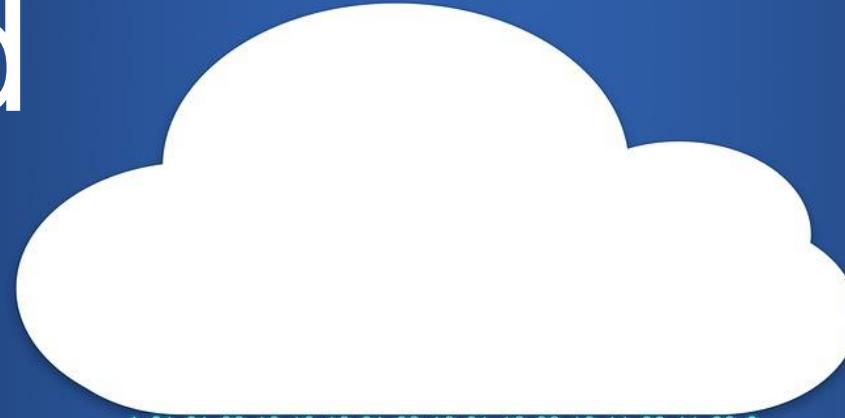


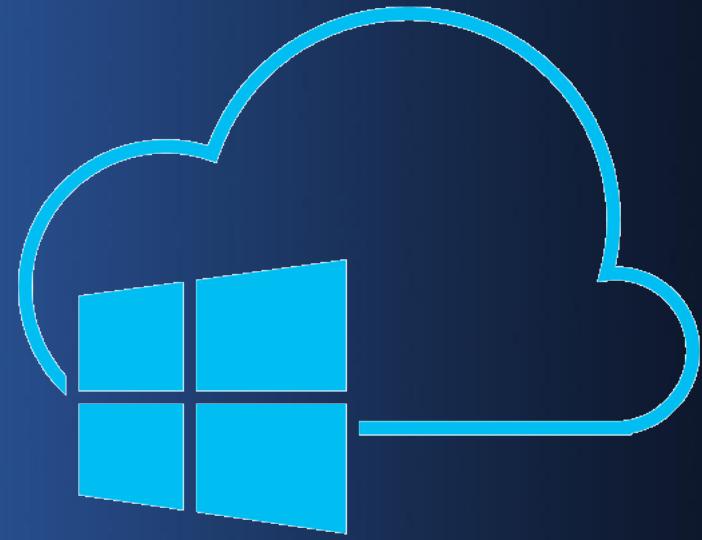
Advanced

Azure



```
1 01 01 00 10 10 10 01 00 10 01 10 00 10 11 00 11 00 0  
1 01 11 11 10 11 00 11 10 10 01 10 10 11 01 10 11 10 0  
0 10 10 10 10 10 10 00 11 00 00 00 00 01 01 11 10 10 0  
0 11 01 11 00 00 01 00 11 11 00 11 11 01 10 00 10 00 1  
0 00 11 00 01 11 01 10 10 10 01 00 11 11 11 01 01 11 0  
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1 00 10 00 01 00 10 11 01 00 00 10 10 10 01 10 01 10 0  
1 10 11 00 01 11 00 10 01 11 11 11 11 10 11 01 01 1  
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```

Develop a passion for learning.





WORKFORCE DEVELOPMENT



PARTICIPANT GUIDE



Content Usage Parameters

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medium outside of the
training program

4

Content is intended as
reference material only to
supplement the instructor-
led training

LOGISTICS



Class Hours:

- Instructor will set class start and end times.
- There will be regular breaks in class.



Telecommunication:

- Turn off or set electronic devices to silent (not vibrate)
- Reading or attending to devices can be distracting to other students
- Try to delay until breaks or after class

Miscellaneous:

- Courseware
- Bathroom
- Fire drills

COURSE OBJECTIVES

At the end of this course, you will:

- Have an understanding of the different services Azure offers and be able to choose the correct solution for different workloads
- Deploy applications in a resilient manner
- Use Entra ID for authentication
- Monitor applications running in Azure
- More!

Hi!

Jason Smith

Cloud Consultant with a Linux sysadmin background.
Focused on cloud-native technologies: automation,
containers & orchestration



github

<https://github.com/jruels>

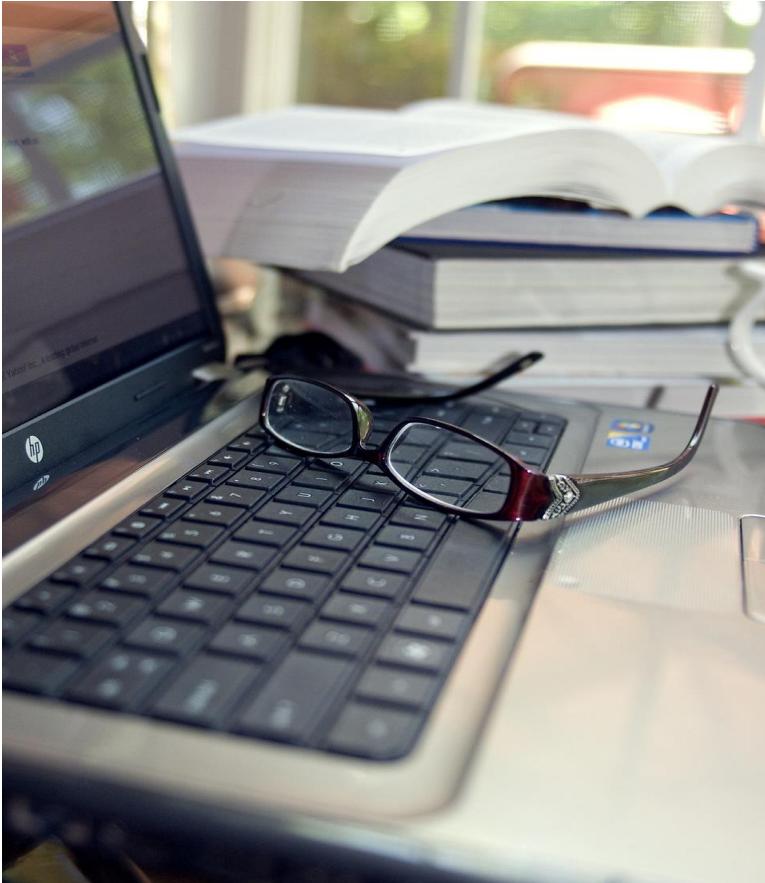
mail

jason@innovationinsoftware.com

Expertise

- Cloud
- Automation
- CICD
- Docker
- Kubernetes

LAB-FOCUSED COURSE



**This is a hands-on,
functional course.**

We will focus on doing labs and
learning through interaction with Azure

INTRODUCTIONS

Hello!

- Name
- Job Role
- Cloud/Azure experience
- Expectations for course

AZURE CLOUD SERVICES

PORTAL OVERVIEW

The screenshot shows the Microsoft Azure portal interface for a virtual machine named "myVM1". The portal has a blue header bar with the Microsoft Azure logo, a search bar, and various navigation and utility icons. The main content area displays the "Overview" page for the VM, including its resource group, status, location, subscription, and operating system details. A red box highlights the left sidebar, which contains links for Overview, Activity log, Access control (IAM), Tags (marked with a red circle 9), Diagnose and solve problems, Resource visualizer, Connect, Networking, Settings, Availability + scale, Security, Backup + disaster recovery, Operations, Monitoring, Automation, and Help. Another red box highlights the top navigation bar, which includes "Copilot", "Feedback", and "CLI / PS" (marked with a red circle 8). Red numbers 1 through 10 are placed around specific UI elements to indicate their significance.

1 Microsoft Azure

2 Home > Virtual machines > myVM1

3 Search resources, services, and docs (G+)

4 Copilot

5 Feedback

6 CLI / PS

7 user@contoso.com
CONTOSO (CONTOSO.CONTO...)

8

9

10

Overview

Resource group ([move](#)) : [SimpleWinVmResourceGroup](#)

Status : Running

Location : [East US](#)

Subscription ([move](#)) : [mySubscription](#)

Subscription ID : 00000000-0000-0000-0000-000000000000

Operating system : Windows (Windows Server 2022 Datacenter Azure Edition)

Size : Standard D2s v3 (2 vcpus, 8 GiB memory)

Public IP address : [00.000.00.00](#)

Virtual network/subnet : [myVM1-vnet/default](#)

DNS name : [Not configured](#)

Health state : -

Time created : 6/13/2024, 10:24 PM UTC

Tags ([edit](#)) : [Add tags](#)

Properties **Monitoring** Capabilities (8) Recommendations (1) Tutorials

Show data for : [Last 24 hours](#)

Health events (1) Azure outages (1)

No events **No issues**

Alerts

Performance and utilization

Platform metrics [See all Metrics](#)

VM Availability (Preview) CPU (average)

AZURE DASHBOARDS HUB

Microsoft Azure Search resources, services, and docs (G+) Copilot More

Dashboard > Create a dashboard ...

Search

Custom
Create a custom dashboard.

Azure inventory
This dashboard uses Azure Resource Graph to provide a summary view of all your azure resources.

Azure Cosmos DB health
This dashboard provides a summary view of the overall performance, failures and capacity of your Azure Cosmos DB resource.

Application Insights
This dashboard provides a summary view of your application's health and performance using Application Insights.

SQL database health
This dashboard provides insight into the health of your SQL database through key metrics like database utilization, performance, and data usage.

VM scale set
This dashboard provides insight into the health and performance of your VM Scale Set.

App Service tracking
This dashboard provides insight into the health of your App Service and through key metrics like CPU consumption, memory and requests, and response time.

IoT Hub
This dashboard provides insight into the health and performance of your IoT Hub through metrics like connected devices, throttling errors, grid latency, and

CUSTOMIZING DASHBOARDS

Dashboard Save Preview Cancel

+ Add tiles
You can resize, move, edit tiles, or add tiles to your dashboard.

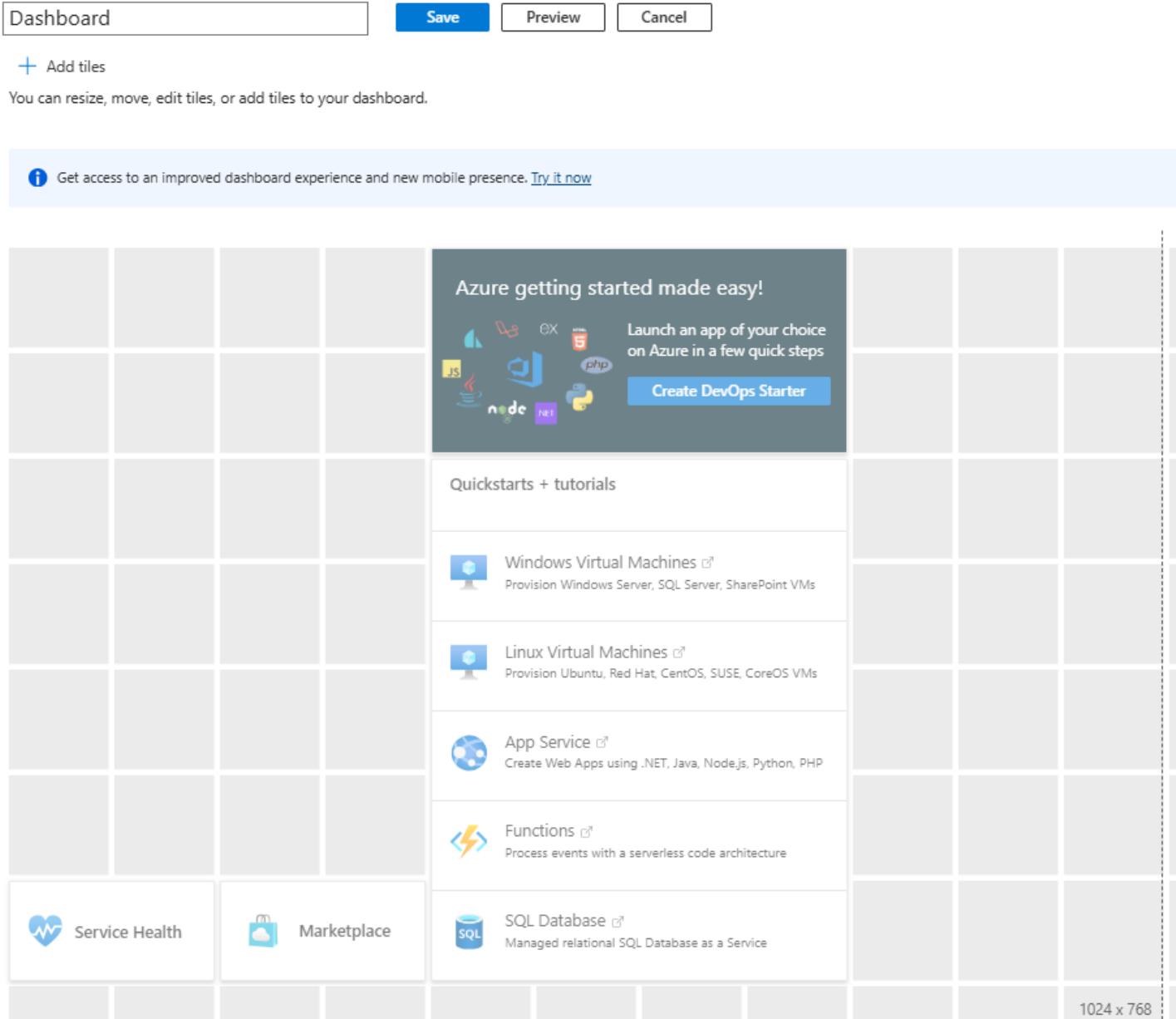
Get access to an improved dashboard experience and new mobile presence. [Try it now](#)

Azure getting started made easy!
Launch an app of your choice on Azure in a few quick steps
[Create DevOps Starter](#)

Quickstarts + tutorials

- Windows Virtual Machines Provision Windows Server, SQL Server, SharePoint VMs
- Linux Virtual Machines Provision Ubuntu, Red Hat, CentOS, SUSE, CoreOS VMs
- App Service Create Web Apps using .NET, Java, Node.js, Python, PHP
- Functions Process events with a serverless code architecture
- SQL Database Managed relational SQL Database as a Service

Service Health Marketplace



1024 x 768

Tile Gallery

Drag and drop or select tile and click "Add". You can add other parts of the portal to the dashboard by pinning.
[Learn more](#)

Filter tiles



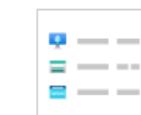
Metrics chart

Metrics in Azure Monitor are lightweight and capable of supporting near real-time scenarios...



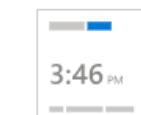
Resource groups

A resource group is a container that holds related resources for an Azure solution. See a list of your resource...



All resources

An Azure resource is a manageable item that is available through Azure. Virtual machines, storage accounts,...



Clock

Display the time in the time zone of your choice.



Markdown

Display custom, static content. For example, you can show basic instructions, an image, or a set of...



Users and groups

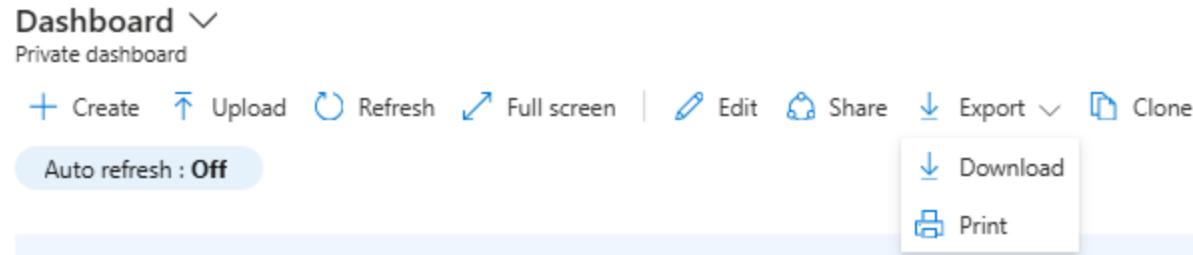
Display the top Microsoft Entra users and groups.



User sign-in summary

Display monthly user sign-ins for your Microsoft Entra tenant.

EXPORTING DASHBOARDS



You can export dashboards from the Azure Portal's Dashboard hub to inspect or reuse their structure programmatically. After export, you can also use the output as a template for future dashboards.

Security & Management

Security Center

Portal

Microsoft Entra ID

Azure AD B2C

Multi-Factor Authentication

Automation

Scheduler

Key Vault

Store/ Marketplace

VM Image Gallery & VM Depot

Platform Services

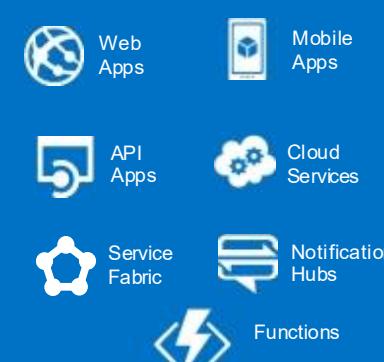
Media & CDN



Integration



Application Platform



Data



Intelligence



Compute Services



Developer Services



Analytics & IoT



Compute



Storage



Networking



Datacenter Infrastructure (52 regions worldwide)



Hybrid Cloud

Azure Health Monitoring



Domain Services

Backup

Operational Analytics

Import/Export

Azure Site Recovery

StorSimple

AZURE RESOURCES

Microsoft Azure

Search resources, services, and docs (G+)

Copilot

All services

All

Filter services

Service providers : Microsoft

Release Status : All

Favorites

Recents

Recommended for you

Categories

- AI + machine learning
 - Azure Machine Learning
- Analytics
- Compute
- Containers
- Databases
 - Event Hubs
- DevOps
- General
- Hybrid + multicloud
 - Host groups
- Identity
 - Restore Point Collections PREVIEW
- Integration
- Internet of Things
- Management and governance
 - Cloud services (extended support)
- Migration
 - Container Apps Environments
- Mixed reality
 - Batch accounts
- Monitor
- Networking
- Security
- Storage
 - Azure Cosmos DB for MongoDB (vCore)
- Web & Mobile
 - SQL managed instances
 - SQL Server - Azure Arc
 - Azure Managed Redis
 - Azure DevOps organizations
 - Managed DevOps Pools
 - API Connections
 - Dashboard hub PREVIEW
 - Resource Explorer

AI Search

Content moderators

Language

Translators

Data Lake Analytics

Azure Data Explorer Clusters

Log Analytics workspaces

Availability sets

Image templates

SSH keys

VM application definitions

Azure Spring Apps

Function App

Quantum Workspaces PREVIEW

Kubernetes fleet manager

Container App Jobs

Azure Database for MySQL flexible servers

SQL virtual machines

Azure Cache for Redis

SQL Server stretch databases

DevTest Labs

Microsoft Dev Box

API Management services

Deploy a custom template

Resource Graph Explorer

Azure AI Video Indexer

Custom vision

Metrics advisors

Intelligent Recommendations Accounts

Data Lake Storage Gen1

Data Share Invitations

Managed Prometheus

Community images

Images

Azure Virtual Desktop

VM image definitions

Virtual Instances for SAP solutions

Kubernetes service - Automatic (Preview)

SAP HANA on Azure PREVIEW

Azure Red Hat OpenShift clusters

Azure Cosmos DB

Azure Managed Instance for Apache Cassandra

Azure Arc data controllers

Azure Database Migration Services

Chaos Studio

GitHub

Network connections

Application Insights

Management groups

Resource groups

Anomaly detectors

Document intelligences

Azure OpenAI

Azure Synapse Analytics

Azure DataBricks

Data Shares

Stream Analytics clusters

Compute Fleet

Lab accounts

Virtual machine scale sets

VM image versions

Azure VMware Solution

Kubernetes services

Machines - Azure Arc

Service Fabric clusters

Azure Database for PostgreSQL flexible servers

Oracle Database@Azure

PostgreSQL servers – Azure Arc PREVIEW

Elastic Job agents

Azure Deployment Environments

Azure Lab Services

Playwright Testing PREVIEW

Monitor

Marketplace

All resources

Projects

Recent

Subscriptions

Bot Services

Face APIs

Personalizers

Analysis Services

HDInsight clusters

Power BI Embedded

Stream Analytics jobs

Azure compute galleries

Proximity placement groups

Virtual machines

App Services

Container Apps

BareMetal Instances

Container instances

Service Fabric managed clusters

Azure SQL Database Hyperscale

SQL databases

SQL managed instances - Azure Arc

Dev centers

Azure Load Testing

Projects

All resources

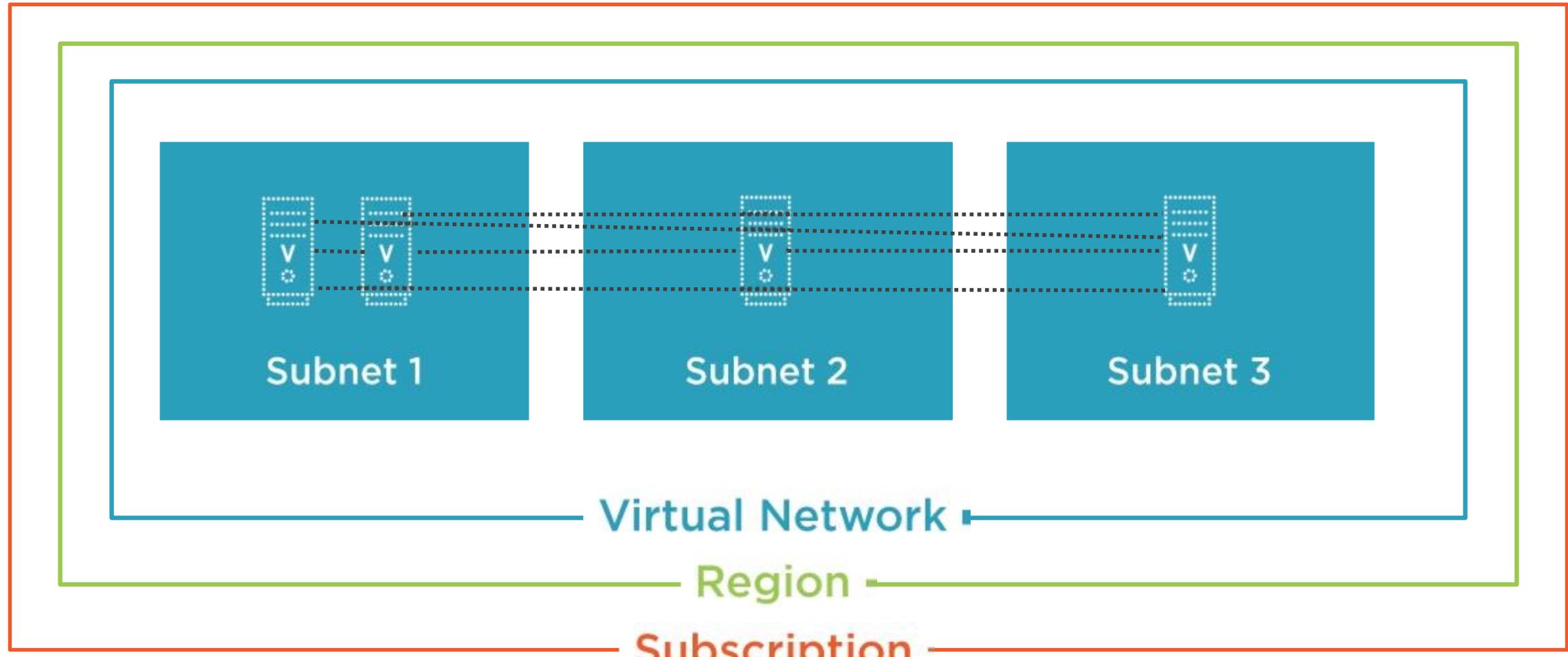
Recent

Subscriptions

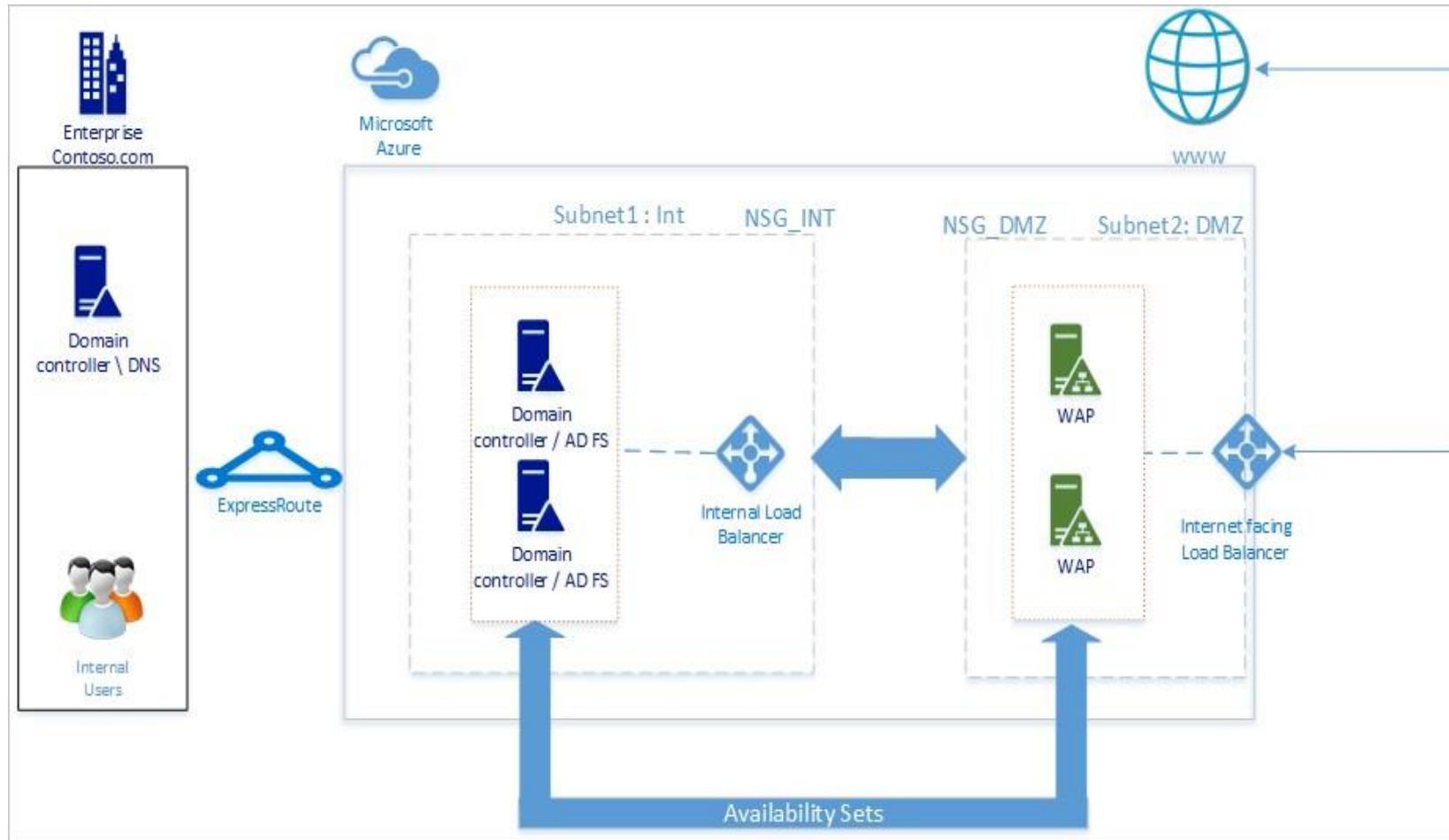
AZURE VIRTUAL NETWORKS (VNET)

- A VNet is a representation of your own network in the cloud. A VNet is a logical isolation of the Azure cloud dedicated to your subscription.
- Provides network access between Cloud resources
- Private network only accessible in your cloud

VNET DIAGRAMS



VNET DIAGRAMS

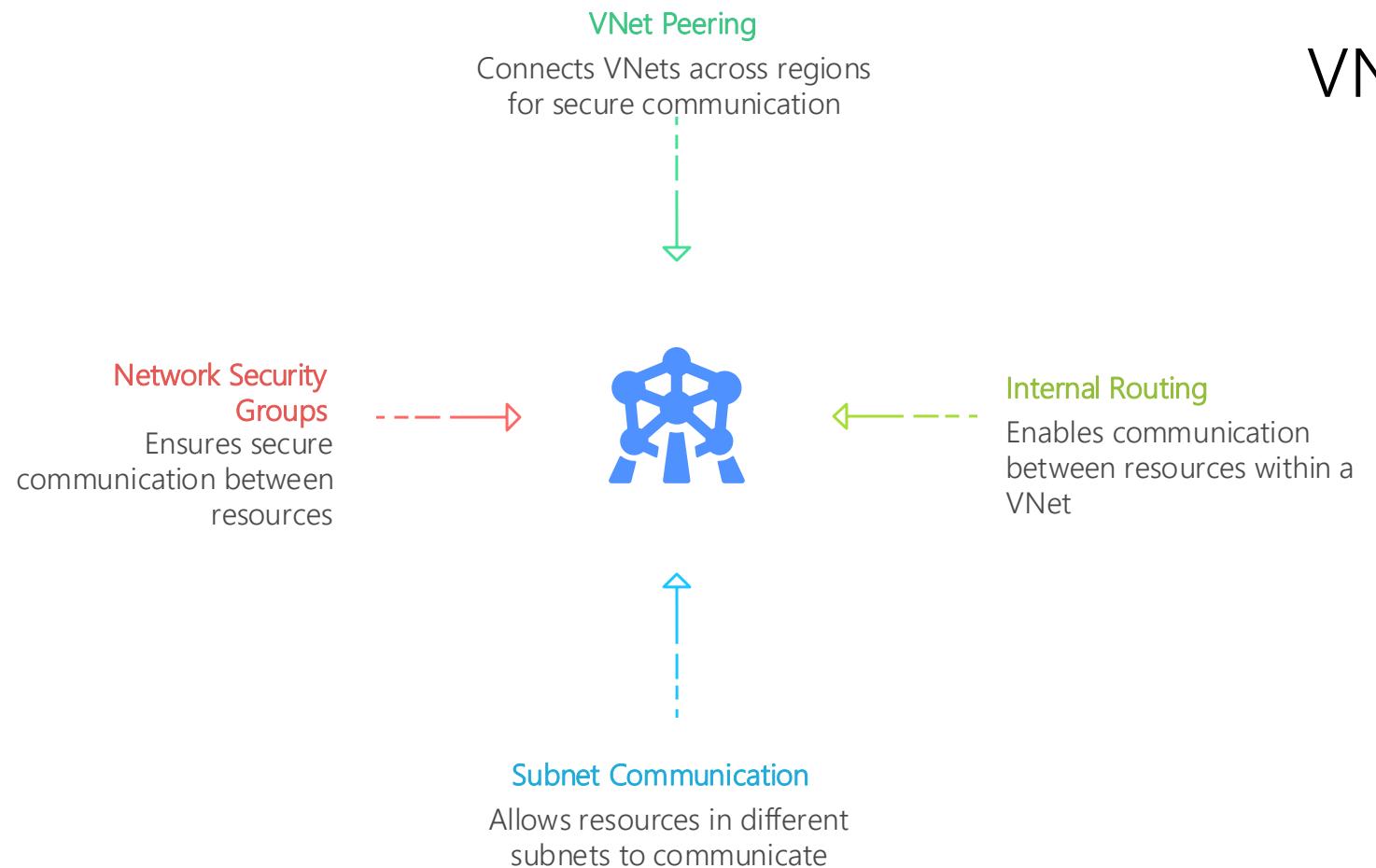


VNET CAPABILITIES

Isolation

- VNets are isolated from one another
- Highly customizable
 - VNets for Dev, Test, Prod with same CIDR
 - VNets with different CIDRs connected
- Azure provides internal DNS resolution for Vnets (Optional)

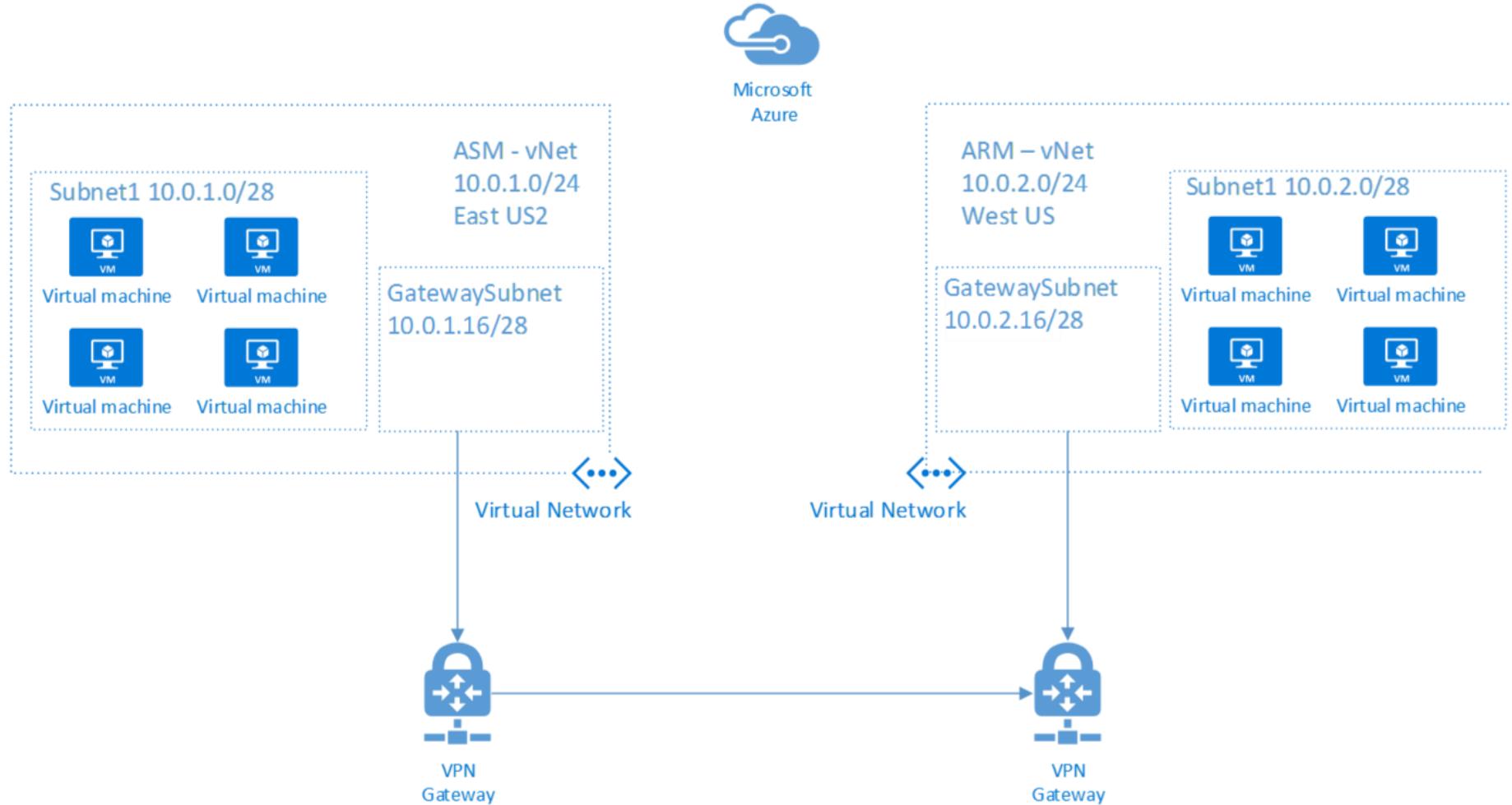
VNET CAPABILITIES



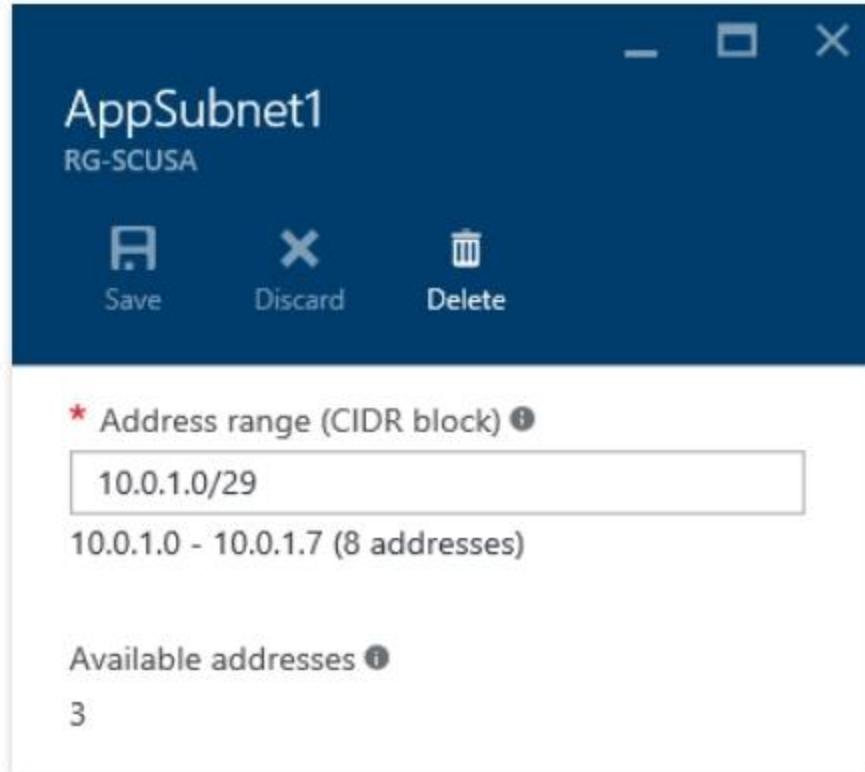
VNet connectivity

- VNets can be connected to each other.
- Any resource can communicate with any other resource even on different Subnets.
- App server can connect to database server on different Subnet

VNET DIAGRAMS

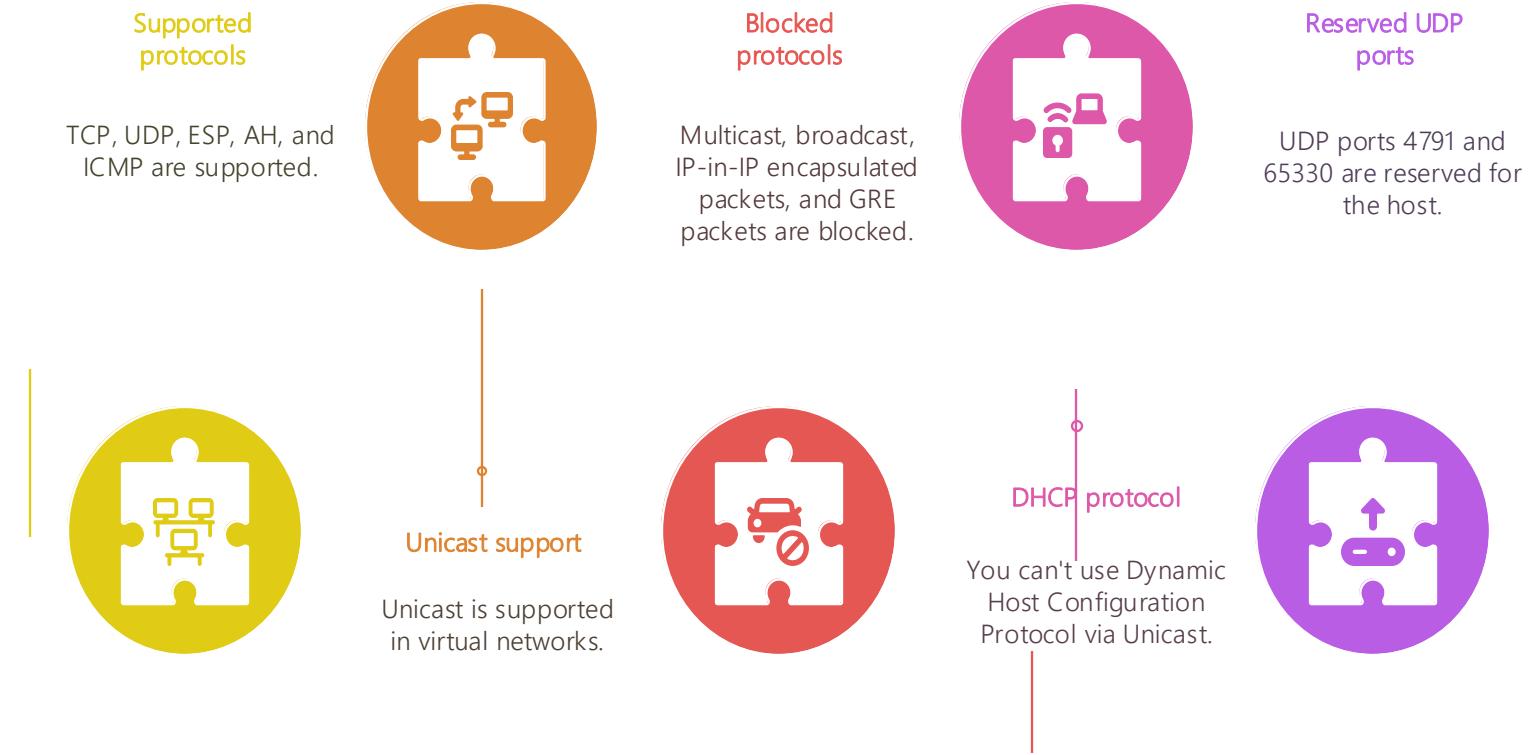


VNET RESERVED IPS

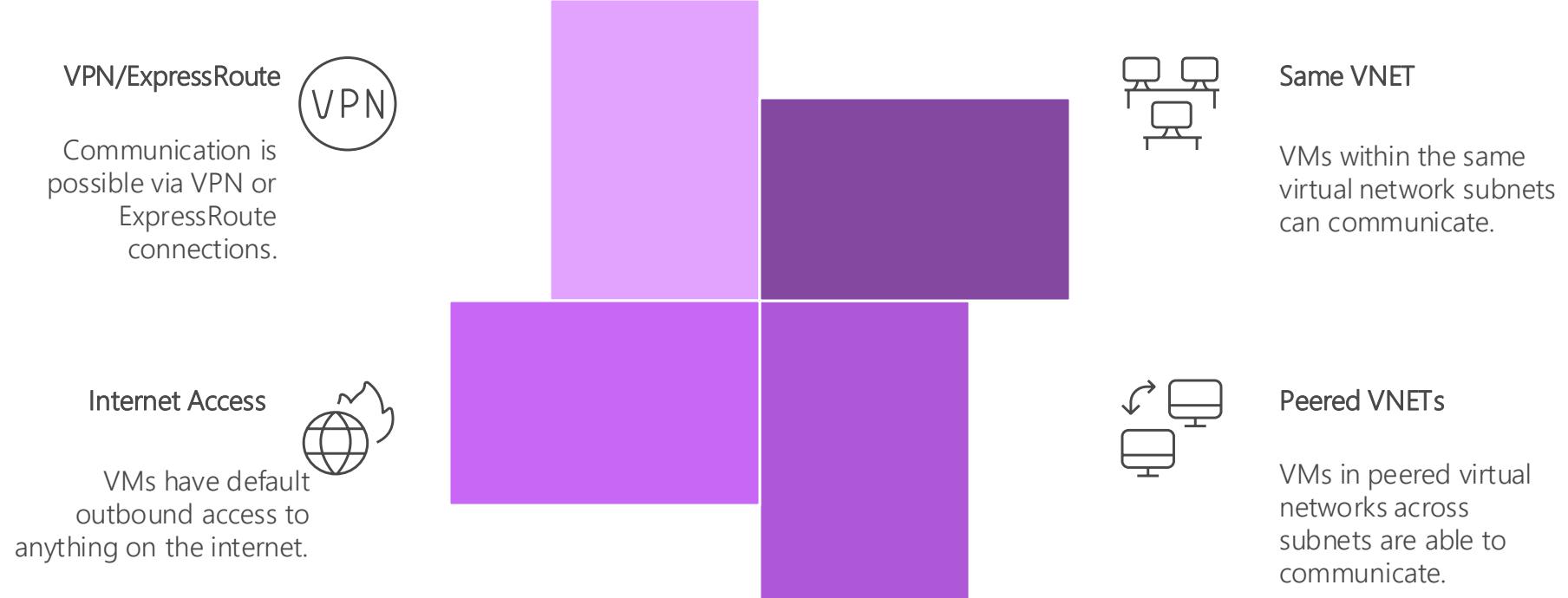


- Certain IPs reserved for Azure's internal use
- First and last reserved per protocol for host ID and broadcast
- The first 3 IP addresses are reserved

VNET PROTOCOL SUPPORT AND LIMITATIONS



TRAFFIC FLOW IN A VNET



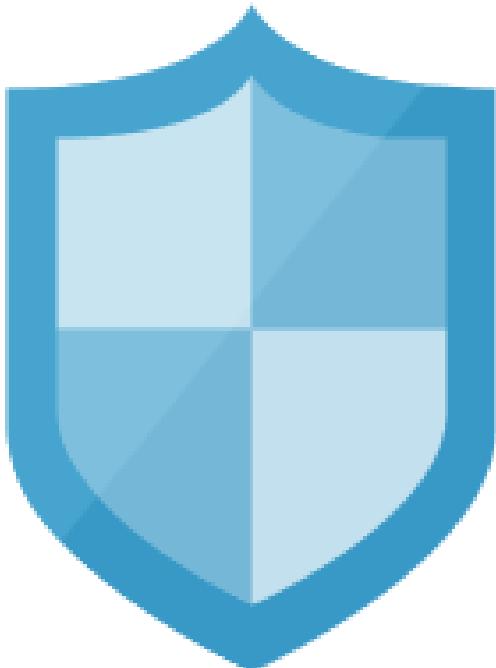
TRAFFIC FLOW IN A VNET



This may not always be desired:

- A multi-tiered application may only require neighbor tiers to communicate.
- May want to restrict public outbound access (DMZ)
- May want to restrict types of traffic.

NETWORK SECURITY GROUPS



Enable rules and assign to NSGs

In Azure, you create custom security rules and assign them to a **Network Security Group (NSG)**, which acts as a ruleset container.

Apply NSGs to subnets or NICs (or both)

NSGs can be associated with either an entire **subnet** or individual VM **NICs** — or even both.

Subnet-level NSGs aren't edge firewalls

Associating an NSG to a subnet doesn't create a perimeter-only filter — **rules are enforced per NIC**. Every VM NIC in that subnet enforces those rules as if applied locally.

Order of rule evaluation:

Inbound traffic: Subnet NSG is evaluated first; if allowed, the NIC NSG is evaluated next. Both must allow traffic for it to pass.

Outbound traffic: NIC NSG rules are evaluated first, then subnet NSG rules. Again, both must permit the traffic to succeed.

NSG RULES

5 Tuple

Azure Network Security Group rules are defined using a **five-tuple** model. Each rule specifies:

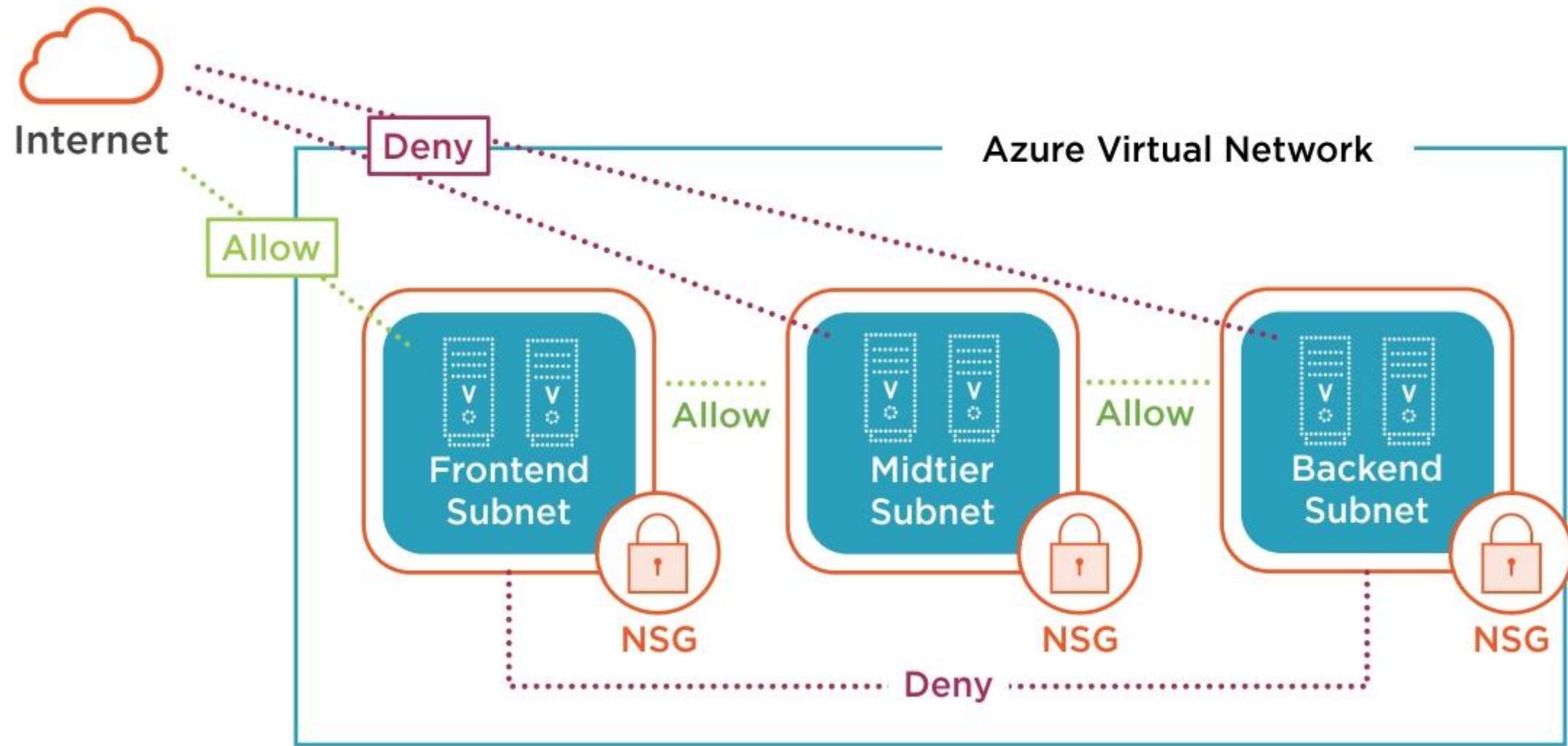
- Source IP** – can be a specific IP, a CIDR range, a service tag (like Internet, VirtualNetwork), or an Application Security Group
- Source port** – can be a single port, a range (e.g., 1000-2000), or for any port
- Destination IP** – similar flexibility to source (IP, CIDR, tag, ASG)
- Destination port** – can be a specific port, range, or wildcard
- Protocol** – TCP, UDP, ICMP, ESP, AH, or to match all

NSG RULES

5 Tuple

- CIDR used to define source/destination
- Three special identifies
 - VIRTUAL_NETWORK: identifies traffic within the virtual network address space
 - AZURE_LOADBALANCER: The Azure infrastructure load balancer
 - INTERNET: IP address space external to the virtual network

NSG EXAMPLE



NSG EXAMPLE

- Rules are combined in a NSG
- Based on the priority flexible configurations are possible
- Lower priority number means higher priority

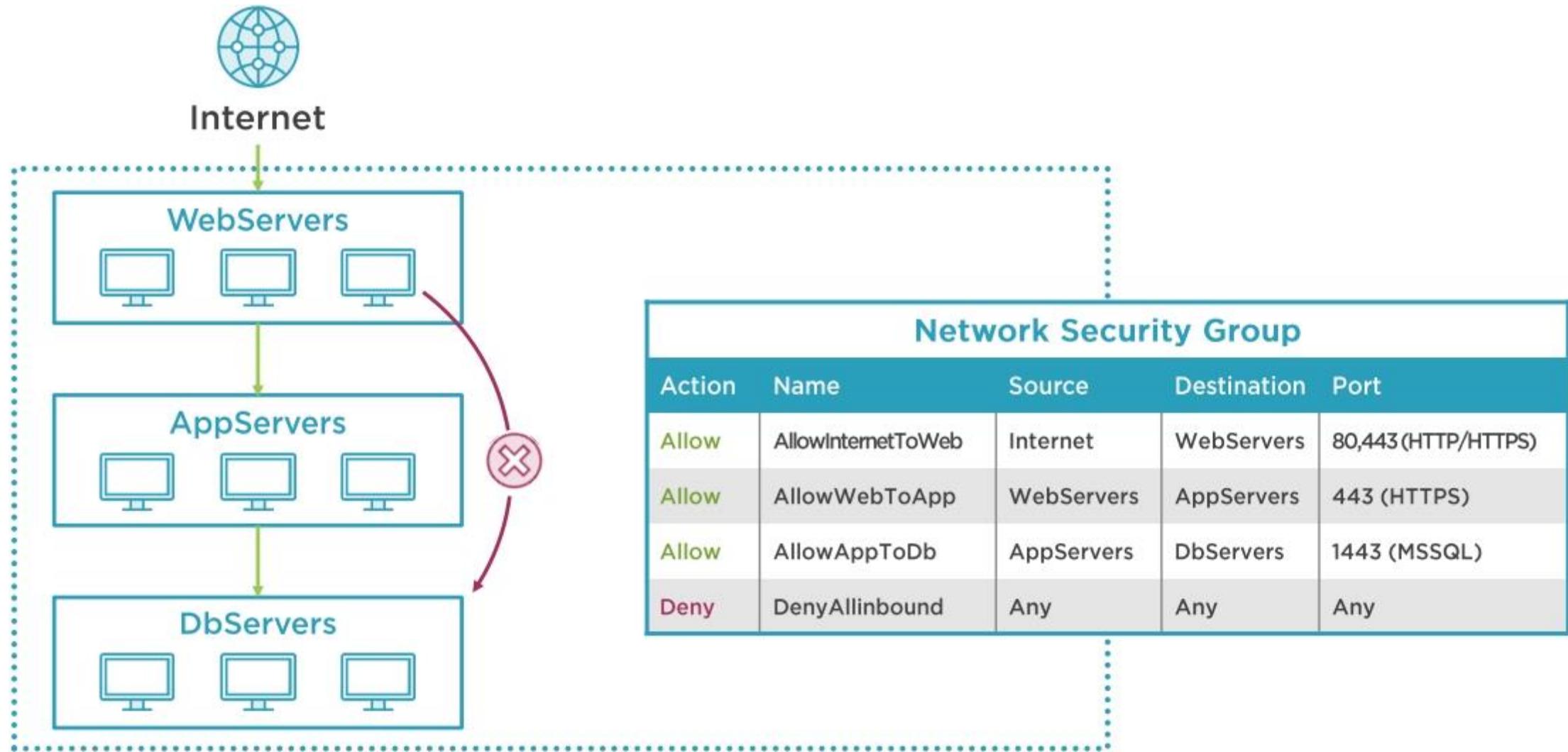
Description	Priority	Source Address	Source Port	Destination Address	Destination Port	Action
ILB	1010	AZURE_LOADBALANCER	*	*	10000	Allow
Inbound RDP	2005	VIRTUAL_NETWORK	*	*	3389	Allow
Deny all inbound	4000	*	*	*	*	Deny

APPLICATION SECURITY GROUPS



- NSGs are focused on the IP address ranges which may be difficult to maintain for growing environments
- ASGs enable monikers for different application roles to be defined, e.g. Web, DB, WebApp
- The NIC for a VM is made a member of one or more ASGs
- ASGs are used in rules that are part of NSGs to control flow of communication and can still use NSG features like service tags

ASG EXAMPLE



POP QUIZ:

Scenario:

VNet-EastUS (10.1.0.0/24) is peered with VNet-WestEurope (10.2.0.0/24). You want only DB servers in WestEurope to talk to App servers in EastUS—nothing else should cross the peering.

What is the *simplest and most secure* way to enforce this?

- A. Deploy Azure Firewall in EastUS to filter peered traffic
- B. Use “Block traffic to remote VNet” on WestEurope peering + NSG allow only DB subnet
- C. Apply NSG on EastUS subnet allowing only 10.2.0.0/24 → 10.1.0.0/24
- D. Use User Defined Route to drop all remote VNet IP ranges except the DB subnet

POP QUIZ:

Scenario:

VNet-EastUS (10.1.0.0/24) is peered with VNet-WestEurope (10.2.0.0/24). You want only DB servers in WestEurope to talk to App servers in EastUS—nothing else should cross the peering.

What is the *simplest and most secure* way to enforce this?

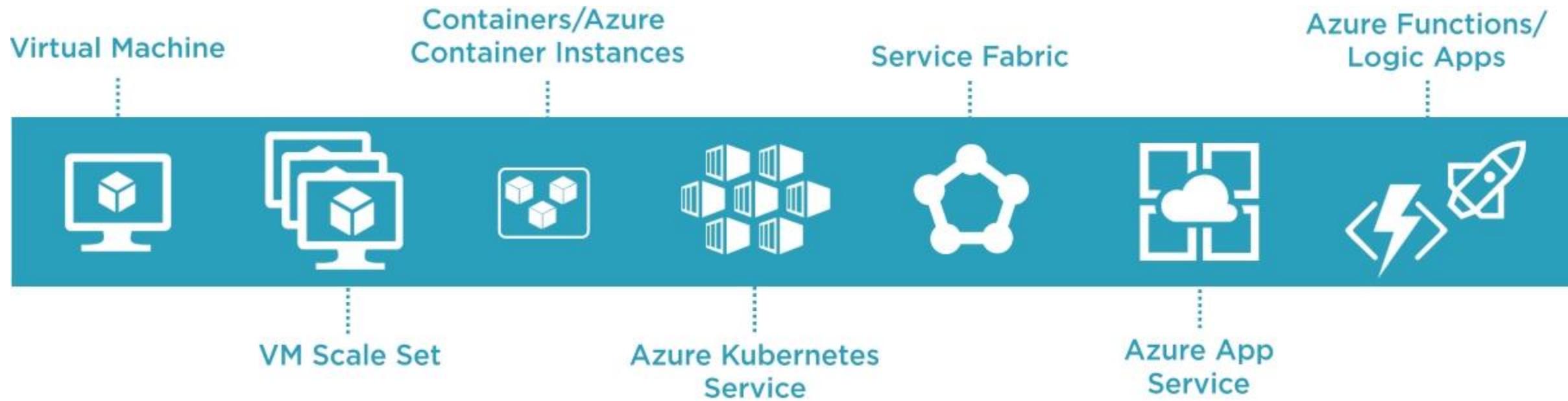
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- B. Use “Block traffic to remote VNet” on WestEurope peering + NSG allow only DB subnet
- C. Apply NSG on EastUS subnet allowing only 10.2.0.0/24 → 10.1.0.0/24
- D. Use User Defined Route to drop all remote VNet IP ranges except the DB subnet

Choosing the Right Compute Service

KEY FACTORS WHEN SELECTING COMPUTE

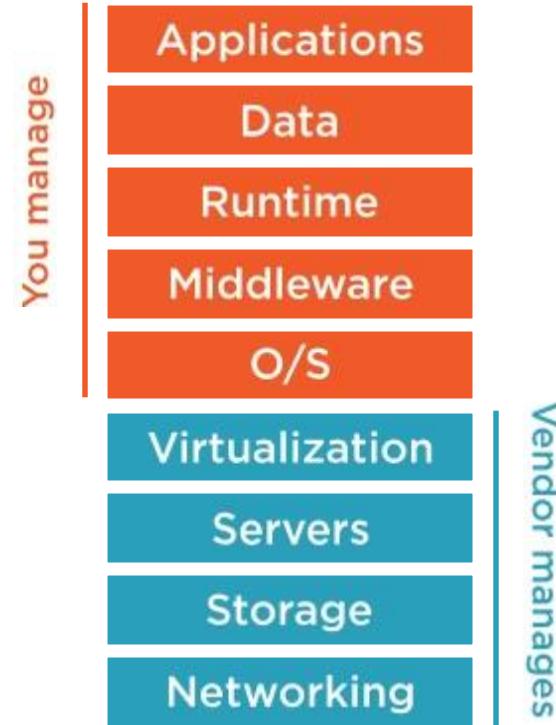
Characteristic	Azure VMs	App Service	Container Apps	Functions
 OS Control	Full control	Azure managed	Azure managed	Azure managed
 OS Support	Windows or Linux	Windows or Linux	Windows or Linux	Windows or Linux
 Portability	Limited	Limited	Strong	Limited
 Dev Productivity	Lower	Higher	Medium	Higher
 Multi-Instance	Scale sets	Built-in	Built-in	Built-in
 Cost	Higher	Predictable	Variable	Lower

COMPUTE OPTIONS



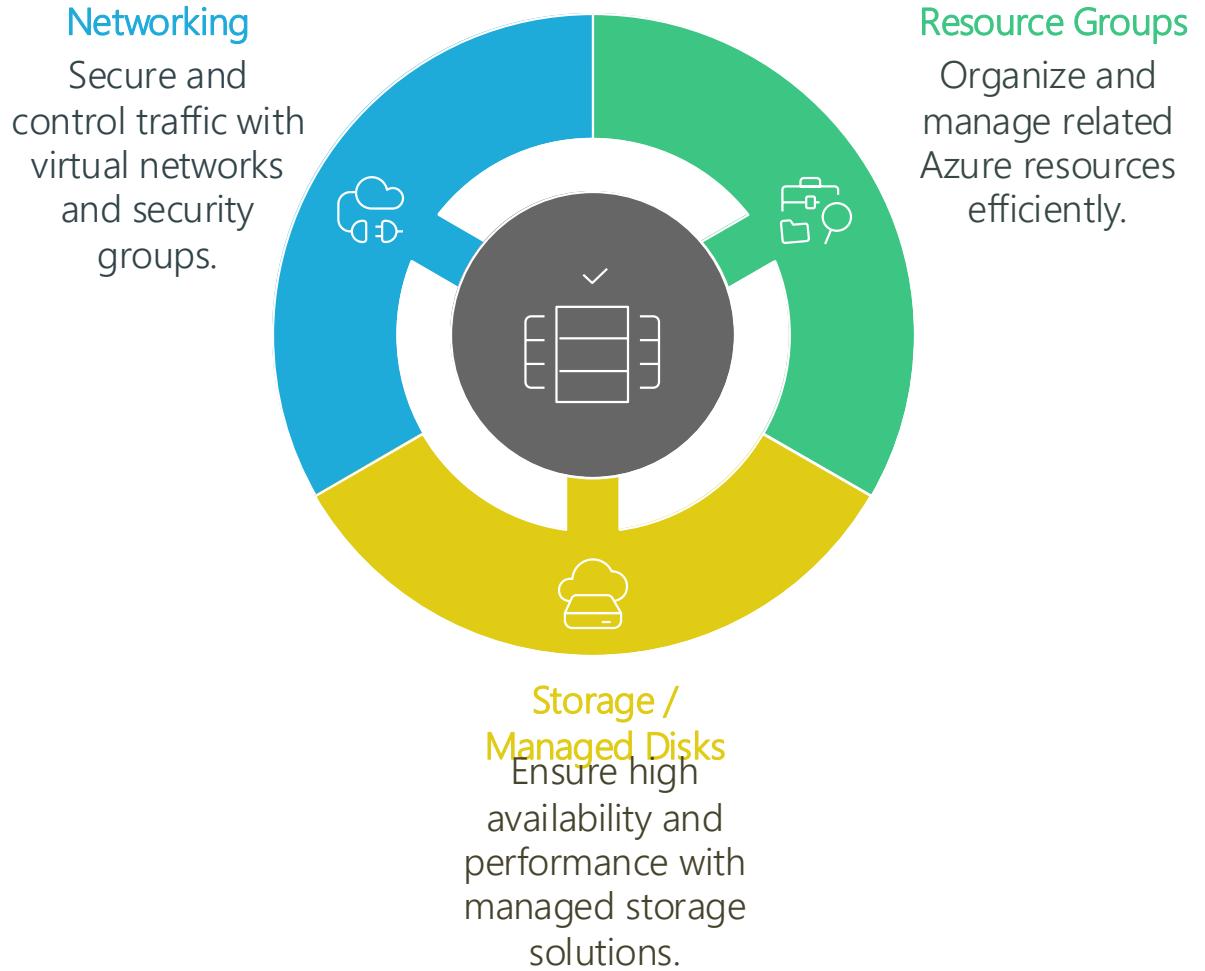
VIRTUAL MACHINES

- Provides a VM from a variety of series and sizes with different capabilities
- VMs are placed on a virtual network which can provide connectivity to on-premises networks
- Windows and Linux guest OS support with large library of extensions
- Full access and responsibility for everything inside the VM
- Template support for prescriptive, repeatable deployment



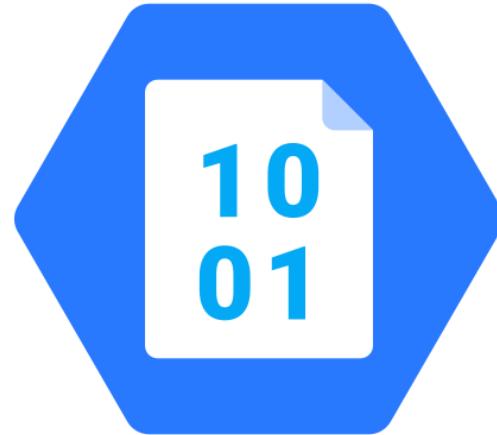
VIRTUAL MACHINES

When deploying Azure Virtual Machines, it's important to understand that they don't operate in isolation. They rely on several foundational Azure services to function properly



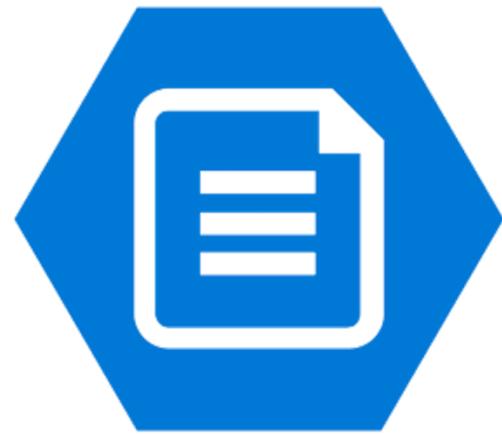
Storage

AZURE STORAGE ACCOUNTS



Blob Storage

- Object and Disk Storage
- Blog Storage Tiers
- Azure Search integration



File Storage

- SMB File Shares
- Attach to VMs as file shares
- Azure File Sync

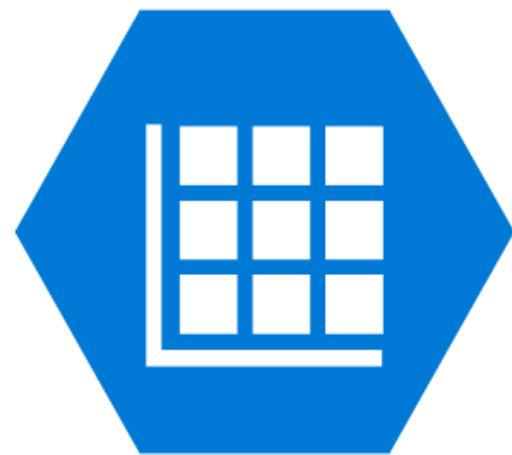


Table Storage

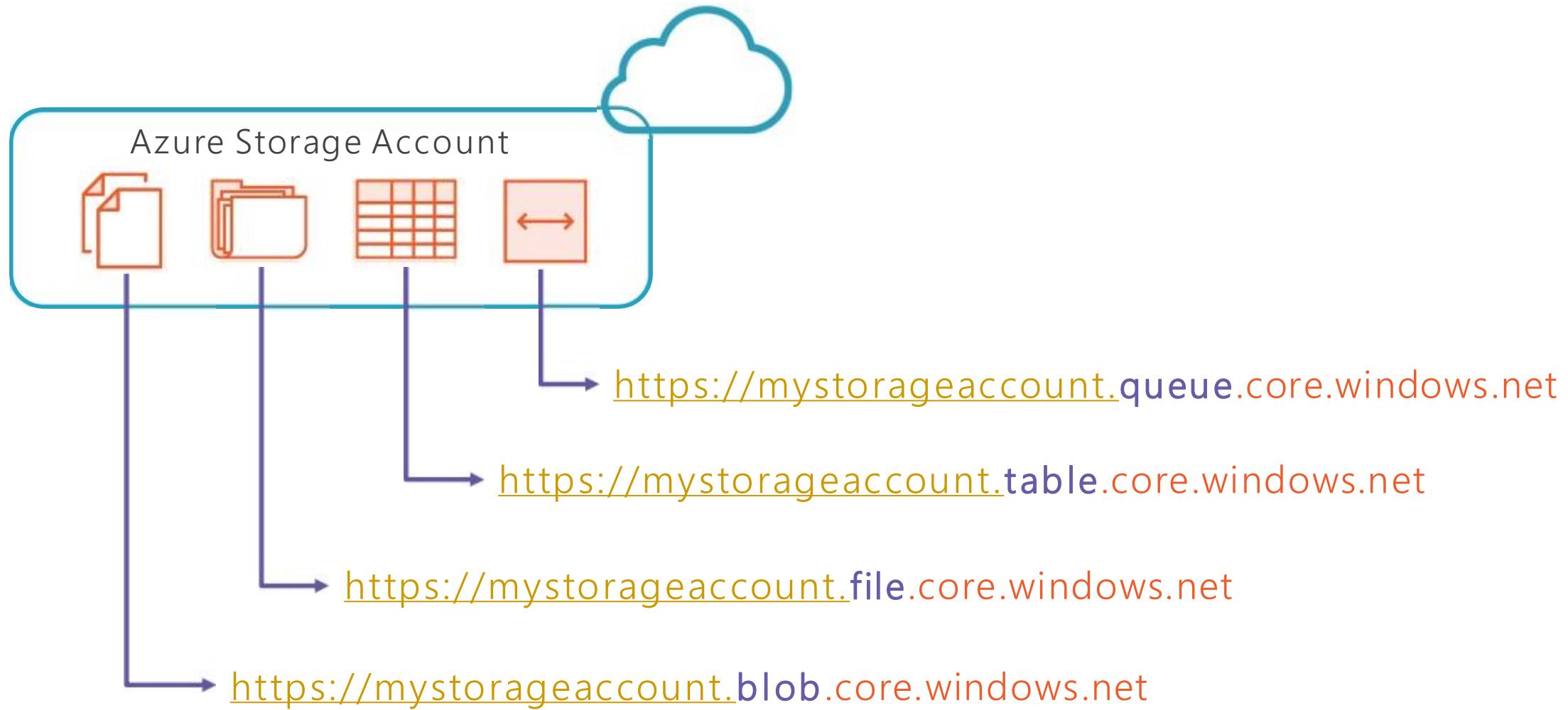
- NoSQL Data Store
- Schema-less design
- Azure Cosmos DB



Queue Storage

- Message based
- For building synchronous apps

AZURE STORAGE ACCOUNT ENDPOINTS



AZURE STORAGE CUSTOM DOMAIN NAME

fstorage100 | Front Door and CDN ★ ...
Storage account

domain X ≪

Security + networking

Front Door and CDN

Endpoints

Click on your endpoint below to manage and configure different features of your existing CDN endpoints. [Learn more about adding custom domains](#)

Host name	Profile name	Service type

New Endpoint

Service type

Azure Front Door (Recommended)

Azure CDN

Create new/use existing profile

Create new

Use existing

Profile name *

Endpoint name *

Endpoint host name

Origin host name *

Azure Front Door Standard
Content delivery optimized

Azure Front Door Premium
Security optimized

Caching ⓘ

Enable caching

Enable WAF

Create

Azure Storage accounts can be accessed using **custom domain names** setup with Azure Front Door.

AZURE BLOB STORAGE TYPES



Block Blob

- 190.7 TB Max file size
- Composed of 4000MB blocks
- Insert, replace, delete blocks



Append Blob

- 195GB Max file size
- Can only append blocks
- Ideal for log/audit files



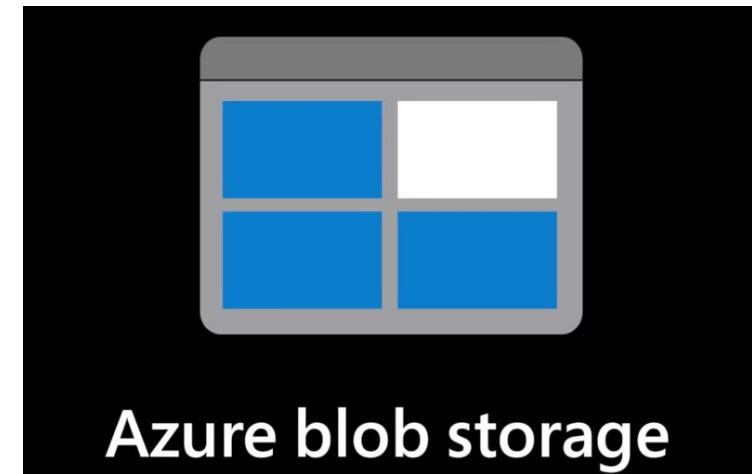
Page Blob

- 8TB max file size
- Frequent read/write operations
- Standard/Premium Storage

USE CASES

Use Cases

- Data Lakes (ADLS2)
- Cloud-native workloads
- Archives
- Machine learning
- High performance computing
- All Big Data use cases



BLOB STORAGE TIERS

	Hot	Cool	Archive
USE	Storing data that is frequently accessed or modified	Storing data that is infrequently accessed, but needs to remain accessible nonetheless	Storing data that is hardly ever accessed, but still needs to be kept
PROS	Low data access and transaction cost, and no minimum retention period	Storage costs are lower than the Hot tier	Has the lowest storage costs
CONS	The highest storage cost	Access and transaction costs are more than the Hot tier; also has a minimum data retention period of 30 days	The highest access and transaction cost and latency usually measured in hours; also has a minimum data retention period of 180 days

DEMO – CREATE AZURE STORAGE ACCOUNT WITH PYTHON

Setup and Prerequisites

Azure Subscription

Ensure you have an active subscription and required permissions.

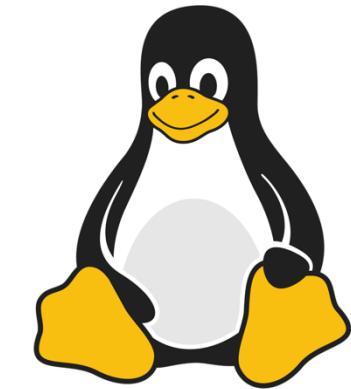
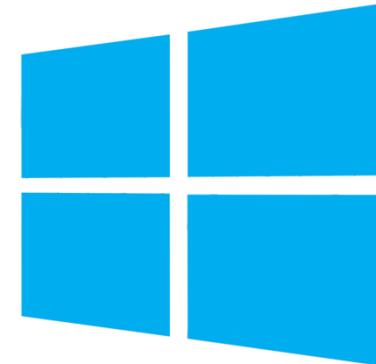
Python 3.8+ Environment

```
python --version
```

Install Required Packages

```
sudo apt-get update
```

```
pip install azure-identity azure-mgmt-resource azure-mgmt-storage azure-storage-blob
```



DEMO – CREATE AZURE STORAGE ACCOUNT WITH PYTHON

Create a project directory:

```
mkdir blobdemo & cd blobdemo  
touch provision_blob.py
```

Add the provisioning code

Run:

```
az login  
python provision_blob.py
```

```
import os  
from azure.identity import DefaultAzureCredential  
from azure.mgmt.resource import ResourceManagementClient  
from azure.mgmt.storage import StorageManagementClient  
  
SUBSCRIPTION_ID = "" # Replace with your Azure subscription ID  
LOCATION = "eastus"  
RG_NAME = "demo-rg"  
STORAGE_ACCOUNT_NAME = "demostorageacct2030" # Must be globally unique  
  
cred = DefaultAzureCredential()  
rg_client = ResourceManagementClient(cred, SUBSCRIPTION_ID)  
stg_client = StorageManagementClient(cred, SUBSCRIPTION_ID)  
  
rg_client.resource_groups.create_or_update(RG_NAME, {"location": LOCATION})  
print(f"Resource group '{RG_NAME}' created in {LOCATION}")  
  
stg_async = stg_client.storage_accounts.begin_create(  
    RG_NAME, STORAGE_ACCOUNT_NAME,  
    {  
        "location": LOCATION,  
        "sku": {"name": "Standard_LRS"},  
        "kind": "StorageV2",  
        "enable_https_traffic_only": True  
    }  
)  
stg_account = stg_async.result()  
print(f"Storage account '{STORAGE_ACCOUNT_NAME}' created")
```

DEMO – UPLOAD TO AZURE STORAGE ACCOUNT WITH PYTHON

Create an upload script

touch upload_blob.py

Add the file upload code

Run:

python upload_blob.py

```
# upload_blob.py

import os, uuid
from azure.identity import DefaultAzureCredential
from azure.storage.blob import BlobServiceClient

ACCOUNT_NAME = "demostorageacct2030" # Replace with your storage account name
ACCOUNT_URL = f"https://{{ACCOUNT_NAME}}.blob.core.windows.net"
CONTAINER_NAME = "demo-container"
LOCAL_FILE_PATH = "data/myfile.txt"
BLOB_NAME = f"{{uuid.uuid4()}}-{{os.path.basename(LOCAL_FILE_PATH)}}
```

```
# Authenticate and connect
blob_service_client = BlobServiceClient(ACCOUNT_URL, credential=DefaultAzureCredential())

# 1. Create container if missing
try:
    container_client = blob_service_client.create_container(CONTAINER_NAME)
    print(f"Container '{CONTAINER_NAME}' created.")
except Exception:
    container_client = blob_service_client.get_container_client(CONTAINER_NAME)
    print(f"Using existing container '{CONTAINER_NAME}'.")

# 2. Upload blob
blob_client = container_client.get_blob_client(BLOB_NAME)
with open(LOCAL_FILE_PATH, "rb") as f:
    blob_client.upload_blob(f)
print(f"Uploaded blob: {BLOB_NAME}")
```

POP QUIZ:

Scenario: Your team must ensure blobs can never be deleted or overwritten for 7 days, except under legal hold. Which feature supports this?

- A. Read-access geo-redundant storage (RA-GRS)
- B. Immutable Blob Storage policies with retention
- C. Soft-delete and versioning
- D. Premium GPv2 with snapshots enabled

POP QUIZ:

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- B. Immutable Blob Storage policies with retention**
- C. Soft-delete and versioning
- D. Premium GPv2 with snapshots enabled

RESOURCES

AZURE RESOURCE MANAGER

Brand new JSON-based API that
is built on resource providers

Resources belong to a resource group
and share a common life-cycle

Cloud services not used
for IaaS (but still for PaaS)

JSON-based deployments are
declarative, idempotent and understand
dependencies between resources
to govern creation order

AZURE RESOURCE MANAGER

Massive parallelism

Tags used to organize resources which are also visible in billing

Can also use PowerShell and the modern Azure Portal

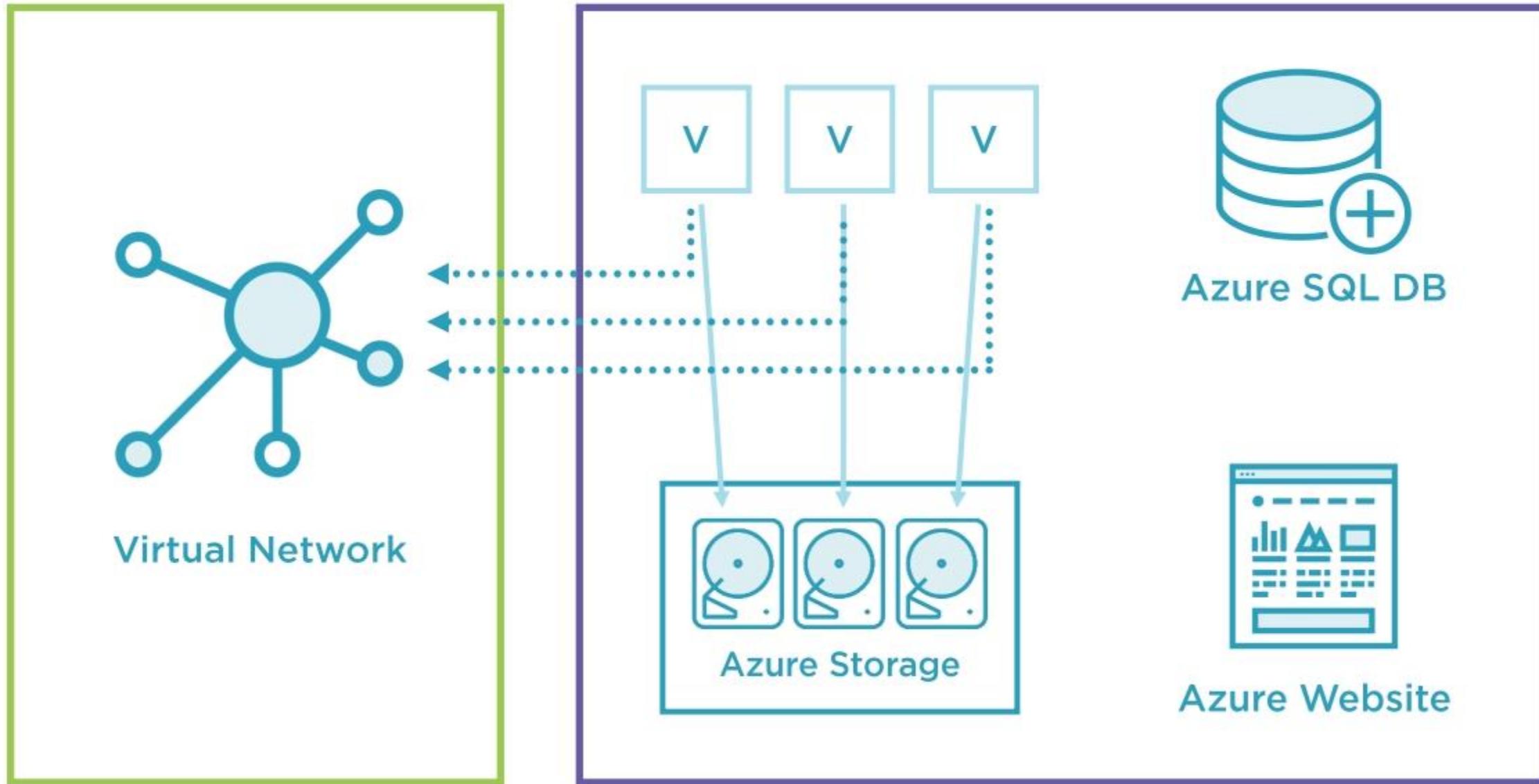
Resource Groups

- Every ARM resource exists in one, and only one, resource group
- While resource groups are created in a region they can contain resources from outside the region
- Resources can be moved between resource groups

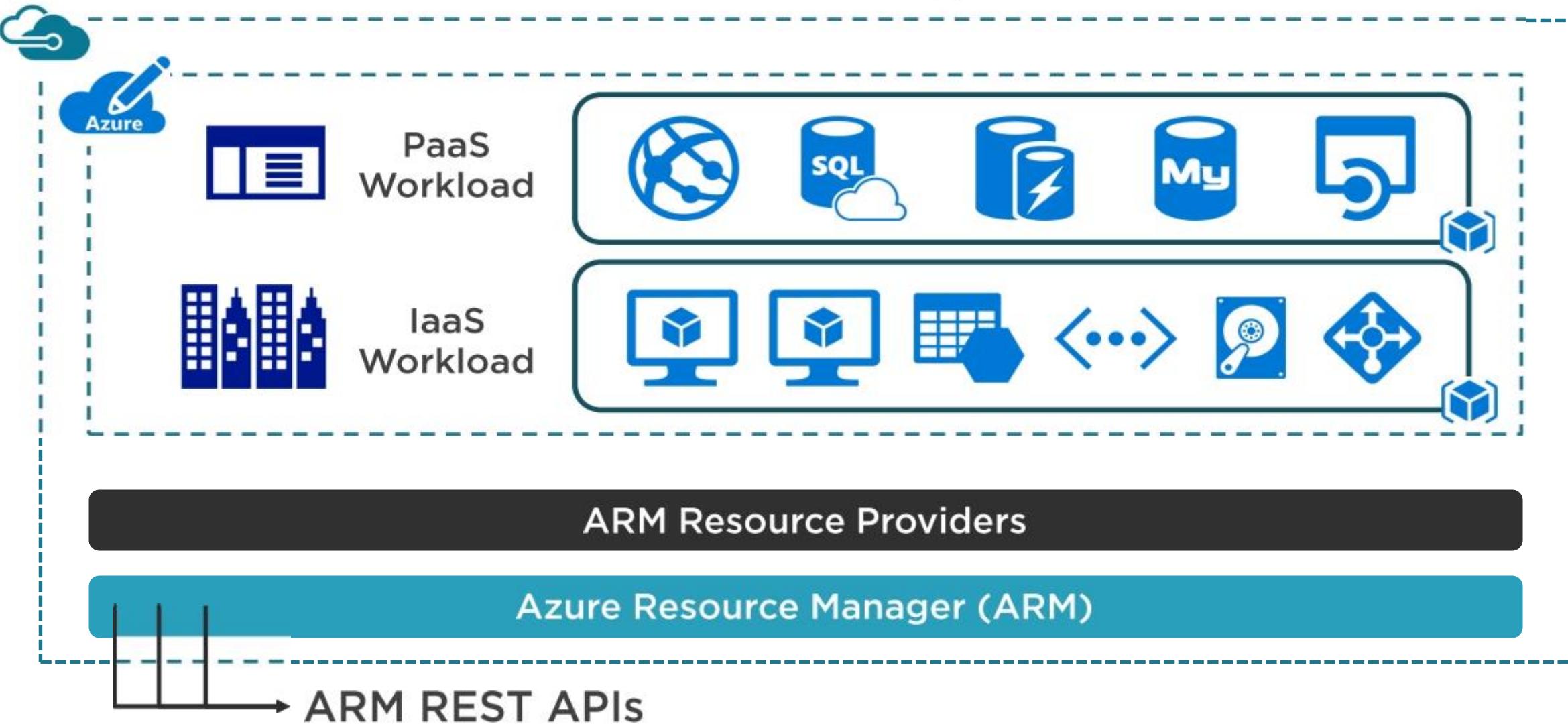
Resource Groups

- All resources in your group should share same lifecycle.
 - deploy, update and delete together
- Resource groups can be heterogeneous or homogeneous
- Resource groups are not a boundary of access

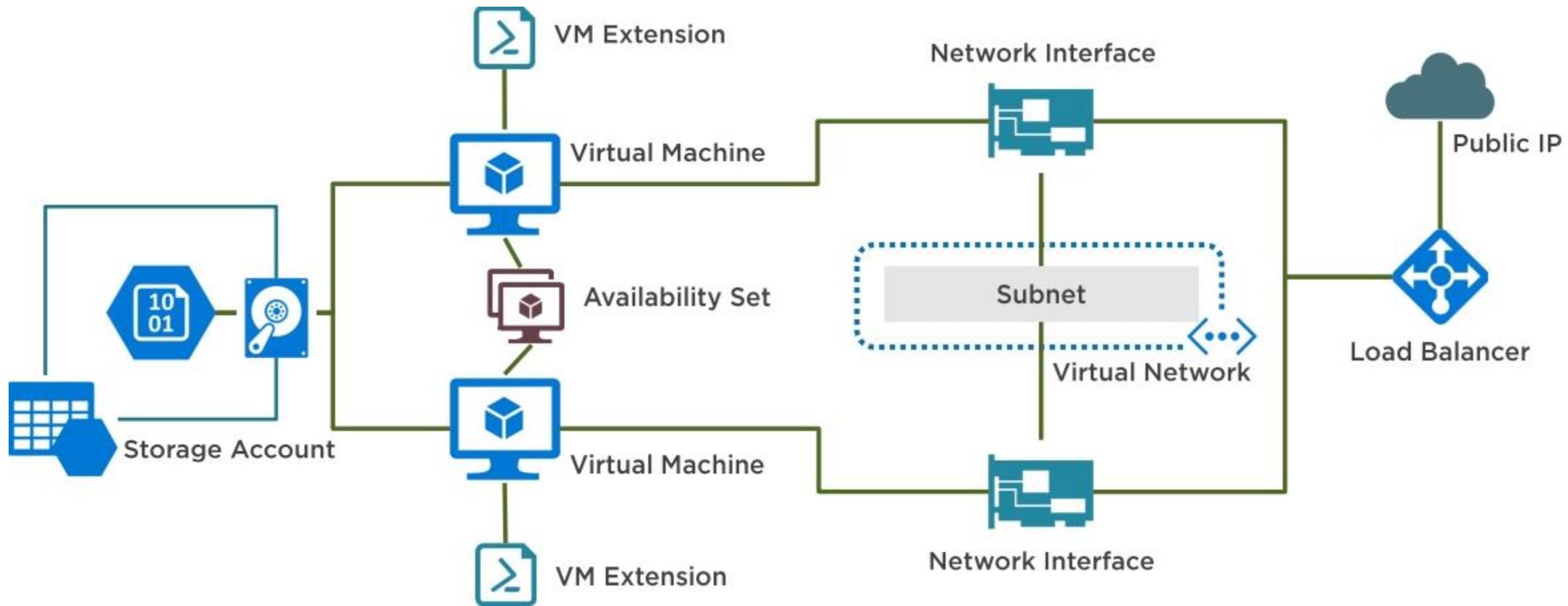
Resource Group Example



AZURE RESOURCE MANAGER ARCHITECTURE



RESOURCES AND DEPENDENCIES



Resource Group Limits

- 800 resource groups per subscription
- 800 resources per resource type per resource group
- 15 tags per resource group
- Bound by subscription

RESOURCE PROVIDERS

```
PS C:\WINDOWS\system32> Get-AzureRmResourceProvider

ProviderNamespace : Microsoft.AlertsManagement
RegistrationState : Registered
ResourceTypes    : {alerts, alertsSummary, smartGroups, smartDetectorAlertRules...}
Locations       : {global, North Central US, West Central US, East US...}

ProviderNamespace : Microsoft.AAD
RegistrationState : Registered
ResourceTypes    : {DomainServices, DomainServices/oucontainer, locations, locations/operationresults...}
Locations       : {West US, Central US, East US, South Central US...}

ProviderNamespace : Microsoft.SqlVirtualMachine
RegistrationState : Registered
ResourceTypes    : {SqlVirtualMachineGroups, SqlVirtualMachines, SqlVirtualMachineGroups/AvailabilityGroupListeners, operations...}
Locations       : {Australia Central, Australia Central 2, Australia East, Australia Southeast...}

ProviderNamespace : microsoft.insights
RegistrationState : Registered
ResourceTypes    : {monitoredObjects, dataCollectionRules, dataCollectionRuleAssociations, dataCollectionEndpoints...}
Locations       : {Australia Southeast, Canada Central, Poland Central, Israel Central...}

ProviderNamespace : Microsoft.KeyVault
RegistrationState : Registered
ResourceTypes    : {vaults, vaults/secrets, vaults/accessPolicies, operations...}
Locations       : {North Central US, East US, North Europe, West Europe...}

ProviderNamespace : Microsoft.MachineLearningServices
RegistrationState : Registered
ResourceTypes    : {workspaces/batchEndpoints, workspaces/batchEndpoints/deployments, workspaces, workspaces/capabilityhosts...}
Locations       : {North Central US, Canada Central, Central India, UK South...}

ProviderNamespace : Microsoft.Storage
RegistrationState : Registered
ResourceTypes    : {locations/ActionsRPOperationStatuses, storageAccounts/reports, storageAccounts/storageTaskAssignments,
storageAccounts/storageTaskAssignments/reports...}
Locations       : {East US 2, Japan East, Japan West, South India...}
```

RESOURCE TYPES

```
PS C:\WINDOWS\system32> Get-AzureRmResourceProvider -ProviderNamespace Microsoft.Compute | Select-Object ResourceTypes,Locations | Sort-Object ResourceTypes
```

ResourceTypes	Locations
{availabilitySets}	{East US, East US 2, West US, Central US...}
{diskAccesses}	{Southeast Asia, East US 2, Central US, West Europe...}
{diskEncryptionSets}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/diskOperations}	{Southeast Asia, East US 2, Central US, West Europe...}
{snapshots}	{Southeast Asia, East US 2, Central US, West Europe...}
{disks}	{Southeast Asia, East US 2, Central US, West Europe...}
{galleries/applications/versions}	{West Central US, South Central US, East US 2, Southeast Asia...}
{restorePointCollections/restorePoints/diskRestorePoints}	{Southeast Asia, East US 2, Central US, West Europe...}
{galleries/applications}	{West Central US, South Central US, East US 2, Southeast Asia...}
{locations/galleries}	{West Central US, South Central US, East US 2, Southeast Asia...}
{galleries/images/versions}	{West Central US, South Central US, East US 2, Southeast Asia...}
{galleries/images}	{West Central US, South Central US, East US 2, Southeast Asia...}
{galleries}	{West Central US, South Central US, East US 2, Southeast Asia...}
{locations/capsOperations}	{West Central US, South Central US, East US 2, Southeast Asia...}
{locations/artifactPublishers}	{West Central US, South Central US, East US 2, Southeast Asia...}
{payloadGroups}	{South Central US, West Europe}
{virtualMachineScaleSets/disks}	{East US, East US 2, West US, Central US...}
{cloudServices}	{Southeast Asia, East US 2, Central US, West Europe...}
{cloudServices/roles}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/logAnalytics}	{East US, East US 2, West US, Central US...}
{locations/vmSizeRecommendations}	{West Central US, Southeast Asia, East US 2, East US...}
{locations/placementRecommendations}	{West Central US, Southeast Asia, East US 2, East US...}
{locations/placementScores}	{West Central US, Southeast Asia, East US 2, East US...}
{locations/diagnosticOperations}	{West Central US, Southeast Asia, East US 2, East US...}
{locations/diagnostics}	{West Central US, Southeast Asia, East US 2, East US...}
{images}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/usages}	{East US, West US, Central US, South Central US...}
{cloudServices/publicIPAddresses}	{Southeast Asia, East US 2, Central US, West Europe...}
{cloudServices/roleInstances/networkInterfaces}	{Southeast Asia, East US 2, Central US, West Europe...}
{cloudServices/networkInterfaces}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/cloudServiceOsFamilies}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/cloudServiceOsVersions}	{Southeast Asia, East US 2, Central US, West Europe...}
{locations/csOperations}	{Southeast Asia, East US 2, Central US, West Europe...}
{cloudServices/roleInstances}	{Southeast Asia, East US 2, Central US, West Europe...}
{sharedVMImages/versions}	{West Central US, South Central US, East US 2, Southeast Asia...}
{hostGroups}	{Central US, East US 2, West Europe, Southeast Asia...}
{sharedVMImages}	{West Central US, South Central US, East US 2, Southeast Asia...}
{locations/sharedGalleries}	{East US, East US 2, West US, Central US...}
{locations/virtualMachines}	{East US, East US 2, West US, Central US...}
{locations/runCommands}	{East US, East US 2, West US, Central US...}
{locations/vmSizes}	{East US, East US 2, West US, Central US...}
{locations/operations}	{East US, East US 2, West US, Central US...}
...	...

RESOURCE REST APIs

<https://management.azure.com/subscriptions/{subscription-id}/providers/{provider-name}?api-version={api-version}>

```
PS C:\WINDOWS\system32> ((Get-AzureRmResourceProvider -ProviderNamespace Microsoft.Compute).ResourceTypes | Where-Object {$_.ResourceTypeName -eq 'virtualMachines'}).ApiVersions
```

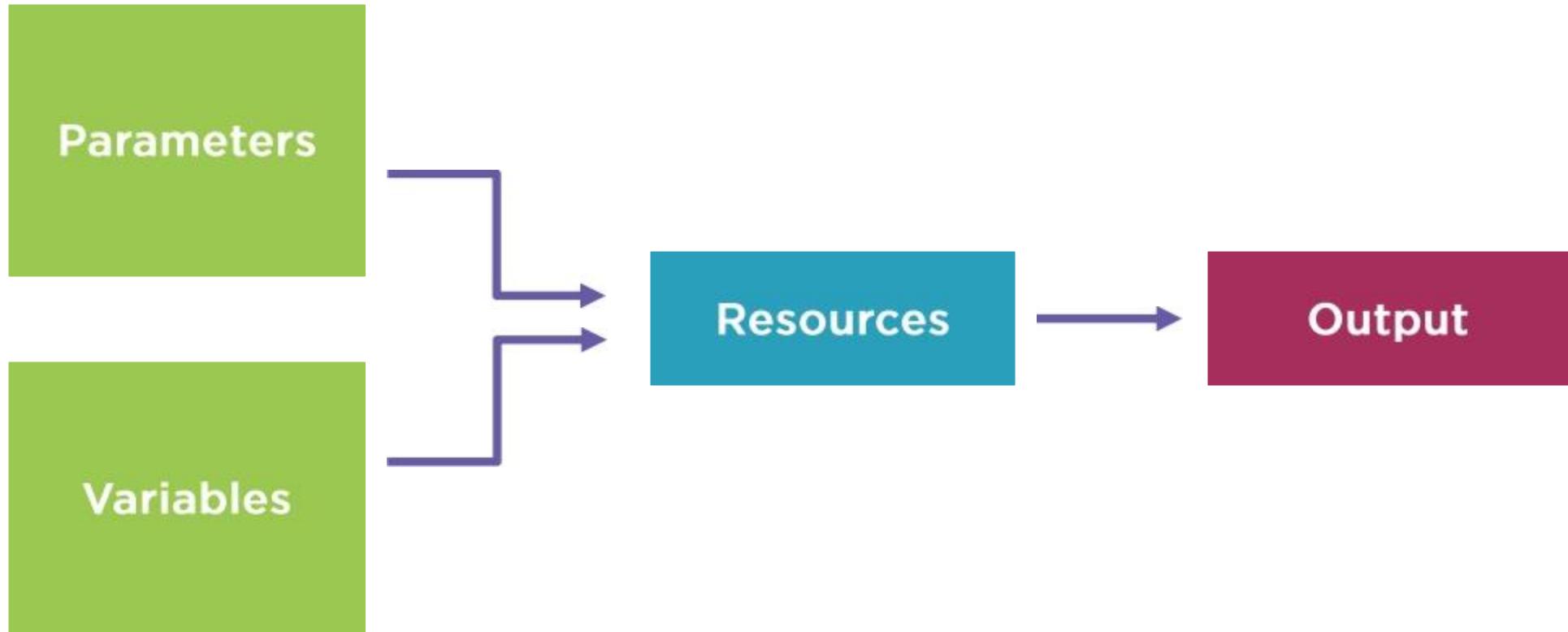
2024-11-01
2024-07-01
2024-03-01
2023-09-01
2023-07-01
2023-03-01
2022-11-01
2022-08-01
2022-03-01
2021-11-01
2021-07-01
2021-04-01
2021-03-01
2020-12-01
2020-06-01
2019-12-01
2019-07-01
2019-03-01
2018-10-01
2018-06-01
2018-04-01
2017-12-01
2017-03-30
2016-08-30
2016-04-30-preview
2016-03-30
2015-06-15
2015-05-01-preview

JSON TEMPLATES

| Provide a scalable and repeatable method for deploying Azure resources

| Behind the scenes all ARM resources are built on JSON

JSON FLOW



SAMPLE JSON TEMPLATE

```
{  
  $schema: https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#,  
  contentVersion: 1.0.0.0,  
  parameters: {  
    storageAccountName: {  
      type: string,  
      defaultValue: mystorageacctdemo,  
      metadata: {  
        description: Name of the storage account  
      }  
    },  
    location: {  
      type: string,  
      defaultValue: [resourceGroup().location],  
      metadata: {  
        description: Location for all resources  
      }  
    }  
  },  
  variables: {  
    storageAccountType: Standard_LRS  
  },  
  resources: [  
    {  
      type: Microsoft.Storage/storageAccounts,  
      apiVersion: 2022-09-01,  
      name: [parameters('storageAccountName')],  
      location: [parameters('location')],  
      sku: {  
        name: [variables('storageAccountType')]  
      },  
      kind: StorageV2,  
      properties: {}  
    }  
,  
  outputs: {  
    storageAccountEndpoint: {  
      type: string,  
      value: [reference(parameters('storageAccountName')).primaryEndpoints.blob]  
    }  
  }  
}
```

Template Highlights:

Parameters: Accepts storageAccountName and location.

Variables: Defines the storage account type (Standard_LRS).

Resources: Deploys a StorageV2 account using the provided parameters and variable.

Outputs: Returns the blob endpoint of the created storage account.

SAMPLE BICEP TEMPLATE

```
param storageAccountName string
param location string = resourceGroup().location

var storageAccountType = 'Standard_LRS'

resource storageAccount 'Microsoft.Storage/storageAccounts@2022-09-01' = {
    name: storageAccountName
    location: location
    sku: {
        name: storageAccountType
    }
    kind: 'StorageV2'
    properties: {}
}

output blobEndpoint string =
storageAccount.properties.primaryEndpoints.blob
```

Template Highlights:

Parameters:

Accepts storageAccountName and location.

Variables: Defines the storage account type (Standard_LRS).

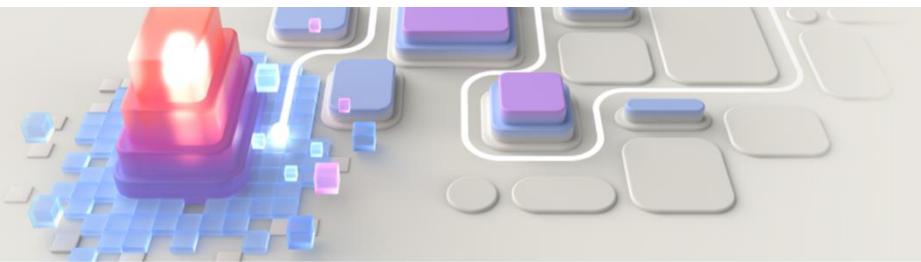
Resources: Deploys a StorageV2 account using the provided parameters and variable

Outputs: Returns the blob endpoint of the created storage account.

AZURE QUICKSTART TEMPLATES

Sample Code from Microsoft Developer Tools

Get started with Microsoft developer tools and technologies. Explore our samples and discover the things you can build.



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Azure Resource Manager x

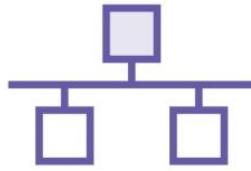
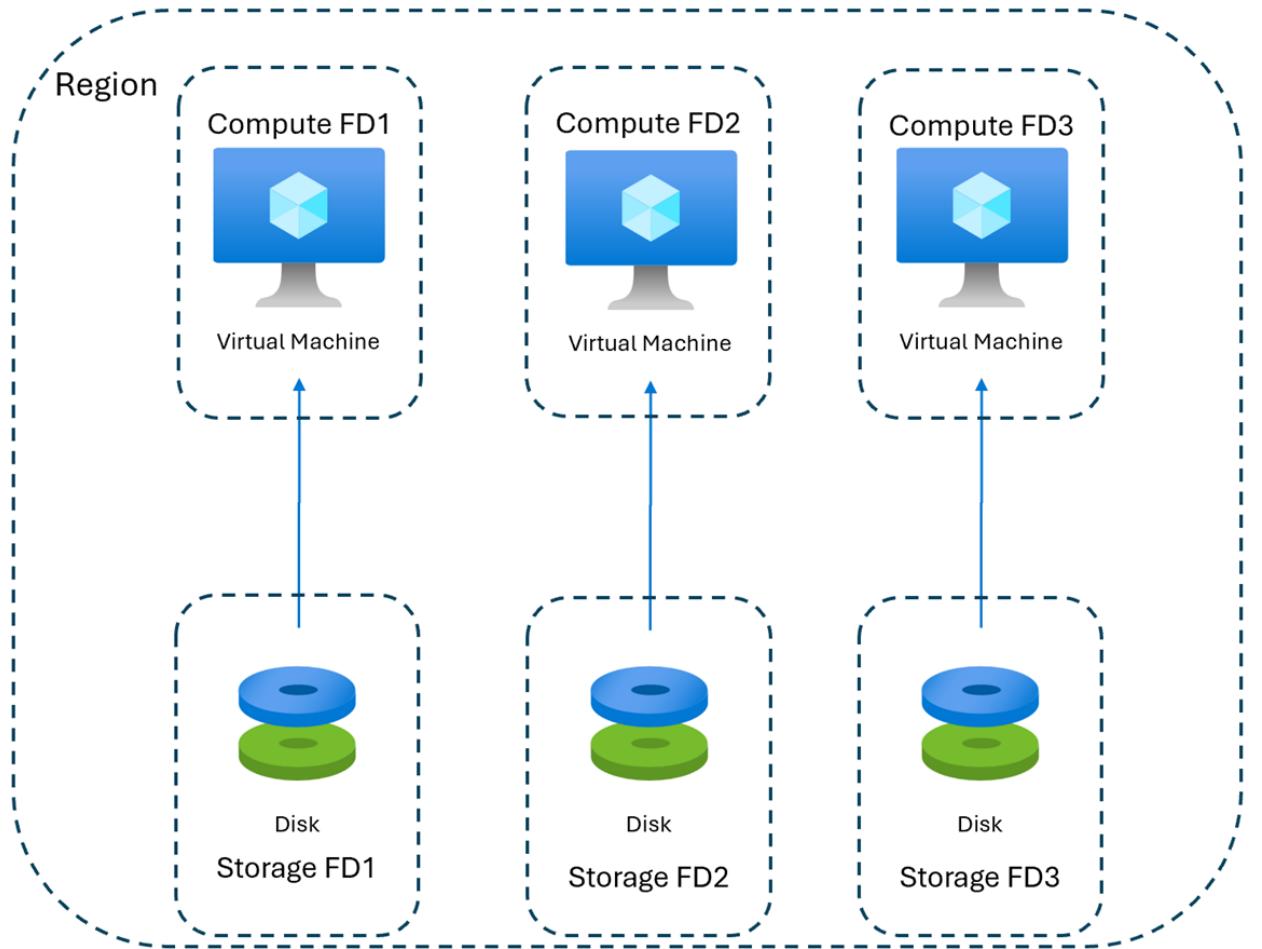
1,247 results

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LAB: ARM Template

- Create ARM template
- Create linked template for storage resources
- Upload linked template to Azure Blob Storage
 - Generate SAS token
- Modify the main template to call linked template
- Modify main template to update dependencies
- Upload main template to Azure Blob Storage
- Deployed resources to Azure using AZ CLI

AVAILABILITY SETS



VMs are placed on
nodes in a rack



Failures can occur at node
and rack levels

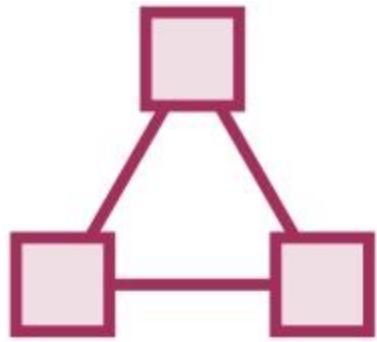


Maintenance is also
required on hosts and
VMs are **not** live
migrated

AVAILABILITY SETS



To ensure availability of services, always deploy minimum 2 instances of any service and place in a unique availability set

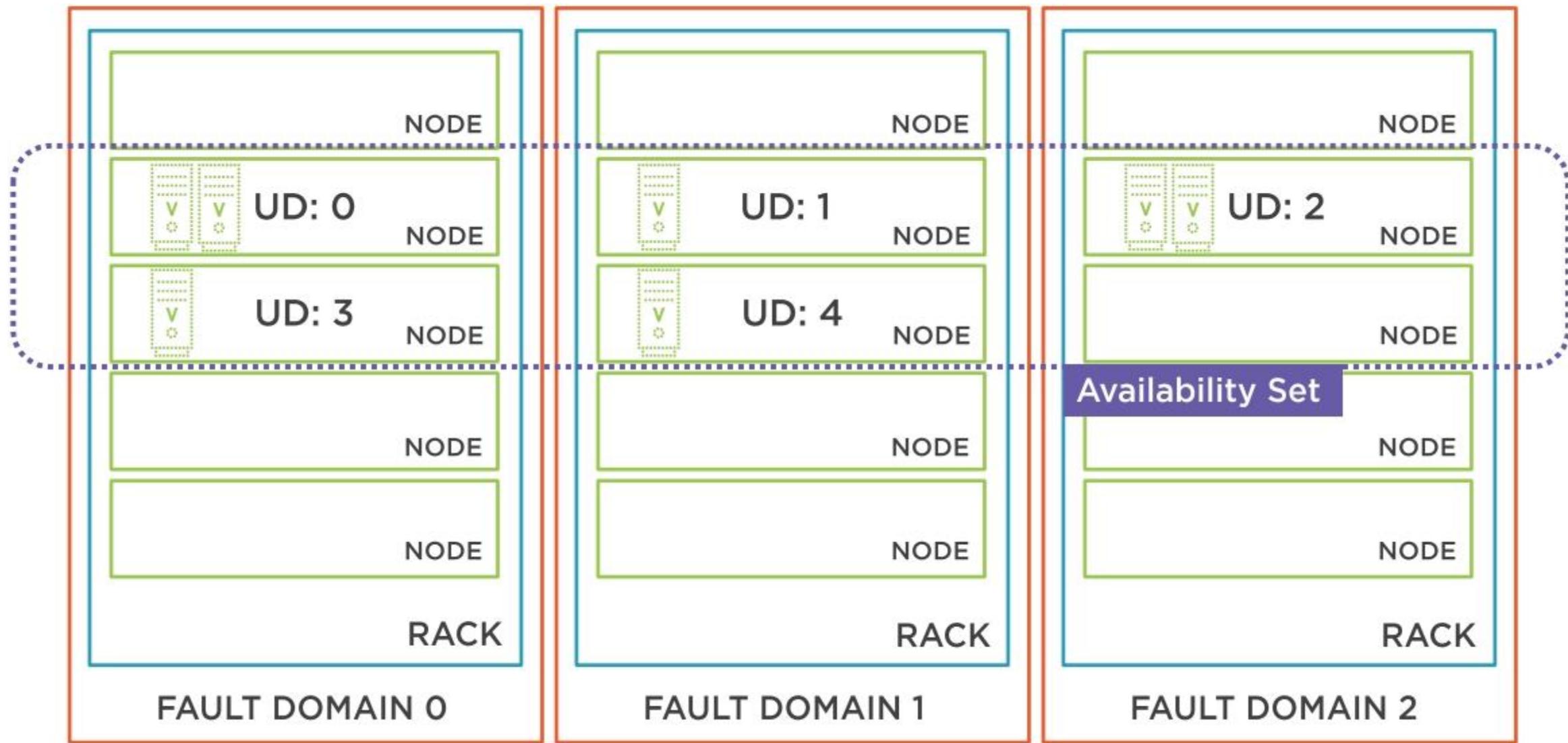


This ensures VMs are spread over three fault domains (racks) and five (by default) update domains



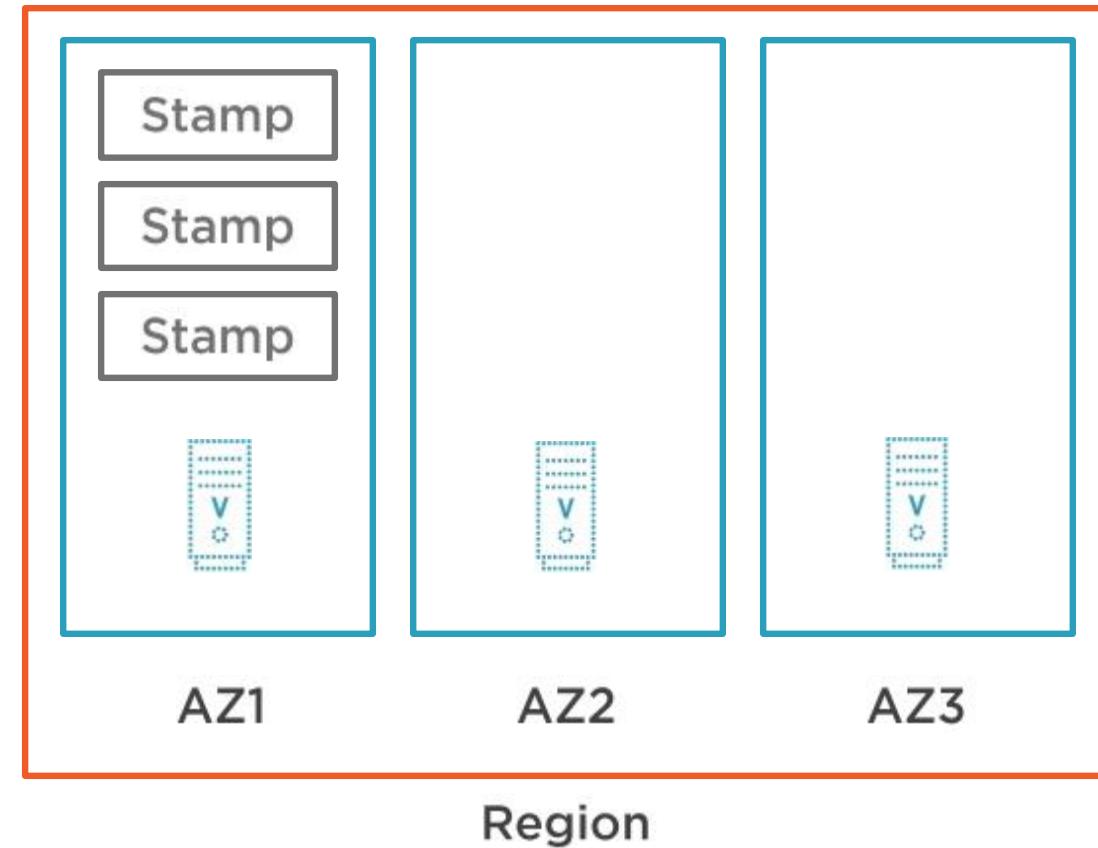
Must have minimum 2 VMs to receive SLA of 99.95%

AVAILABILITY SETS



AVAILABILITY ZONES

- Regions are broken up into physically separate AZs
- AZs have independent power, cooling and networking
- 3 AZs are exposed per subscription
- VMs spread over AZs receive 99.99% SLA
- Each AZ can be thought of as separate fault domain and update domain
- Virtual networks span AZs

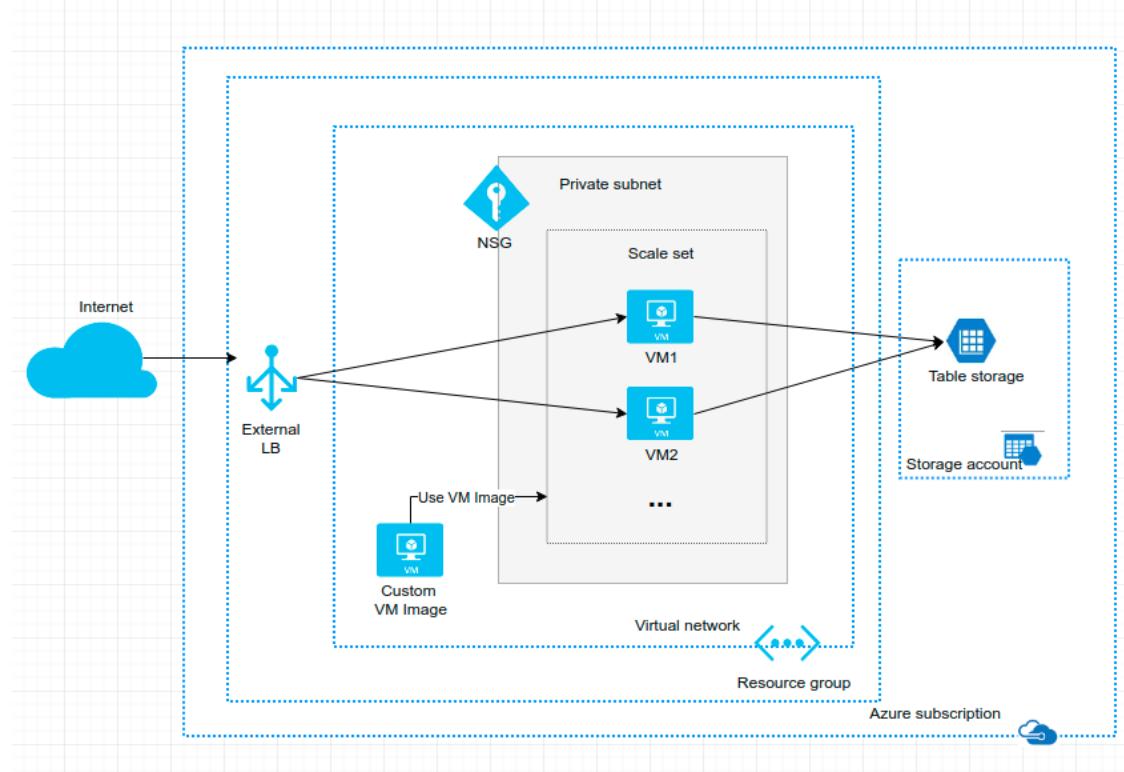


REGIONS



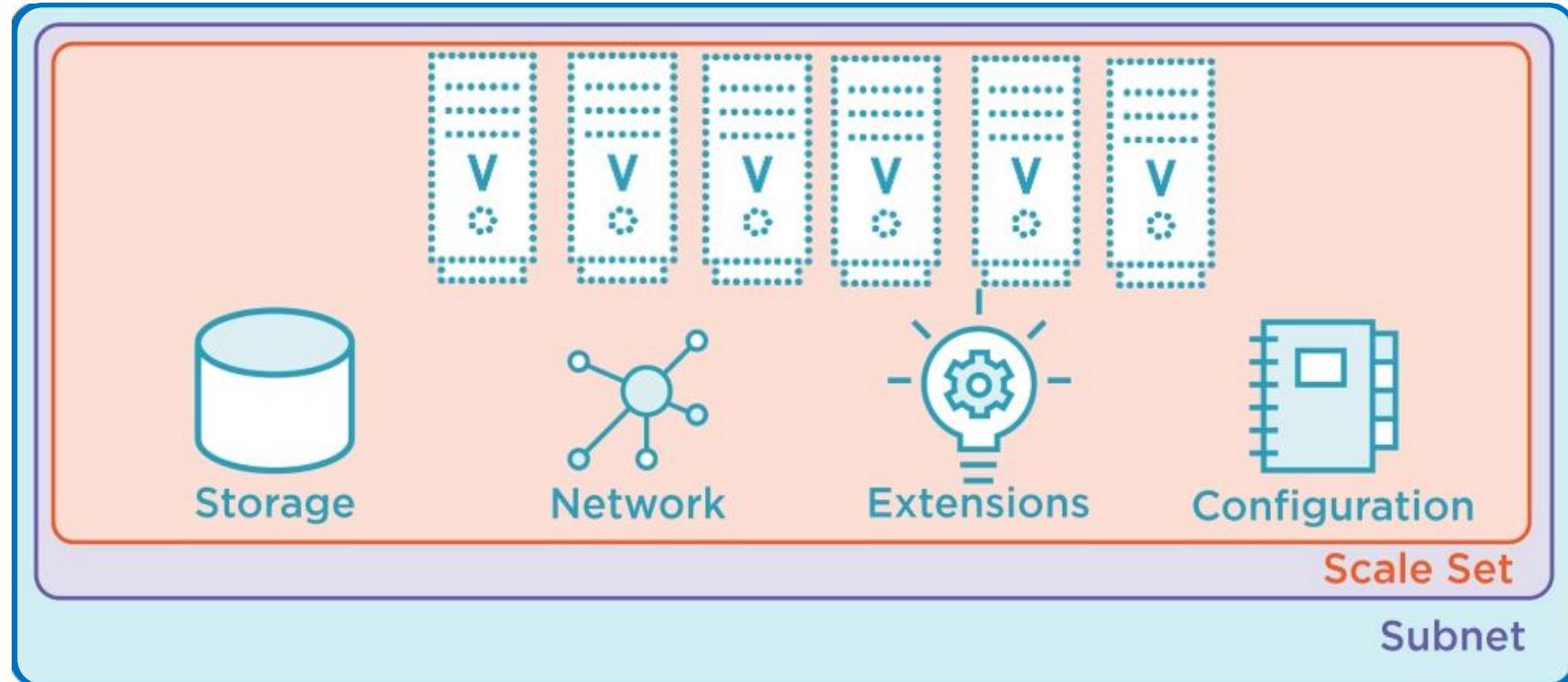
SCALE SETS

- Enables large scale deployment of VMs from single gold image with automatic configuration
- Supports auto-scale based on metrics and schedules
- Scale sets can be updated without taking down the entire set



SCALE SETS

- Azure VM Scale Sets enable the entire deployment to be managed in a simple fashion
- Enable rollout of updates without taking down the entire service.



SCALE SETS LIMITATIONS



- 1000 VMs per Scale Set maximum and use with Azure Standard Load Balancer for matching scale



- 2000 Scale Sets per region per subscription

Auto-scaling Scale Sets

Scheduled

Metric-Based

Scale Sets support many types of scale

- On a schedule both specific day and recurrence (enables scaling ahead of the load increase)
- Based on resource metrics
- Can combine (schedule rules take precedence over metric rules)

POP QUIZ:

You need high availability in a single region and want to support 200 instances in a scale set. Which option should you choose?

- A. Regional scale set (non-zonal) without placement groups
- B. Zonal scale set with true Availability Zones
- C. Regional scale set with placement groups
- D. Single VM in an Availability Set

POP QUIZ:

You need high availability in a single region and want to support 200 instances in a scale set. Which option should you choose?

- A. Regional scale set (non-zonal) without placement groups
- B. Zonal scale set with true Availability Zones
- C. Regional scale set with placement groups**
- D. Single VM in an Availability Set

Notifications & Logs

Can notify on scaling changes

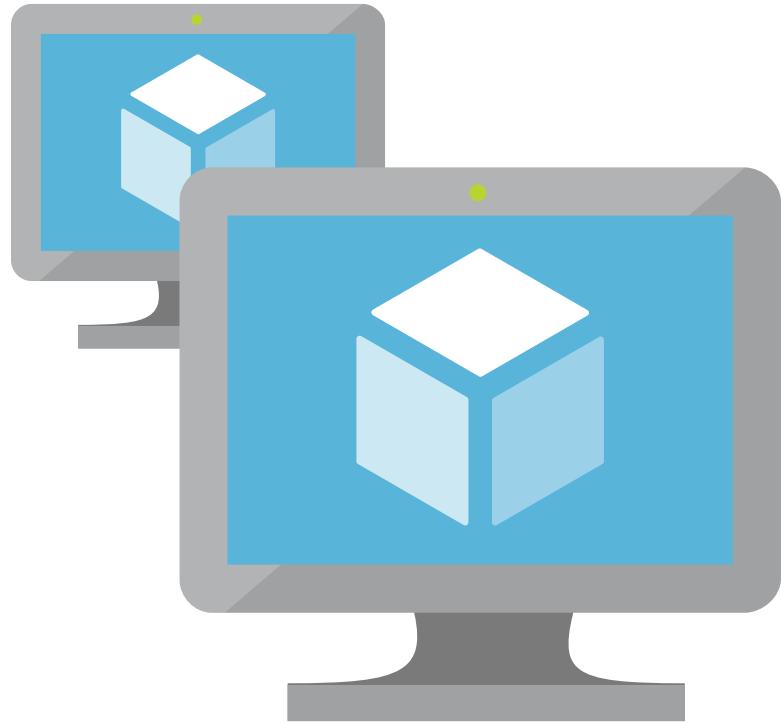
- Email a team
- Integrate with external APIs via event hooks

Can create JSON templates just to change the scale

Audit logs will show scale history actions

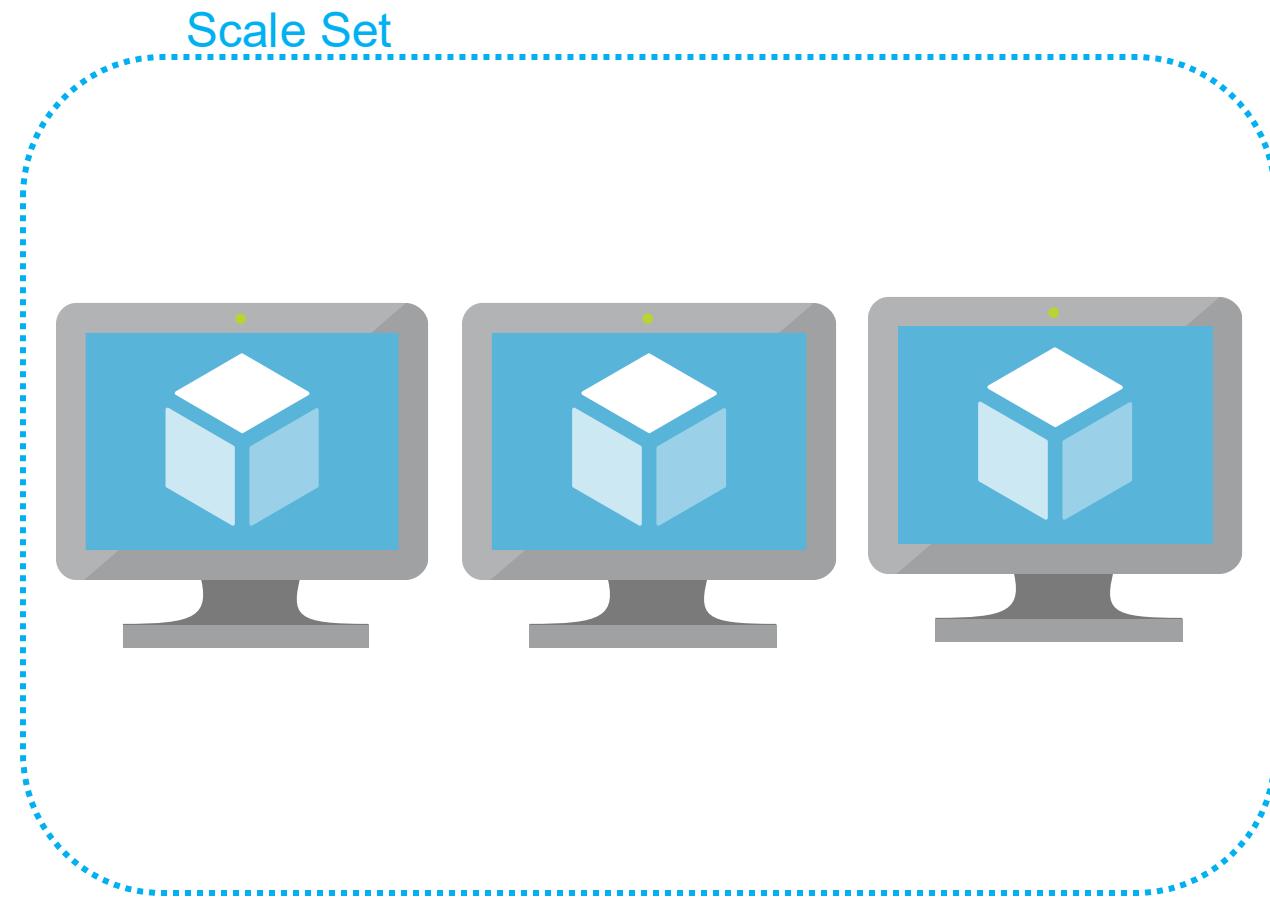
SCALE VERTICALLY

- Can be cheaper to scale vertically
 - Add more memory, CPU
 - Save money by scaling down
- Requires VM to reboot



SCALE HORIZONTALLY

- Recommended for cloud applications
- Added redundancy
- No downtime



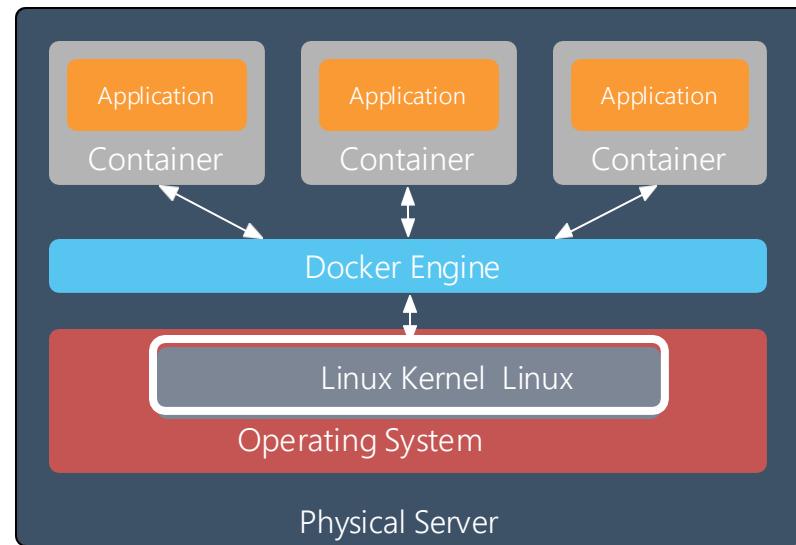
LAB: Deploy VMs

- Deploy Azure VMs by using the Azure portal, Azure PowerShell, and Azure Resource Manager templates
- Configure networking settings of Azure VMs running Windows and Linux operating systems
- Deploy and configure Azure VM scale sets

Azure Container Service

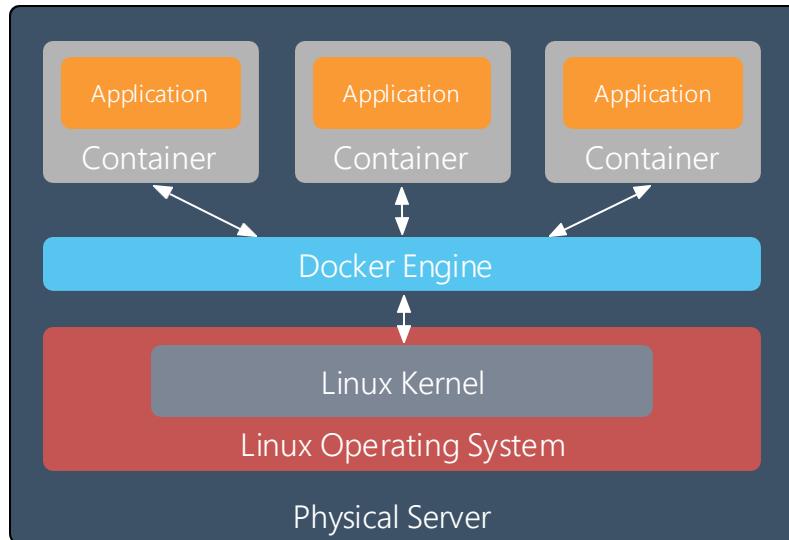


CONTAINERS



Shared kernel on the host to run multiple guest applications

CONTAINERS OVER VMs

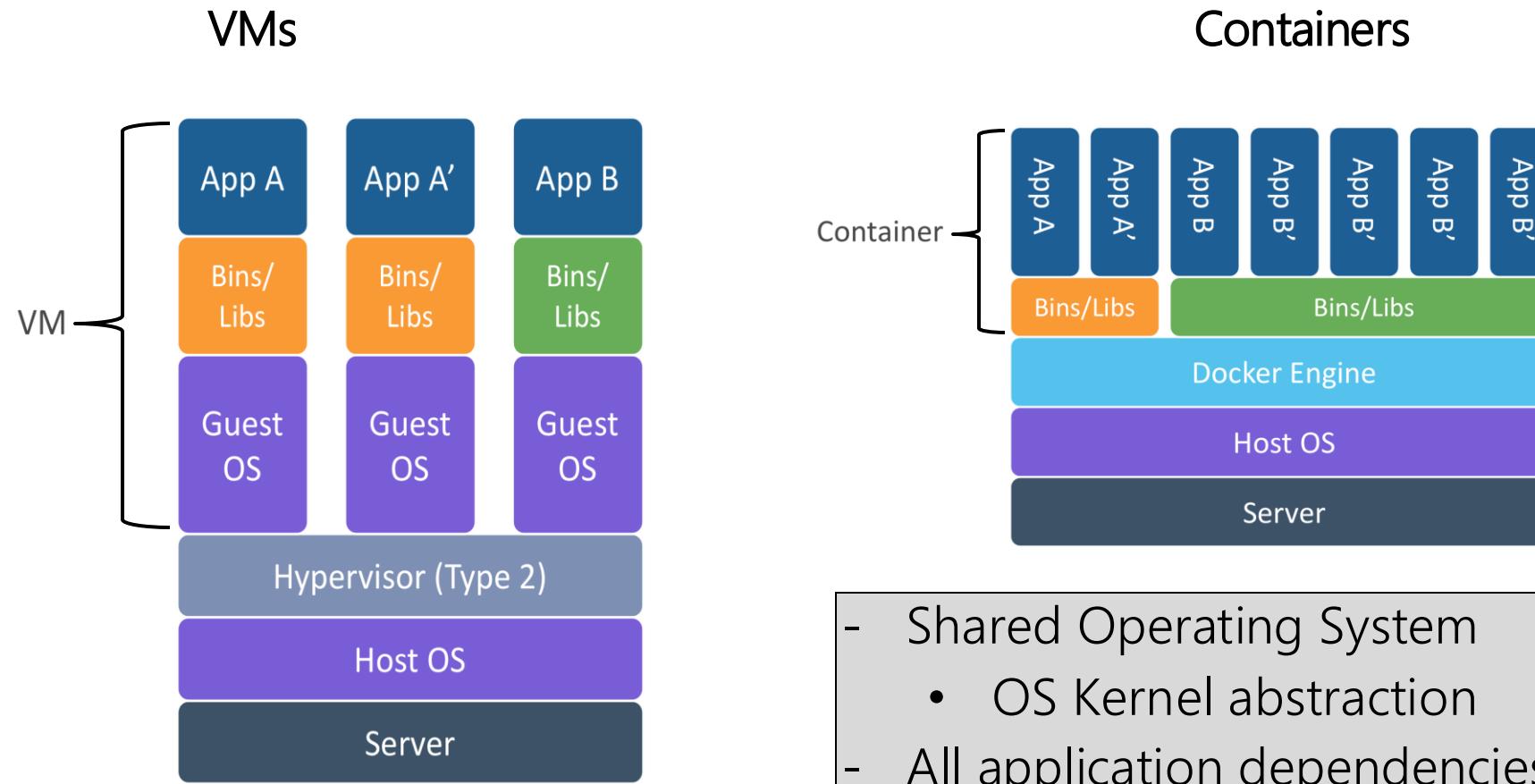


Shared kernel on the host to run multiple guest applications

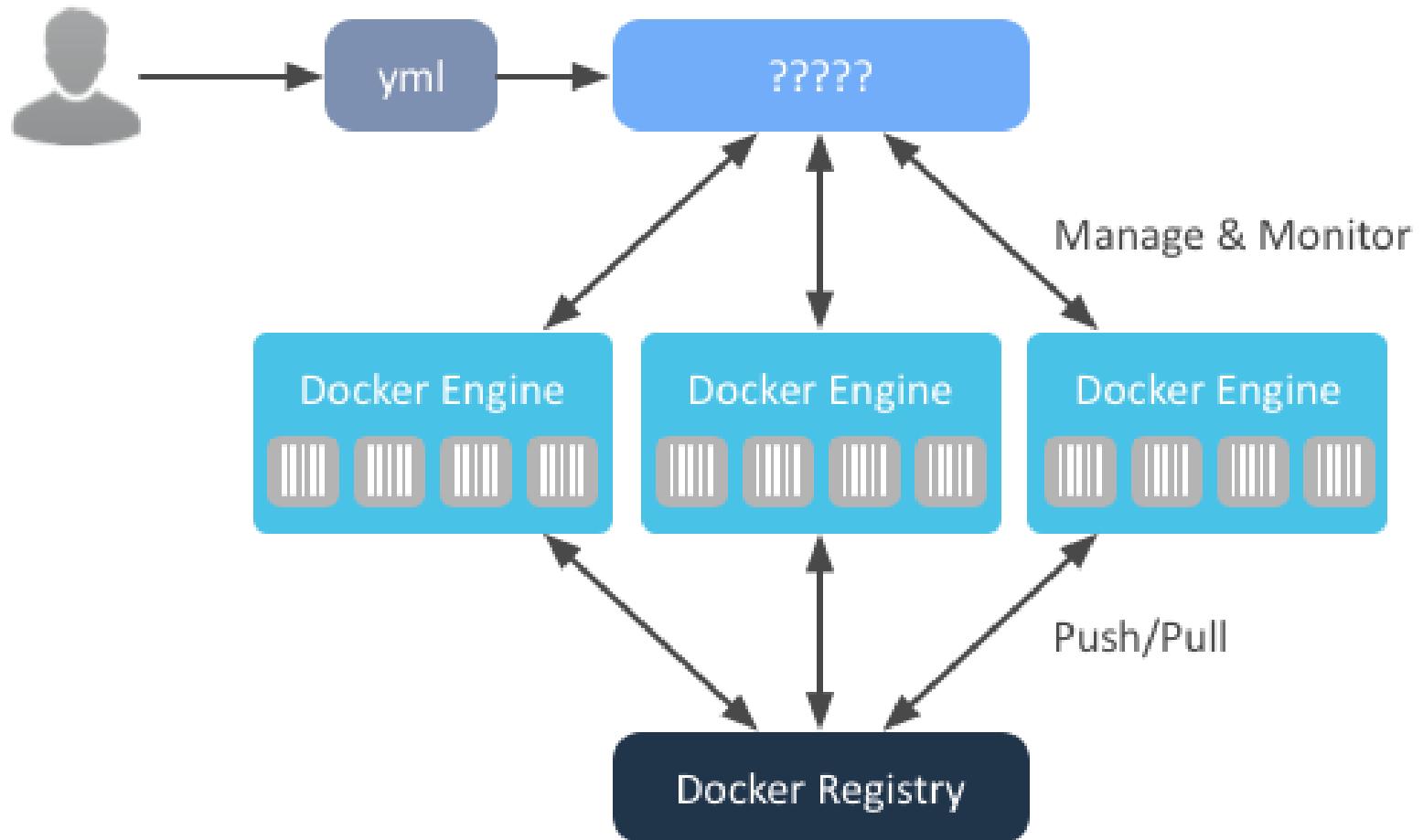
Advantages over VMs

- Containers are more lightweight
- No need to install a guest Operating System
- Less CPU, RAM, storage overhead
- More containers per machine
- Greater portability

VM-BASED VS CONTAINER-BASED ARCHITECTURE

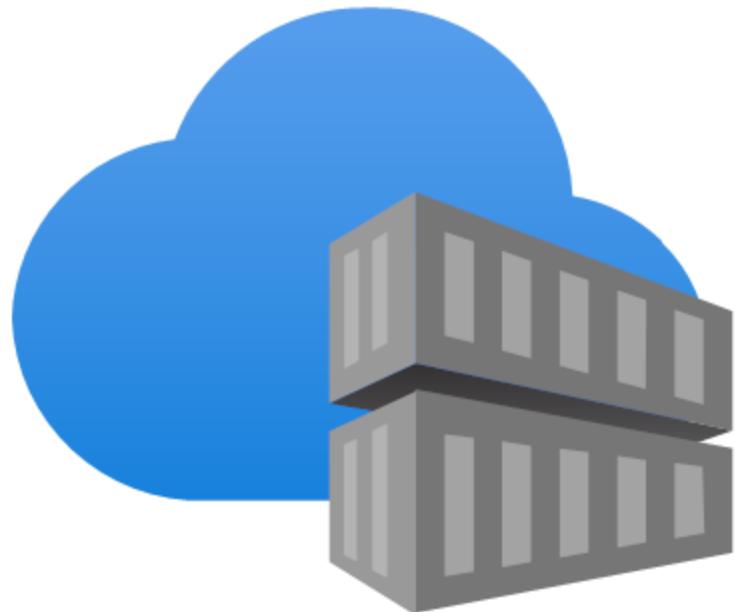


END GOAL: MANAGE AS SINGLE POOL OF RESOURCES



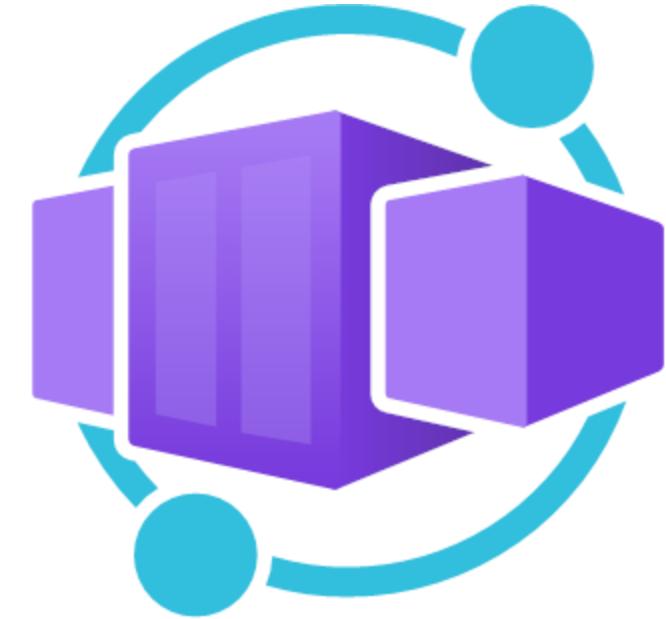
AZURE CONTAINER REGISTRY

Azure Container Registry (ACR) is a **fully managed, geo-replicated OCI-compliant registry** that simplifies the entire container lifecycle—from build to deployment.



AZURE CONTAINER APPS

Azure Container Apps is a **serverless container platform** designed for running **microservices, APIs, background jobs, and AI-powered applications** without managing infrastructure.



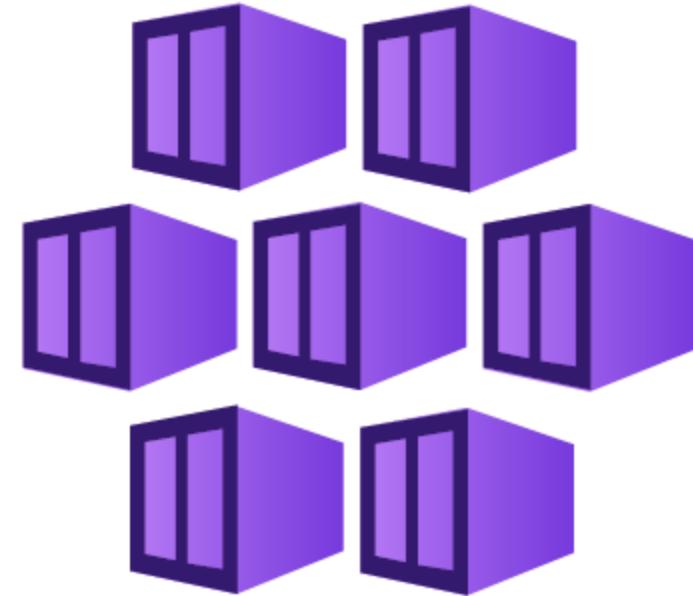
AZURE FUNCTIONS



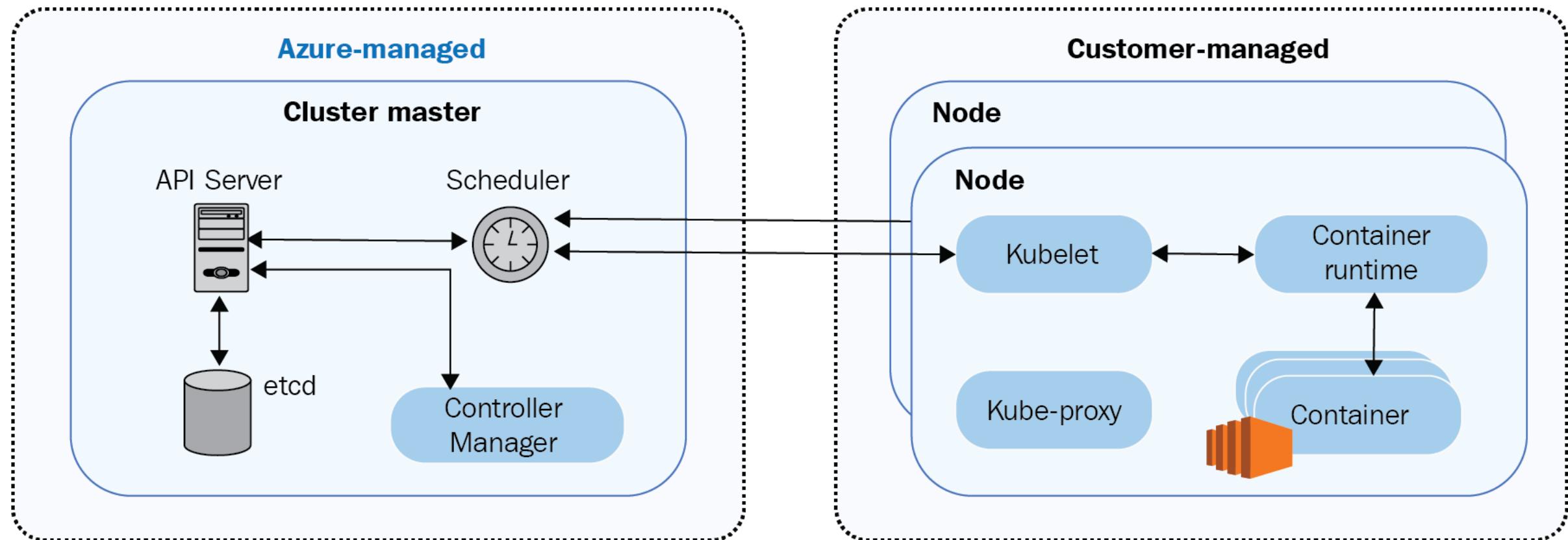
Execute code on-demand with a pay-per-use model, ideal for variable workloads.

AZURE KUBERNETES SERVICE (AKS)

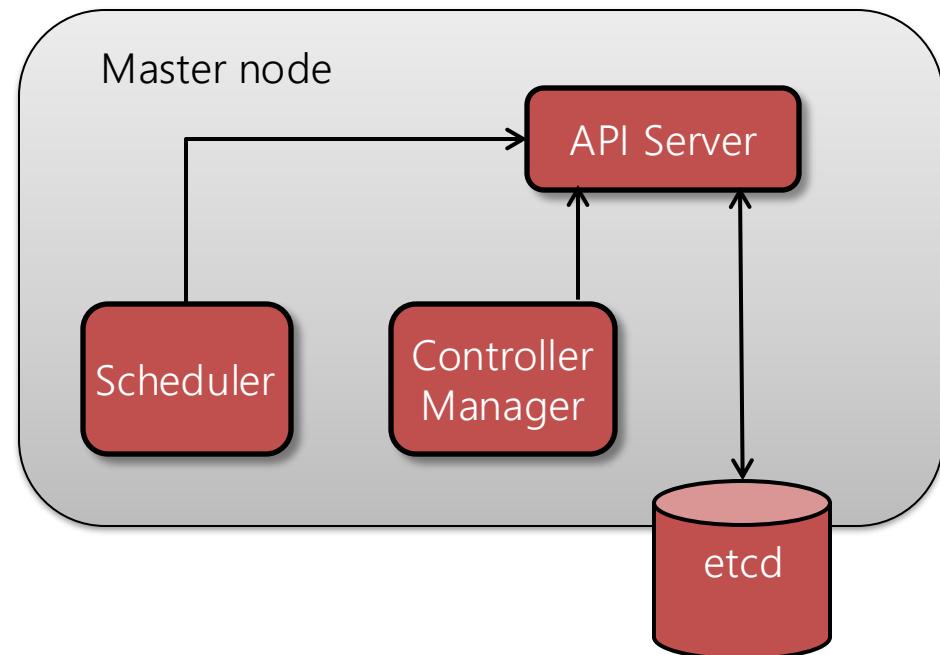
Azure Kubernetes Service (AKS) is a **fully managed Kubernetes platform** that simplifies the deployment, management, and scaling of containerized applications.



AKS ARCHITECTURE



KUBERNETES MASTER COMPONENTS

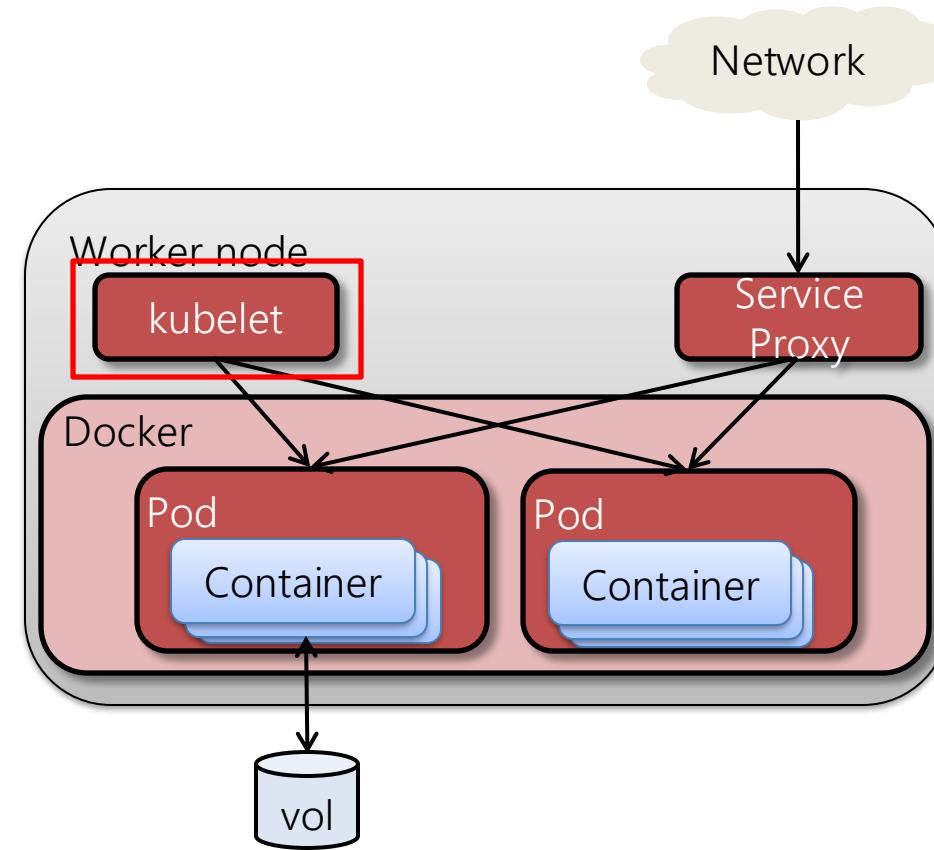


K8s components
written in Go
(golang.org)

- **API Server (`kube-apiserver`)**: exposes the Kubernetes REST API, and can be scaled horizontally
- **Scheduler (`kube-scheduler`)**: selects nodes for newly created pods to run on
- **Controller manager (`kube-controller-manager`)**: runs background controller processes for the system to enforce declared object states, e.g. Node Controller, Replication Controller, ...
- **Persistent data store (`etcd`)**: all K8s system data is stored in a distributed, reliable key-value store. etcd may run on separate nodes from the master

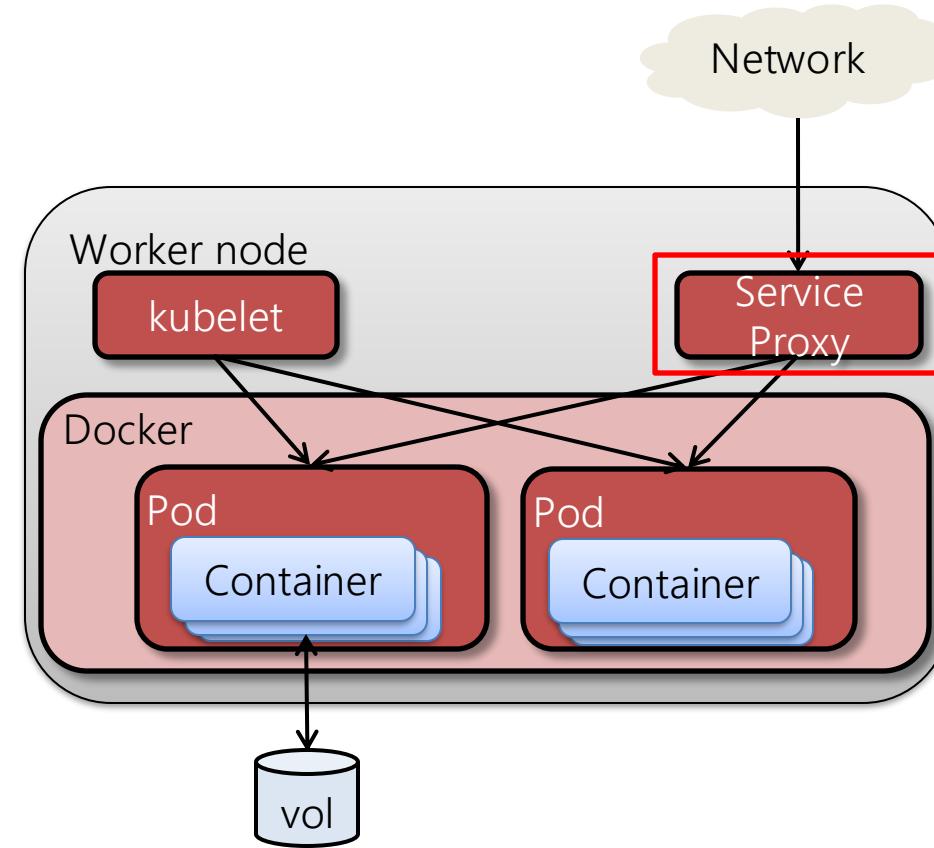
KUBERNETES WORKER COMPONENTS

- **kubelet**: local K8s agent that is responsible for operations on the node, including
 - Watching for pod assignments
 - Mounting pod required volumes
 - Running a pod's containers
 - Executing container liveness probes
 - Reporting pod status to system
 - Reporting node status to system
- **Service proxy (kube-proxy)**: enables K8s service abstractions by maintaining host network rules and forwarding connections
- **Docker**: runs the containers



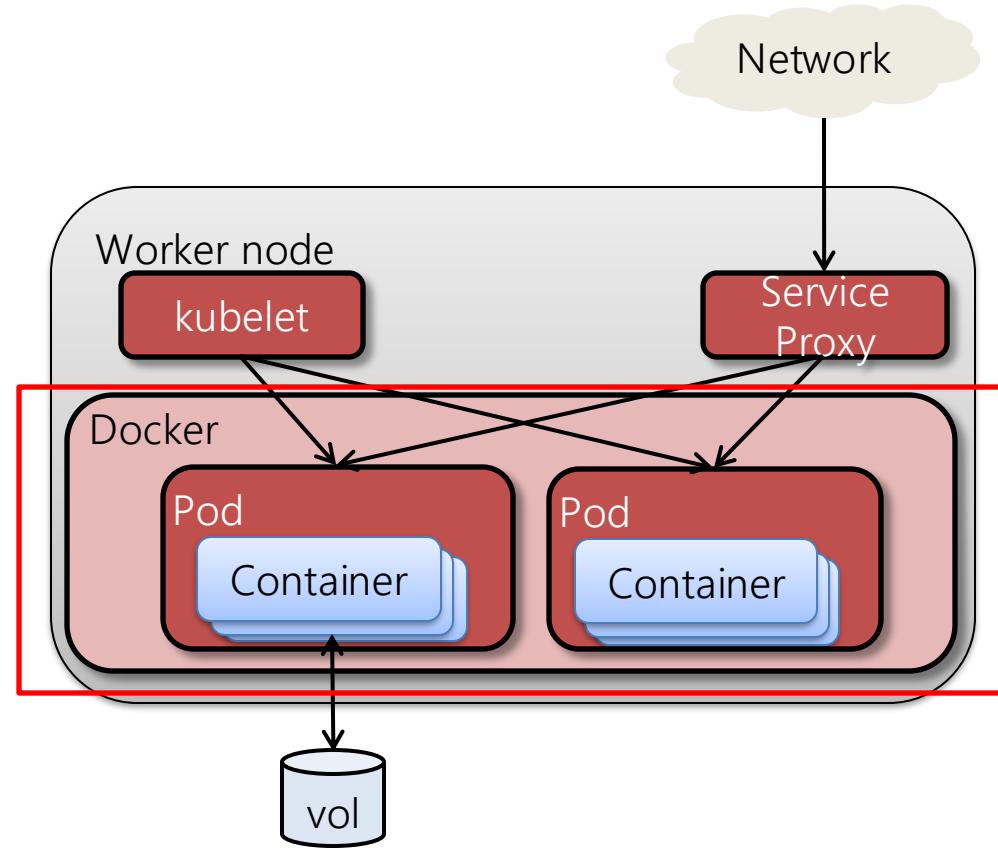
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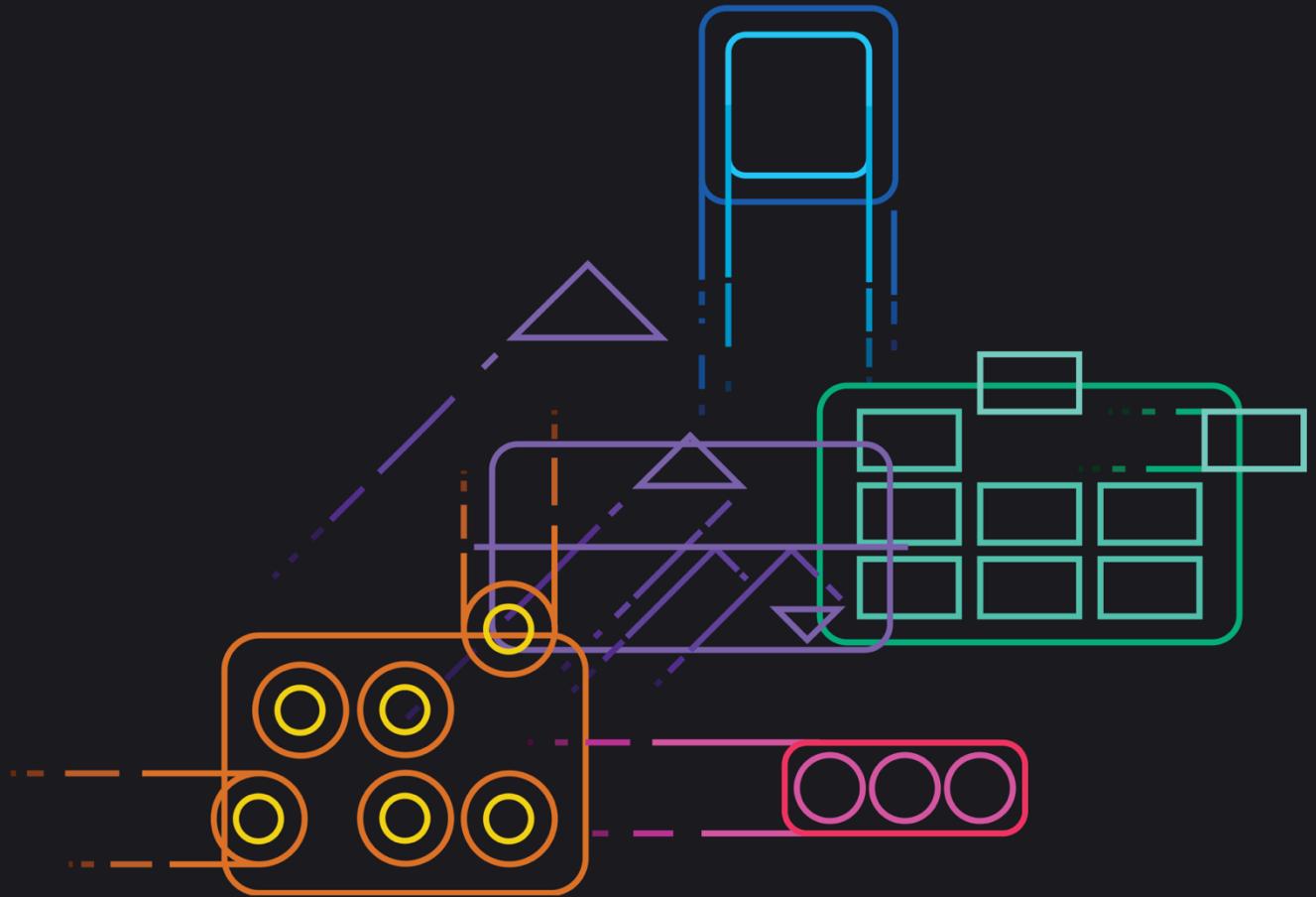


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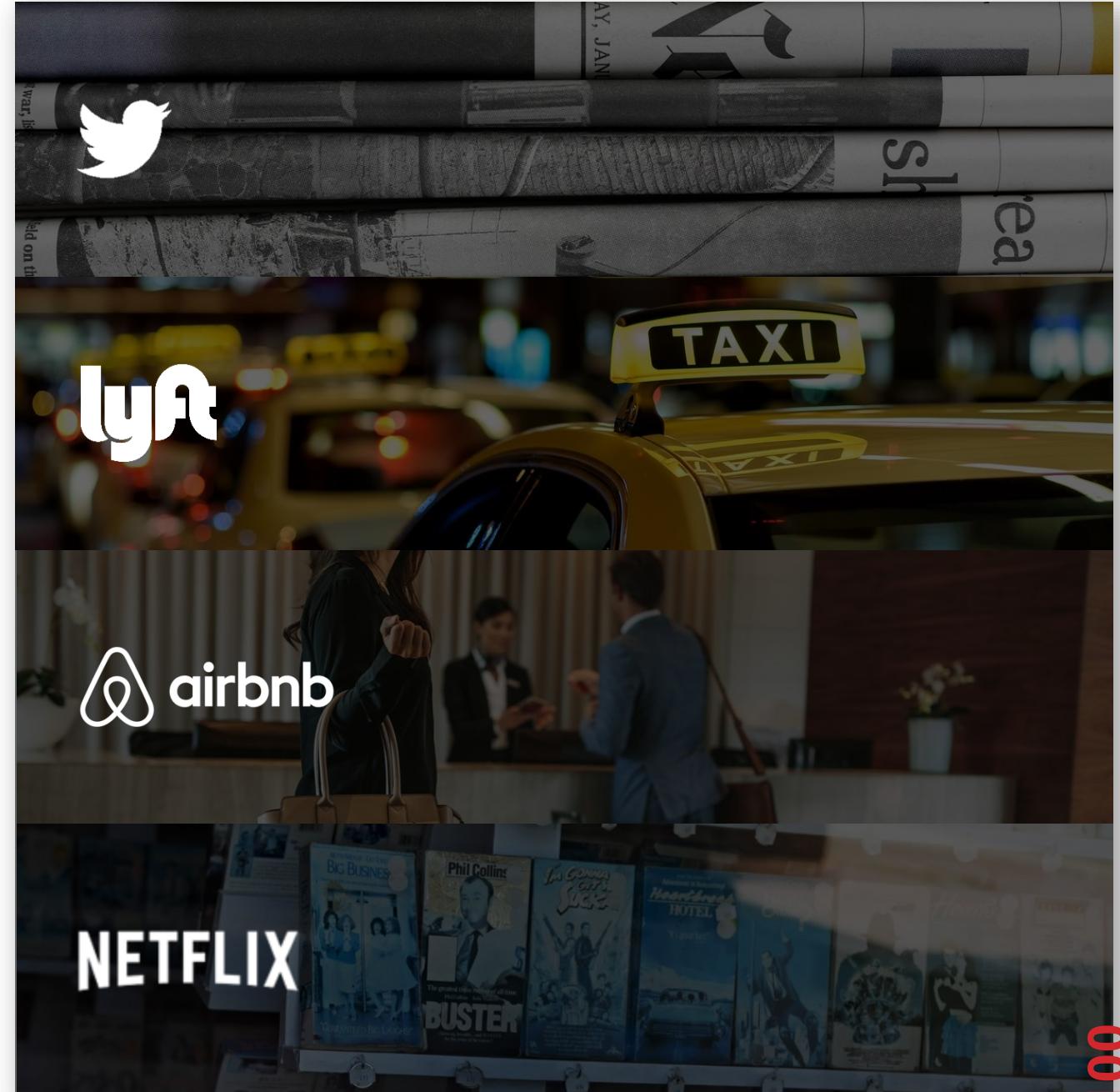


Azure Devops

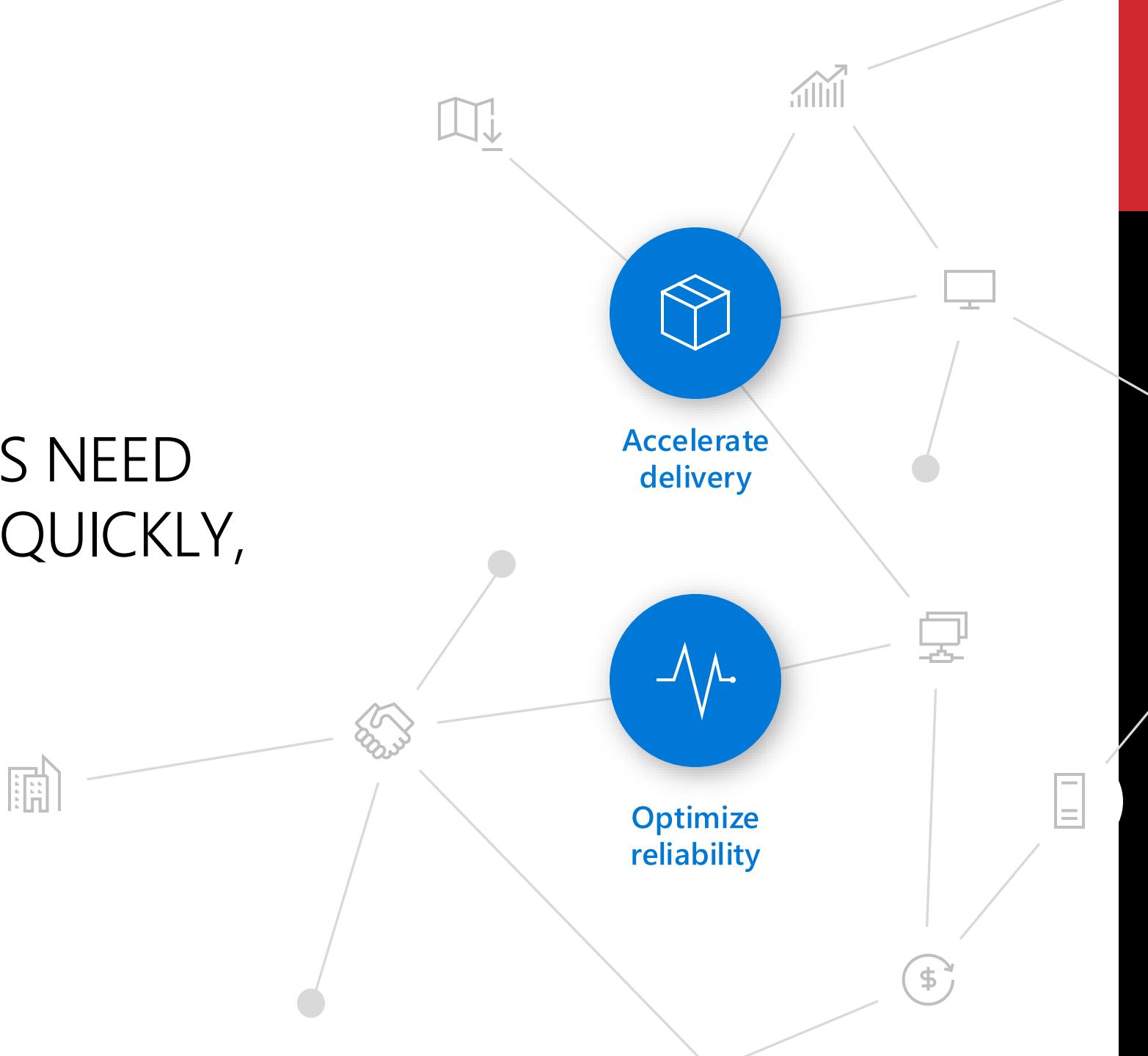


50% of Fortune 500 in 2000 now replaced by organizations that use technology to deliver customer value faster, better, and cheaper

The Fortune 500 of today face the same challenge tomorrow

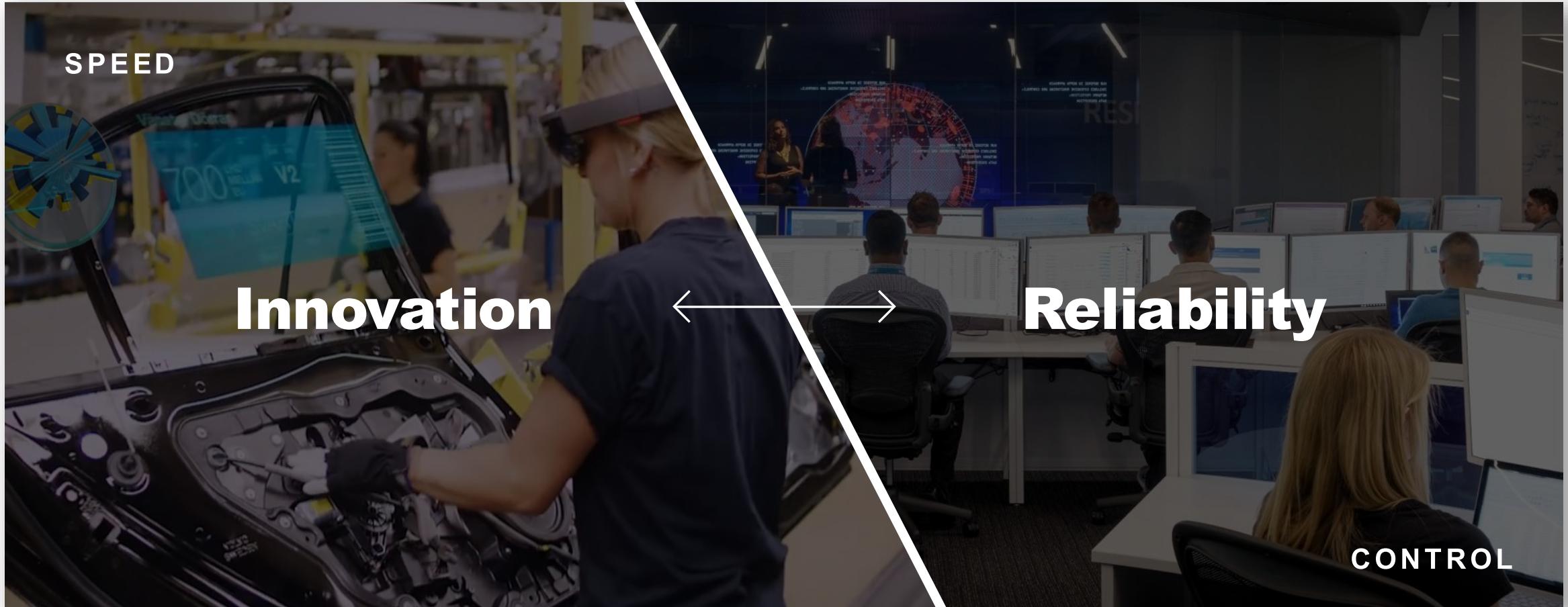


PRODUCT INNOVATIONS NEED
TO REACH CUSTOMERS QUICKLY,
AND STAY AVAILABLE

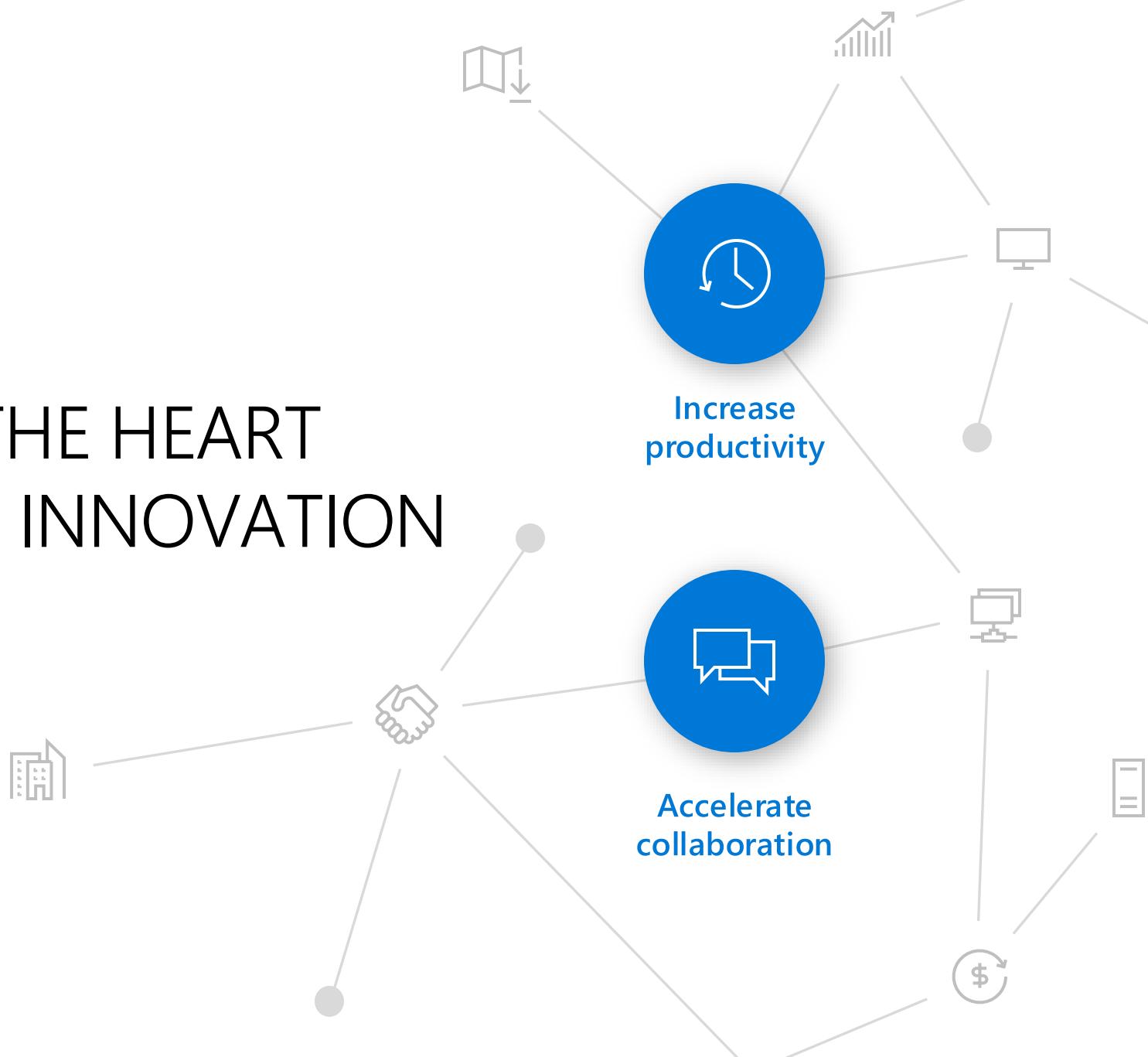


SOFTWARE DELIVERY PARADOX

Speed vs. control impedes innovation

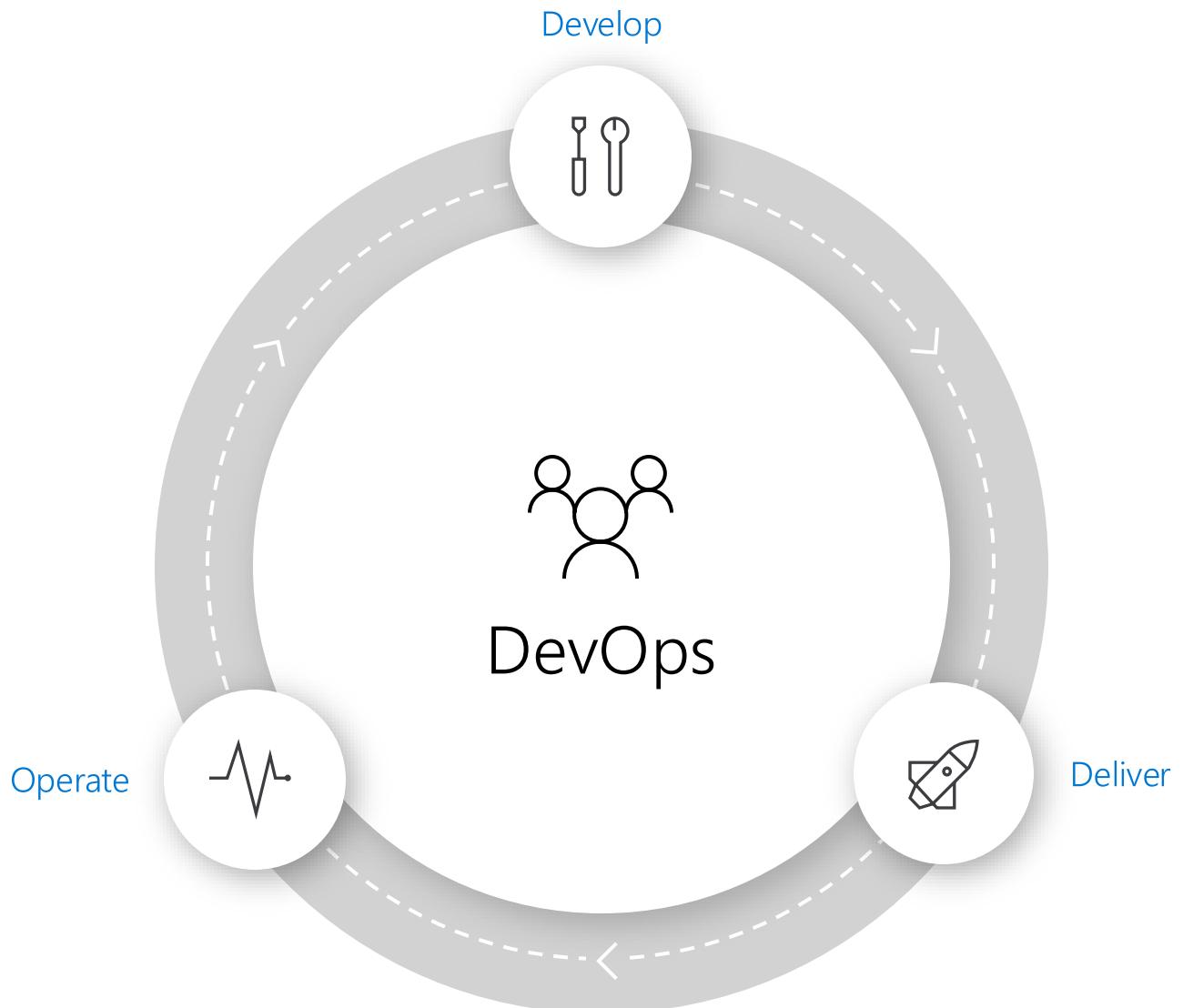


DEVELOPERS ARE AT THE HEART OF YOUR COMPANY'S INNOVATION



ACCELERATING DELIVERY WITH DEVOPS

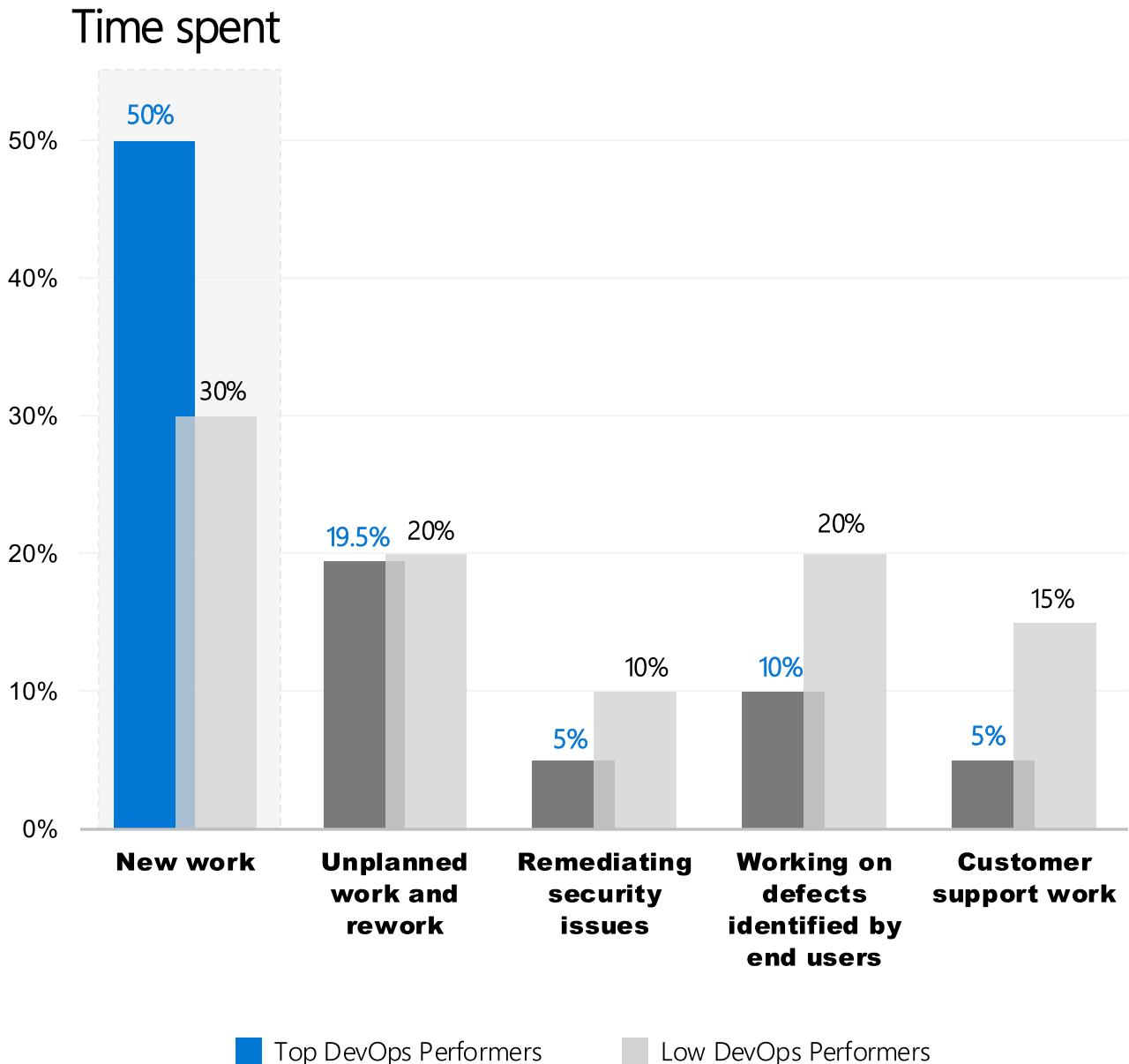
DevOps is the union of **people**, **process**, and **products** to enable continuous delivery of value to your end users.



INNOVATION WITH OVERSIGHT

Top performing DevOps companies spend more time innovating and less time keeping the lights on.

The result: better products, delivered faster, to happier customers by more engaged teams



DELIVER WITH AZURE DEVOPS



Azure Boards



Azure Repos



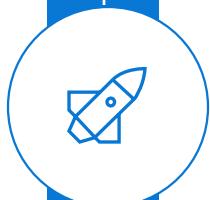
Azure Pipelines



Azure Artifacts



Azure Test Plans



Deliver



Azure Boards



Azure Repos



Azure Pipelines



Azure Artifacts



Azure Test Plans

The screenshot shows the Azure DevOps Boards interface for the 'FabrikamFiber' project. The main area is titled 'FabrikamFiber Board' and displays a Kanban-style board with three columns: 'New', 'Active', and 'Staging'. The 'Active' column is currently selected. The board contains several work items, each with a title, description, and status. Some items have associated users and labels like 'Xamarin' or 'General'. The sidebar on the left provides navigation links for other Azure DevOps services.

Connecting ideas to releases

Scrum ready to help your teams run sprints, stand-ups, and plan work

Integrated with GitHub commits and pull requests

Insights into project status and health



Deliver



Azure Boards



Azure Repos



Azure Pipelines



Azure Artifacts



Azure Test Plans

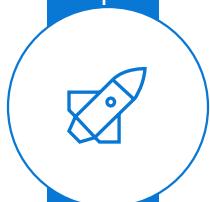
The screenshot shows the Azure DevOps interface for the AdventureWorks Mobile repository. The left sidebar includes options for Overview, Boards, Repos, Files, Commits, Pushes, Branches, Tags, Pull requests (which is selected), Pipelines, Test Plans, and Artifacts. The main area is titled "Pull requests" and lists several items under "Mine". The first item is "Initialize client with .client.init" by Kat Larsson, requested #238 into master, created 3 minutes ago with 1 vote. The second item is "Testing configuration settings" by Kat Larsson, requested #230 into features/config, created 1 hour ago. Other items include "Check returned identity for null status" by Colin Ballinger, requested #212 into master, created 15 minutes ago; "[WIP] Add tests for deployment mapping" by Robin Counts, requested #221 into master, created 7/9/2018, 1 update, 2 others; "Add exception on disconnect" by Colin Ballinger, requested #249 into master, created 2 minutes ago, new pull request; "Maintain structure when converting isomorphs" by Robin Counts, requested #234 into master, created 15 minutes ago; and "Hotfix payload to releases/99" by Robin Counts, requested #201 into releases/99, created 20 minutes ago, 99+ updates.

Private Git and TFVC repos for your teams

Code review via branch pull requests

Branch policies and build validation

Easy migration path to / from GitHub



Deliver



Azure Boards



Azure Repos



Azure Pipelines



Azure Artifacts



Azure Test Plans

The screenshot shows the Azure DevOps Pipelines interface for the AdventureWorks Mobile project. It displays three parallel jobs: Windows Job (Running, 1m 53s), Linux Job (Running, 3m 29s), and macOS Job (Running, 3m 07s). The Linux Job logs show the execution of various commands including yarn install, node build/npm/preinstall.js, and npm run compile. The interface includes tabs for Summary, Logs, Tests, and YAML, and a sidebar with options like Overview, Pipelines, Builds, Releases, Library, and Deployment groups.

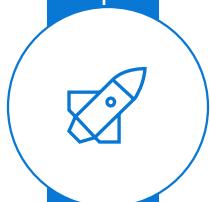
Cloud-hosted pipelines for Linux, macOS and Windows

Any language, any platform, any cloud

Native support for containers and Kubernetes

Best-in-class for open source





Deliver



Azure Boards



Azure Repos



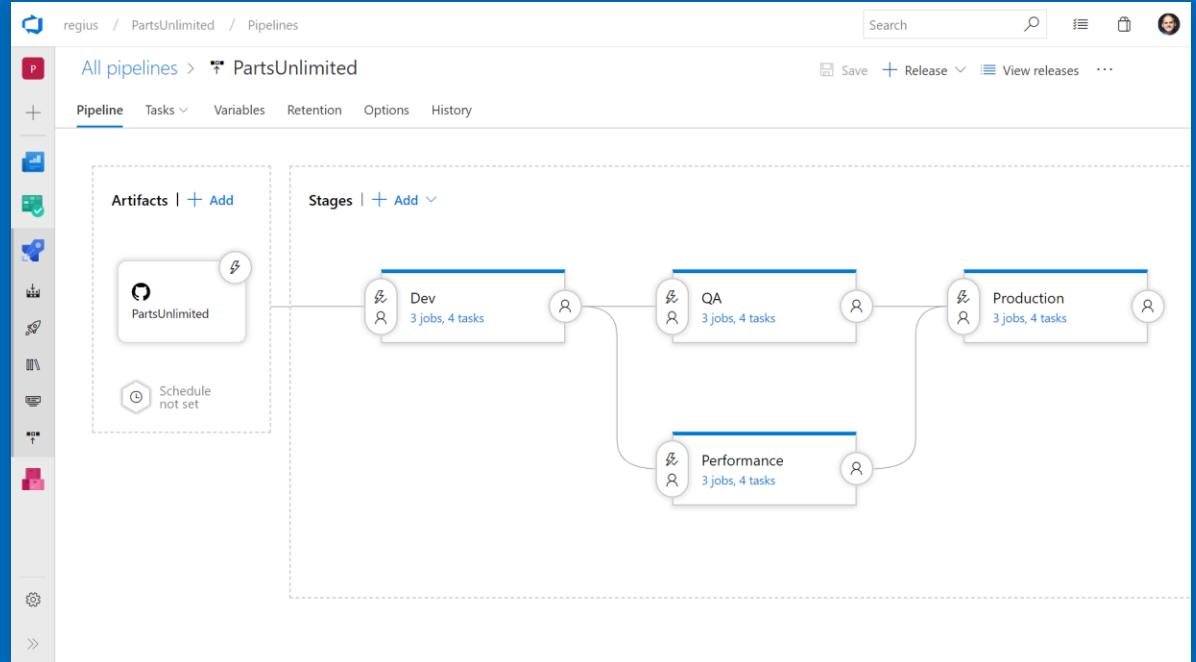
Azure Pipelines



Azure Artifacts



Azure Test Plans

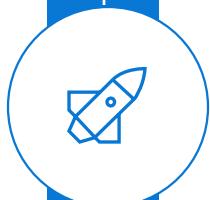


Deploy to on-premises, ANY cloud or a hybrid of cloud and on-prem

Staged environment releases

Pre and post deployment approvals with gates to automate approval based on conditions





Deliver



Azure Boards



Azure Repos



Azure Pipelines



Azure Artifacts



Azure Test Plans

The screenshot shows the Azure DevOps Artifacts interface for the AdventureWorks Mobile project. The left sidebar includes links for Overview, Boards, Repos, Pipelines, Test Plans, and Artifacts. The main area is titled 'Artifacts' and shows a list of packages with columns for Package, Views, Source, Last pushed, and Description. The listed packages are:

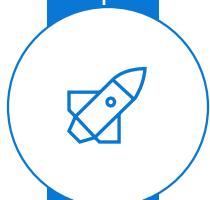
Package	Views	Source	Last pushed	Description
abbrev	Version 1.1.0	nuget	a year ago	Like ruby's abbrev module, but in js
accepts	Version 1.3.3	npmjs	a year ago	Higher-level content negotiation
acorn	Version 5.0.3	MyFeed	a year ago	ECMAScript parser
acorn-dynamic-import	Version 2.0.2	maven	a year ago	Support dynamic imports in acorn
aclr-jsx	Version 3.0.1	nuget	a year ago	Alternative, faster React.js JSX parser
acorn-object-spread	Version 1.0.0	maven	a year ago	Custom JSON-Schema keywords for ajv validator
ajv	Version 4.11.7	npmjs	a year ago	Alphanumeric sorting algorithm
ajv-keywords	Version 1.5.1	nuget	a year ago	ANSI escape codes for manipulating the terminal
alphanum-sort	Version 1.4.0	npmjs	a year ago	An elegant lib that converts the chalked (ANSI) text to HTML.

Share code efficiently

Keep your Maven, npm, NuGet and Python packages and more in the same place

Aggregate from public registries and internal teams

Publish and track from any pipeline



Deliver



Azure Boards



Azure Repos



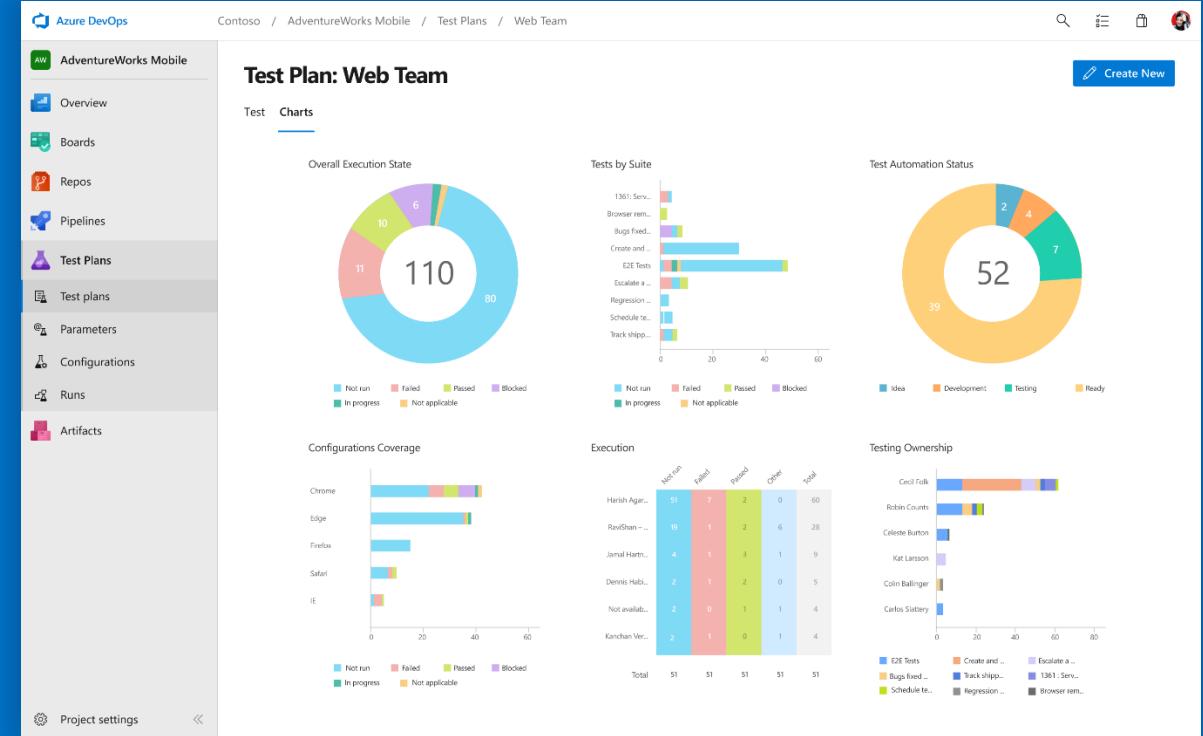
Azure Pipelines



Azure Artifacts



Azure Test Plans



Run tests and log defects from your browser

Track and assess quality throughout your lifecycle

Capture rich data for reproducibility

Create tests directly from exploratory sessions



Deliver with



Azure Boards



Azure Repos



Azure Pipelines



Azure Artifacts



Azure Test Plans

GitHub

GitHub brings the premier social coding workflows to your team, breaking down silos and enabling Inner Source through:

- Expertise sharing
- Cross-team collaboration
- Improved code reuse
- Increased velocity



GitHub

THE #1 DEVELOPER
COMMUNITY ON THE
PLANET

Most contributions [1.1B in 2018](#)

Most developers [33M](#)

Most Repos [100M](#)

Most secure [5M vulnerability alerts in 2018](#)



AZURE DEVOPS INTEGRATED WITH GITHUB

Rich integration with Azure Pipelines and
Azure Boards

The screenshot shows the GitHub Marketplace page for Azure Pipelines. At the top, there's a navigation bar with links for Pull requests, Issues, Marketplace, and Explore. Below the navigation, the page title is "Marketplace // Azure Pipelines". A large button on the left says "Set up a new plan". To the right, there's a section titled "Azure Pipelines" with a sub-section "Continuously build, test, and deploy to any platform and cloud". It mentions that Azure Pipelines offers cloud-hosted pipelines for Linux, macOS, and Windows with 10 free parallel jobs and unlimited minutes for open source projects. There's also a "Read more..." link. On the right side, there's a large blue box titled "Linux, macOS, and Windows agents" which describes simplifying hardware and VM management. It shows a pipeline with four stages: "Test" (27 succeeded), "Build Linux" (6 succeeded), "Build Windows" (2 succeeded), and "Build macOS" (64% in progress). Each stage has a green checkmark icon.



AZURE PIPELINES

Free unlimited build minutes for
public projects

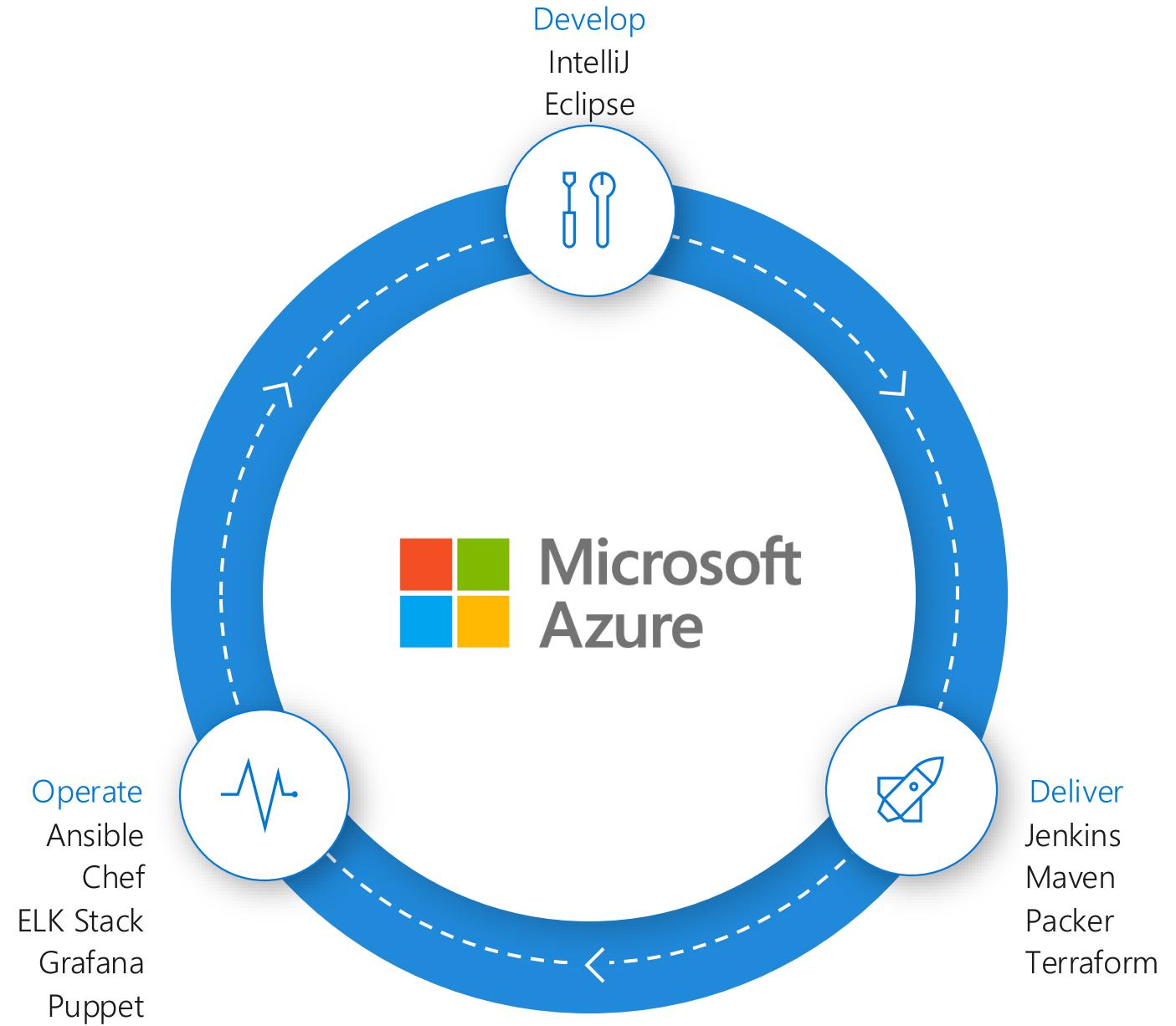
Up to 10 free parallel jobs across
Windows, Linux and macOS



<https://azure.com/pipelines>

Microsoft ❤️ Open Source

Azure and GitHub are fully integrated with your existing tools and workflow



Azure DevOps Services Pricing

Open Source Projects

Free

Unlimited users and build time

- Azure Pipelines: 10 parallel jobs with unlimited minutes for CI/CD
- Azure Boards: Work item tracking and Kanban boards
- Azure Repos: Unlimited public Git repos

Small Teams

Free

Start free with up to 5 users

- Azure Pipelines: Run 1 Microsoft-hosted job for 1,800 minutes per month and 1 self-hosted job for any amount of time
- Azure Boards: Work item tracking and Kanban boards
- Azure Repos: Unlimited public Git repos
- Azure Artifacts: package management
- Unlimited stakeholders

Teams of any size

Starts at \$6

per user, per month for Boards & Repos

Easy pricing that grows with your team

- Azure Pipelines: Run 1 Microsoft-hosted job for 1,800 minutes per month and 1 self-hosted job for any amount of time
- Azure Boards: Work item tracking and Kanban boards
- Azure Repos: Unlimited public Git repos
- Azure Artifacts: package management
- Unlimited stakeholders
- Boards & Repos included for Visual Studio subscribers

LAB: AKS

- Deploy Azure Kubernetes cluster
- Configure Kubectl
- Deploy multi-tier application
- Scale frontend of application
- Perform rolling update

INDIVIDUAL KEY TAKEAWAYS



Write down three key insights from today's session.

Highlight how these take aways influence your work.

Q&A AND OPEN DISCUSSION



