to customers over the internet.	A model in which a third-party provider hosts application development platforms and tools on its own infrastructure and makes them available to customers over the internet.	A model in which a third-party provider hosts servers, storage and other virtualized compute resources and makes them available to customers over the internet.
EXAMPLES: Salesforce, NetSuite and Concur	EXAMPLES: AWS Elastic Beanstalk, Google App Engine and Heroku	EXAMPLES: AWS, Microsoft Azure and Google Compute Engine

Cloud computing service models

SaaS Software as a service	PaaS Platform as a service	IaaS Infrastructure as a service	FaaS Function as a service
A software distribution model in which a third-party provider hosts applications and makes them available to customers over the internet. EXAMPLES: Salesforce, NetSuite and Concur	A model in which a third-party provider hosts application development platforms and tools on its own infrastructure and makes them available to customers over the internet. EXAMPLES: AWS Elastic Beanstalk, Google App Engine and Heroku	A model in which a third-party provider hosts servers, storage and other virtualized compute resources and makes them available to customers over the internet. EXAMPLES: AWS, Microsoft Azure and Google Compute Engine	A serverless computing model that lets users run code in the cloud without worrying about the underlying infrastructure. Functions that respond to events or triggers can be deployed in this model. EXAMPLES: IBM Cloud Function, AWS Lambda, Microsoft Azure Functions, Google Cloud Functions and OpenFaas

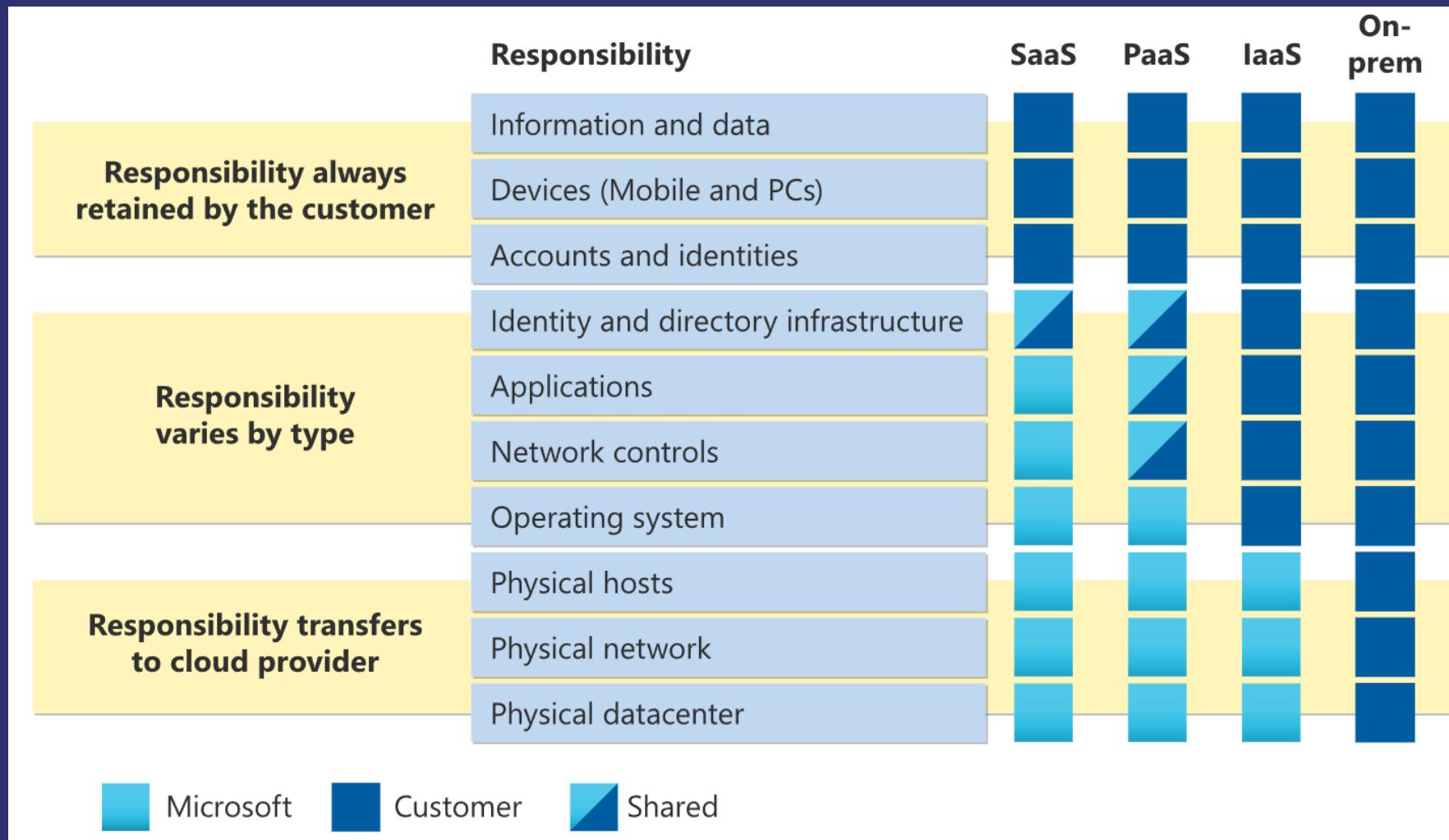
Cloud computing service models

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EXAMPLES: Salesforce, NetSuite and Concur	EXAMPLES: AWS Elastic Beanstalk, Google App Engine and Heroku	EXAMPLES: AWS, Microsoft Azure and Google Compute Engine	AlaaS AI as a service
			MaaS Monitoring as a service
			VaaS Video as a service

Cloud computing service models

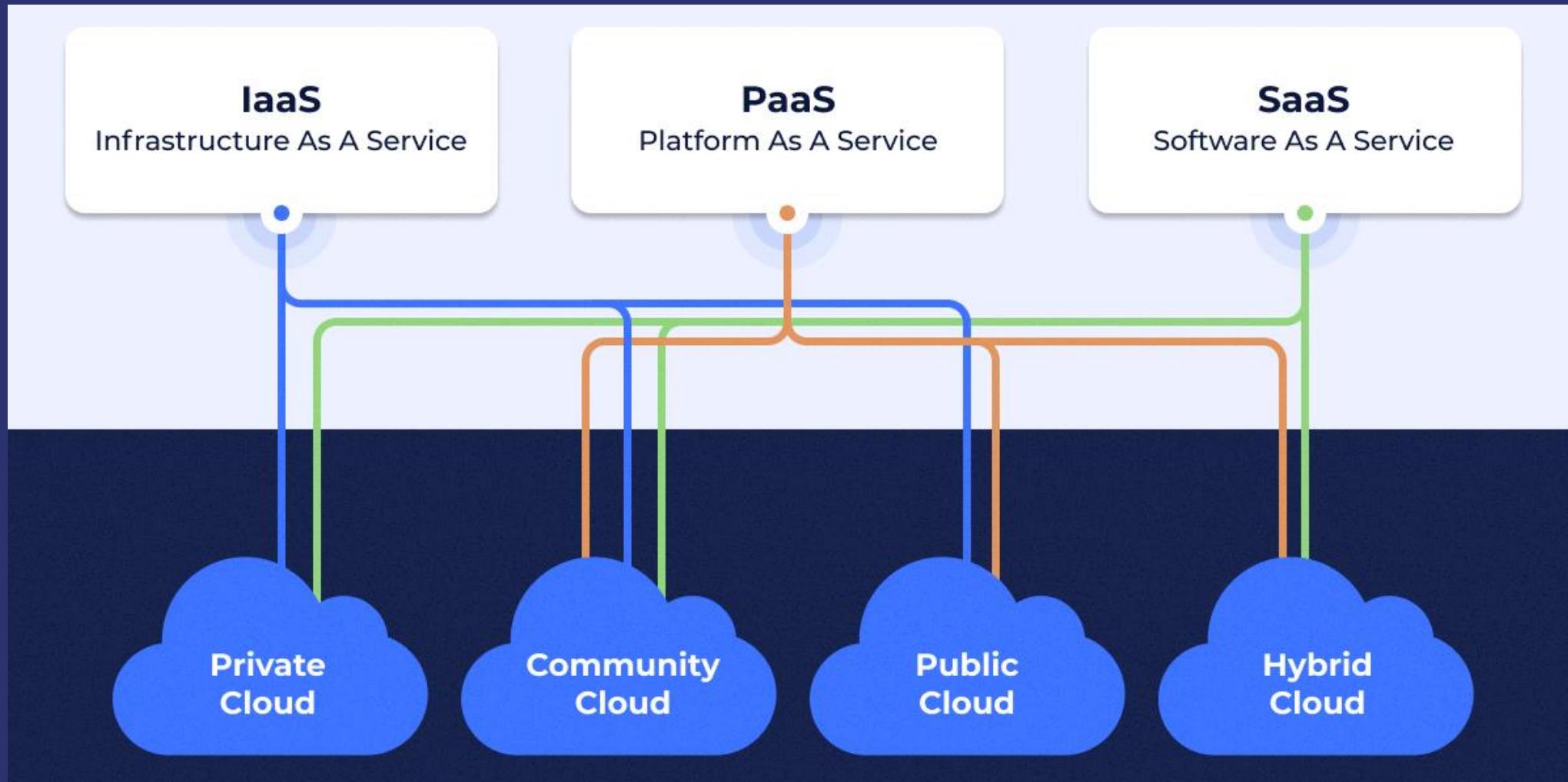
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Cloud computing shared responsibility

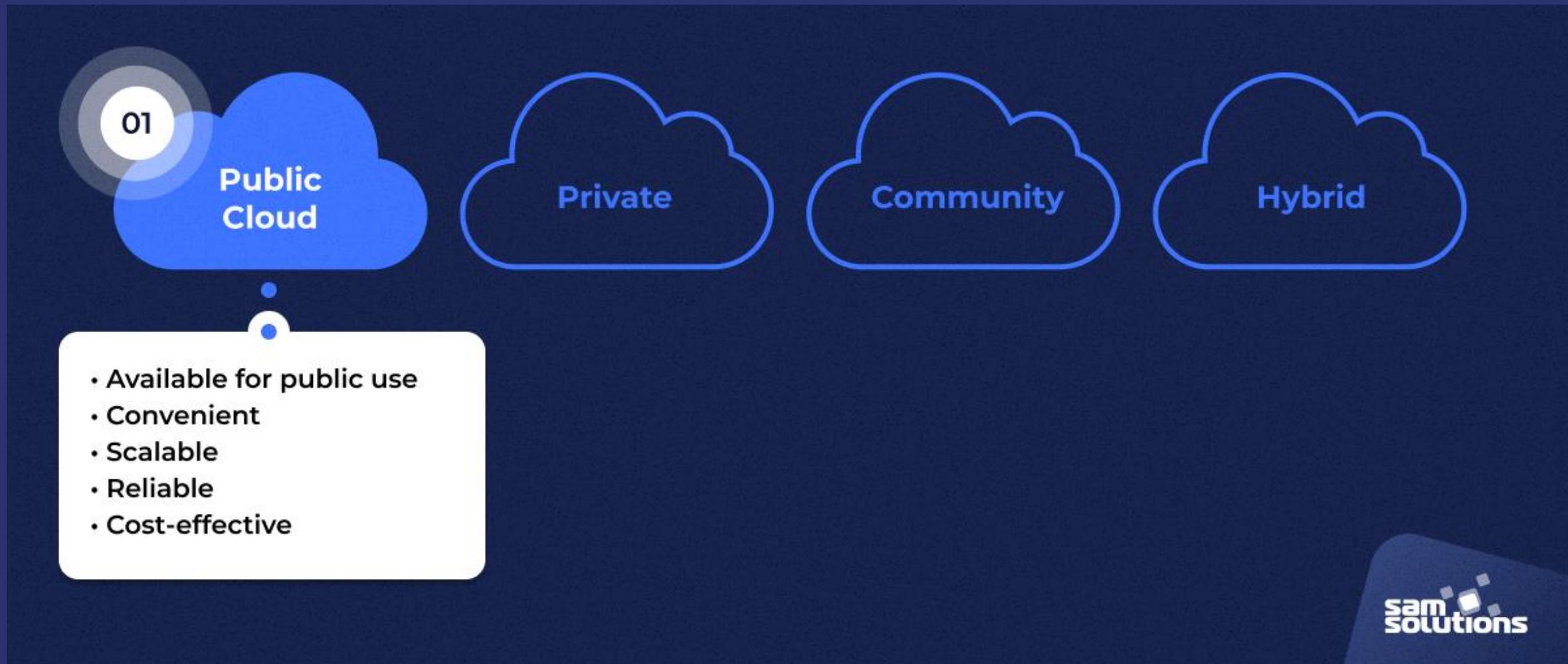


Cloud Computing deployment models

Cloud computing deployment models



Cloud computing deployment models



Public Cloud

Advantages

- Convenience
- Reliability
- Scalability



Disadvantages

- Potential security issues
- Simplicity
- Potential diminished reliability



Cloud computing deployment models



Private Cloud

Advantages

- Security & Privacy
- Customization
- Reliability



Disadvantages

- Potential higher initial cost



Cloud computing deployment models



Community Cloud

Advantages

- Cost savings
- Security and privacy
- Collaboration

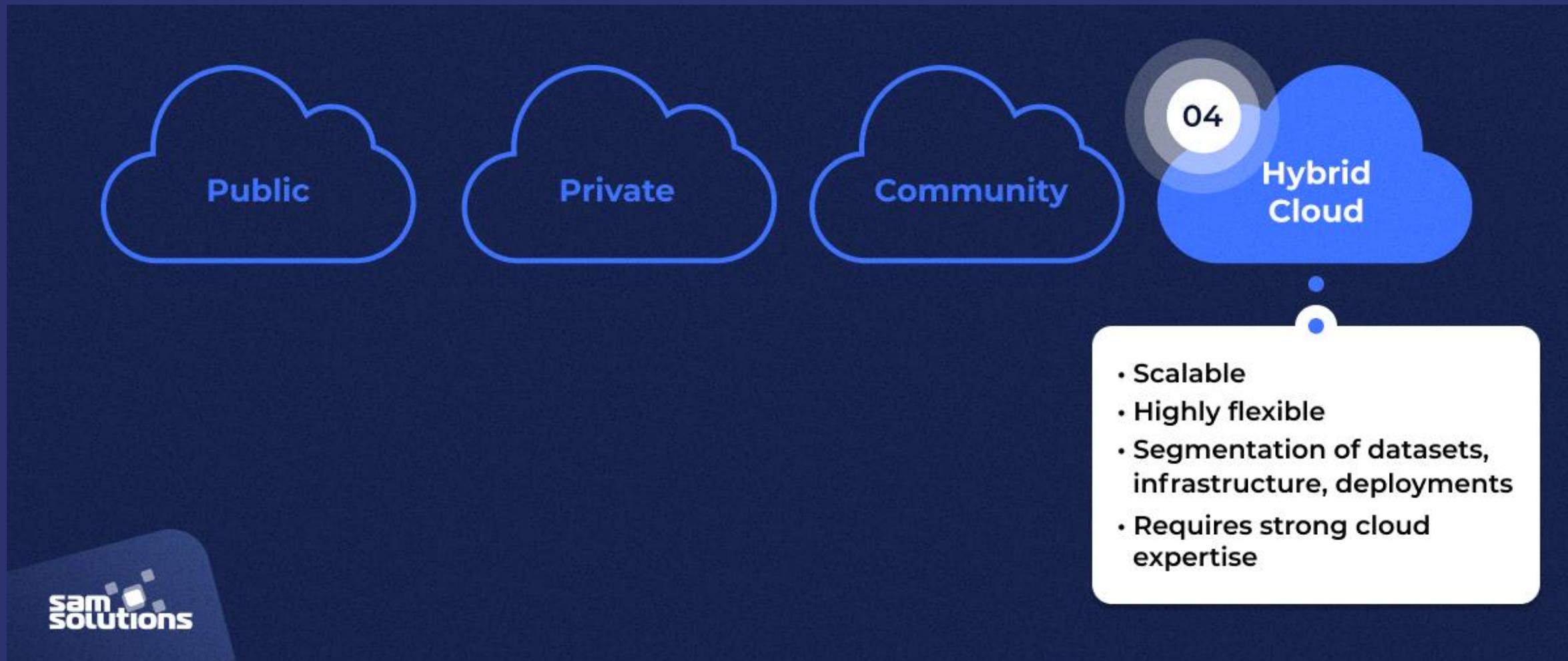


Disadvantages

- Rarity
- Relatively high costs
- Limited bandwidth and storage



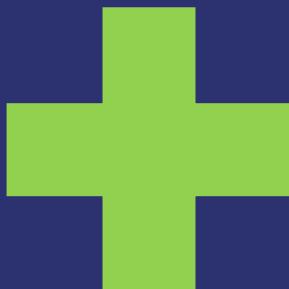
Cloud computing deployment models



Hybrid Cloud

Advantages

- Security and privacy
- Potential cost savings
- Superior flexibility and scalability



Disadvantages

- Potential complex implementation



Cloud computing deployment models - comparison

	Public Cloud	Private Cloud	Community Cloud	Hybrid Cloud
Setup and Use	Handle In-house	Requires IT Professionals	Requires IT Professionals	Requires IT Professionals
Privacy and Security	Low	High	Medium	Varies from low to high
Control of Data	Low	High	Medium	Medium
Overall Reliability	Medium	High	Medium	Medium to high

Cloud computing deployment models - comparison

	Public Cloud	Private Cloud	Community Cloud	Hybrid Cloud
Flexibility and Scalability	High	Medium (stable capacity)	Medium (stable capacity)	Very high
Cost	Lowest	Relatively high	Variable	Medium/ Variable
Hardware	Third-party	Variable (can be on-site or third-party)	Variable	Medium/ Variable

QUIZ
Time





Cloud Platforms and Tools



Cloud Computing platforms

Cloud computing platforms



- Most popular:
 - Amazon Web Services (AWS)
 - Microsoft Azure
 - Google Cloud
- Others
 - Alibaba | IBM | Salesforce | Tencent | Oracle



Cloud computing platforms market share



source: statica.com data for Q3 2024

Cloud computing platforms

PRODUCT	aws	Microsoft Azure	Google Cloud Platform
Virtual Servers	Instances	VMs	VM Instances
Platform-as-a-Service	Elastic Beanstalk	Cloud Services	App Engine
Serverless Computing	Lambda	Azure Functions	Cloud Functions
Docker Management	ECS	Container Service	Container Engine
Kubernetes Management	EKS	Kubernetes Service	Kubernetes Engine
Object Storage	S3	Block Blob	Cloud Storage
Archive Storage	Glacier	Archive Storage	Coldline
File Storage	EFS	Azure Files	ZFS / Avere
Global Content Delivery	CloudFront	Delivery Network	Cloud CDN
Managed Data Warehouse	Redshift	SQL Warehouse	Big Query

source: res.cloudordinary.com

Cloud computing platforms



Strengths

- Dominance in the market
- Extensive, mature offerings
- Support for large organizations
- Extensive training
- Global reach

Weaknesses

- Difficult to use
- Cost management
- Overwhelming options

Strengths

- Second largest provider
- Integration with Microsoft tools and software
- Broad feature set
- Hybrid cloud
- Support for open source

Weaknesses

- Issues with documentation
- Incomplete management tooling

Strengths

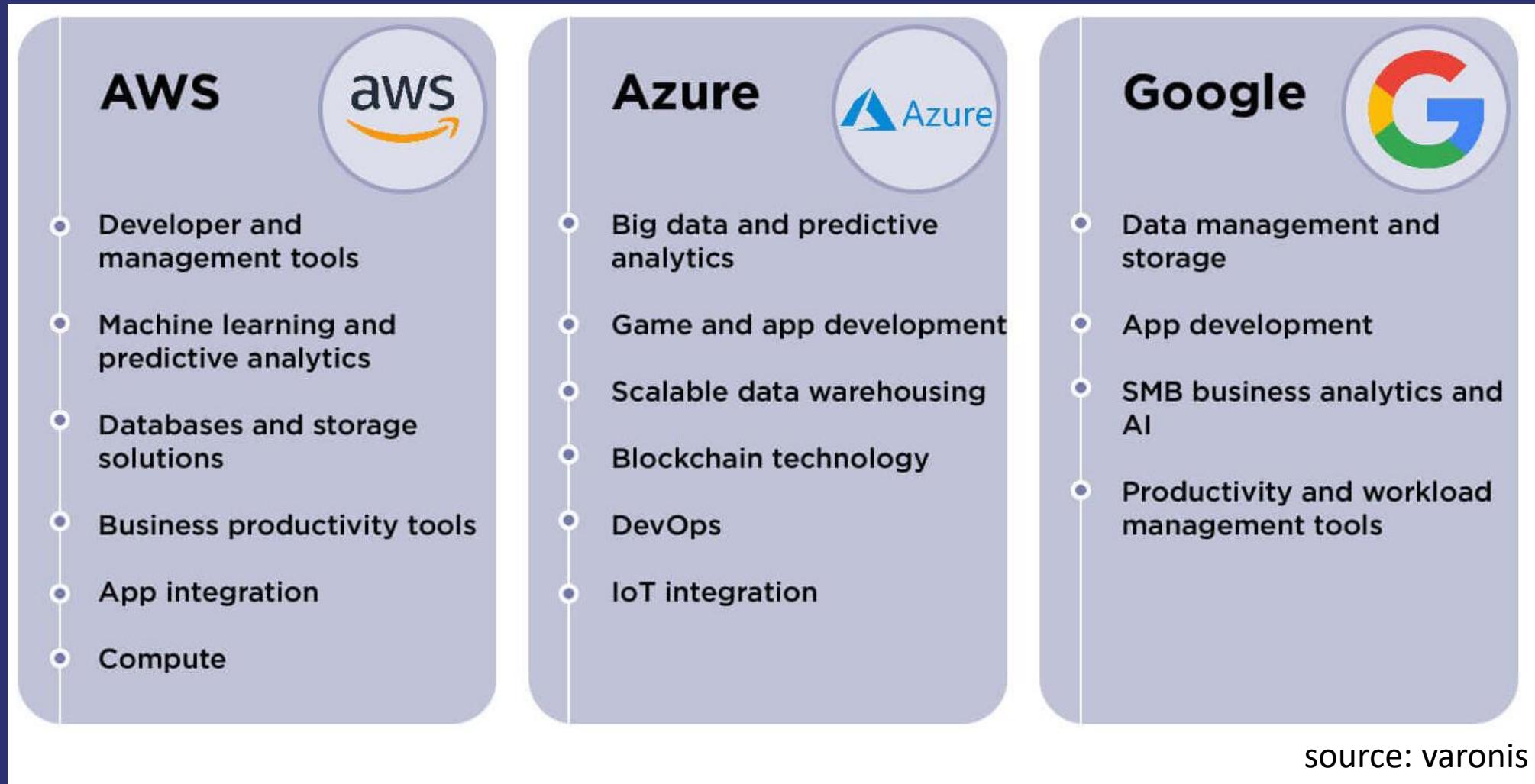
- Designed for cloud-native businesses
- Commitment to open source & portability
- Deep discounts & flexible contracts
- DevOps expertise

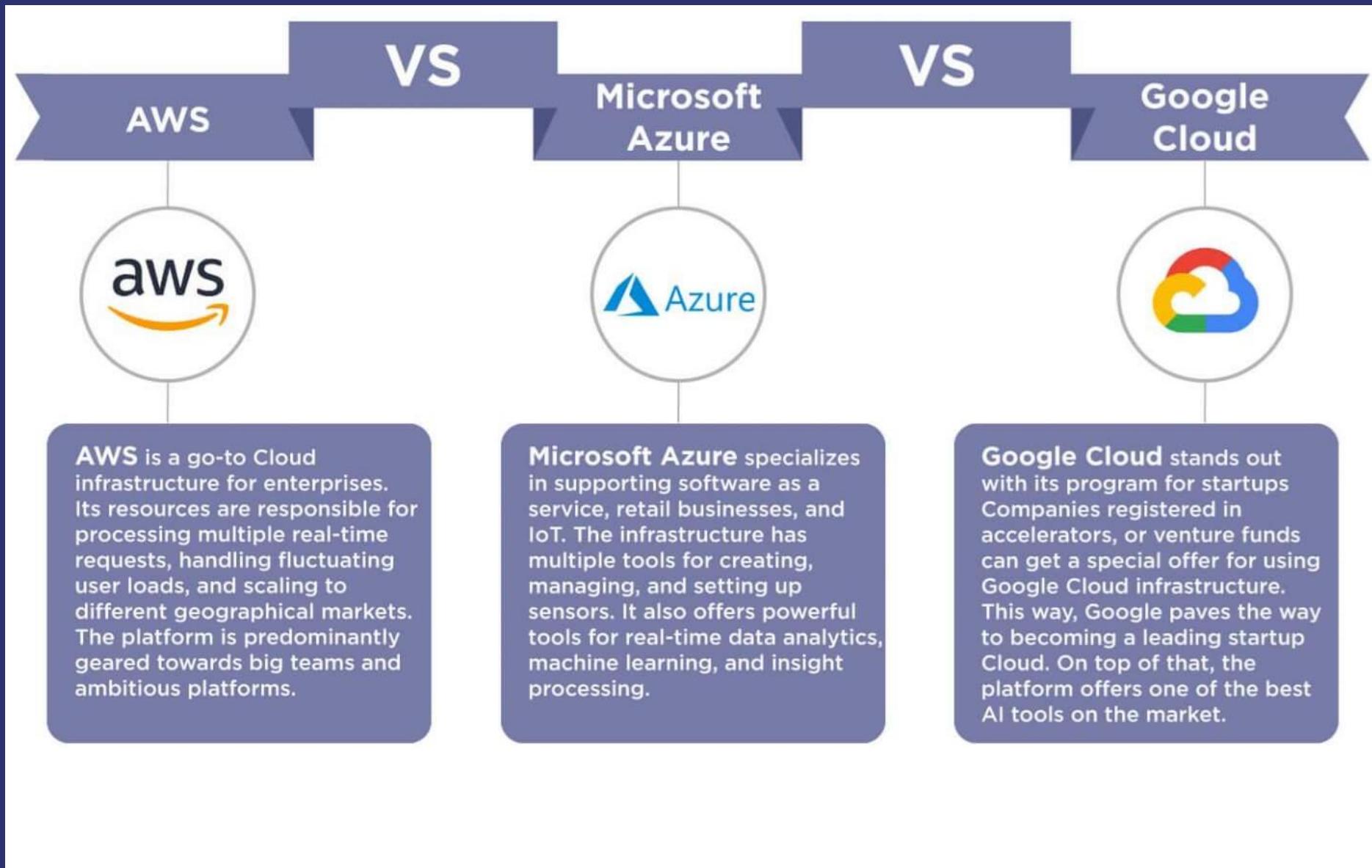
Weaknesses

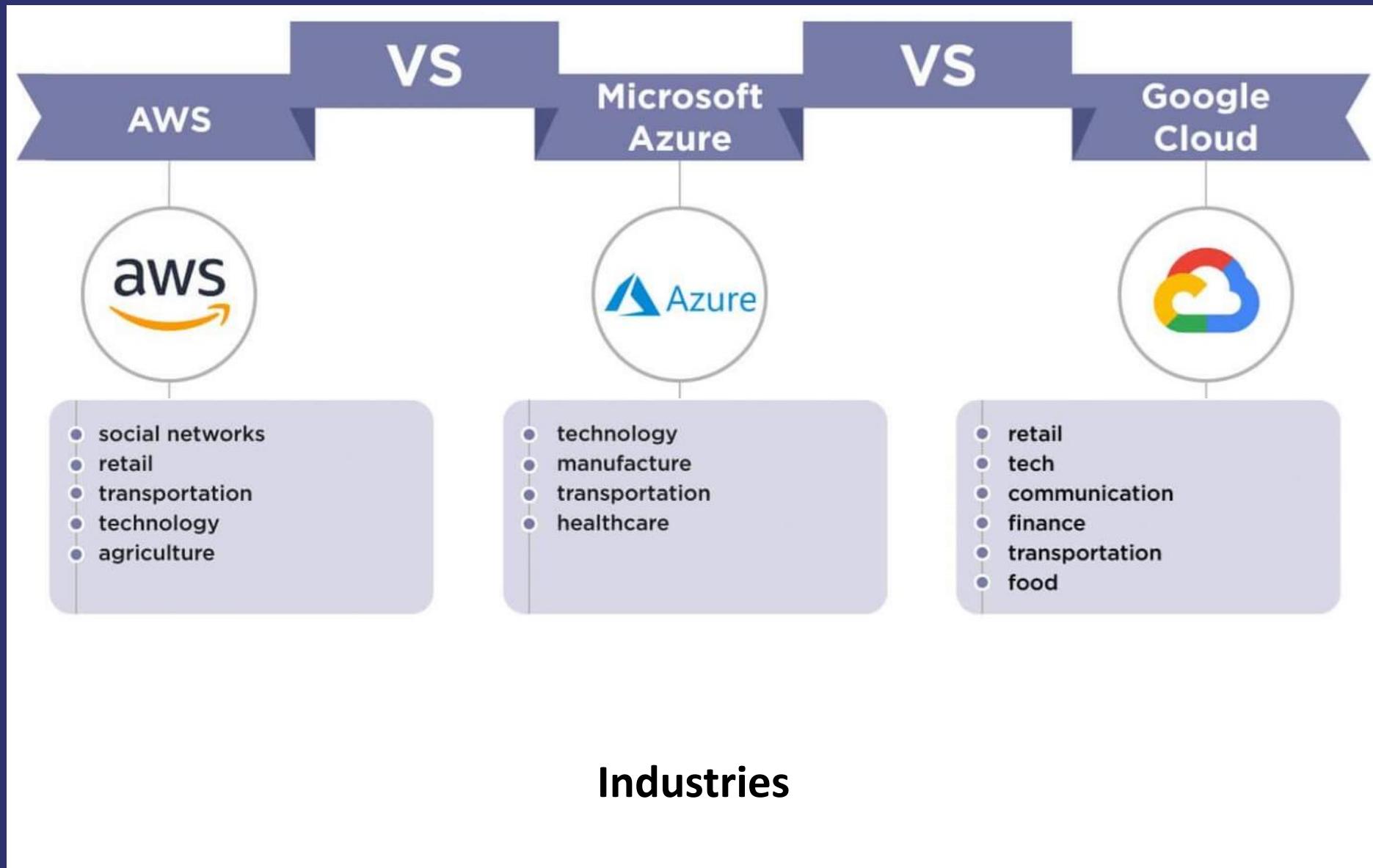
- Late entrant to IaaS market
- Fewer features and services
- Historically not as enterprise focused

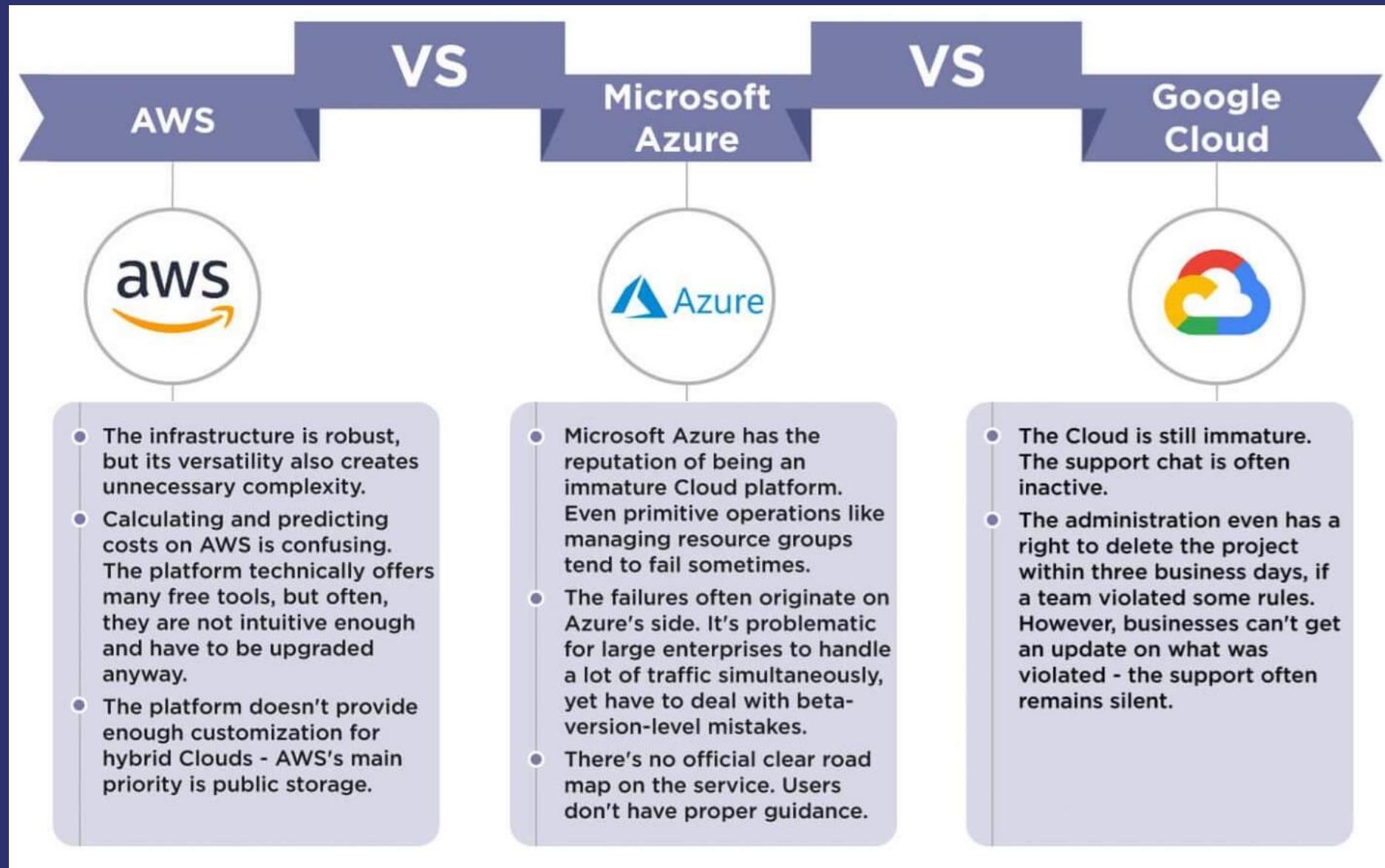
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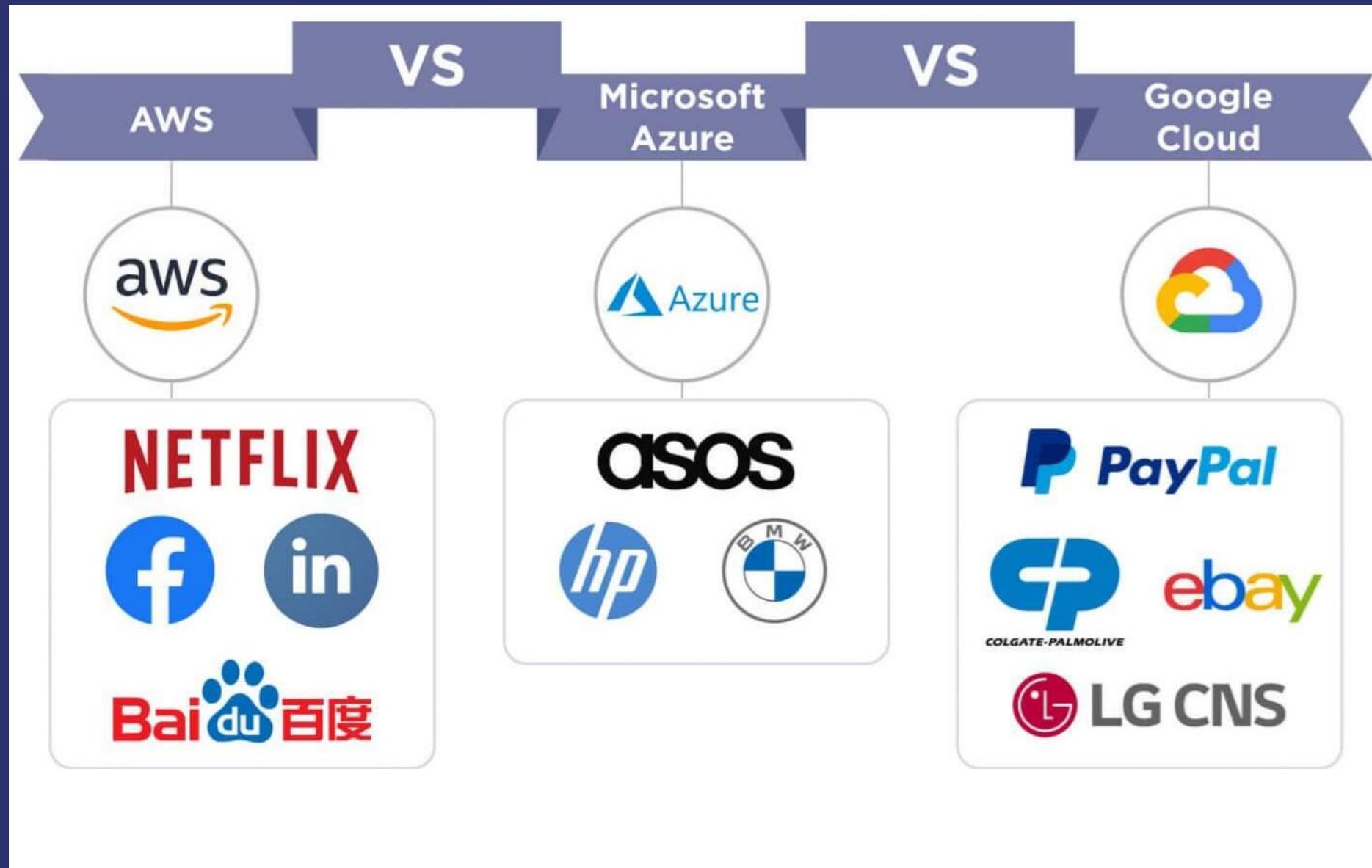
Cloud computing platforms – use cases













Cloud Computing Tools

Azure Virtual Machine

Azure Virtual Machine

One of several types of **on-demand, scalable computing resources** that Azure offers.

An Azure virtual machine gives you the **flexibility of virtualization** without having to buy and maintain the physical hardware that runs it.

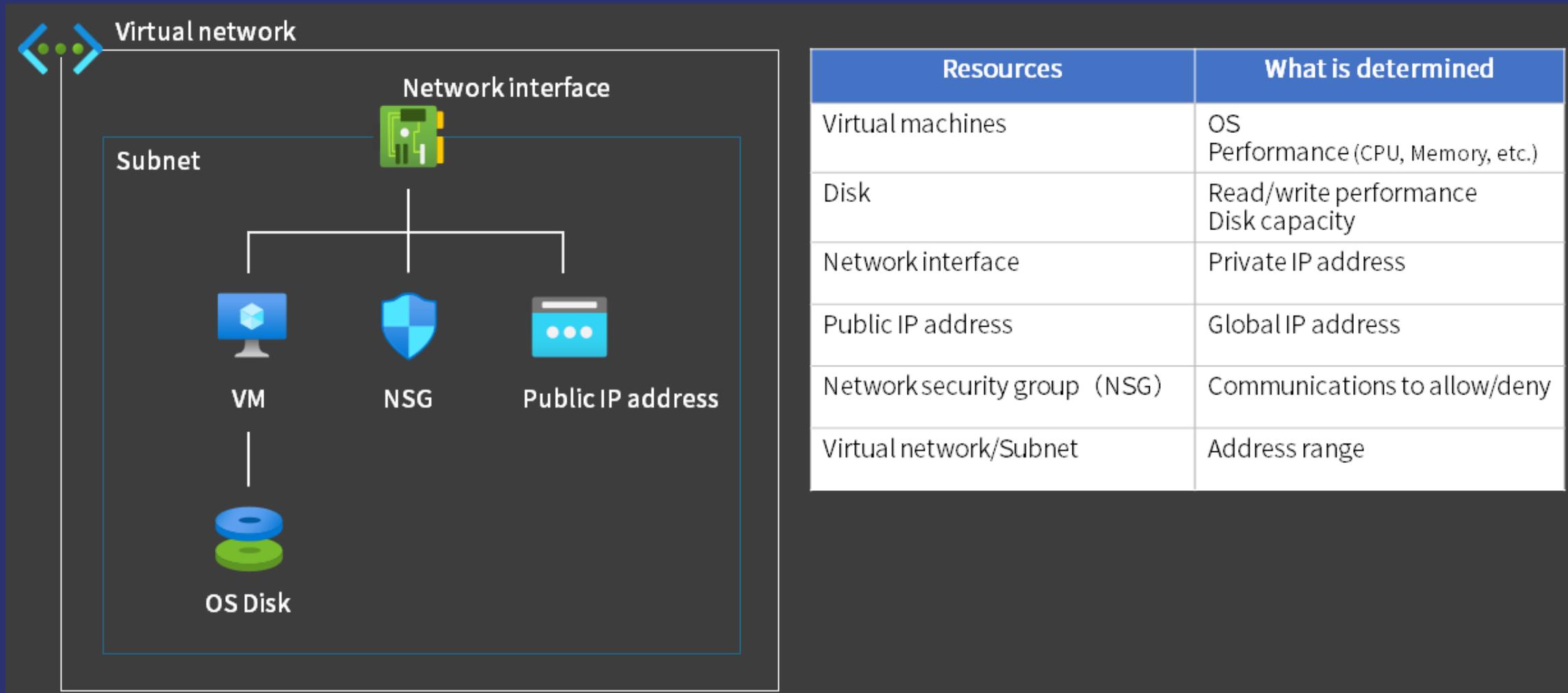
Azure Virtual Machine

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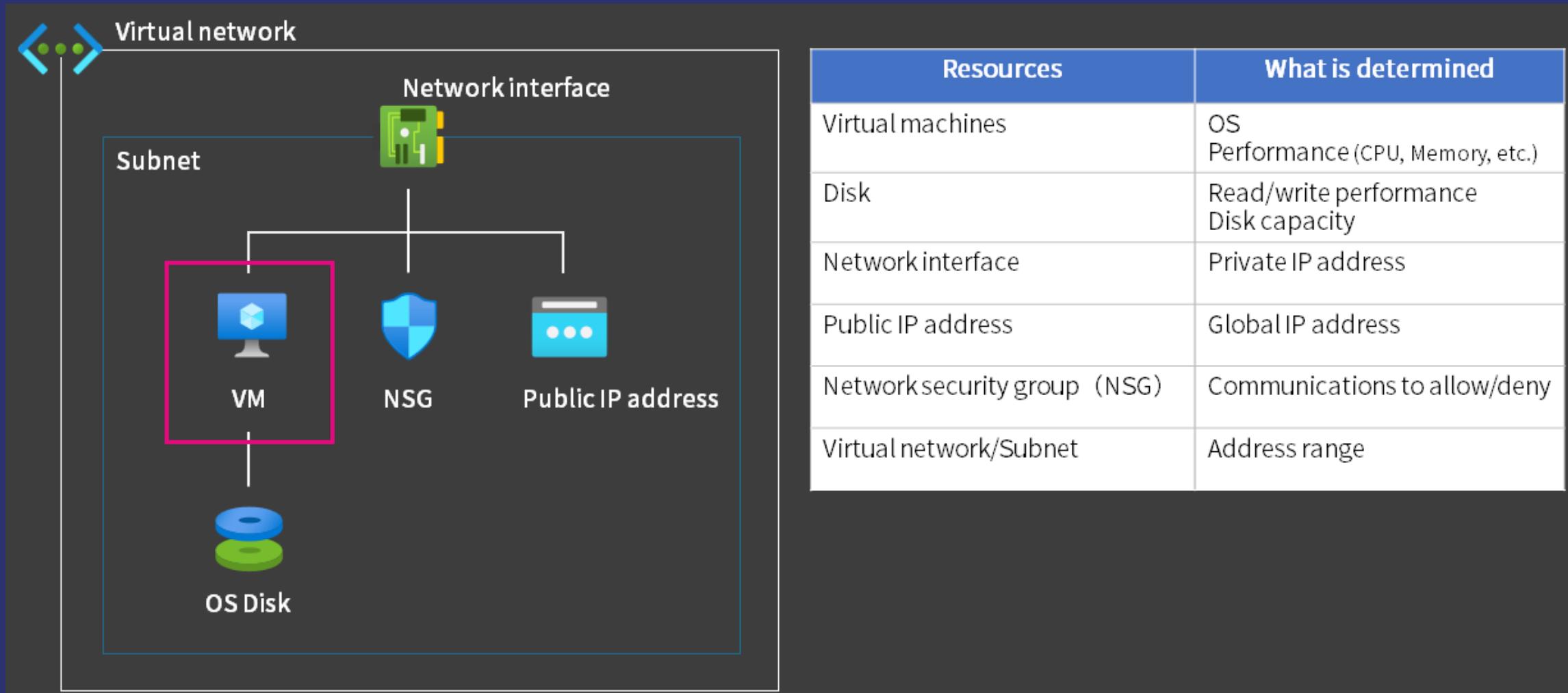
An Azure virtual machine gives you the **flexibility of virtualization** without having to buy and maintain the physical hardware that runs it.

You still need to maintain the virtual machine by performing tasks, such as configuring, patching, and installing the software that runs on it.

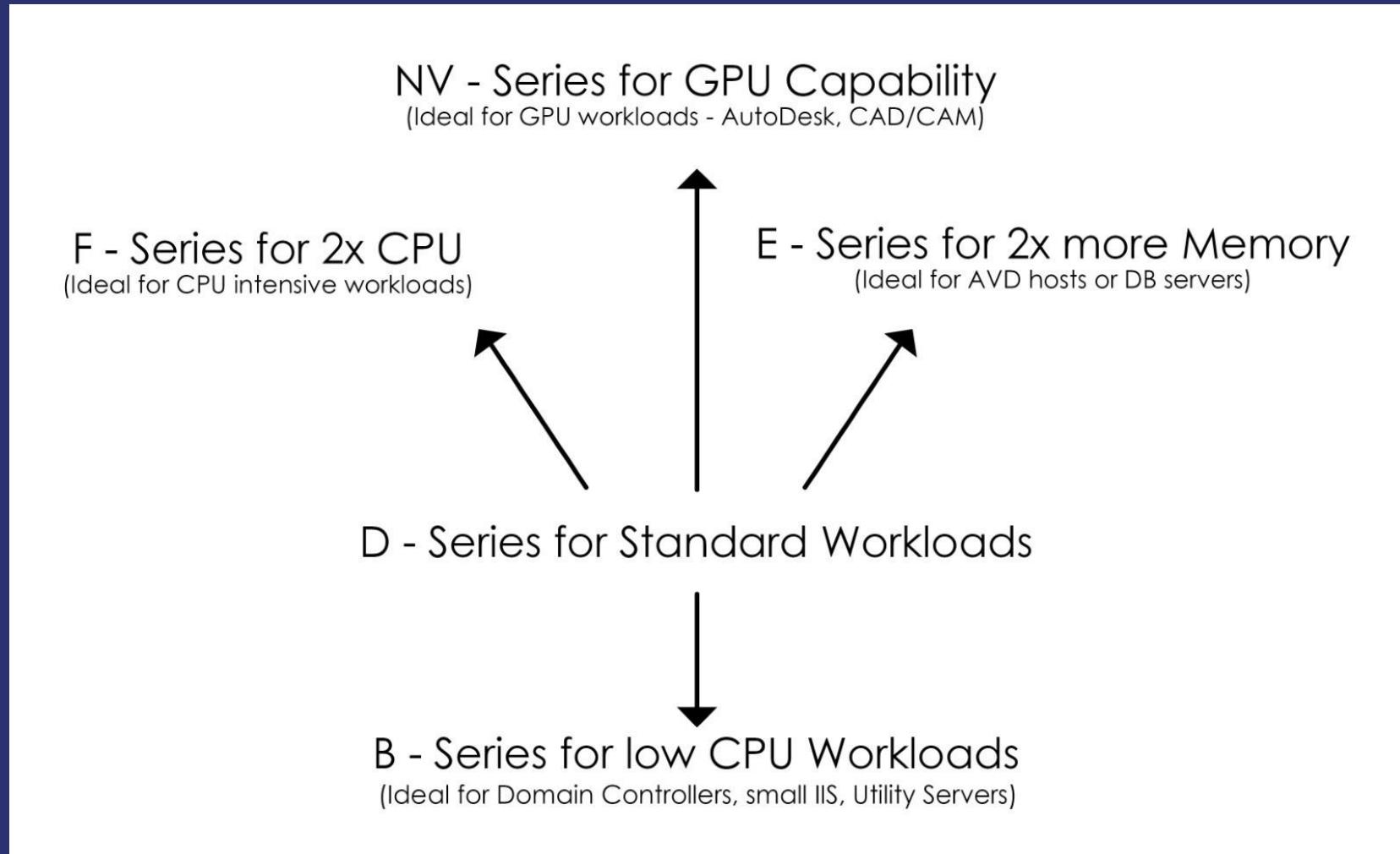
Azure Virtual Machine components



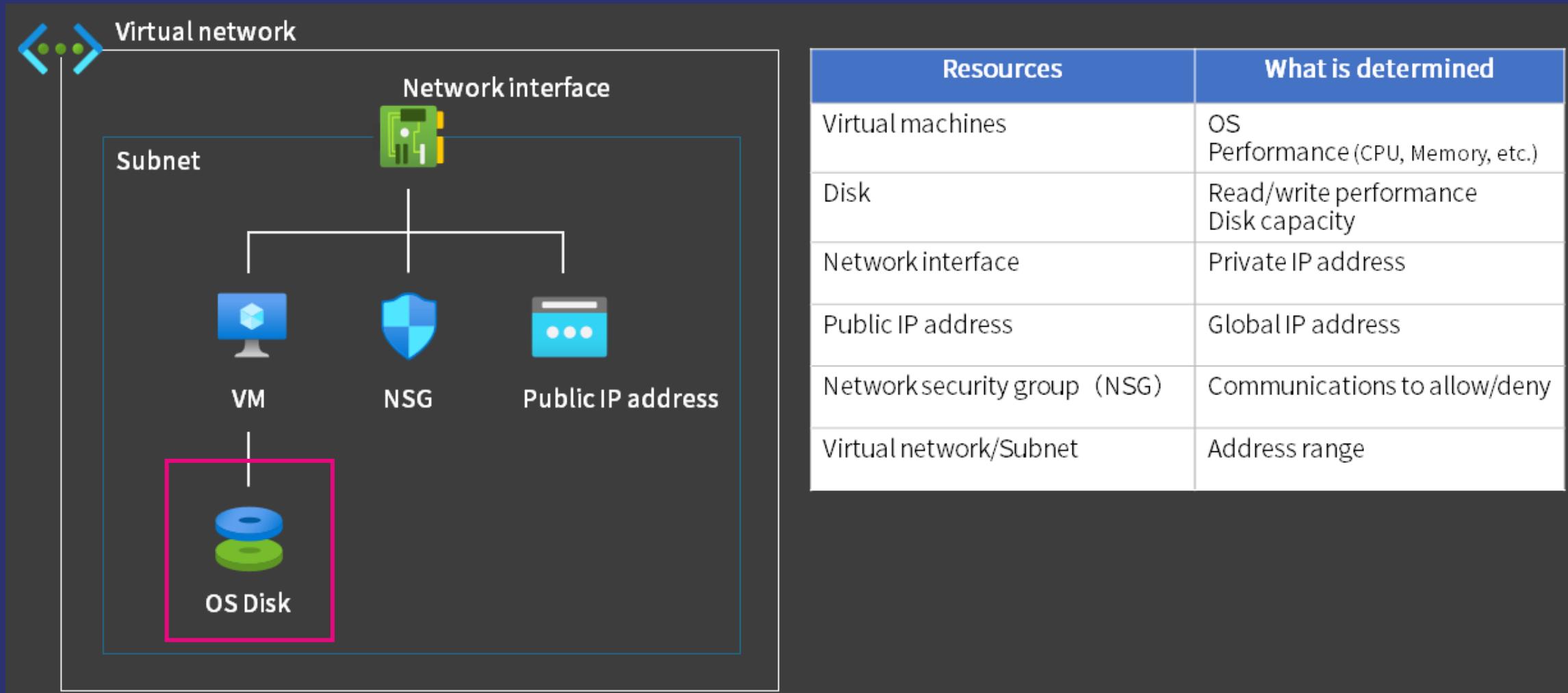
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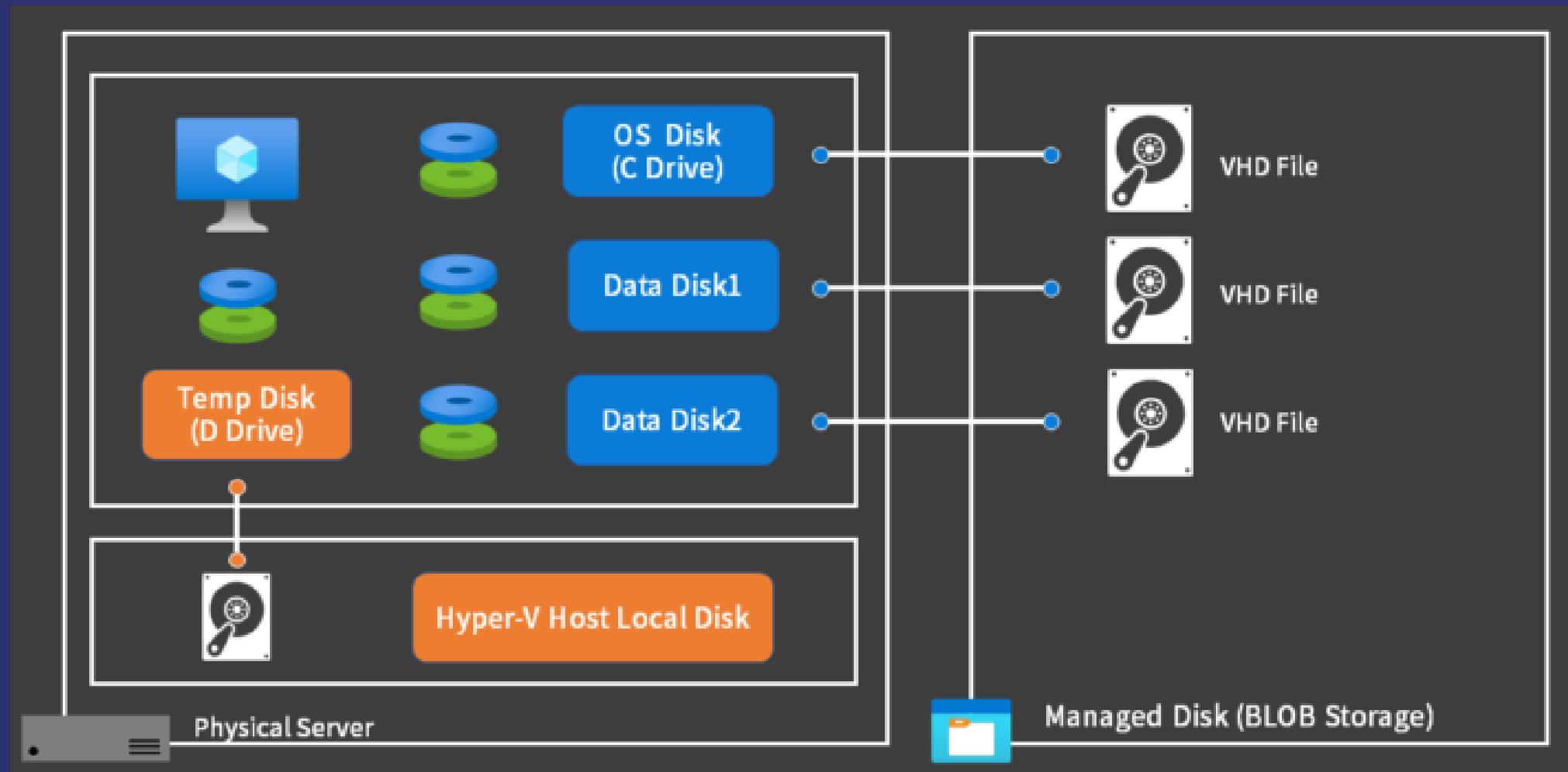
Azure Virtual Machine SKUs



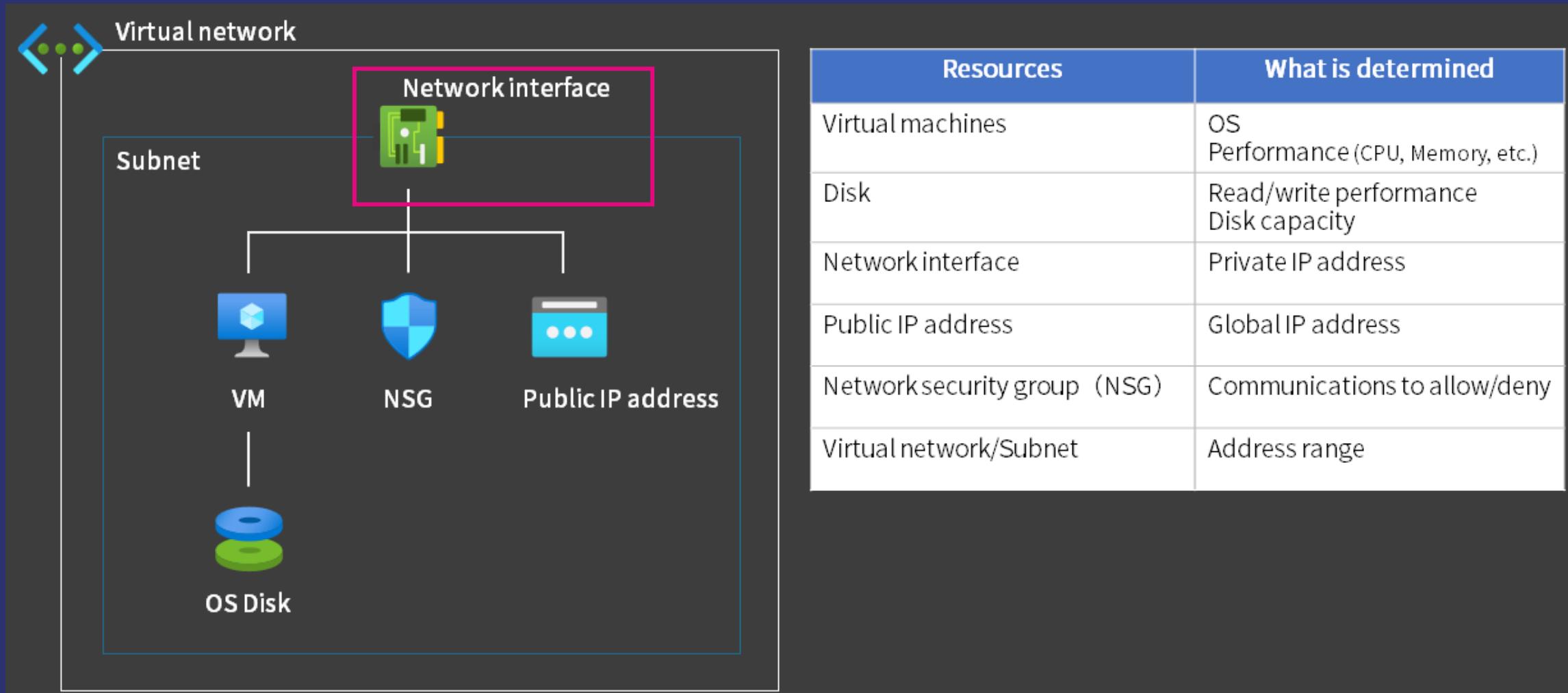
Azure Virtual Machine components



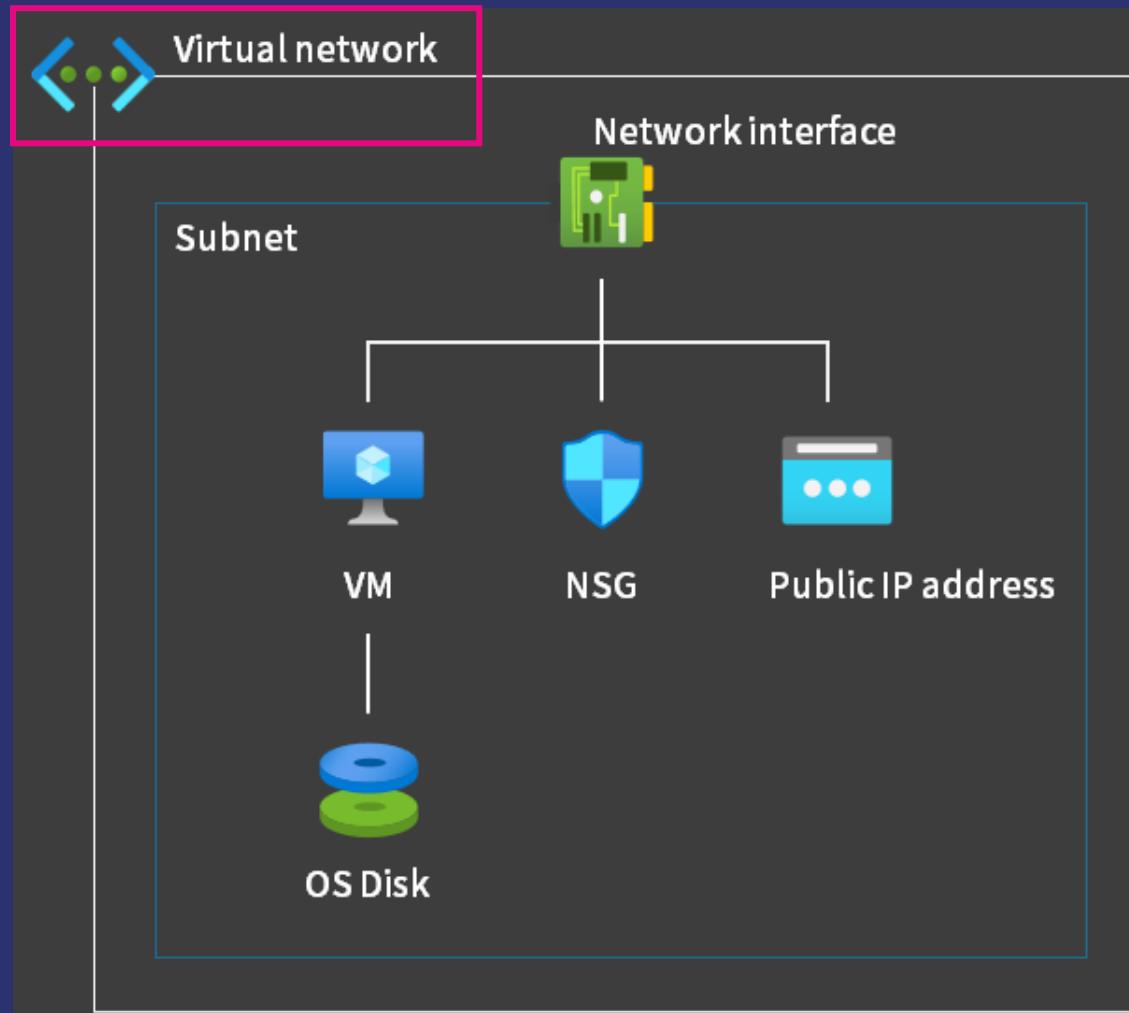
Azure Virtual Machine disks



Azure Virtual Machine components

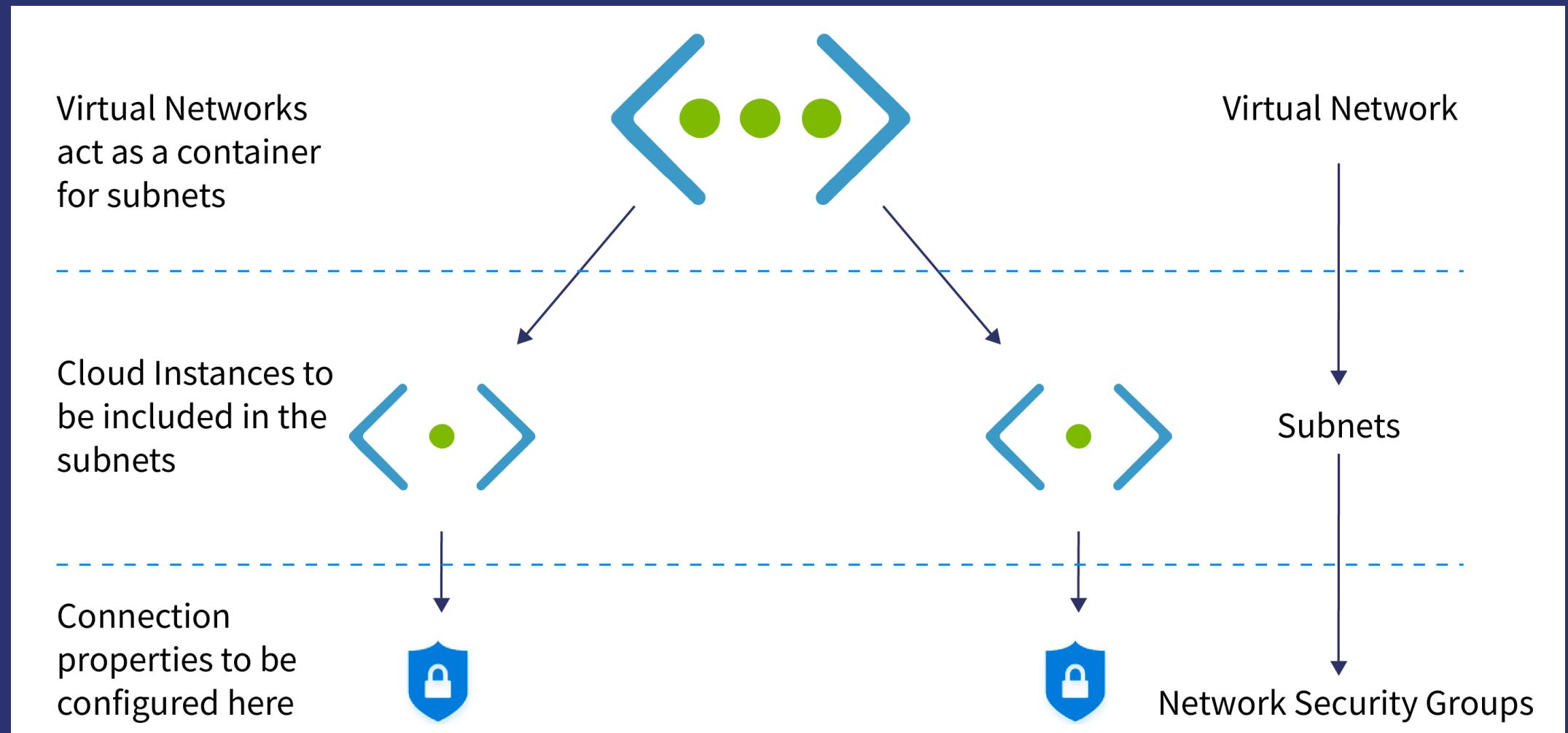


Azure Virtual Machine components



Resources	What is determined
Virtual machines	OS Performance (CPU, Memory, etc.)
Disk	Read/write performance Disk capacity
Network interface	Private IP address
Public IP address	Global IP address
Network security group (NSG)	Communications to allow/deny
Virtual network/Subnet	Address range

Azure Virtual Networks, subnets & security groups



Exercise: Create a Windows virtual machine



800 XP

Create a Windows virtual machine in Azure

51 min • Module • 7 Units

[Feedback](#)

Beginner Administrator Developer Student Azure Azure Virtual Machines Azure Windows Virtual Machines

Azure virtual machines (VMs) enable you to create dedicated compute resources in minutes that can be used just like a physical desktop or server machine.

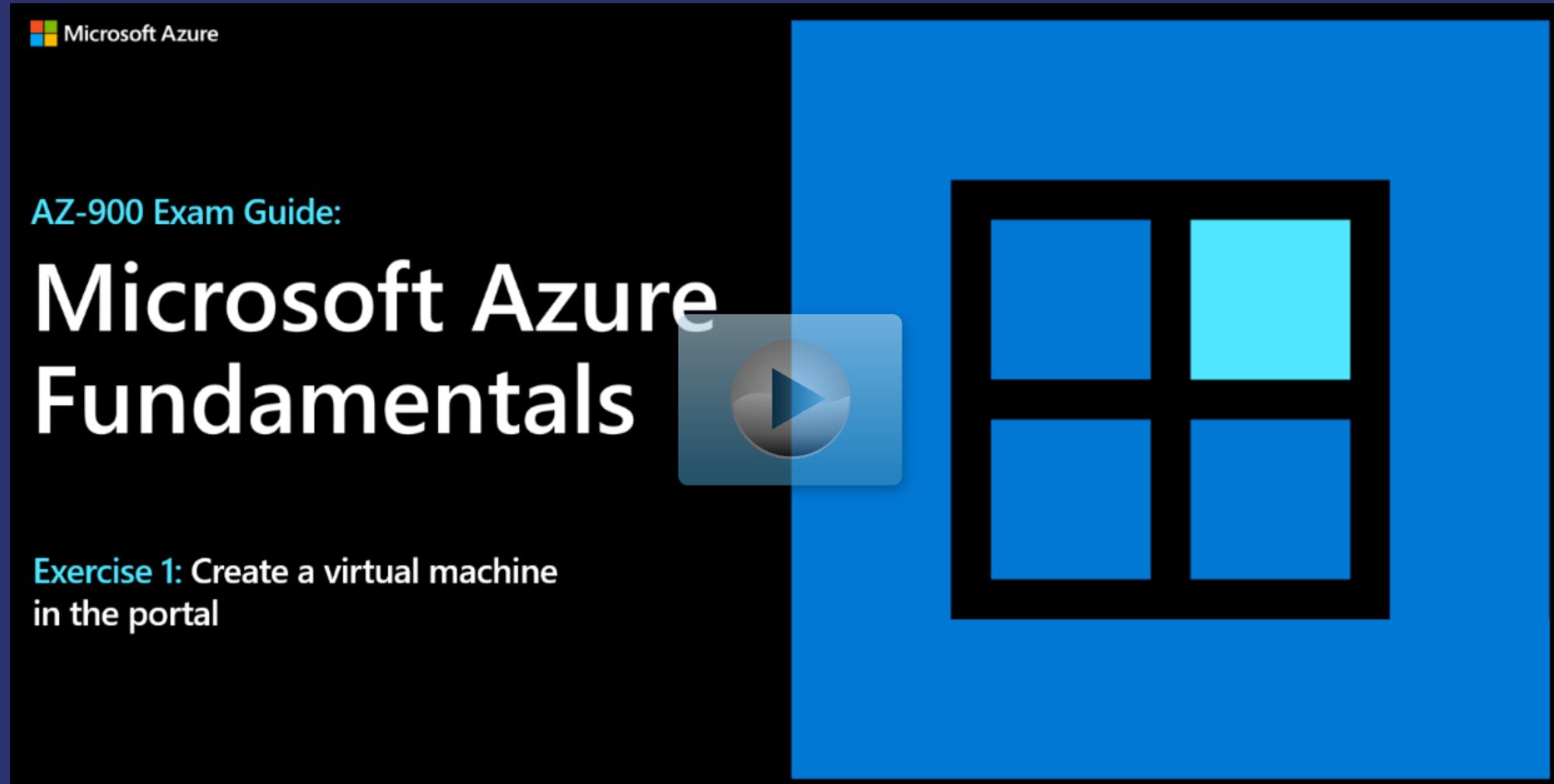
Learning objectives

In this module, you will:

- Create a Windows virtual machine using the Azure portal.
- Connect to a running Windows virtual machine using Remote Desktop.
- Install software and change the network configuration on a VM using the Azure portal.



Exercise: Create a virtual machine



The slide is a Microsoft Azure exam guide for AZ-900. It features a dark blue background with white and light blue text. At the top left is the Microsoft Azure logo. Below it, the text "AZ-900 Exam Guide:" is followed by the title "Microsoft Azure Fundamentals" in large, bold, white font. A large blue rectangular area on the right contains a play button icon and a 2x2 grid of four colored squares (blue, cyan, blue, cyan). At the bottom left, the text "Exercise 1: Create a virtual machine in the portal" is displayed.

Microsoft Azure

AZ-900 Exam Guide:

Microsoft Azure Fundamentals

Exercise 1: Create a virtual machine in the portal

Exercise: Create a VM with a template



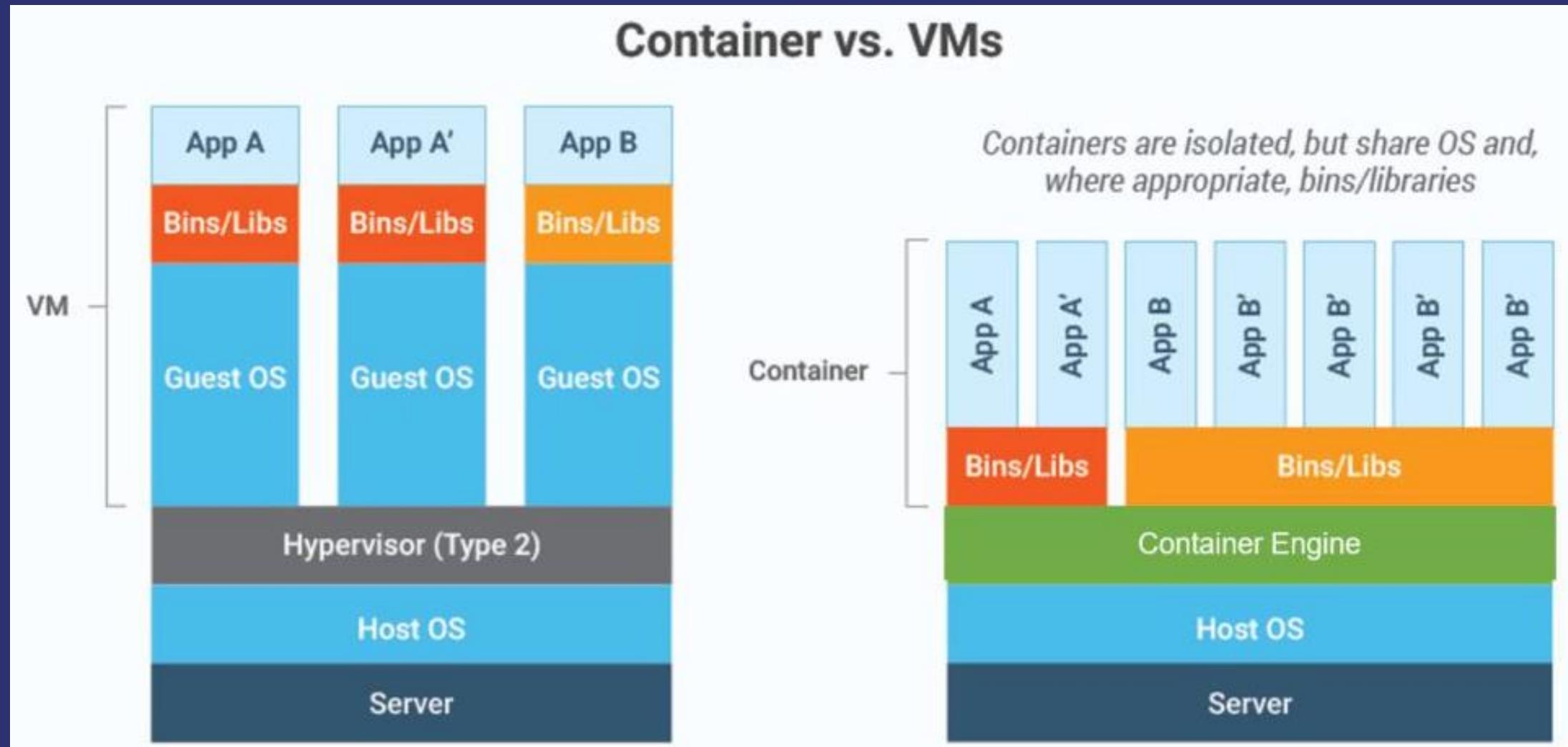
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Cloud Computing Tools

Docker container

Containers



Docker container

A **lightweight, standalone, and executable package** that includes everything needed to run a piece of software, including the **code, runtime, system tools, libraries, and settings**.

Containers are **isolated** from each other and the underlying operating system, which allows them to be **consistent** and **portable** across different environments.

Docker container

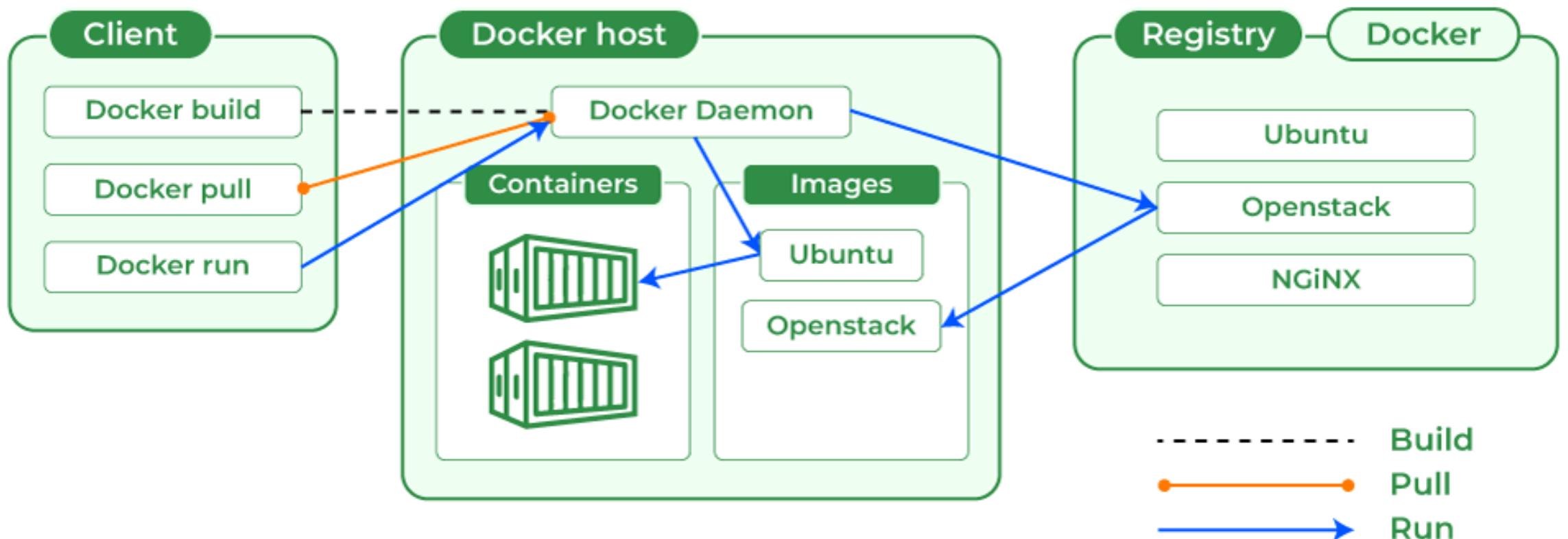
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Containers are **isolated** from each other and the underlying operating system, which allows them to be **consistent** and **portable** across different environments.

Docker containers are built from Docker images and can be easily created, deployed, and managed using Docker tools.

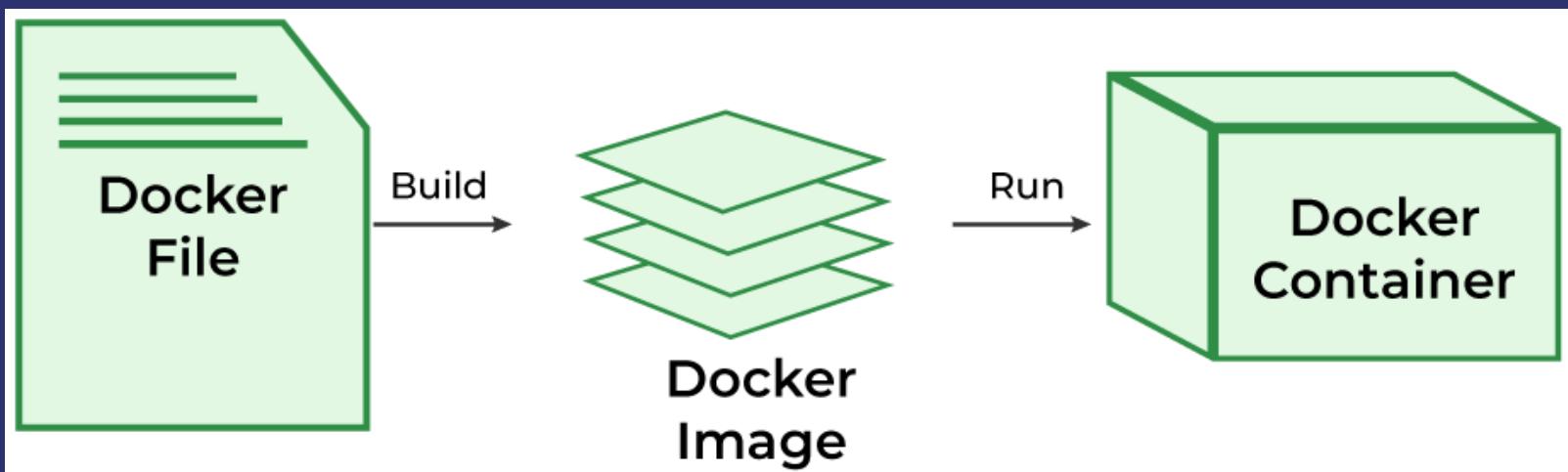
Docker Architecture

- Client-server architecture.



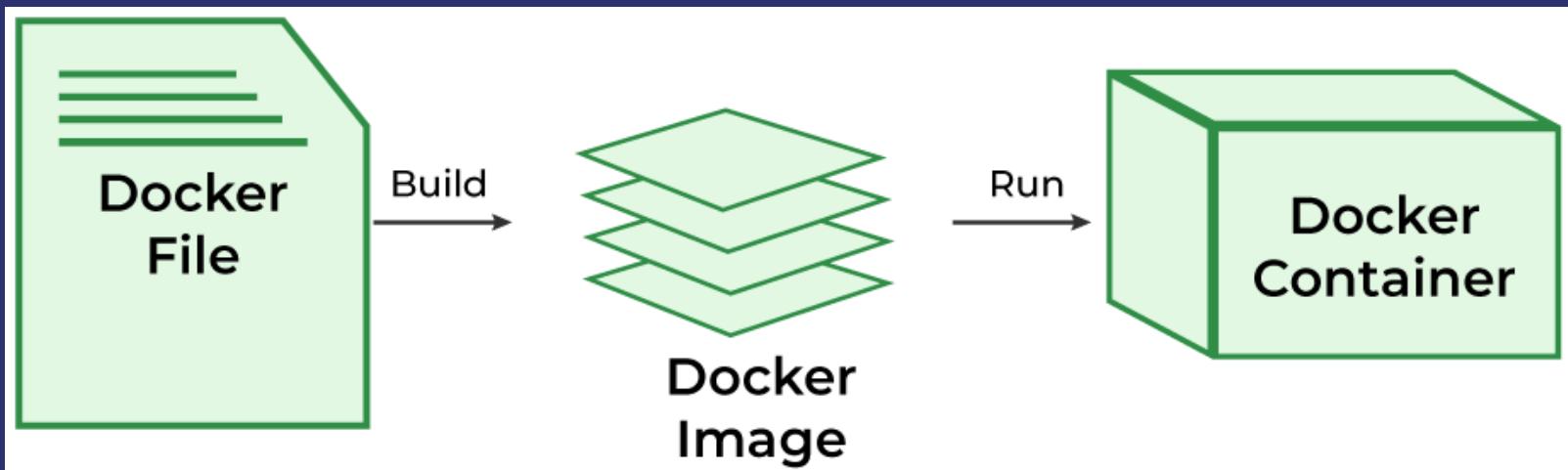
Docker File

- Text document that contains necessary commands which on execution help **assemble a Docker Image**.
- Docker image is created using a Dockerfile.



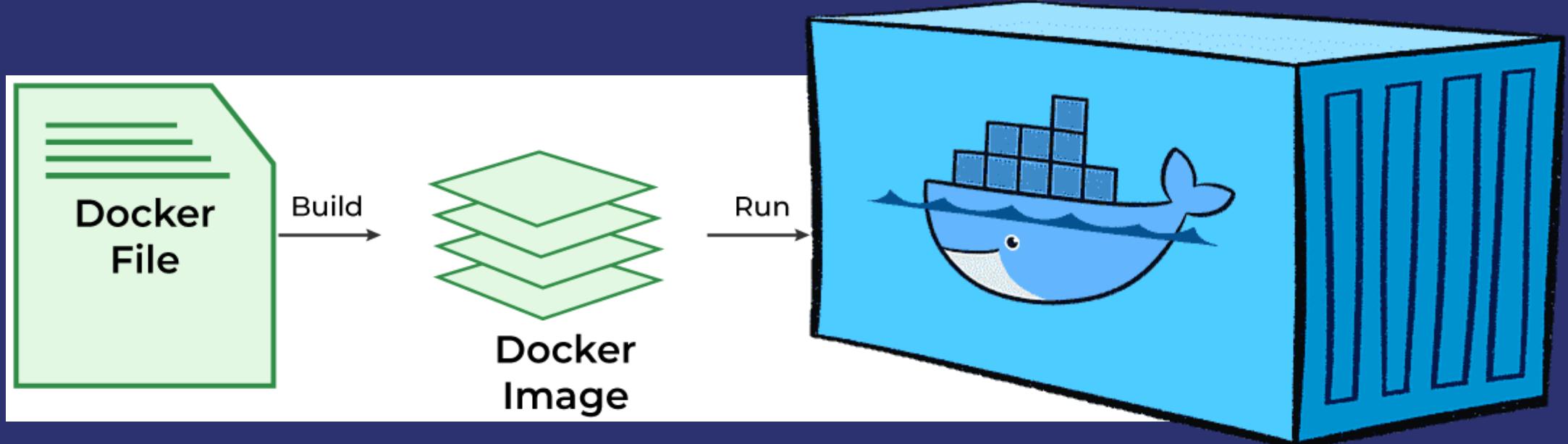
Docker Image

- Executable **package of software** that includes everything needed to run an application.
- Informs **how a container should instantiate**, determining which software components will run and how.



Docker Container

- **Runtime instances** of Docker images.
- Contain the **whole kit** required for an application, so the application can be run in an **isolated** way.

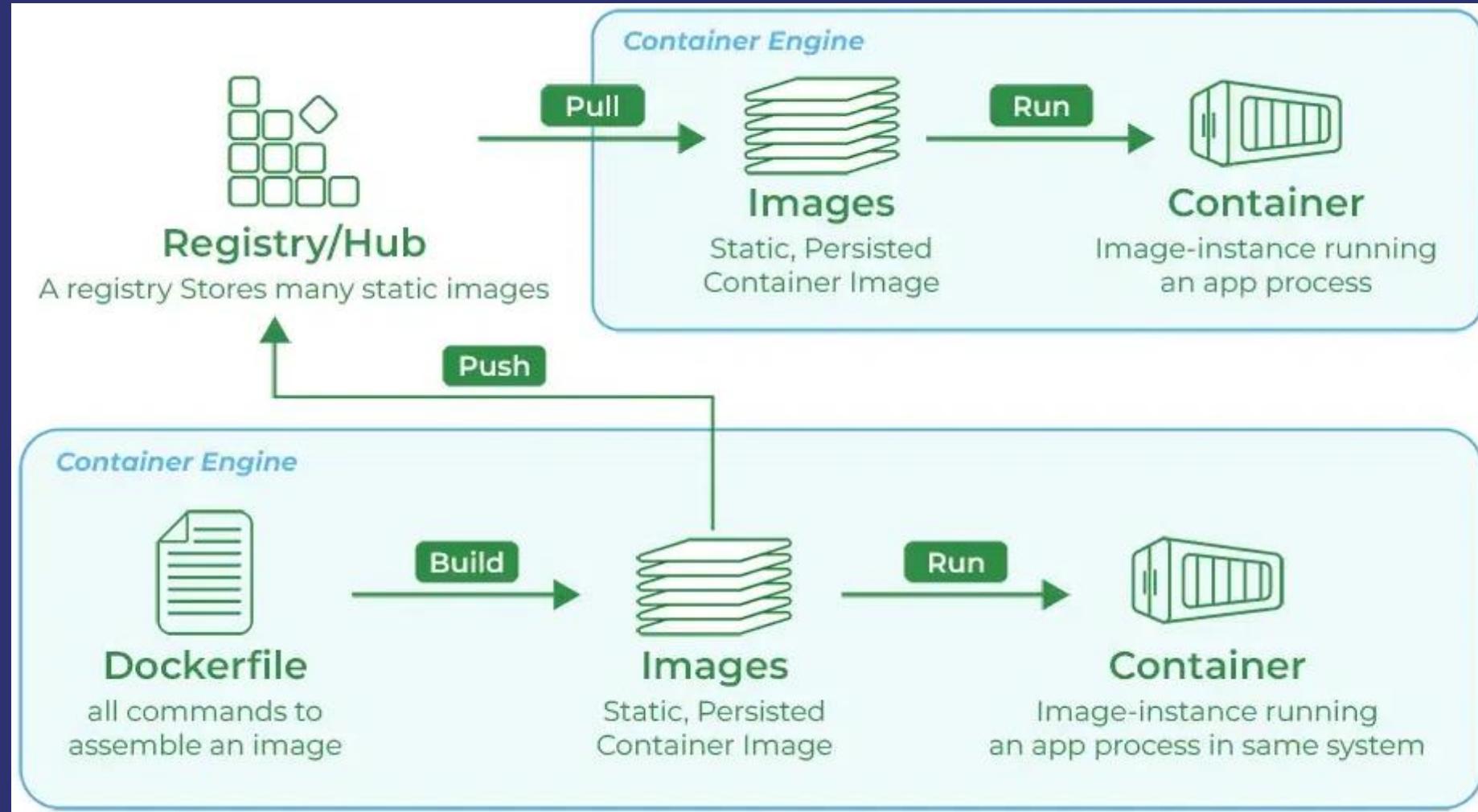


Docker Hub (or container registry)

- Cloud-based **repository service** where people push Docker Container Images to and pull Docker Container Images from anytime or anywhere **via the internet**.
- Push images to a private/public registry to **store, share, and reuse** Docker images.



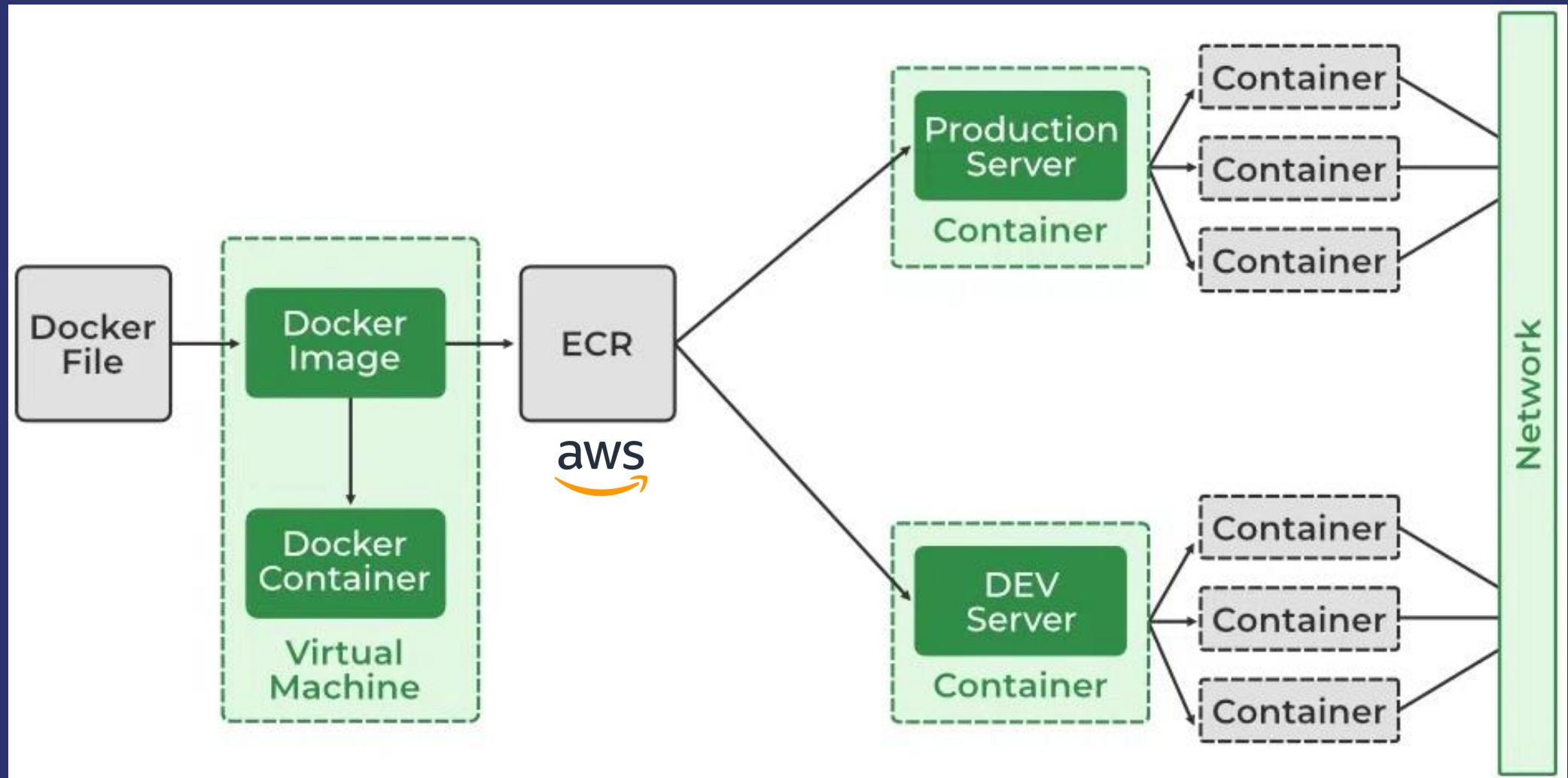
Docker Hub (or container registry)



Docker Networking

- A **group of two or more devices** that can **communicate** with each other either physically or virtually.
- A **virtual network** created by Docker to **enable communication** between Docker containers.
- If two containers are running on the same host they can communicate with each other **without the need for ports to be exposed** to the host machine.

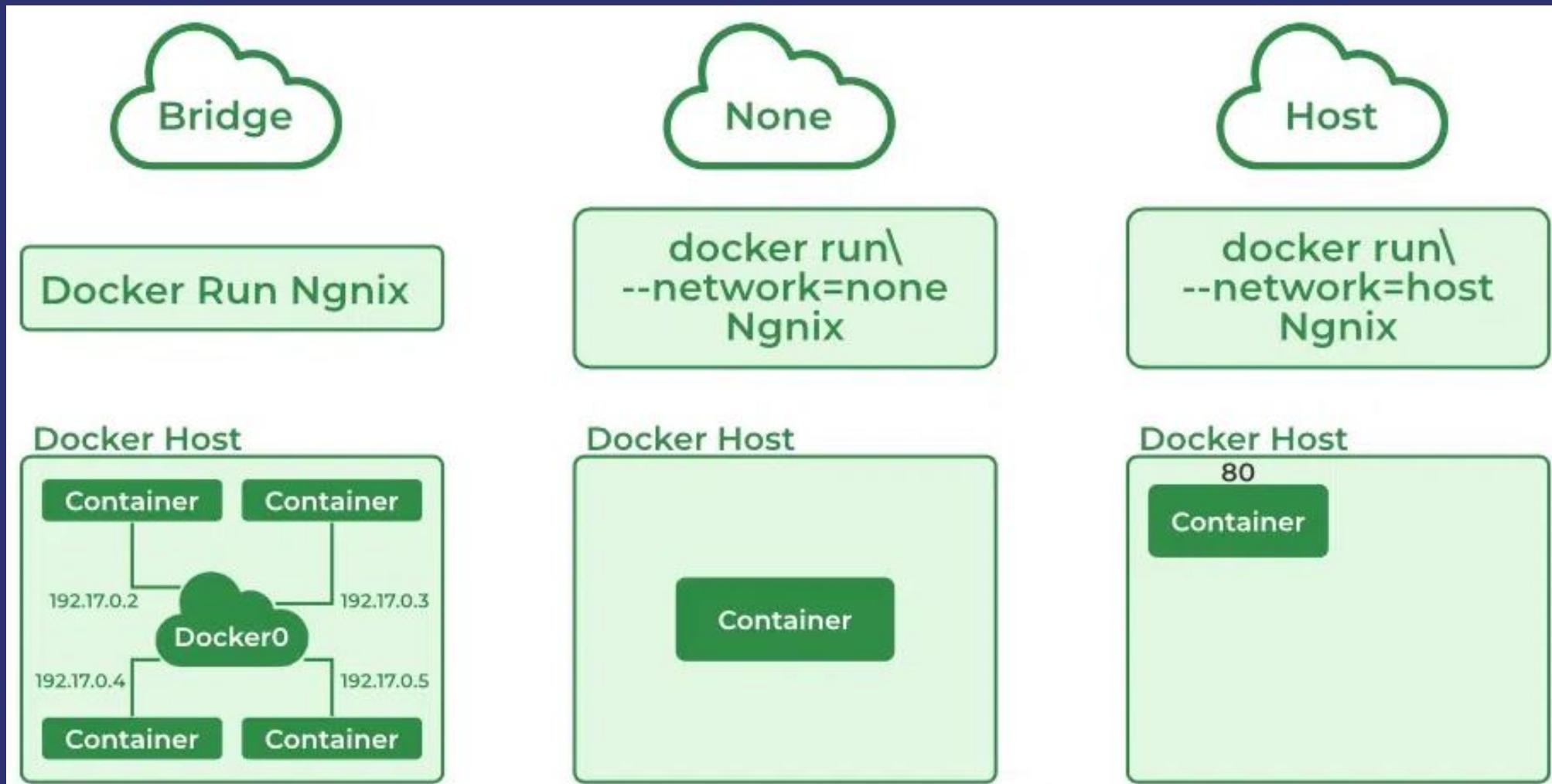
Docker Networking



Docker Network Drivers

- **bridge:** container will only be created in the bridge network, which is the default network.
- **host:** containers will not have any IP address but will be directly created in the system network which will remove isolation between the docker host and containers.
- **none:** IP addresses won't be assigned to containers. These containers are not accessible from outside or from any other container.
- **overlay:** enable connection between multiple Docker deamons and make different Docker swarm services communicate with each other.
- **ipvlan:** users have complete control over both IPv4 and IPv6 addressing by using the IPvlan driver.
- **macvlan:** macvlan driver makes it possible to assign MAC addresses to containers.

Docker Network Drivers



Docker Commands

- **Docker Run:** launches containers from images by specifying runtime options and commands.
- **Docker Pull:** fetches container images from container registry like Docker Hub to the local machine.
- **Docker ps:** displays running containers along with important information like container ID, image used & status.
- **Docker Stop:** halts running containers by gracefully shutting down the processes within them.
- **Docker Start:** restarts stopped containers, resuming operations from the previous state.
- **Docker Login:** logs into the docker registry enabling access to private repositories.

Docker Containers

Advantages

- uses less memory.
- full operating system is not required
- containers run faster than VMs
- lightweight
- allows the use of a remote repository to share containers



Disadvantages

- complexity increases due to layering.
- difficult to manage large numbers of containers.
- Docker is not suitable for apps that need better graphics.
- Cross-platform compatibility is not allowed.



Exercise: Build a containerized web app with Docker



Build a containerized web application with Docker

15 min remaining • Module • 5 of 8 units completed

[Feedback](#)

Beginner Developer Student Azure

Package a web app so that it can be deployed as a Docker image and run from an Azure Container Instance.

Learning objectives

In this module, you will:

- Create a Dockerfile for a new container image based on a starter image from Docker Hub.
- Add files to an image using Dockerfile commands.
- Configure an image's startup command with Dockerfile commands.
- Build and run a web application packaged in a Docker image.
- Deploy a Docker image using the Azure Container Instance service.



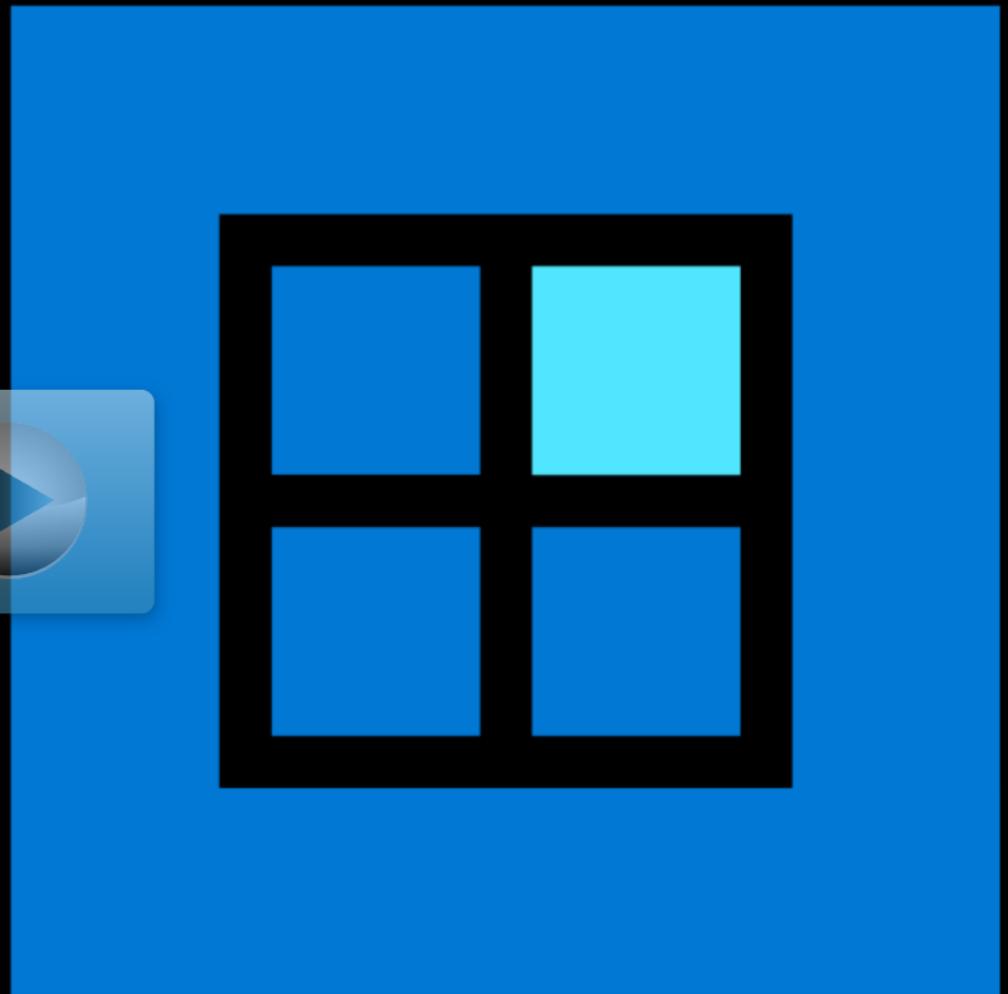
Exercise: Create a web app (Docker container)

Microsoft Azure

AZ-900 Exam Guide:

Microsoft Azure Fundamentals

Exercise 2: Create a web app



The blue rectangular box contains a central graphic element. On the left side of the box, there is a light blue square button with a dark blue play icon in the center. To the right of the button is a 2x2 grid of four squares. The top-left square is blue, the top-right is cyan, the bottom-left is blue, and the bottom-right is blue. All squares have a black border.

Exercise: Deploy Azure Container Instances



The slide features a dark blue background with a light blue decorative wavy border at the top. In the top-left corner, the Microsoft Azure logo is displayed. Below it, the text "AZ-900 Exam Guide:" is written in a teal color. The main title "Microsoft Azure Fundamentals" is prominently displayed in large white font. In the bottom-left corner, the text "Exercise 3: Deploy Azure Container Instances" is shown in teal. On the right side of the slide, there is a large blue rectangular area containing a play button icon and a 2x2 grid of four squares, where the top-right square is cyan and the others are blue.



Cloud Computing Tools

Kubernetes

Kubernetes (K8s)

open-source **container orchestration platform** that automates deployment, scaling, and management of containerized applications. Kubernetes allows you to manage **clusters** of compute instances and run containerized applications across a variety of environments.



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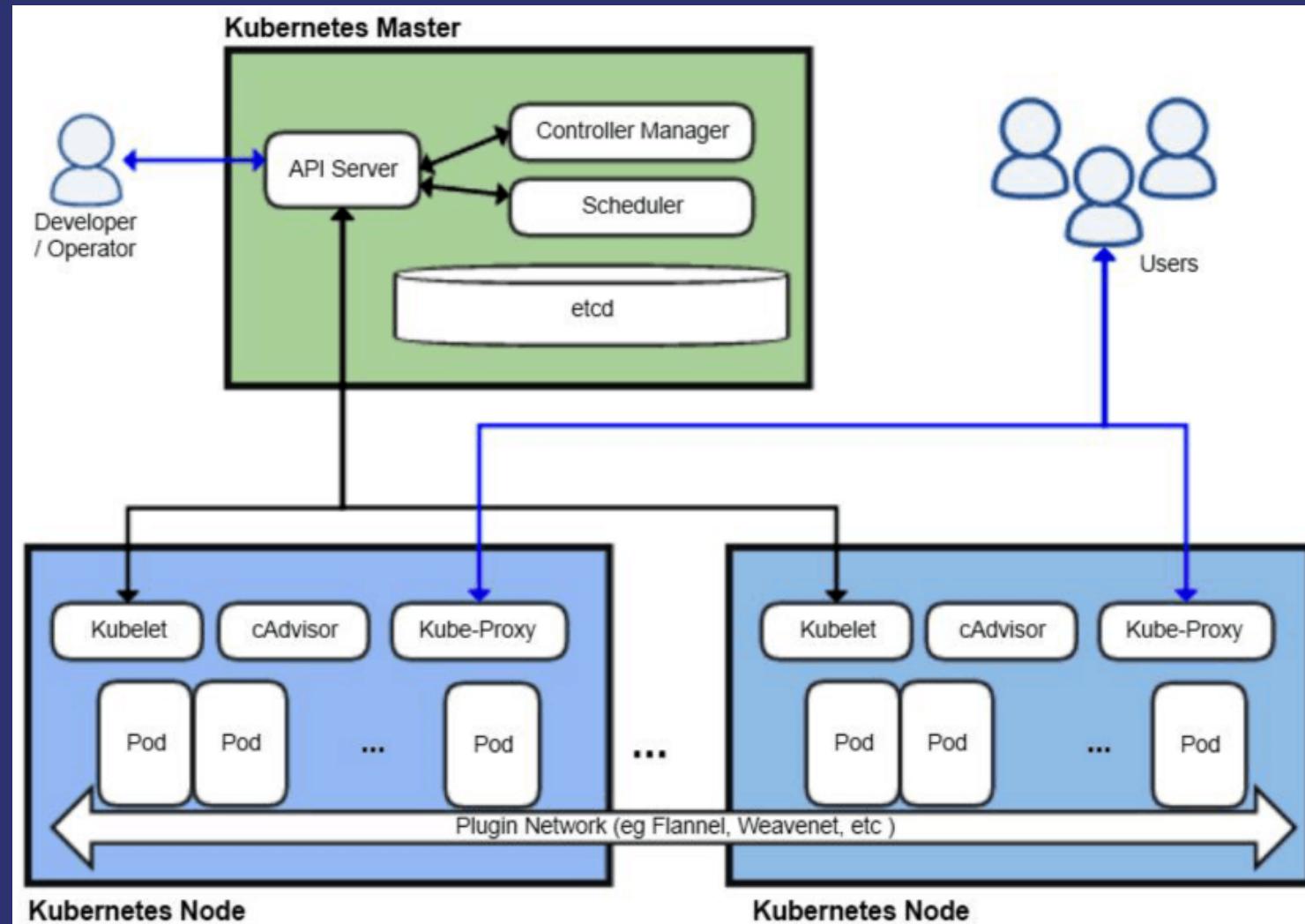
It was originally developed by Google and is now maintained by the Cloud Native Computing Foundation (CNCF).

“Kubernetes” is a Greek word, which means helmsman or pilot.

Kubernetes Architecture

- consists of Master nodes and Worker nodes
- the Master communicates with the Worker(s) using API-server
- multiple Master nodes may exist to provide High Availability

Kubernetes Architecture

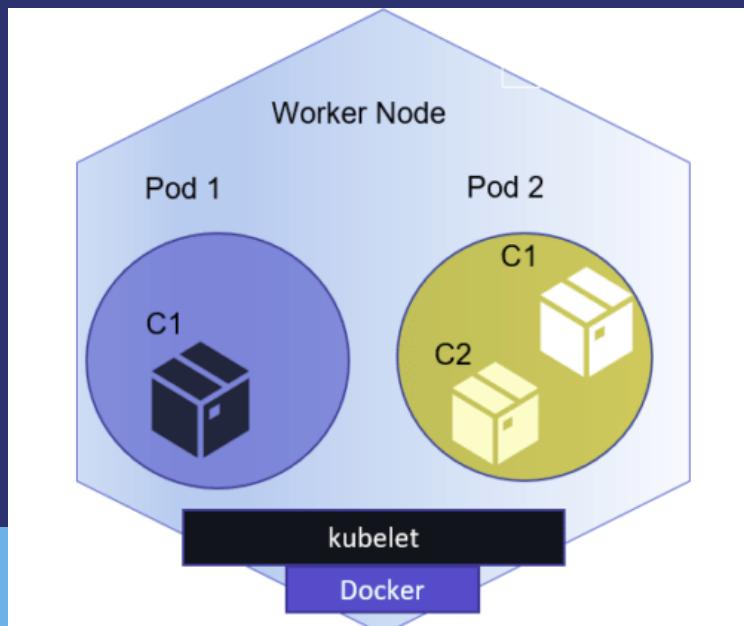


K8s Basic Objects

- **Pod:** group of one or more containers, a simple deployable unit of K8s.
- **Service:** a logical set of pods as well as the policy for accessing them.
- **Volume:** lets us persist data; necessary because containers are ephemeral (data is deleted when the container is deleted).
- **Namespace:** segment of the cluster dedicated to a certain purpose, for example, a certain project or team of devs.

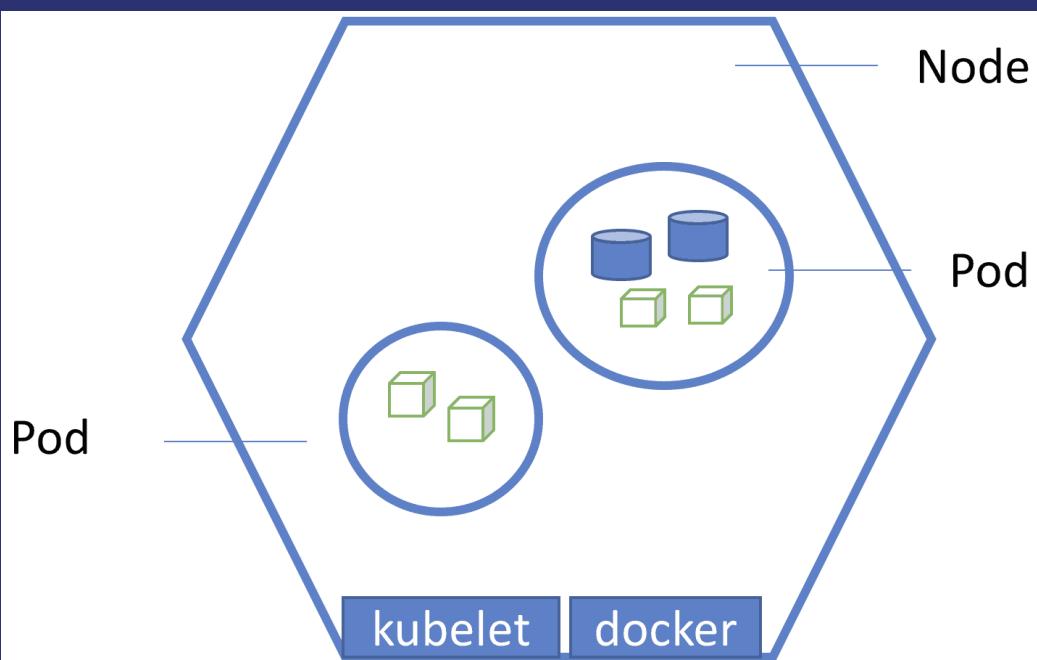
K8s Pods

- can contain **one or more containers** that are scheduled and deployed together on the same node.
- containers in a Pod **share the same network namespace**, allowing them to communicate using localhost.
- can **share storage volumes**, allowing data sharing and persistence between containers within the same Pod.



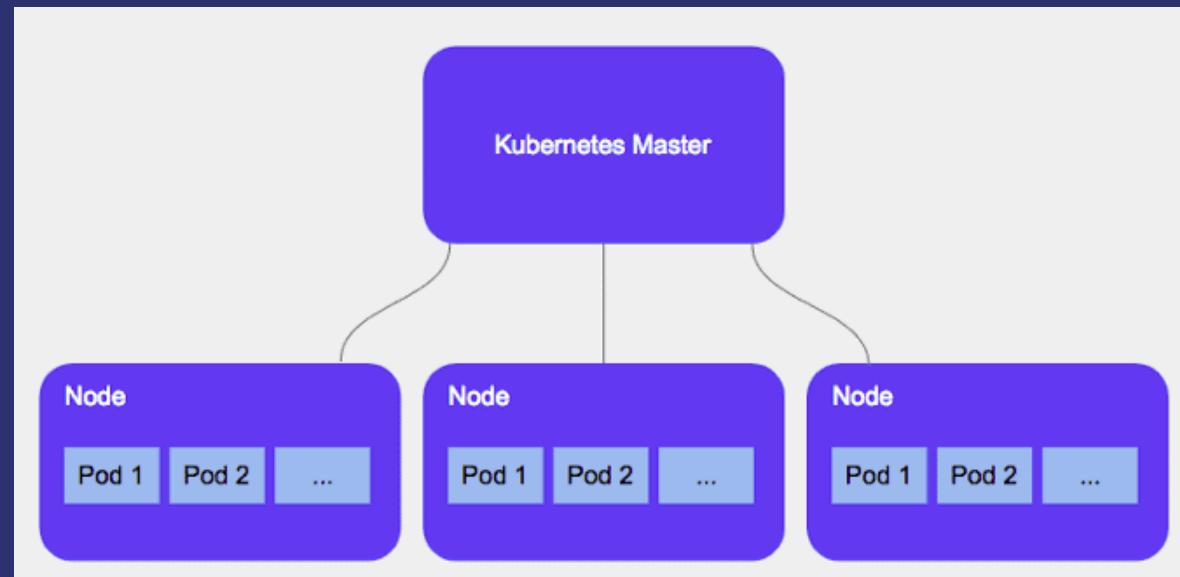
K8s Node

- a **worker machine**; virtual or physical, depending on the cluster.
- can have **multiple pods**. (one-to-many relationship).
- **managed by the Master**; automatically handles scheduling the pods across the Nodes in the cluster



K8s Cluster

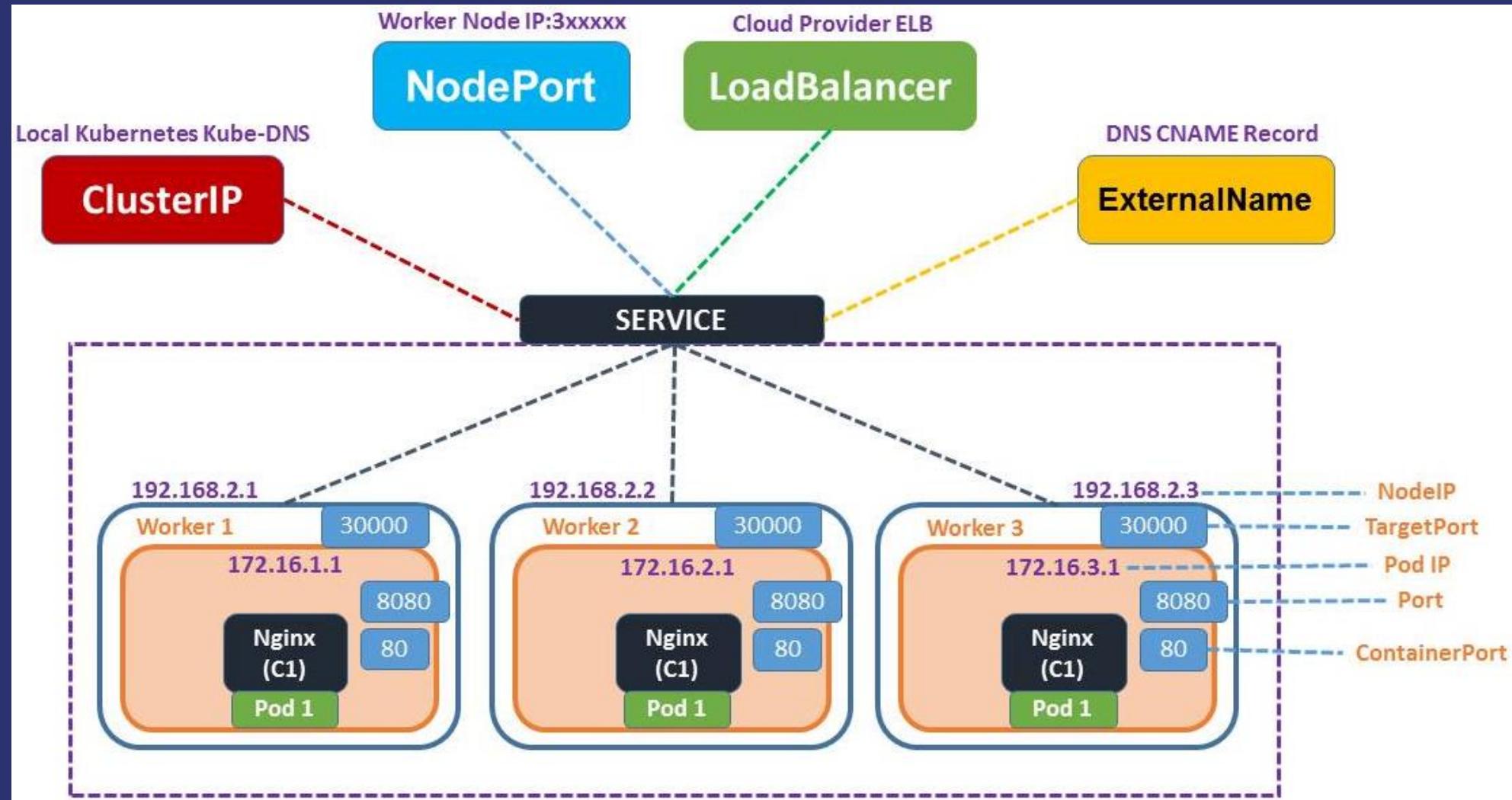
- **group of nodes** or machines running together.
- consists of **two types of servers**: Master Node and Worker Node.
- servers can be **virtual** (VM) **or physical** (Bare metal).
- controlled by the services that make up the **Control Plane**.



K8s (Micro) Service

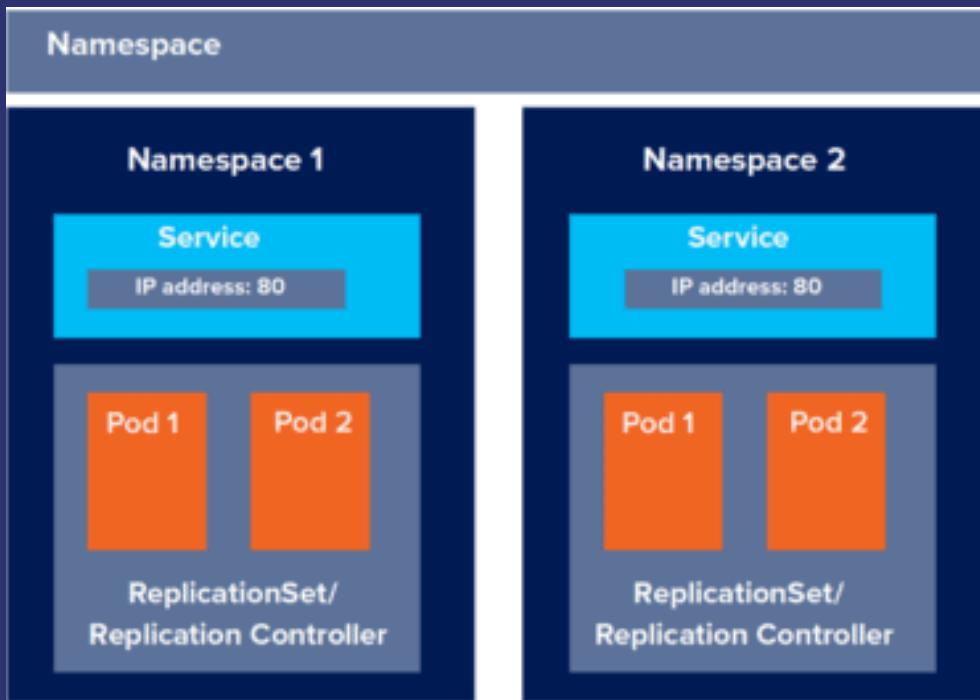
- coupling of a set of pods to a **policy** by which to access them.
- used to **expose** containerized applications to origins from outside the cluster.
- both an **abstraction** that defines a logical set of pods and a policy for accessing the pod set.
- 4 types: **NodePort, ClusterIP, LoadBalancer & ExternalName**.

K8s (Micro) Service



K8s Namespaces

- a way to create **multiple virtual K8s clusters** within a single cluster.
- normally used for **wide-scale deployments** where there are many users, teams, and projects.

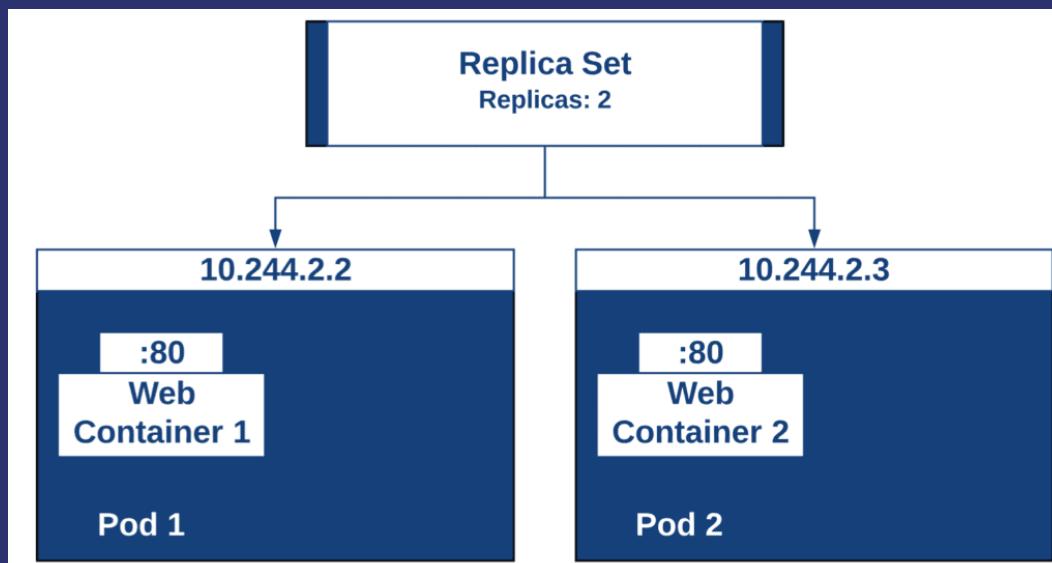


K8s Controllers

- **ReplicaSet (RS):** ensures the desired amount of pods are running.
- **Deployment:** offers declarative updates for pods in an RS.
- **StatefulSet:** workload API object that manages stateful applications, such as databases.
- **DaemonSet:** ensures all or some worker nodes run a copy of a pod. useful for daemon applications like Fluentd.
- **Job:** creates one or more pods, runs a certain task(s) to completion, then deletes the pod(s).

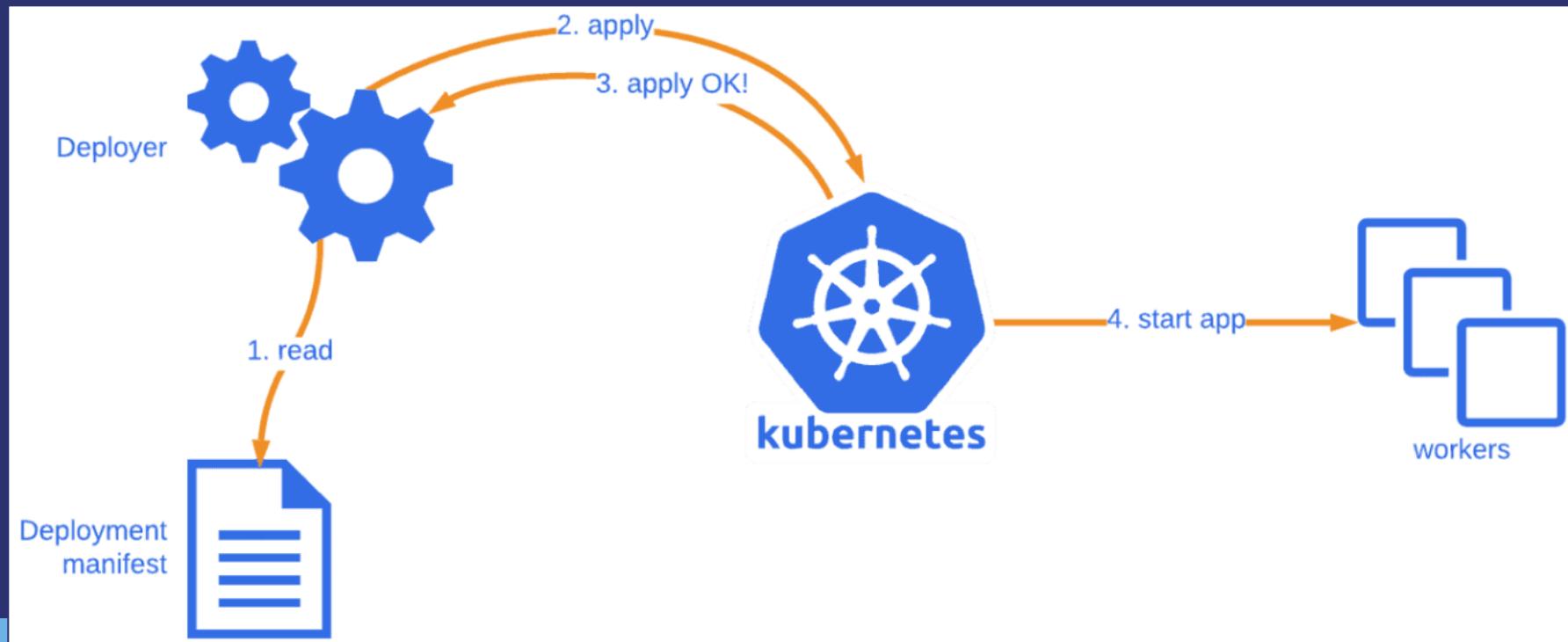
K8s Replica Set

- ensures the defined number of pods are **running at all time**.
- defined number of pods could be "1".
- if a pod crashes, it will be **recreated** to get back to the **desired state**.
- preferred over a naked pod because it provides **high availability**.



K8s Deployment

- way to define the **desired state** of pods or replica sets.
- used to define **HA policies** for number of containers that must be running.
- describes **how to run the container** as a Pod and how many replicas to run.



Azure Kubernetes Service (AKS)

a **fully-managed service** that allows you to run Kubernetes in Azure without having to manage your own Kubernetes clusters.

Azure manages all the complex parts of running Kubernetes
so you can focus on your containers.

AKS is one of the pioneers of managed Kubernetes service.



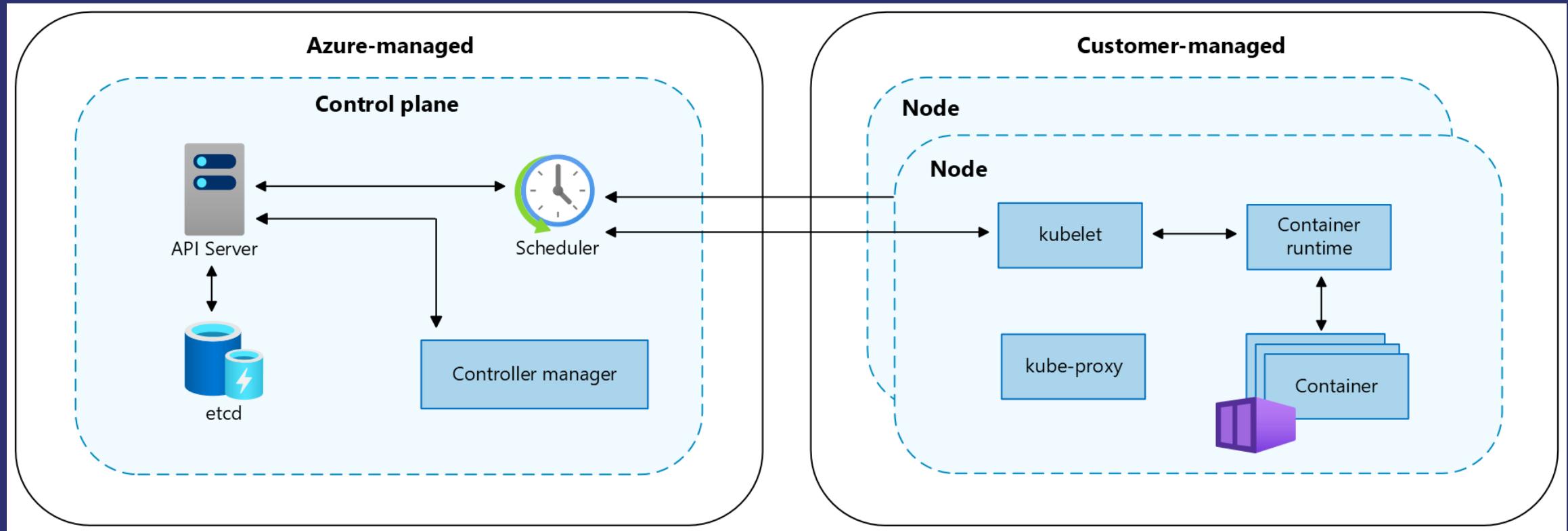
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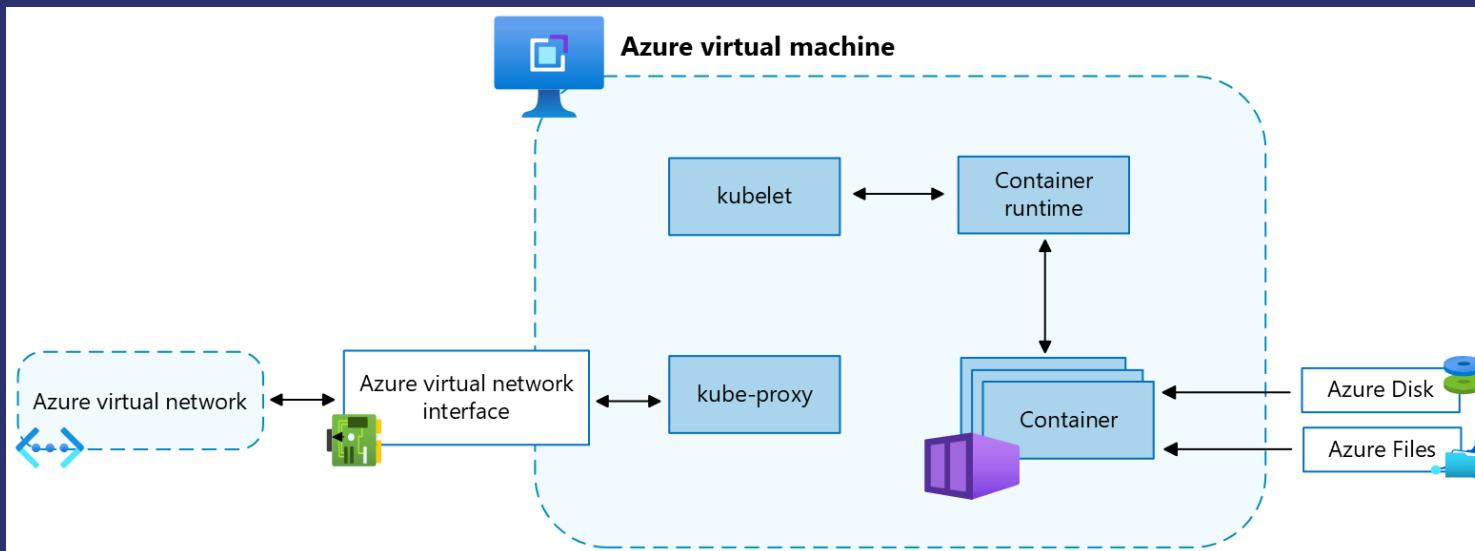
AKS architecture



AKS nodes

Each AKS cluster has at least one node

- **node:** an Azure VM that runs Kubernetes node components.
- **kubelet:** ensures containers are running in a pod.
- **kube-proxy:** a network proxy that maintains network rules on nodes.
- **container runtime:** manages the execution and lifecycle of containers.



Exercise: Deploy a containerized application on AKS



Deploy a containerized application on Azure Kubernetes Service

34 min remaining • Module • 1 of 6 units completed

[Feedback](#)

Beginner Solution Architect Developer DevOps Engineer Azure Azure Kubernetes Service (AKS)
Azure Container Registry

Rapidly deploy a containerized application hosted on Azure Container Services or any other registrar to Azure Kubernetes Service by using declarative manifest files.

Learning objectives

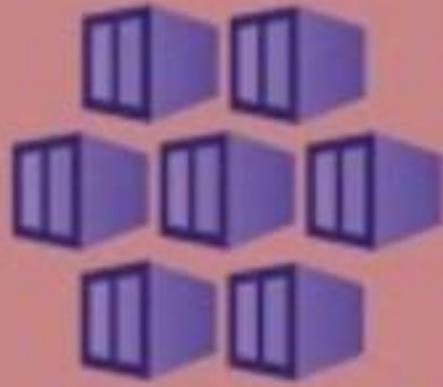
By the end of this module, you'll be able to:

- Create and set up an Azure Kubernetes Service cluster.
- Deploy Kubernetes workloads by using deployment YAML files.

800 XP

Video: Deploy applications to Azure Kubernetes Service (AKS)





**Azure
Kubernetes Service
(AKS)**

**How to deploy a web
application to Azure
Kubernetes Service
(AKS) cluster**

QUIZ
Time





Cloud Resource Optimization



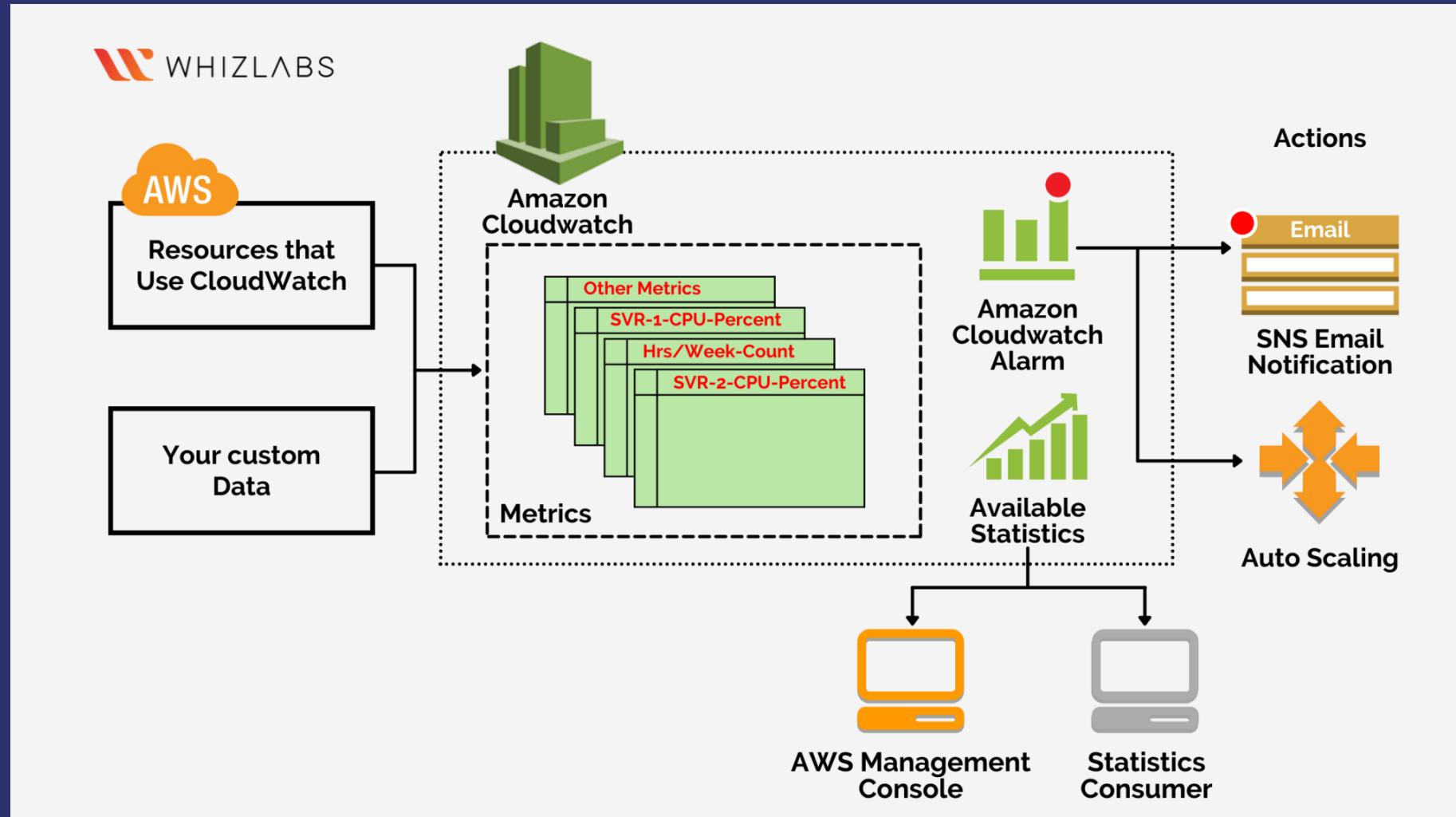
Cloud Resource Optimization

Monitoring

AWS CloudWatch

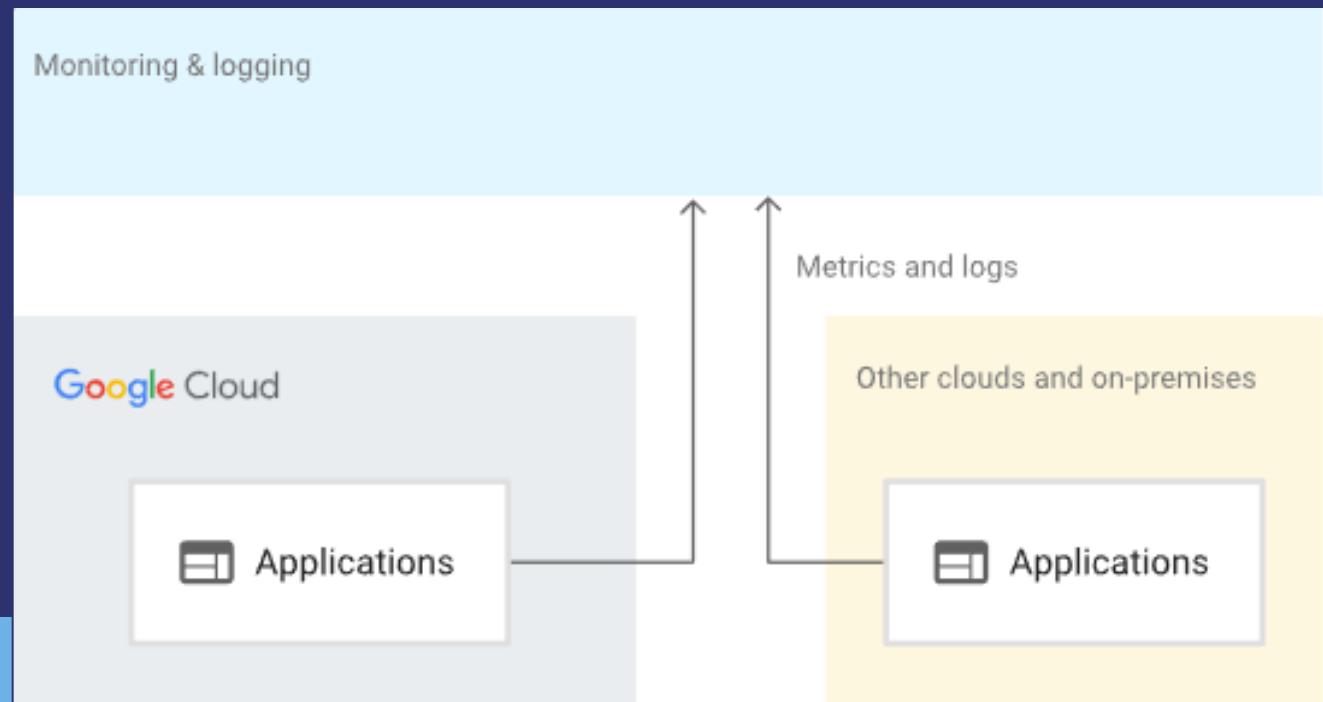
- observability and **monitoring** service by Amazon
- particularly brought into action for DevOps engineers, SREs, IT Managers, and usual developers to keep track of actionable insights for **application monitoring**.
- also used to **respond to changes** within system performances and resource utilization.
- has the potential to **collect data as metrics, events, and logs**.
- operational and monitoring data collected by CloudWatch are of the apps, services, and resources running over AWS.

AWS CloudWatch



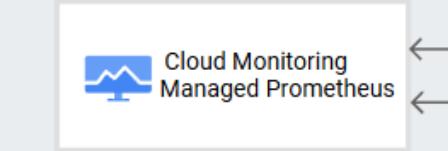
Google Cloud Monitoring

- collects metrics, events, and metadata from Google Cloud, Amazon Web Services (AWS), synthetic monitors, and application instrumentation.
- ingests data and generates insights with dashboards, charts, and alerts.

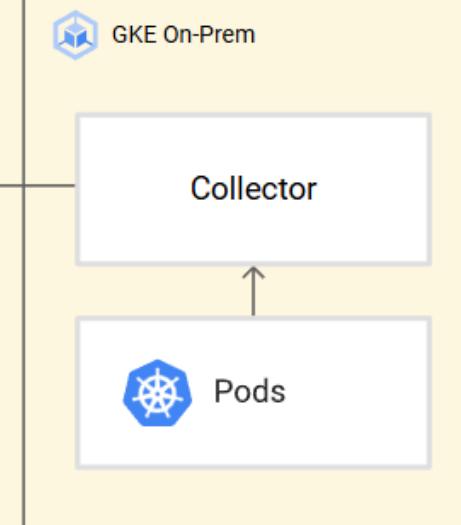
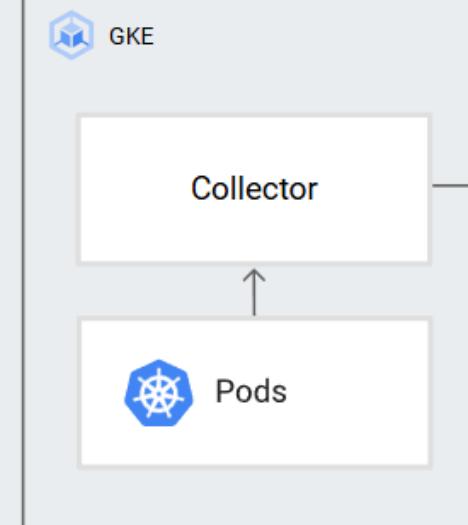


Hybrid Google Kubernetes Engine monitoring

Google Cloud



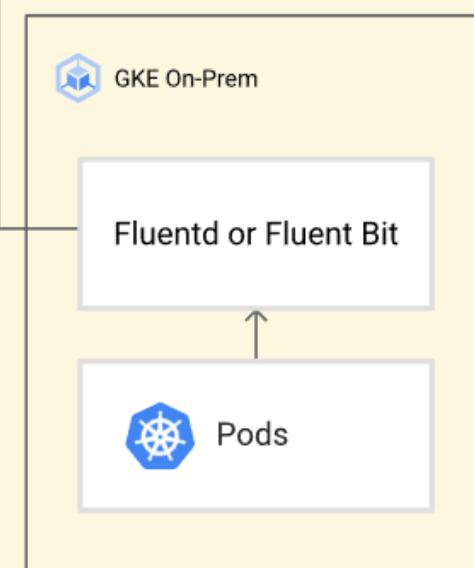
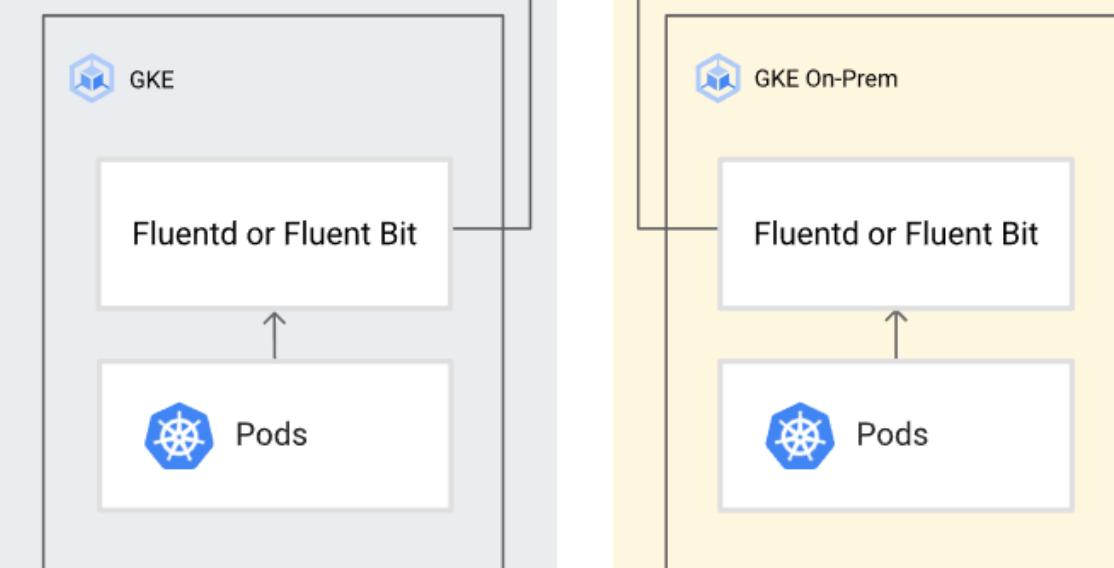
On-premises



Google Cloud

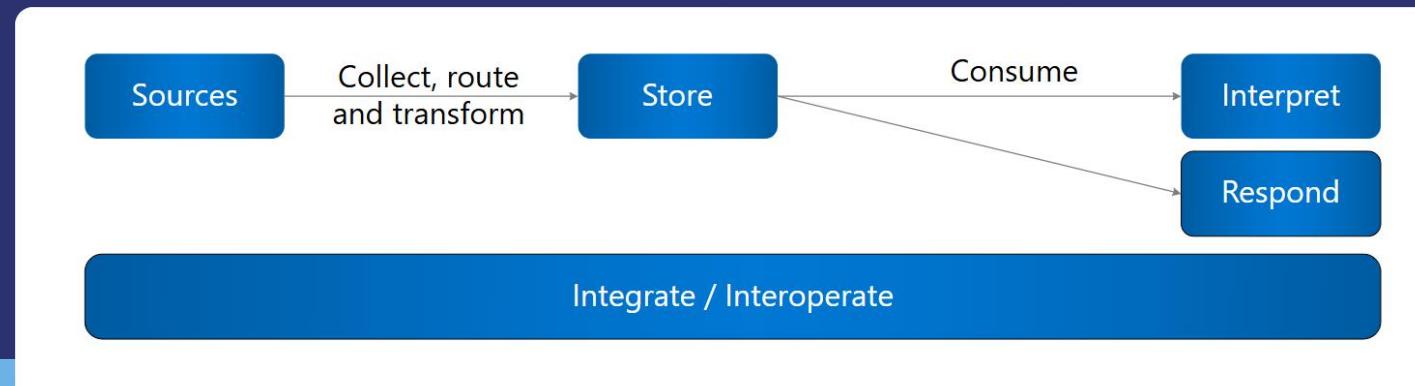


On-premises

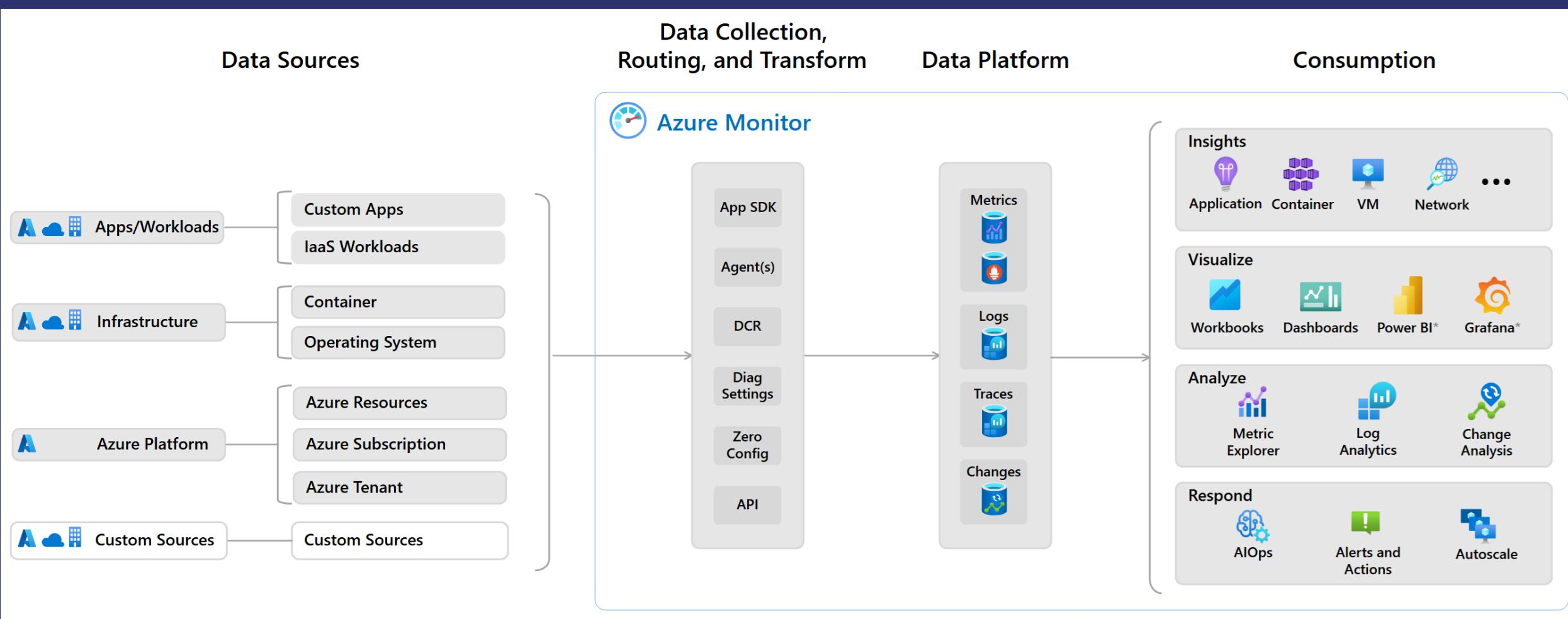


Azure Monitoring

- comprehensive monitoring solution for **collecting, analyzing, and responding to monitoring data** from your cloud and on-premises environments.
- use to **maximize availability and performance** of your applications and services.
- helps to understand how applications are performing and respond to system events.
- **collects and aggregates data** from every layer and component across multiple Azure and non-Azure subscriptions and tenants.
- stores in a common data platform for consumption by a common set of tools to **correlate, analyze, visualize, and/or respond to the data**.



Azure Monitoring



Azure Monitoring

The screenshot shows the Azure Monitor Overview page. On the left is a navigation sidebar with links like Home, Monitor | Overview, Search, Overview, Activity log, Alerts, Metrics, Logs, Change Analysis, Service Health, Workbooks, Insights (Applications, Virtual Machines, Storage accounts, Containers, Networks, SQL (preview), Azure Cosmos DB, Key Vaults, Azure Cache for Redis, Azure Data Explorer Clusters, Log Analytics workspaces, Azure Stack HCI (preview), Service Bus (preview), and Insights Hub). The main content area has two sections: 'Insights' and 'Detection, triage, and diagnosis'. The 'Insights' section contains four cards: Application insights (monitor app availability, performance, errors, usage), Container Insights (gain visibility into controller, node, container health), VM Insights (monitor VM health, performance, dependencies), and Network Insights (view network resource health and metrics). The 'Detection, triage, and diagnosis' section contains six cards: Metrics (create charts for resource usage and performance), Alerts (get notified using alerts and actions), Logs (analyze issues with log queries), Workbooks (view, create, share interactive reports), Change Analysis (investigate what changed in incidents), and Azure Monitor SCOM managed instance (SCOM managed instance monitors workloads on cloud and on-prem).

Azure Monitoring

[Overview](#) [Tutorials](#) [What's new](#)

Insights

Use curated monitoring views for specific Azure resources. [View all insights](#)



Application insights

Monitor your app's availability, performance, errors, and usage.



[View](#) [More](#)



Container Insights

Gain visibility into the performance and health of your controllers, nodes, and containers.



[View](#) [More](#)



VM Insights

Monitor the health, performance, and dependencies of your VMs and VM scale sets.



[View](#) [More](#)



Network Insights

View the health and metrics for all deployed network resources.



[View](#) [More](#)

Azure Monitoring

Detection, triage, and diagnosis

Visualize, analyze, and respond to monitoring data and events. [Learn more about monitoring](#)



Metrics

Create charts to monitor and investigate the usage and performance of your Azure resources.

[View](#) [More](#)



Alerts

Get notified and respond using alerts and actions.

[View](#) [More](#)



Logs

Analyze and diagnose issues with log queries.

[View](#) [More](#)



Workbooks

View, create and share interactive reports.



Change Analysis

Investigate what changed to triage incidents.



Azure Monitor SCOM managed instance

SCOM managed instance monitors workloads running on cloud and on-prem.

Azure Monitoring

Analysis of Page Views

Page views correspond to user activity in your app. Understanding how your users interact with your pages will give you good insights into what is working in your app and what aspects need improvements.

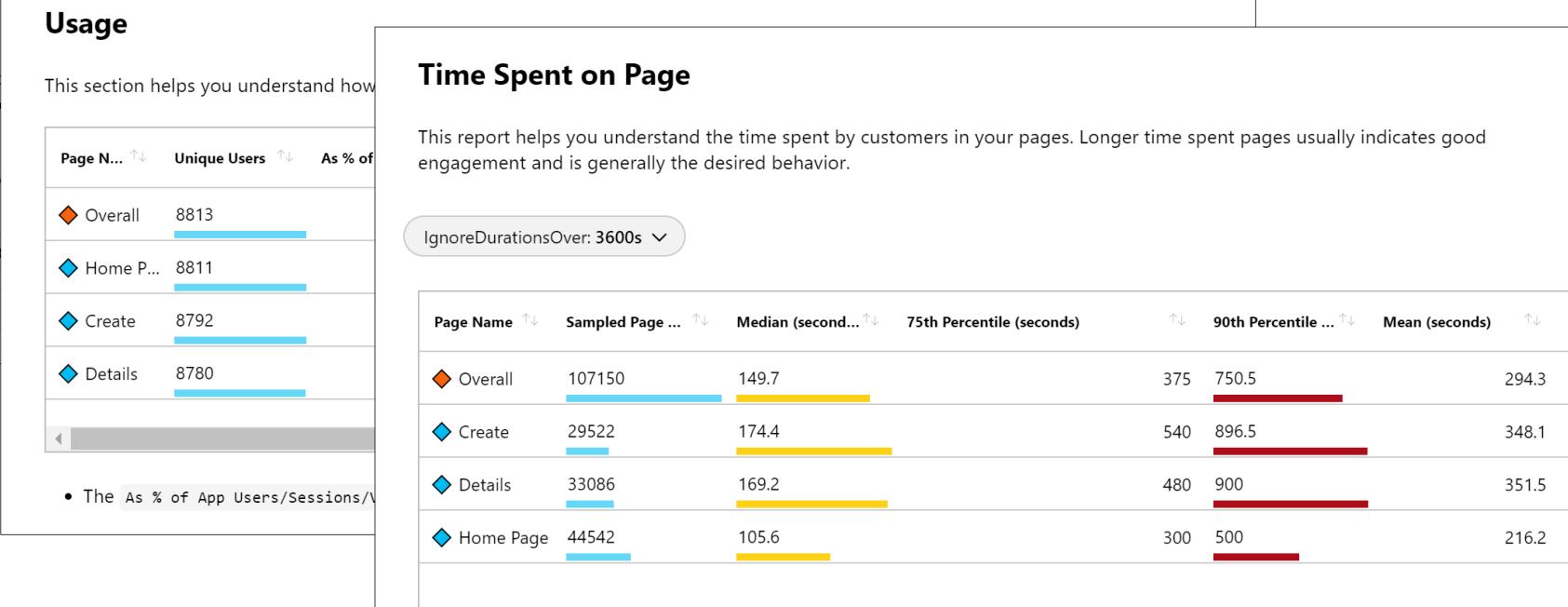
This report will help

- Usage
- Time spent on page
- Time to first interaction
- Exit rates

If your telemetry does not include

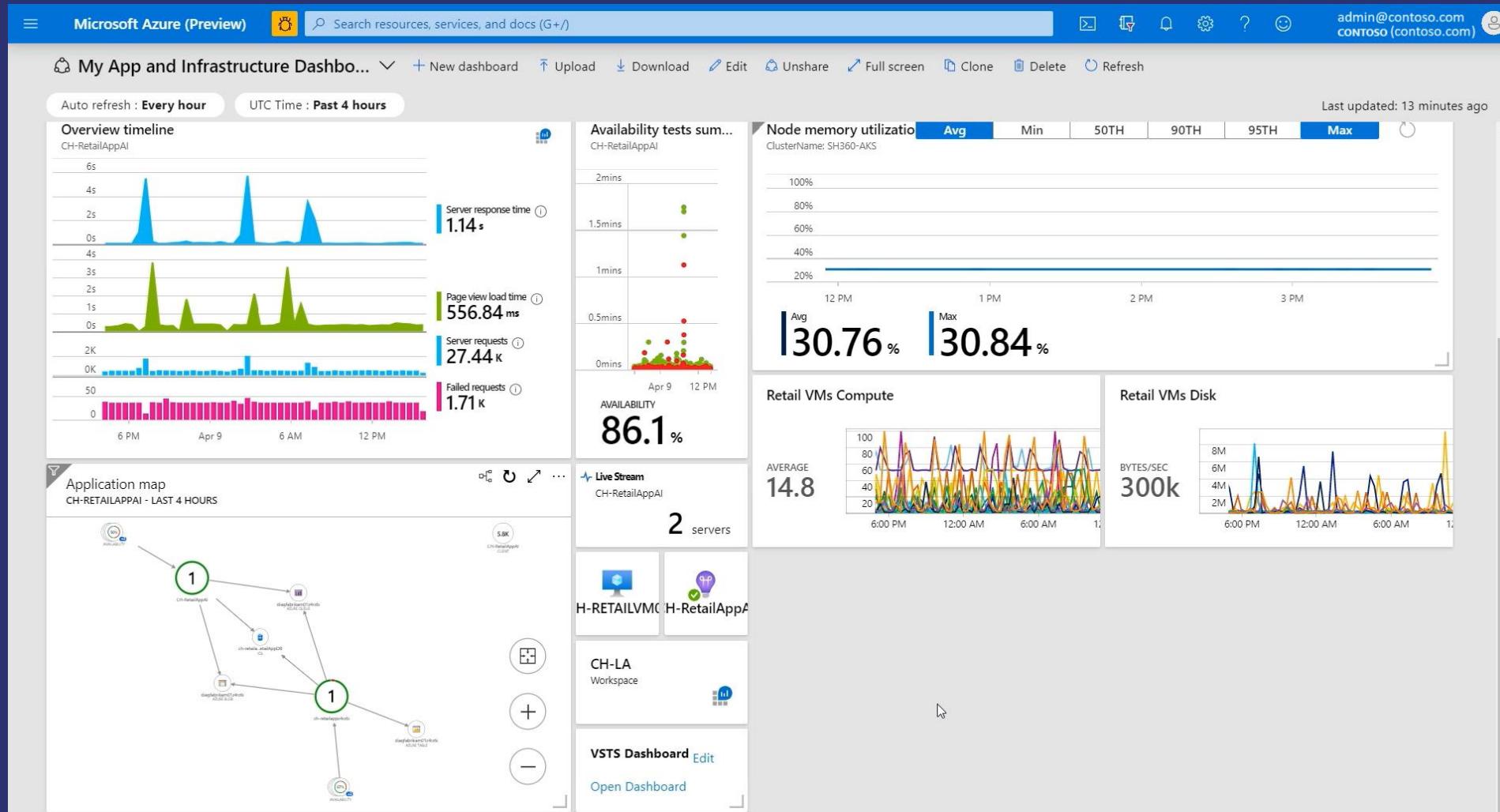
Pages: Home Page, Details

OptimizeCalculationsFor

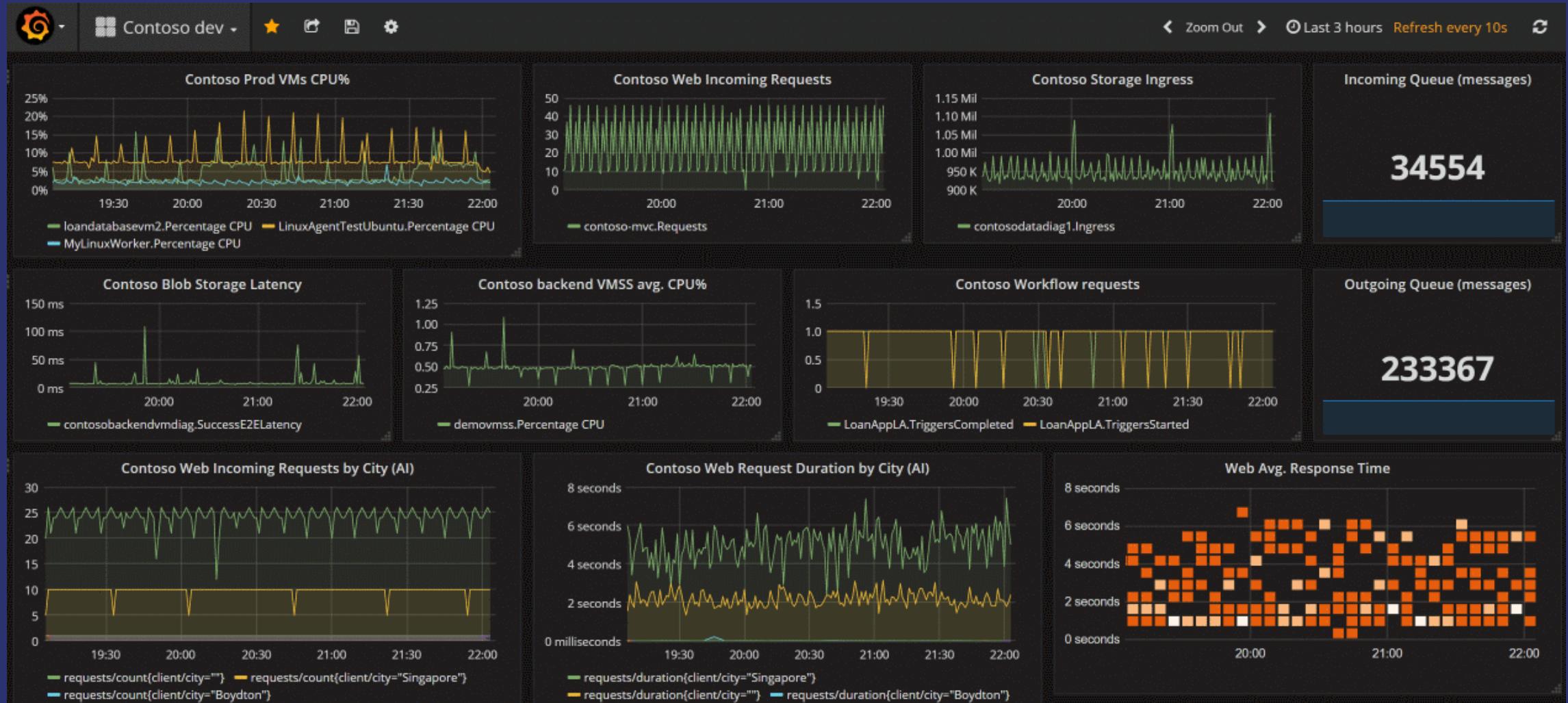


- The calculations may use sampling based on the OptimizeCalculationsFor parameter.
- Time Spent on Page does not consider exit pages (last page of the session) in this calculations. The Sampled Page Views column may be fewer than the sampling count of 100000 because of this.

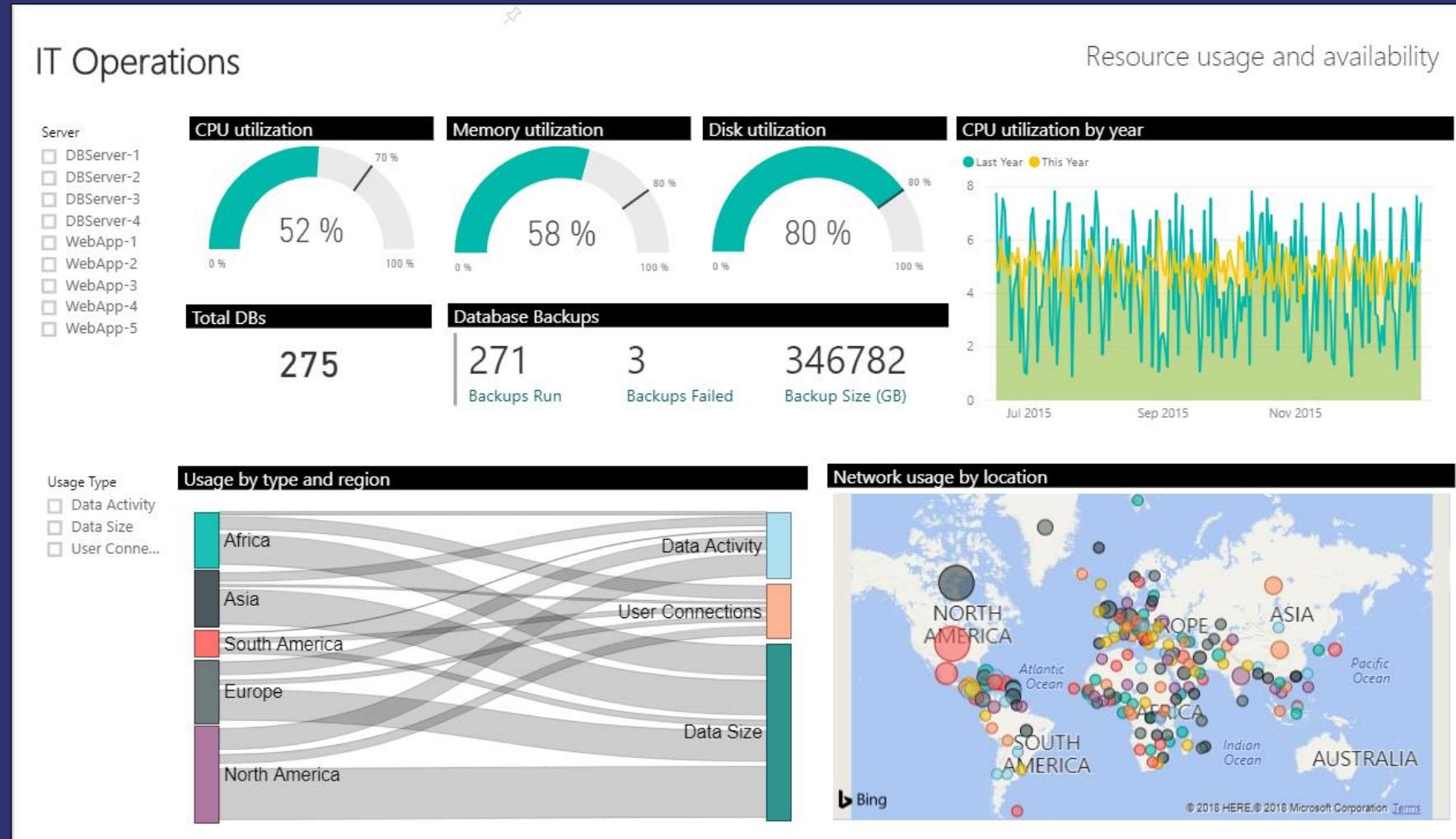
Azure Monitoring - custom dashboard



Azure Monitoring datasource plug-in for Grafana



Azure Monitoring log query import for PowerBi



Azure Monitoring visualization best practice

"We recommend using **Azure Managed Grafana** for **data visualizations and dashboards** in **cloud-native scenarios**, such as Kubernetes and Azure Kubernetes Service (AKS), as well as multicloud, open source software, and third-party integrations.

For **other Azure scenarios**, including **Azure hybrid environments** with Azure Arc, we recommend **Azure workbooks**.

When to use Azure Managed Grafana

- Cloud native environments monitored with Prometheus and CNCF tools
- Multi-cloud and multi-platform environments
- Multi-tenancy and portability support
- Interoperability with open-source and third-party tools
- Sharing dashboards outside of the Azure portal

When to use Azure workbooks

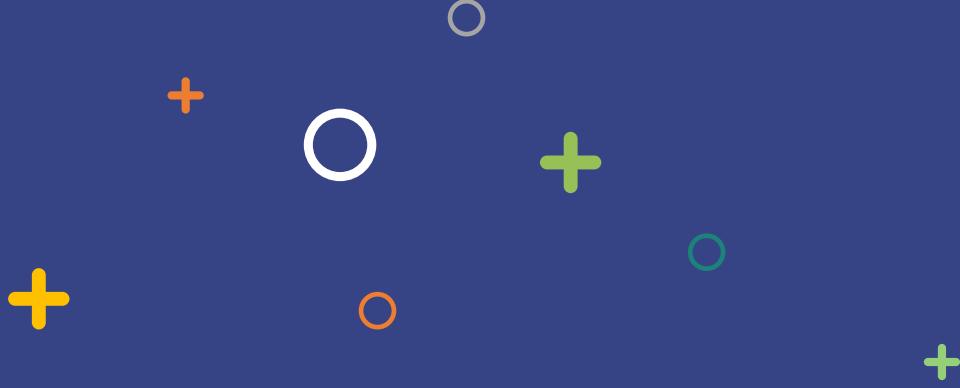
- Azure managed hybrid and edge environments
- Integrations with Azure actions and automation
- Creating custom reports based on Azure Monitor insights

Video: How to create an Azure Monitoring dashboard

Dashboards with Azure Monitor Data

- Monitor the performance, availability, and health of resources
- Allow you to launch tasks for day to day operations
- Can be customized based on projects, tasks, or user roles





Cloud Resource Optimization

Cost Management

Cloud Optimization

the process of managing and allocating cloud resources to
improve service performance, enhance security, minimize waste, and reduce costs.
This involves creating an efficient cloud infrastructure that aligns resource provisioning
with the demands of applications and workloads in real time,
striking a **balance between performance, compliance, and cost-efficiency** needs.

Cloud Optimization strategies

- **Rightsizing:** process of aligning the type and size of cloud computing instances with workloads.
- **Auto scaling:** automates provisioning and deprovisioning of cloud resources, including storage and virtual machine instances, to align resources and demand in real time.
- **Containerization:** packages software code with operating system, configuration files, libraries and dependencies needed to run the code into a single “container,” enabling it to run on any platform or cloud.
- **Reserved instances (RIs):** long-term commitments to use specific services, typically ranging from one to three years.
- **Spot instances:** last-minute resource purchases that are often offered at a reduced cost.
- **Cloud-native applications:** programs made up of reusable components known as microservices.

Azure Cost Management

A **suite** of FinOps tools provided by Microsoft Azure that helps organizations **analyze, monitor, and optimize their cloud costs.**

It allows users to track cloud spending, create budgets, forecast future costs, and **gain insights** through detailed cost analysis and reporting tools.

Azure Cost Management tools

- **Cost Analysis:** break down costs by various dimensions such as resource groups, services, locations, and tags.
- **Budgeting:** set spending limits and receive notifications when you approach or exceed your budget.
- **Cost Alerts:** configure notifications based on budgets or specific spending thresholds.
- **Cost Allocation:** distribute cloud costs across different business units, projects, or customers.
- **Exports:** create custom reports and integrate cost data with other business systems.

Cost Analysis

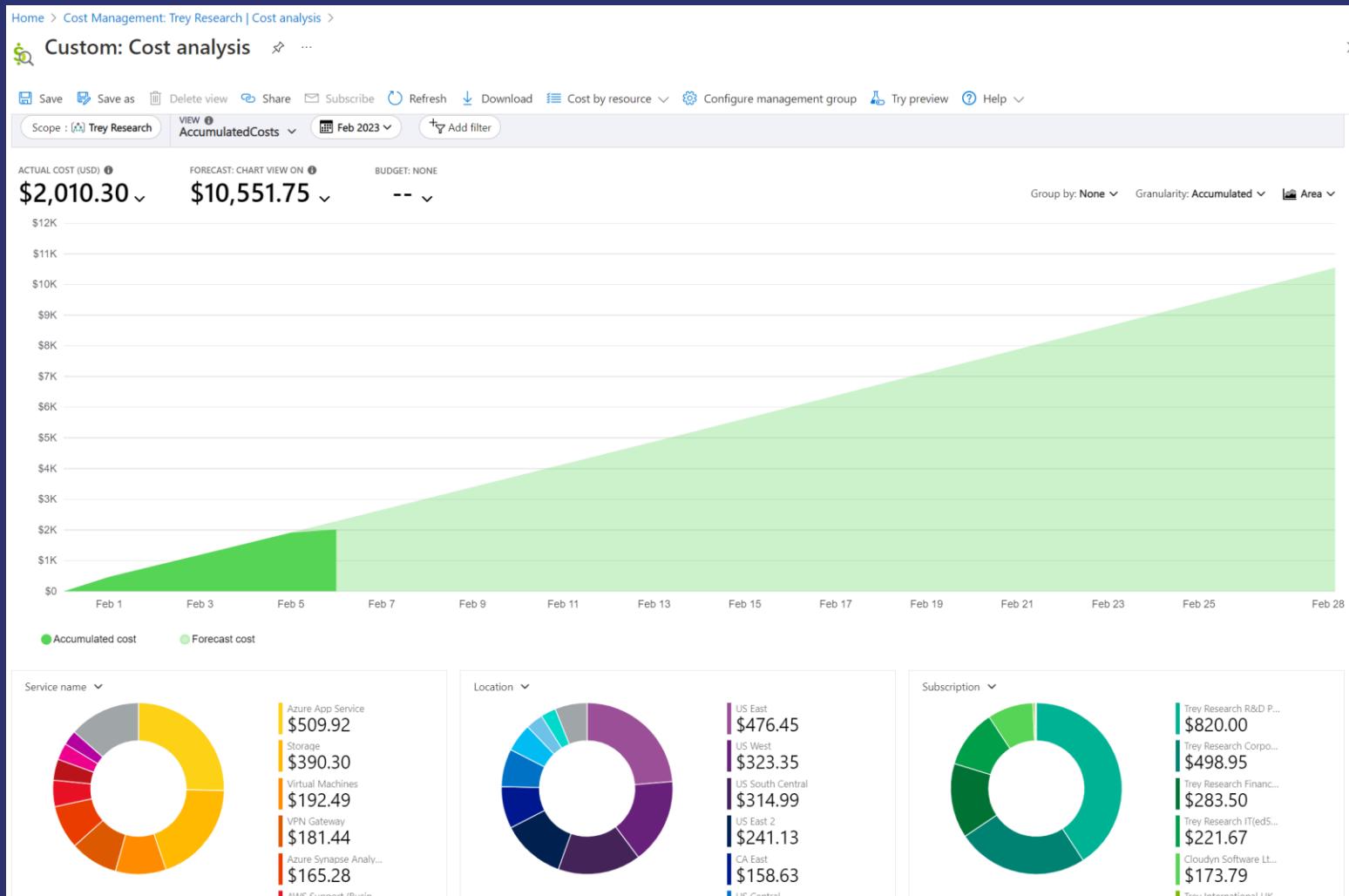
Cost analysis is your tool for **interactive analytics and insights**.

You **explore and analyze costs** using views; a customizable report that summarizes and allows you to drill into your costs.

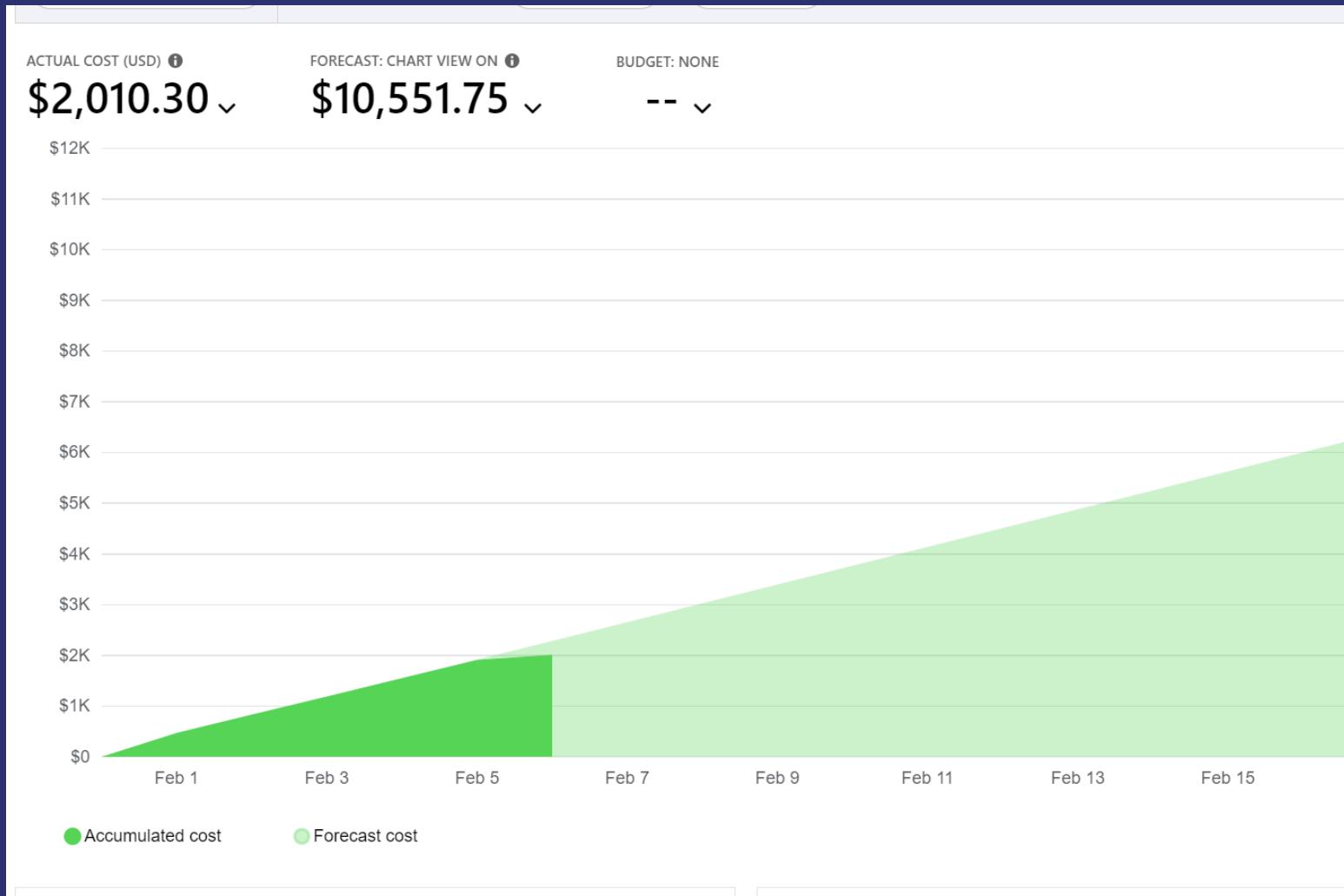
Cost analysis has two types of views:

- smart views that offer intelligent insights and more details by default and
- customizable views you can edit, save, and share to meet your needs.

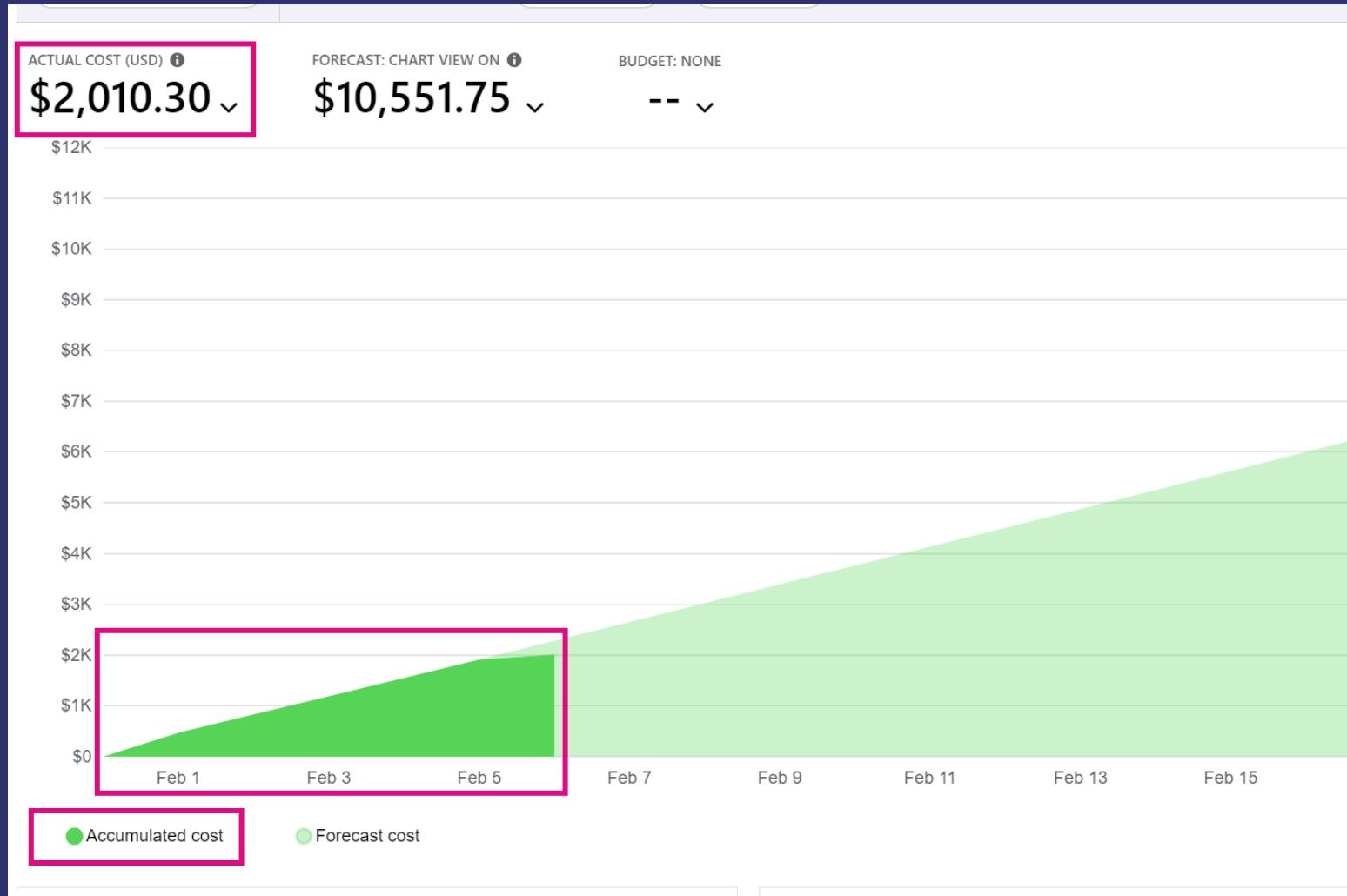
Cost Analysis



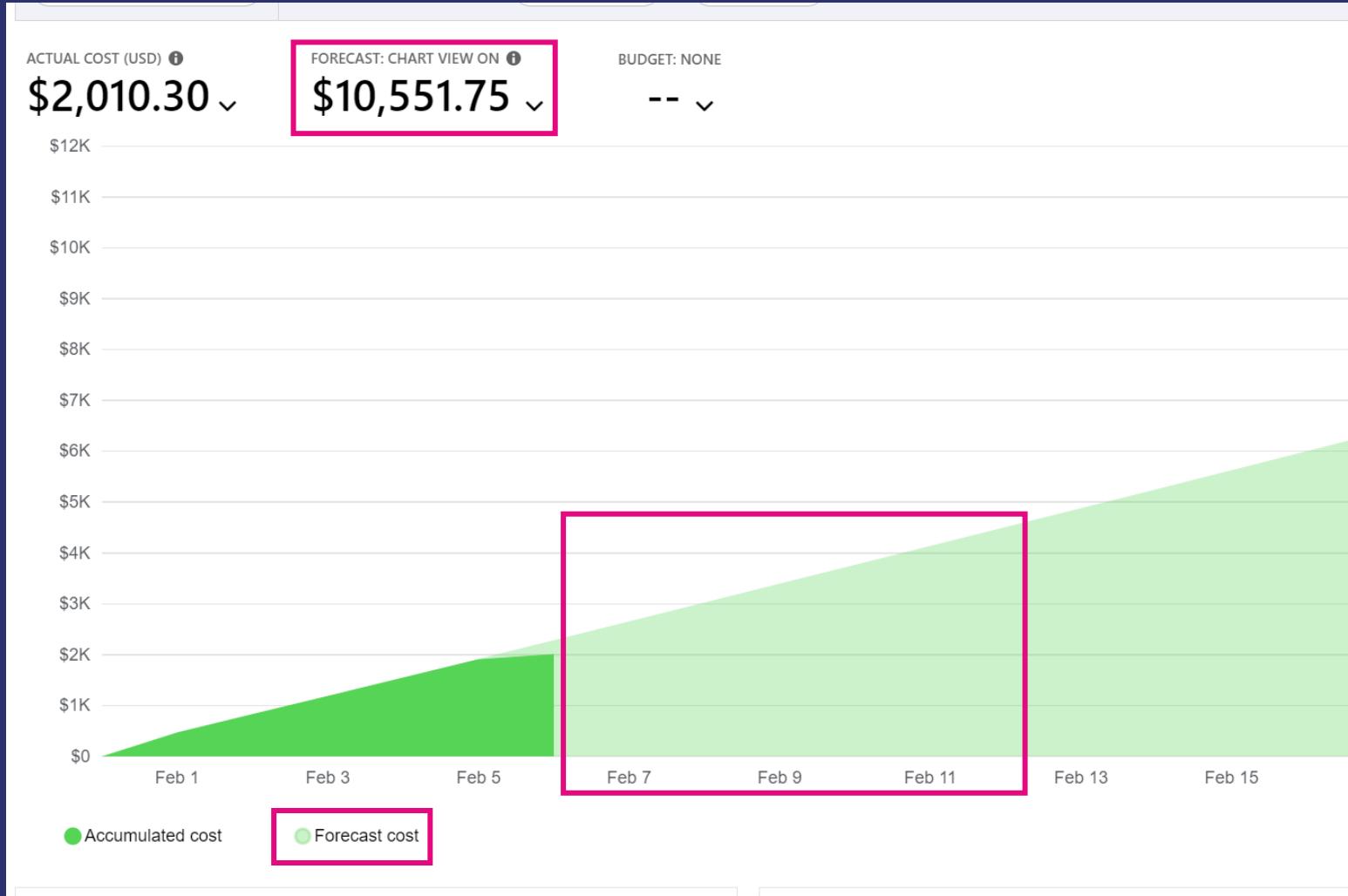
Cost Analysis



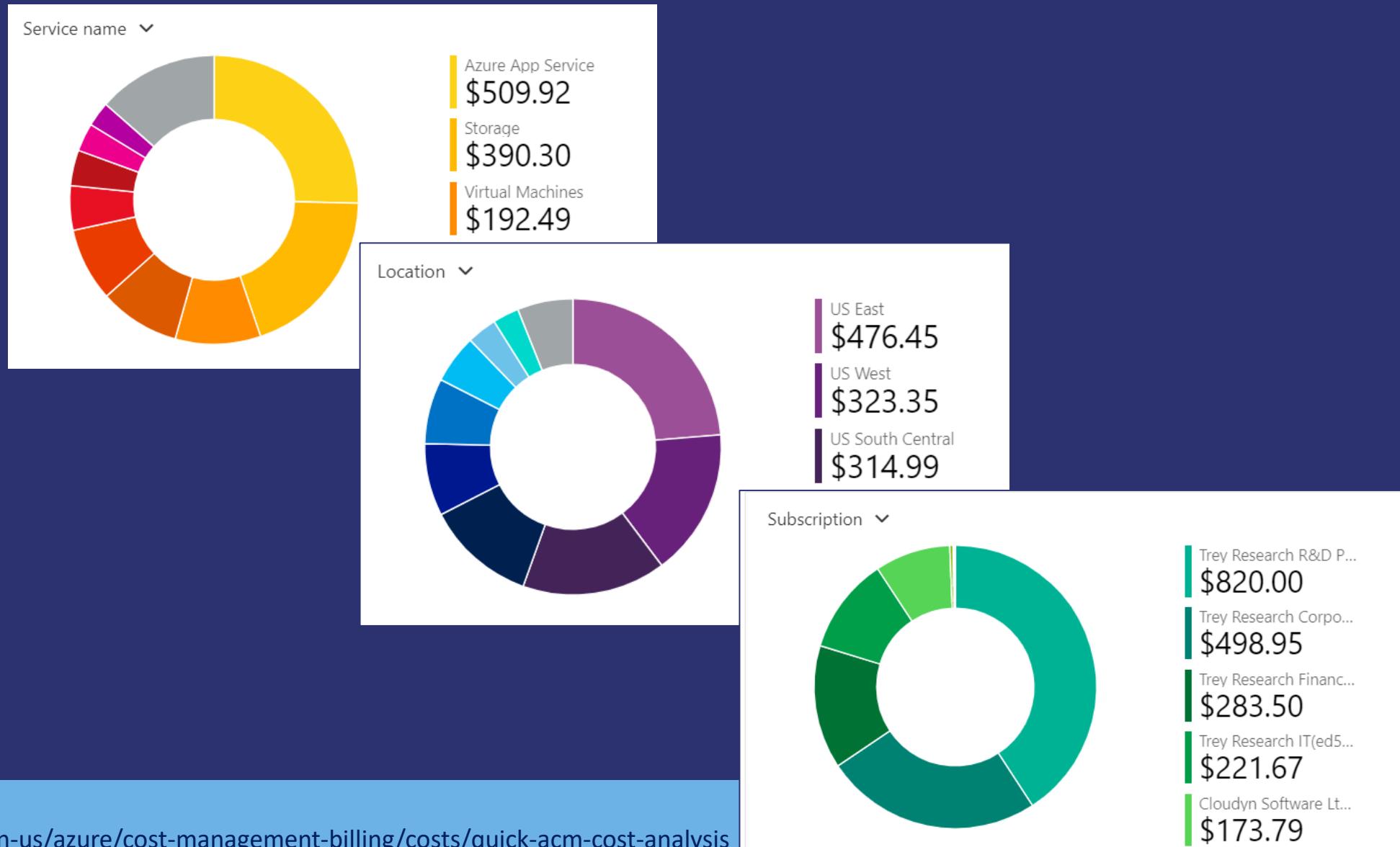
Cost Analysis



Cost Analysis



Cost Analysis



Azure Advisor

- **digital cloud assistant** that helps you follow best practices to optimize your Azure deployments.
- analyzes resource configuration and usage telemetry and **recommends** solutions that can help you **improve** the cost effectiveness, performance, reliability, and security of your Azure resources.
- get proactive, actionable, and personalized best practices recommendations.
- improve **performance, security, and reliability** of your resources.
- get recommendations with proposed actions.

Azure Advisor

Home > Advisor | Overview

Search Subscription equals 27 of 37 selected Recommendation Status equals Active Resource Group equals All Type equals All Add filter

Cost Score 100% Feedback Download as CSV Download as PDF Workbooks

Security Score 54% Feedback Download as CSV Download as PDF Workbooks

Reliability Score 92% Feedback Download as CSV Download as PDF Workbooks

Operational excellence Score 78% Feedback Download as CSV Download as PDF Workbooks

Performance Score 100% Feedback Download as CSV Download as PDF Workbooks

Tips & tricks

Get started in Advisor

Advisor provides Microsoft best practices to help you improve your workloads, identify cost saving opportunities or explore best practices.

Get started

Is Advisor helpful?

Subscription equals 27 of 37 selected

Recommendation Status equals Active

Resource Group equals All

Type equals All

Add filter

Cost

Score 100%

3 Recommendations

0 High impact 3 Medium impact 0 Low impact

3 Impacted resources

Security

Score 54%

You are following all of our security recommendations

See list of security recommendations

5 Recommendations

2 High impact 3 Medium impact 0 Low impact

51 Impacted resources

Reliability

Score 92%

3 Recommendations

0 High impact 2 Medium impact 1 Low impact

40 Impacted resources

Operational excellence

Score 78%

3 Recommendations

0 High impact 2 Medium impact 1 Low impact

40 Impacted resources

Performance

Score 100%

1 Recommendation

0 High impact 1 Medium impact 0 Low impact

1 Impacted resource

Monitoring

Alerts (Preview)

Recommendation digests

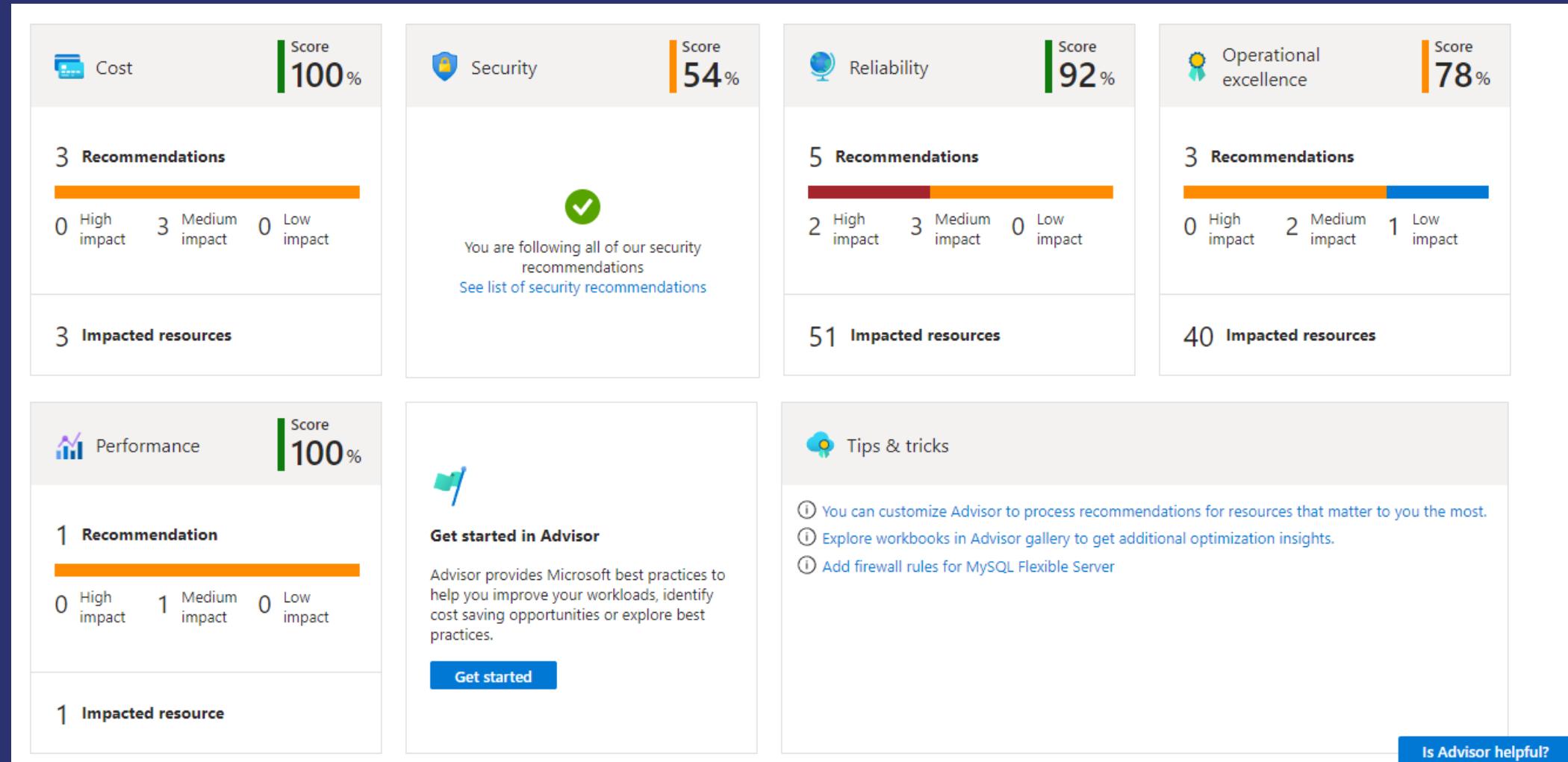
Settings

Configuration

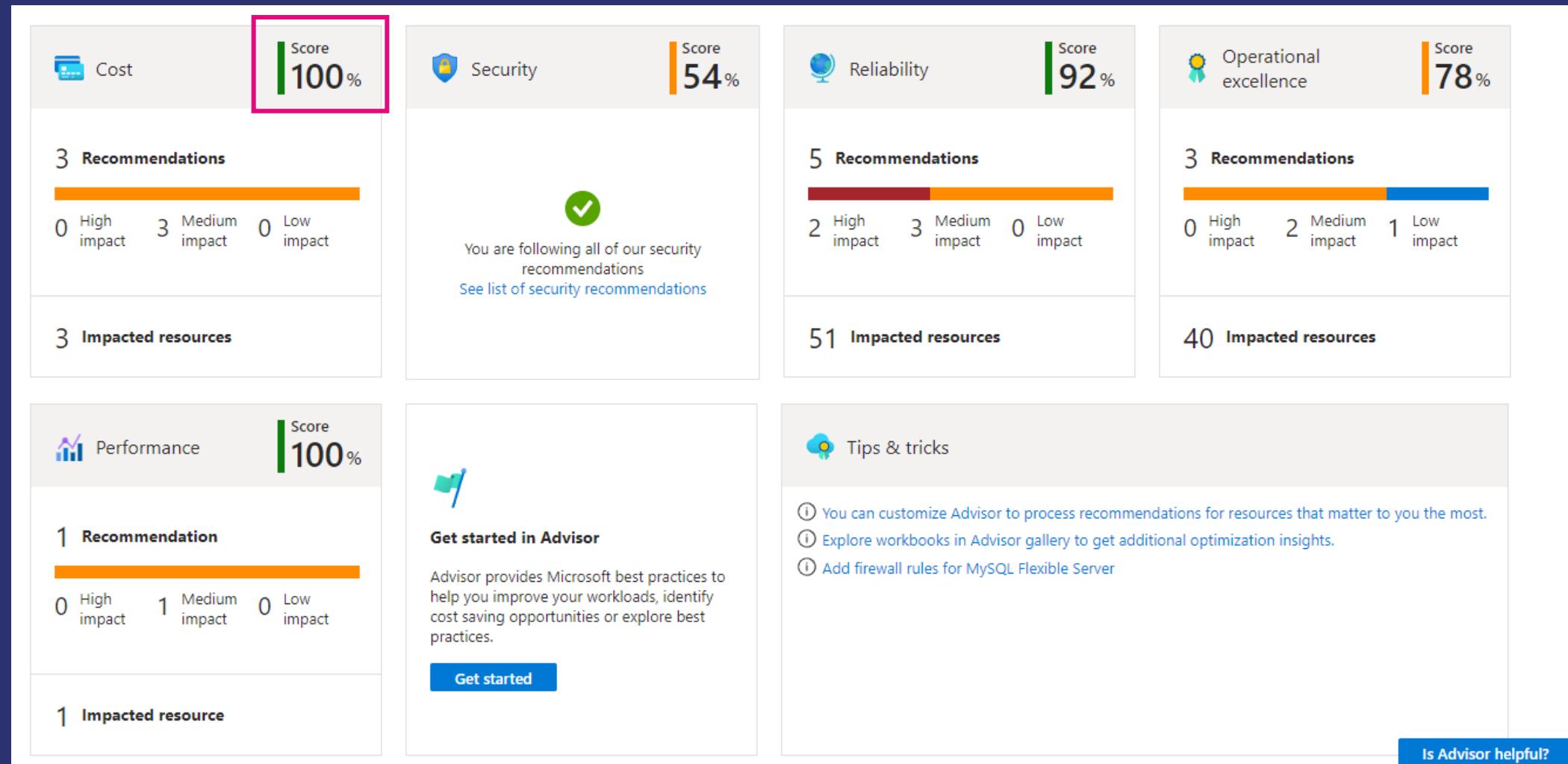
Support + troubleshooting

Support + troubleshooting

Azure Advisor



Azure Advisor



Azure Advisor score

Microsoft Azure Search resources, services, and docs (G+) Feedback Download as CSV Download as PDF Try the new Advisor Score (preview)

Home > Advisor

Advisor | Advisor Score (preview) x

Search (Ctrl+ /) Feedback Download as CSV Download as PDF Try the new Advisor Score (preview)

Subscriptions: All 53 selected – Don't see a subscription? [Open Directory + Subscription settings](#)

All subscriptions All types Active No grouping

Advisor Score (preview) Overview

Recommendations

- Cost
- Security
- Reliability
- Operational excellence
- Performance
- All recommendations

Monitoring

- Alerts (Preview)
- Recommendation digests

Settings

Configuration

Score history Monthly

Score by category

Category	Score	Details
Cost (save 6,740 USD)	81%	Cost
Security	Coming soon	Security
Reliability	83%	Reliability
Operational excellence	99%	Operational excellence
Performance	100%	Performance

Cost 5 **Security** 51 **Reliability** 7 **Operational excellence** 2 **Performance** 1 **All recommendations** 66

Description	Potential yearly savings	Potential score i...	Impacted resources	Last updated
Delete ExpressRoute circuits in the provider status of Not Provisioned	Quick fix	No data	9%	1 ExpressRoute circuit
Delete Public IP address not associated to a running Azure resource	Quick fix	32.14 USD	0%	1 Public IP address
Right-size underutilized SQL Databases		6,514.78 USD	0%	2 SQL databases
Consider taking action on your unused containers		27.65 USD	Not available	3 Cosmos DB accounts

Is Advisor Score experience helpful?

Azure Advisor score

Advisor Score ⓘ
90%
Your Advisor Score refreshes every 24 hours.
[Learn more ↗](#)

Score history Monthly ↘

Score history chart showing a steady increase from June to September.

Score by category ⓘ

Cost (save 6,740 USD):	<div style="width: 81%;"></div> 81%
Security:	Coming soon
Reliability:	<div style="width: 83%;"></div> 83%
Operational excellence:	<div style="width: 99%;"></div> 99%
Performance:	<div style="width: 100%;"></div> 100%

Cost 5 **Security** 51 **Reliability** 7 **Operational excellence** 2 **Performance** 1 **All recommendations** 66

Description	↑↓	Potential yearly savings	↑↓	Potential score i... ↑↓	Impacted resources	↑↓	Last updated	↑↓
Delete ExpressRoute circuits in the provider status of Not Provisioned	Quick fix	No data	9%	1 ExpressRoute circuit	9/09/2020, 06:24 AM			
Delete Public IP address not associated to a running Azure resource	Quick fix	32.14 USD	0%	1 Public IP address	9/09/2020, 06:48 AM			
Right-size underutilized SQL Databases		6,514.78 USD	0%	2 SQL databases	9/09/2020, 07:34 AM			
Consider taking action on your unused containers		27.65 USD	Not available	3 Cosmos DB accounts	9/09/2020, 07:18 AM			

Is Advisor Score experience helpful?

Azure Advisor score

Advisor Score ⓘ

90%

Your Advisor Score refreshes every 24 hours.
[Learn more ↗](#)

Score history

Monthly ↘



Month	Score (%)
Jun	~55%
Jul	~60%
Aug	~65%
Sep	90%

Score by category ⓘ

Cost (save 6,740 USD):	<div style="width: 81%;"></div> 81%
Security:	Coming soon
Reliability:	<div style="width: 83%;"></div> 83%
Operational excellence:	<div style="width: 99%;"></div> 99%
Performance:	<div style="width: 100%;"></div> 100%

Cost 5 **Security** 51 **Reliability** 7 **Operational excellence** 2 **Performance** 1 **All recommendations** 66

Description	Potential yearly savings	Potential score increase	Impacted resources	Last updated	
Delete ExpressRoute circuits in the provider status of Not Provisioned	Quick fix	No data	9%	1 ExpressRoute circuit	9/09/2020, 06:24 AM
Delete Public IP address not associated to a running Azure resource	Quick fix	32.14 USD	0%	1 Public IP address	9/09/2020, 06:48 AM
Right-size underutilized SQL Databases		6,514.78 USD	0%	2 SQL databases	9/09/2020, 07:34 AM
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Is Advisor Score experience helpful?

Azure Advisor score

Cost	Security	Reliability	Operational excellence	Performance	All recommendations
5	51	7	2	1	66
Description	↑↓ Potential yearly savings	↑↓ Potential score i... ↑↓	Impacted resources		
Delete ExpressRoute circuits in the provider status of Not Provisioned	Quick fix	No data	9%	1 ExpressRoute circuit	
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Consider taking action on your unused containers		27.65 USD	Not available	3 Cosmos DB accounts	

QUIZ
Time



Cloud Computing Champion 2025





I love feedback!

THANK YOU
Are there any questions?

<https://github.com/cloud-devops-ninja/myPresentations/tree/main/Alyx/ChangeAgentDay>