

# Table of Contents

---

|  |     |
|--|-----|
| 1 provisioning-and-configuring-azure-virtual-machines-slides                 | 5   |
| 2 creating-and-running-containers-in-azure-slides                            | 30  |
| 3 creating-azure-app-service-web-apps-slides                                 | 50  |
| 4 configuring-azure-app-service-slides                                       | 64  |
| 5 scaling-azure-app-service-slides   | 73  |
| 6 introducing-azure-functions-slides   | 87  |
| 7 implementing-function-triggers-slides                                      | 101 |
| 8 implementing-input-and-output-bindings-slides                              | 110 |
| 9 implementing-azure-durable-functions-slides                                | 120 |
| 10 implement-custom-handlers-slides  | 135 |
| 11 preparing-for-the-exam-slides   | 144 |
| 12 creating-cosmos-db-containers-slides                                      | 178 |
| 13 cosmos-db-performance-slides  | 203 |
| 14 server-side-programming-with-cosmos-db-slides                             | 228 |
| 15 understanding-azure-blob-storage-slides                                   | 243 |
| 16 interacting-with-data-using-the-azure-sdk-for-net-slides                  | 263 |
| 17 setting-and-retrieving-properties-and-metadata-slides                     | 270 |
| 18 implementing-data-archiving-and-retention-slides                          | 275 |
| 19 moving-items-between-storage-accounts-and-containers-slides               | 288 |
| 20 preparing-for-the-exam-slides   | 303 |
| 21 secure-azure-storage-slides   | 335 |
| 1 Microsoft Azure Developer: Implement User Authentication and Authorization | 335 |
| 2 Slide Number 2   | 336 |
| 3 Ways to Secure Azure Storage   | 337 |
| 4 Securing Azure Storage   | 338 |
| 5 Management Plane: RBAC   | 339 |
| 6 Role Assignment  | 340 |
| 7 Data Plane   | 341 |
| 8 Storage Account Access Keys  | 342 |
| 9 Slide Number 9   | 343 |
| 10 Shared Access Signatures  | 344 |
| 11 Shared Access Signatures (SAS)  | 345 |
| 12 Shared Access Signature   | 346 |
| 13 A Typical SAS token   | 347 |
| 14 Kinds of SAS  | 348 |
| 15 Stored Access Policy  | 349 |
| 16 Stored Access Policy  | 350 |
| 17 Slide Number 17   | 351 |
| 18 Additional Resources  | 352 |
| 19 Slide Number 19   | 353 |
| 22 authenticate-using-azure-ad-slides  | 354 |
| 1 Authenticate Using Azure AD  | 354 |
| 2 Slide Number 2   | 355 |

|   |     |
|---|-----|
| 3 The Microsoft Identity Platform   | 356 |
| 4 The Microsoft Identity Platform   | 357 |
| 5 The Microsoft Identity Platform   | 358 |
| 6 Slide Number 6  | 359 |
| 7 Slide Number 7  | 360 |
| 8 Slide Number 8  | 361 |
| 9 Modern Authentication   | 362 |
| 10 Identity   | 363 |
| 11 Legacy   | 364 |
| 12 Modern Authentication  | 365 |
| 13 Open ID Connect  | 366 |
| 14 OpenID Connect (App)   | 367 |
| 15 OpenID Connect (API)   | 368 |
| 16 Open ID Connect Tokens   | 369 |
| 17 Slide Number 17  | 370 |
| 18 Slide Number 18  | 371 |
| 19 Additional Resources   | 372 |
| 20 Additional Resources   | 373 |
| 21 Slide Number 21  | 374 |
| 23 authorize-using-azure-ad-slides  | 375 |
| 1 Authorization Using Azure AD  | 375 |
| 2 Slide Number 2  | 376 |
| 3 What Is Authorization?  | 377 |
| 4 Authorization   | 378 |
| 5 Do not overengineer authorization                                       | 379 |
| 6 Entities  | 380 |
| 7 Authorization   | 381 |
| 8 Slide Number 8  | 382 |
| 9 Slide Number 9  | 383 |
| 10 Slide Number 10  | 384 |
| 11 Slide Number 11  | 385 |
| 12 Slide Number 12  | 386 |
| 13 Slide Number 13  | 387 |
| 14 Slide Number 14  | 388 |
| 24 implement-solutions-that-interact-with-microsoft-graph-slides          | 389 |
| 25 working-with-the-azure-key-vault-slides                                | 417 |
| 26 manage-keys-secrets-and-certificates-by-using-the-keyvault-slides      | 463 |
| 27 preparing-for-the-exam-slides  | 507 |
| 28 configuring-cache-and-expiration-policies-in-azure-cdn-slides          | 551 |
| 29 configuring-cache-and-expiration-policies-for-azure-redis-cache-slides | 563 |
| 30 implementing-application-caching-patterns-slides                       | 577 |
| 31 introduction-to-azure-monitor-and-application-insights-slides          | 591 |
| 32 implement-alerts-and-handle-transient-faults-slides                    | 618 |
| 33 preparing-for-the-exam-slides  | 639 |
| 34 implement-azure-event-grid-solutions-slides                            | 680 |

|  |     |
|--|-----|
| 1 Microsoft Azure Developer: Develop Event-based Solutions | 680 |
| 2 Event Types  | 681 |
| 3 Azure Event Grid   | 682 |
| 4 Register Event Grid Provider                             | 683 |
| 5 Slide Number 5   | 684 |
| 6 Pub/Sub Concepts   | 685 |
| 7 Event Grid Terminology                                   | 686 |
| 8 Event Grid Terminology                                   | 687 |
| 9 Event Grid Terminology                                   | 688 |
| 10 Event Grid Terminology                                  | 689 |
| 11 Event Grid Terminology                                  | 690 |
| 12 Azure Event Publishers                                  | 691 |
| 13 Azure Event Publishers                                  | 692 |
| 14 Custom Topics   | 693 |
| 15 Event Handlers  | 694 |
| 16 Workflow  | 695 |
| 17 Slide Number 17   | 696 |
| 18 Slide Number 18   | 697 |
| 19 Slide Number 19   | 698 |
| 20 Up Next: Implement Azure Event Hub Solutions            | 699 |
| 35 implement-azure-event-hub-solutions-slides              | 700 |
| 1 Implement Azure Event Hubs Solutions                     | 700 |
| 2 Azure Event Hubs   | 701 |
| 3 Scenarios  | 702 |
| 4 Components   | 703 |
| 5 Event Hubs Namespace                                     | 704 |
| 6 Event Hubs Namespace Creation                            | 705 |
| 7 Event Hubs Creation                                      | 706 |
| 8 Slide Number 8   | 707 |
| 9 Send Events to Event Hub                                 | 708 |
| 10 Send Events to Event Hub                                | 709 |
| 11 Send Events to Event Hub                                | 710 |
| 12 Send Events to Event Hub                                | 711 |
| 13 Send Events to Event Hub                                | 712 |
| 14 Partitions  | 713 |
| 15 Slide Number 15   | 714 |
| 16 Read Events from Event Hub                              | 715 |
| 17 Read Events from Event Hub                              | 716 |
| 18 Read Events from Event Hub                              | 717 |
| 19 Read Events from Event Hub                              | 718 |
| 20 Read Events from Event Hub                              | 719 |
| 21 Slide Number 21   | 720 |
| 22 Slide Number 22   | 721 |
| 23 Up Next: Implement Azure Notification Hubs Solutions    | 722 |
| 36 implement-azure-notification-hub-solutions-slides       | 723 |

|  |     |
|--|-----|
| 1 Implement Azure Notification Hubs Solutions                            | 723 |
| 2 Azure Notification Hubs (ANH)  | 724 |
| 3 Azure Notification Hubs Features                                       | 725 |
| 4 Components   | 726 |
| 5 Slide Number 5   | 727 |
| 6 Notification Hubs and Namespaces                                       | 728 |
| 7 Sending Notifications Workflow   | 729 |
| 8 Sending Notifications Workflow   | 730 |
| 9 Sending Notifications Workflow   | 731 |
| 10 Sending Notifications Workflow  | 732 |
| 11 Sending Notifications Workflow  | 733 |
| 12 Register devices  | 734 |
| 13 Send push notification  | 735 |
| 14 Slide Number 14   | 736 |
| 15 Slide Number 15   | 737 |
| 16 Slide Number 16   | 738 |
| 37 azure-queue-storage-slides  | 739 |
| 38 azure-service-bus-slides  | 758 |
| 39 introduction-to-azure-api-management-slides                           | 785 |
| 40 protect-apis-and-improve-their-performance-with-api-management-slides | 812 |
| 41 preparing-for-the-exam-slides   | 832 |
| 42 taking-your-first-steps-for-the-microsoft-az-204-exam-slides          | 881 |
| 43 test-structure-and-strategies-slides                                  | 890 |

# Microsoft Azure Developer: Implement IaaS Solutions

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## PROVISIONING AND CONFIGURING AZURE VIRTUAL MACHINES



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# Course Overview



**Provisioning and Configuring Azure Virtual Machines**

**Creating and Running Containers in Azure**

# Course Coverage for Certification Objectives



## Implement IaaS Solutions

### Provision Virtual Machines

Configure, validate, and deploy ARM templates

### Create container images for solutions

Publish an image to the Azure Container Registry

Run containers by using Azure Container Instances

<https://docs.microsoft.com/en-us/learn/certifications/azure-developer>

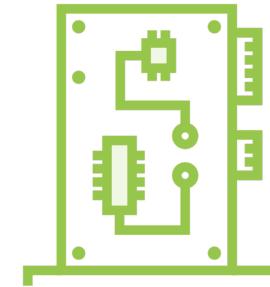
# Virtual Machine Components



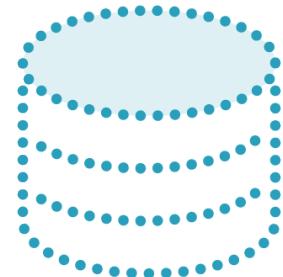
Resource Group



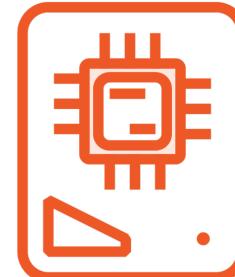
VM Size



Network

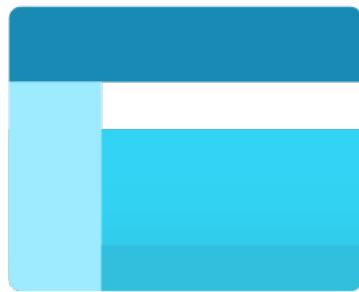


Images



Virtual Disk

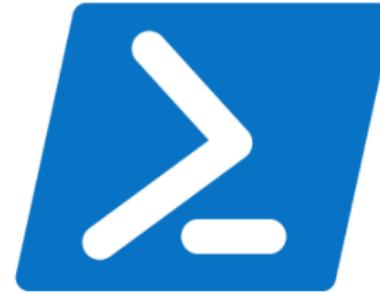
# Methods to Create an Azure Virtual Machine



Azure Portal



Azure CLI



Azure PowerShell  
(Az Module)



Azure ARM  
Templates

# Creating a Virtual Machine in the Azure Portal

**Basics**   Disks   Networking   Management   Advanced   Tags   Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more ↗](#)

**Project details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \* ⓘ   Demonstration Account ▼

Resource group \* ⓘ   (New) psdemo-rg ▼  
[Create new](#)

# Creating a Virtual Machine in the Azure Portal

**Instance details**

Virtual machine name \* ⓘ  ✓

Region \* ⓘ  ▼

Availability options ⓘ  ▼

Image \* ⓘ  ▼  
[Browse all public and private images](#)

Azure Spot instance ⓘ

Size \* ⓘ  ▼  
[Select size](#)

# Creating a Virtual Machine in the Azure Portal

**Administrator account**

Username \*

Password \*

Confirm password \*

# Creating a Virtual Machine in the Azure Portal

## Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports \* ⓘ

None  Allow selected ports

Select inbound ports \*

RDP (3389) ^

HTTP (80)

HTTPS (443)

SSH (22)

RDP (3389)

# Lab Environment



**Azure Account and Subscription**

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

**Ability to create resources in Azure**

**Resource Groups**

**Virtual Machines and Containers**

**Storage Accounts**

**Networking Elements**

**Container Registries**

# Lab Environment



## Azure CLI

[https://docs.microsoft.com/en-us/cli/azure/  
install-azure-cli](https://docs.microsoft.com/en-us/cli/azure/install-azure-cli)

## Azure PowerShell (Az Module)

[https://docs.microsoft.com/en-us/  
powershell/azure/install-az-ps](https://docs.microsoft.com/en-us/powershell/azure/install-az-ps)

## Docker

<https://docs.docker.com/engine/install/>

Demo

**Creating a Virtual Machine in the Azure Portal  
Accessing a VM Remotely**

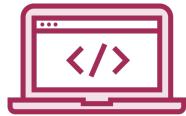
# Creating VMs Programmatically



**Add consistency to your deployments and VM creation**



**Any production system should be implemented using automation**



**Construct similar down-level environments, such as DEV/TEST**

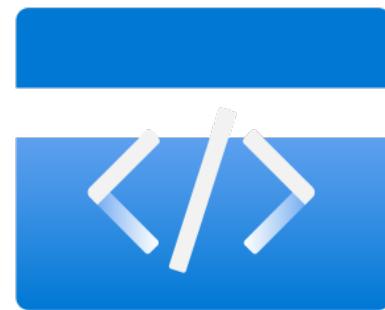
# Tools for Creating a VM Programmatically



Azure CLI



Azure PowerShell  
(Az Module)



ARM Templates

# Creating a VM Programmatically

Create a Resource Group

Create the Virtual Machine

Ensure Remote Access  
Port is Open

Retrieve the Public IP address

**Provisioning Microsoft Azure Virtual Machines**

# Creating a VM with Azure CLI

```
az group create \
--name "psdemo-rg" \
--location "centralus"
```

```
az vm create \
--resource-group "psdemo-rg" \
--name "psdemo-win-cli" \
--image "win2019datacenter" \
--admin-username "demoadmin" \
--admin-password "password123$%^&*"
```

```
az vm create \
--resource-group "psdemo-rg" \
--name "psdemo-linux-cli" \
--image "UbuntuLTS" \
--admin-username "demoadmin" \
--authentication-type "ssh" \
--ssh-key-value ~/.ssh/id_rsa.pub
```

[https://docs.microsoft.com/en-us/cli/azure/vm#az\\_vm\\_create](https://docs.microsoft.com/en-us/cli/azure/vm#az_vm_create)

# Enabling Remote Access with Azure CLI

```
az vm open-port \  
--resource-group "psdemo-rg" \  
--name "psdemo-win-cli" \  
--port "3389"
```

```
az vm open-port \  
--resource-group "psdemo-rg" \  
--name "psdemo-linux-cli" \  
--port "22"
```

```
az vm list-ip-addresses \  
--resource-group "psdemo-rg" \  
--name "psdemo-linux-cli"
```

Demo

**Creating a VM with Azure CLI**

**Enable remote access using Azure CLI**

# Creating a VM with Azure PowerShell

```
$username = 'demoadmin'  
$password = ConvertTo-SecureString 'password123$%^&*' -AsPlainText -Force  
$WindowsCred = New-Object System.Management.Automation.PSCredential ($username, $password)
```

```
New-AzVM ` ` ` ` `  
-ResourceGroupName 'psdemo-rg' ` ` ` ` `  
-Name 'psdemo-win-az' ` ` ` ` `  
-Image 'Win2019Datacenter' ` ` ` ` `  
-Credential $WindowsCred ` ` ` ` `  
-OpenPorts 3389
```

```
Get-AzPublicIpAddress ` ` ` ` `  
-ResourceGroupName 'psdemo-rg' ` ` ` ` `  
-Name 'psdemo-win-az' | Select-ObjectIpAddress
```

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

Demo

## **Creating a VM with Azure PowerShell**

# ARM Templates



**JSON file that defines your resources**

**Building block for automation**

**Templates are submitted to ARM for provisioning**

**Export a ARM Template in Azure Portal**

**Write your own**

**Deploy from the Quickstart template library**

# Deploying ARM Templates



**Azure Portal**

**Azure CLI**

**PowerShell (Az Module)**

**REST API**

**Azure Cloud Shell**

# ARM Template Format

```
{  
  "$schema": "https://schema.management.azure.com/schemas/2019-04-01/.  
deploymentTemplate.json#",  
  "contentVersion": "",  
  "apiProfile": "",  
  "parameters": { },  
  "variables": { },  
  "functions": [ ],  
  "resources": [ ],  
  "outputs": { }  
}
```

[https://docs.microsoft.com/en-us/azure/azure-resource-manager/  
templates/template-functions](https://docs.microsoft.com/en-us/azure/azure-resource-manager/templates/template-functions)

Demo

**Configure, validate, and deploy ARM template**

Up Next:  
Creating and Running Containers in Azure

---

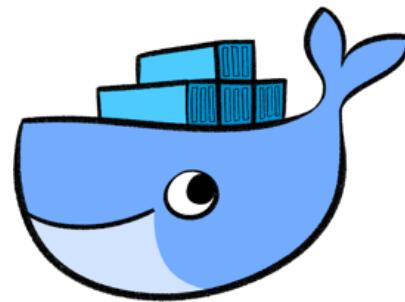
# Creating and Running Containers in Azure

---



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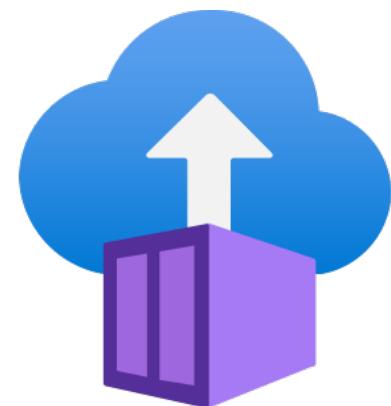
# Running Containers in Azure



**docker**

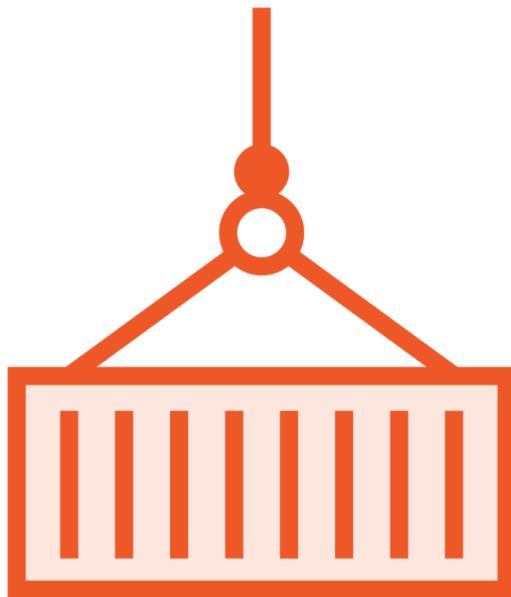


**Azure Container  
Registry (ACR)**



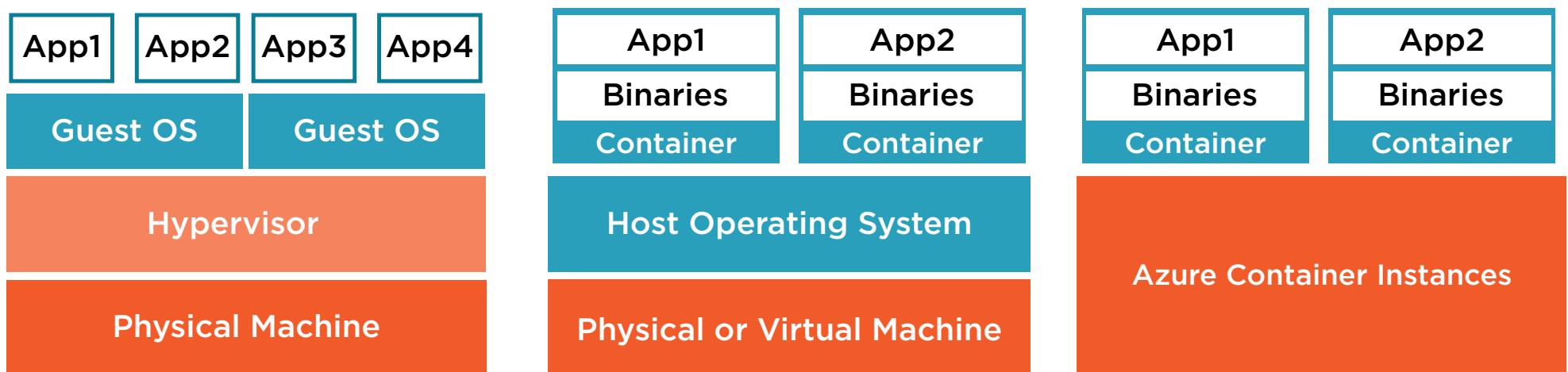
**Azure Container  
Instances (ACI)**

# Container Fundamentals

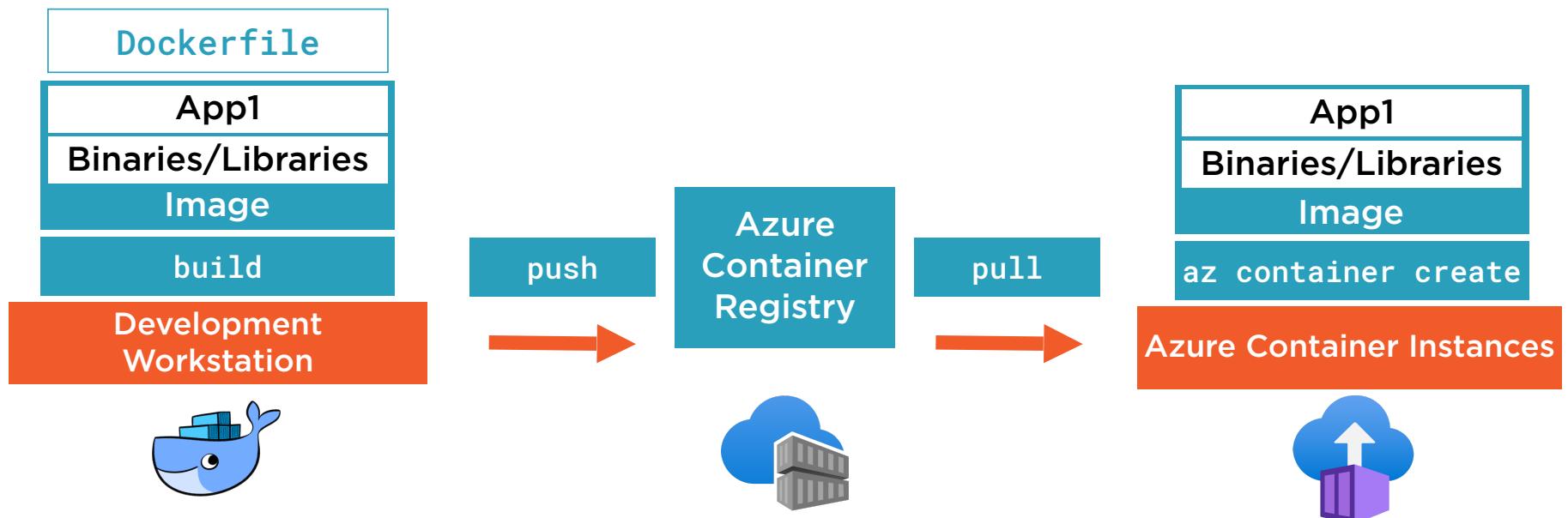


- Binaries, libraries and other components**
- Container image - binary application package**
- Container - running container image**
- One app inside the container**
- Generally very small and very portable**
- Container Registries - enables exchanging of container images**

# Container Fundamentals



# Working with Containers in Azure



# Example Dockerfile

```
FROM mcr.microsoft.com/dotnet/core/aspnet:3.1
```

```
RUN mkdir /app
```

```
WORKDIR /app
```

```
COPY ./webapp/bin/Release/netcoreapp3.1/publish ./
```

```
COPY ./config.sh ./
```

```
RUN bash config.sh
```

```
EXPOSE 80
```

```
ENTRYPOINT [ "dotnet", "webapp.dll" ]
```

```
docker build -t webappimage:v1 .
```

Demo

**Creating a container image using docker**

# Azure Container Registry (ACR)



**Build, store, and manage container images**  
**Key component of building a CI/CD pipeline**  
**ACR Tasks for container image automation**  
**Service tiers**

<https://docs.microsoft.com/en-us/azure/container-registry/container-registry-skus>

# ACR Authentication and Security Options



**Requires authentication for operations**

**Azure Active Directory Identities**

**Users**

**Service Principals**

**ACR Admin**

**Orchestrators, tools and applications should use ‘headless’ authentication**

`az acr login OR docker login`

**Role-based access controls**

<https://docs.microsoft.com/en-us/azure/container-registry/container-registry-authentication>

# ACR Role-Based Authentication

| Role/Permission | Access Resource Manager | Create/delete registry | Push image | Pull image | Delete image data | Change policies | Sign images |
|-----------------|-------------------------|------------------------|------------|------------|-------------------|-----------------|-------------|
| Owner           | X                       | X                      | X          | X          | X                 | X               |             |
| Contributor     | X                       | X                      | X          | X          | X                 | X               |             |
| Reader          | X                       |                        |            | X          |                   |                 |             |
| AcrPush         |                         |                        | X          | X          |                   |                 |             |
| AcrPull         |                         |                        |            | X          |                   |                 |             |
| AcrDelete       |                         |                        |            |            | X                 |                 |             |
| AcrImageSigner  |                         |                        |            |            |                   |                 | X           |

From: <https://docs.microsoft.com/en-us/azure/container-registry/container-registry-roles>

# Creating and Authenticating to Azure Container Registry

```
ACR_NAME='psdemoacr' #<---- THIS NEEDS TO BE GLOBALLY unique in Azure
```

```
az acr create \  
  --resource-group psdemo-rg \  
  --name $ACR_NAME \  
  --sku Standard
```

```
az acr login --name $ACR_NAME
```

# Pushing an Image into ACR

```
ACR_NAME='psdemoacr'
ACR_LOGINSERVER=$(az acr show --name $ACR_NAME --query loginServer --output tsv)

#psdemoacr.azurecr.io

docker tag webappimage:v1 $ACR_LOGINSERVER/webappimage:v1

docker push $ACR_LOGINSERVER/webappimage:v1

#Build using ACR Tasks
az acr build --image "webappimage:v1-acr-task" --registry $ACR_NAME .
```

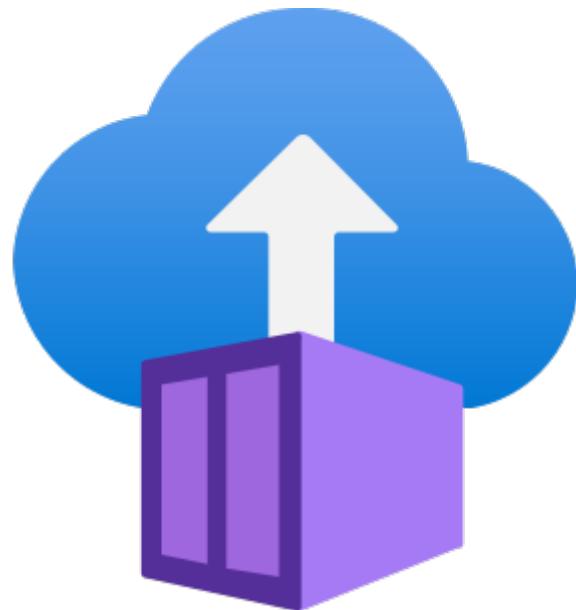
# Demo

**Creating an Azure Container Registry (ACR)**

**Pushing an image into ACR**

**Building an image in ACR using Tasks**

# Deploying Containers in Azure Container Instances



**Serverless container platform**

**Access application via Internet or on an Azure Virtual Network**

**Windows and Linux containers**

**Resource requests for CPU and memory**

**Use Azure Files for persistent storage**

**Deployed in Groups**

**Restart policy - always, on failure and never**

# Deploying Containers in ACI from Container Registries



**Azure Container Registry**



**Docker Hub or other container registries**



**Public or private**



**Login server**



**Username and password**

# Creating a Service Principal for ACI to Pull From ACR

```
ACR_NAME='psdemoacr'  
ACR_REGISTRY_ID=$(az acr show --name $ACR_NAME --query id --output tsv)
```

```
SP_NAME=acr-service-principal  
SP_PASSWD=$(az ad sp create-for-rbac \  
--name http://$ACR_NAME-pull \  
--scopes $ACR_REGISTRY_ID \  
--role acrpull \  
--query password \  
--output tsv)
```

```
SP_APPID=$(az ad sp list \  
--display-name http://$ACR_NAME-pull \  
--query '[].appId' \  
--output tsv)
```

# Running a Container from ACR in ACI

```
ACR_LOGINSERVER=$(az acr show --name $ACR_NAME --query loginServer --output tsv)

az container create \
--resource-group psdemo-rg \
--name psdemo-webapp-cli \
--dns-name-label psdemo-webapp-cli \
--ports 80 \
--image $ACR_LOGINSERVER/webappimage:v1 \
--registry-login-server $ACR_LOGINSERVER \
--registry-username $SP_APPID \
--registry-password $SP_PASSWD
```

psdemo-webapp-cli.centralus.azurecontainer.io

# Demo

## **Deploying containers in Azure Container Instances (ACI)**

- Azure Portal
- Azure CLI

# Summary

**Provision VMs**

**Configure VMs for remote access**

**Create ARM templates**

**Create container images for solutions by using Docker**

**Publish an image to the Azure Container Registry**

**Run containers by using Azure Container Instance**

Thank You!  
@nocentino

# Microsoft Azure Developer: Create Azure App Service Web Apps

---

## CREATING AZURE APP SERVICE WEB APPS



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# What Will Be Covered

- Understanding App Service Plans**
- Isolation with App Service Environments**
- Creating a Web App in the Portal**
- Creating a Web App with Azure CLI**
- Creating a Web App with PowerShell**
- Creating a Web App with an ARM Template**



# Exercise Files

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by Mike Pfeiffer

Familiar with the Microsoft Azure cloud platform, but looking to explore more on deploying web and mobile backends? This course teaches you what you need to know in order to effectively design and implement web applications into the Azure cloud.

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Exercise files

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Download exercise files

Course info

Level Intermediate

Rating ★★★★☆ (39)

My rating ★★★★☆

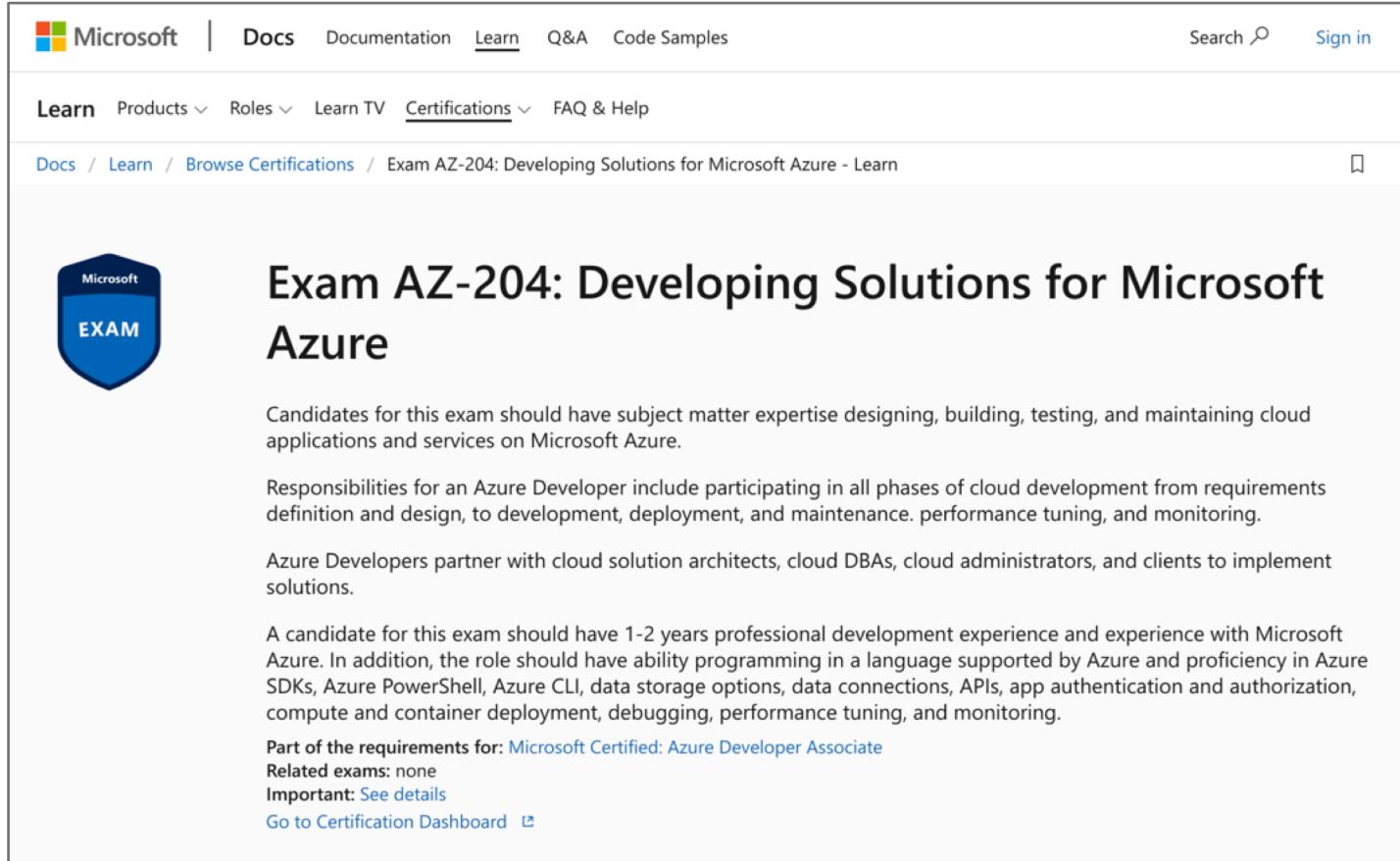
Duration 3h 56m

Updated 12 Jun 2020

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# Developing Solutions for Microsoft Azure (AZ-204)



The screenshot shows the Microsoft Learn website. At the top, there's a navigation bar with the Microsoft logo, a search bar, and a sign-in button. Below the navigation, a secondary navigation bar includes 'Learn' (which is underlined), 'Products', 'Roles', 'Learn TV', 'Certifications' (which is underlined), and 'FAQ & Help'. A breadcrumb trail at the top indicates the page is 'Docs / Learn / Browse Certifications / Exam AZ-204: Developing Solutions for Microsoft Azure - Learn'. The main content area features a blue shield icon with 'Microsoft EXAM' on it. The title 'Exam AZ-204: Developing Solutions for Microsoft Azure' is prominently displayed. Below the title, a paragraph states: 'Candidates for this exam should have subject matter expertise designing, building, testing, and maintaining cloud applications and services on Microsoft Azure.' Another paragraph describes the responsibilities of an Azure Developer. Further down, it mentions Azure Developers partnering with other cloud professionals. A detailed description of the candidate requirements follows, mentioning 1-2 years of professional development experience and proficiency in Azure SDKs, PowerShell, CLI, data storage, APIs, authentication, and monitoring. At the bottom of the page, there are links for 'Part of the requirements for: Microsoft Certified: Azure Developer Associate', 'Related exams: none', 'Important: See details', and 'Go to Certification Dashboard'.

<https://bit.ly/3mH5QoH>



# Understanding Azure App Service

**Http-based  
service for hosting  
web apps**

**Apps run and  
scale on Windows  
and Linux**

**Security, load  
balancing, &  
automation**

**Costs use are  
determined by the  
App Service plan**



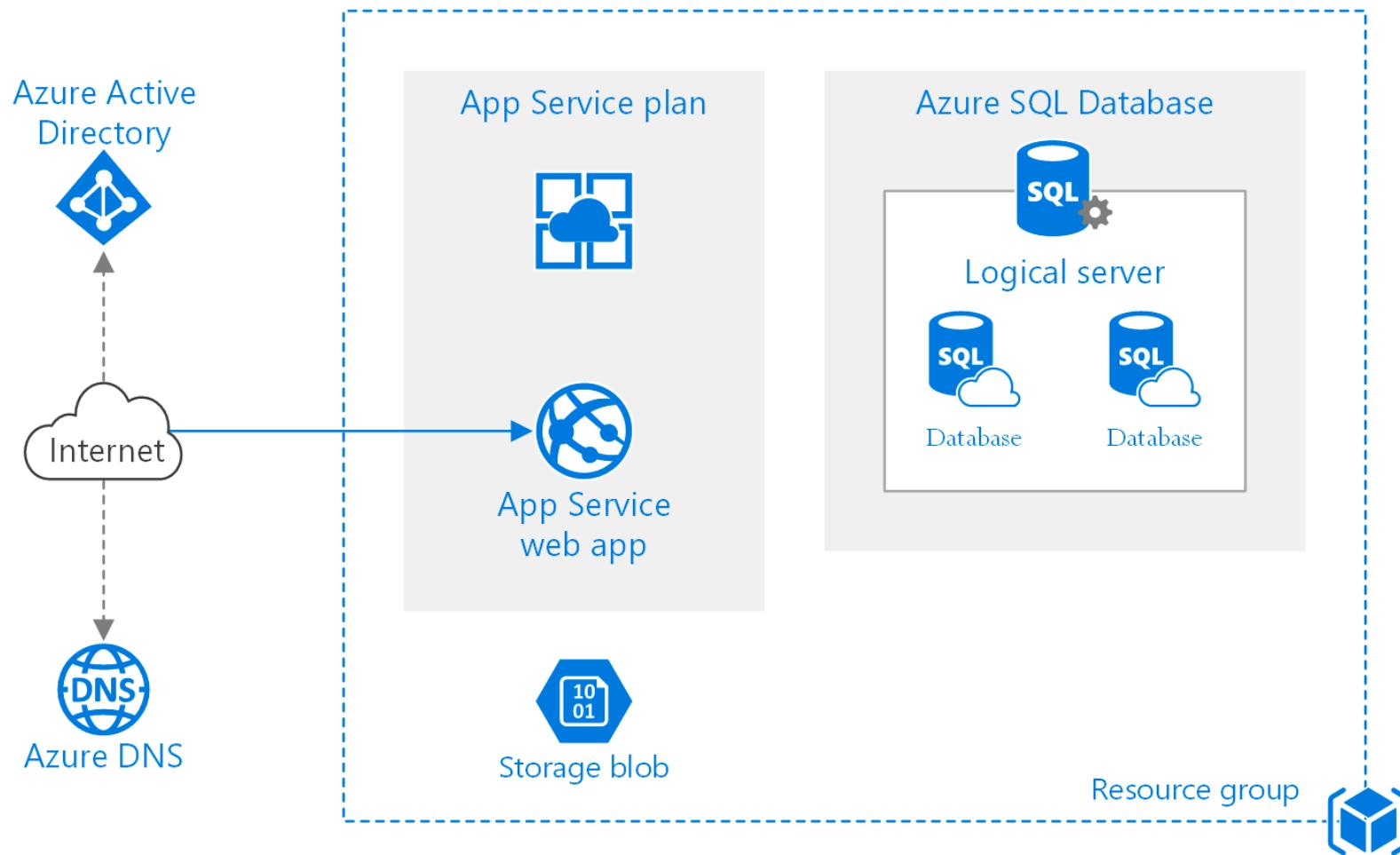
There are two types of App Service Plans



# Non-Isolated & Isolated



# Non-Isolated App Service



<https://bit.ly/35OpxnO>



# Azure App Service

## **Non-isolated App Service Plans**

- Free and Shared (F1, D1)
- Basic (B1, B2, B3)
- Standard (S1, S2, S3)
- Premium v2 (P1v2, P2v2, P3v2)
- Premium v3 (P1v3, P2v3, P3v3)



# Isolation with App Service Environments (ASE)

Fully isolated and dedicated environment for running web apps

High scale, high memory utilization

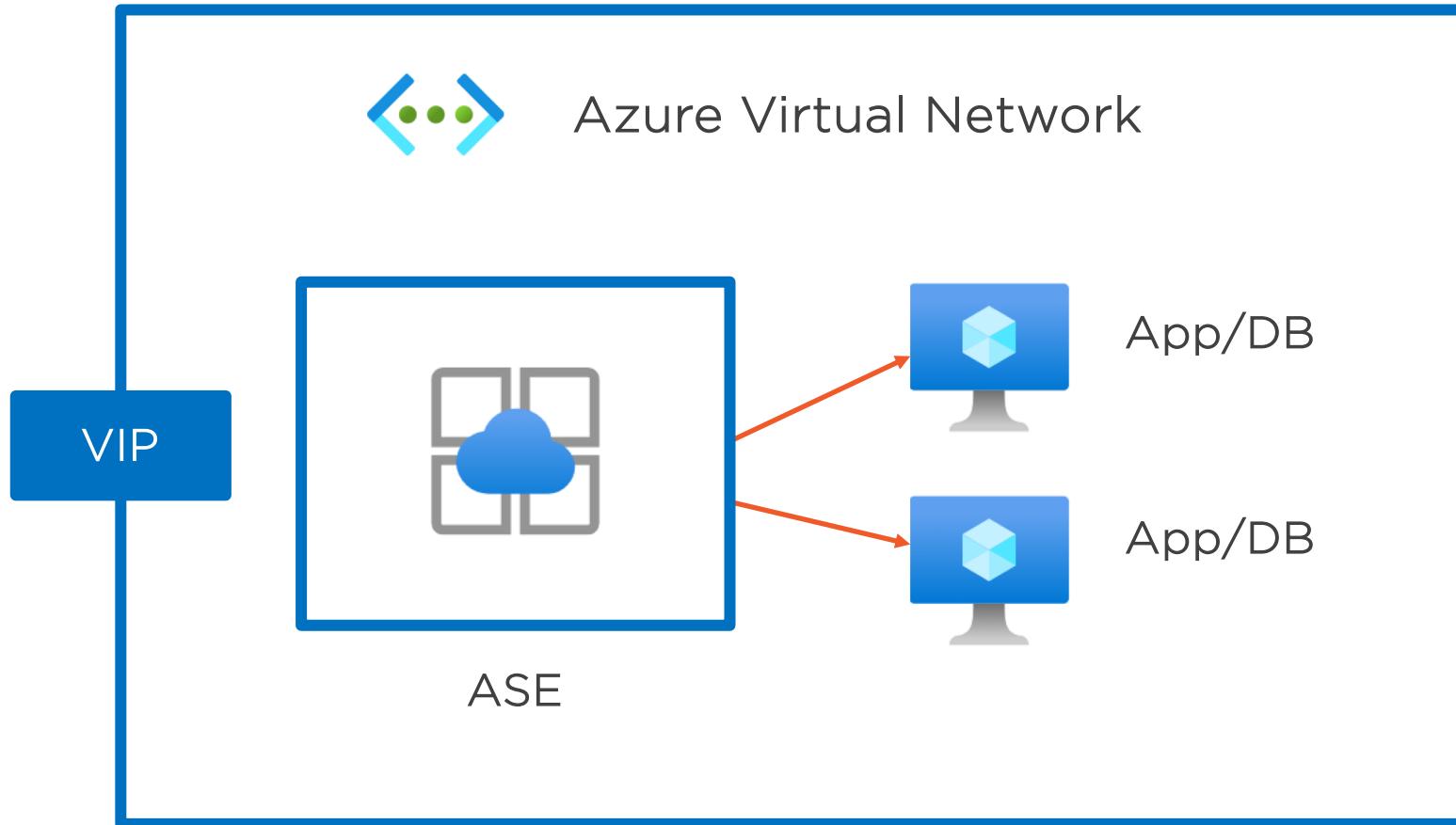
Isolation and secure network access

Fine-grained control over network traffic

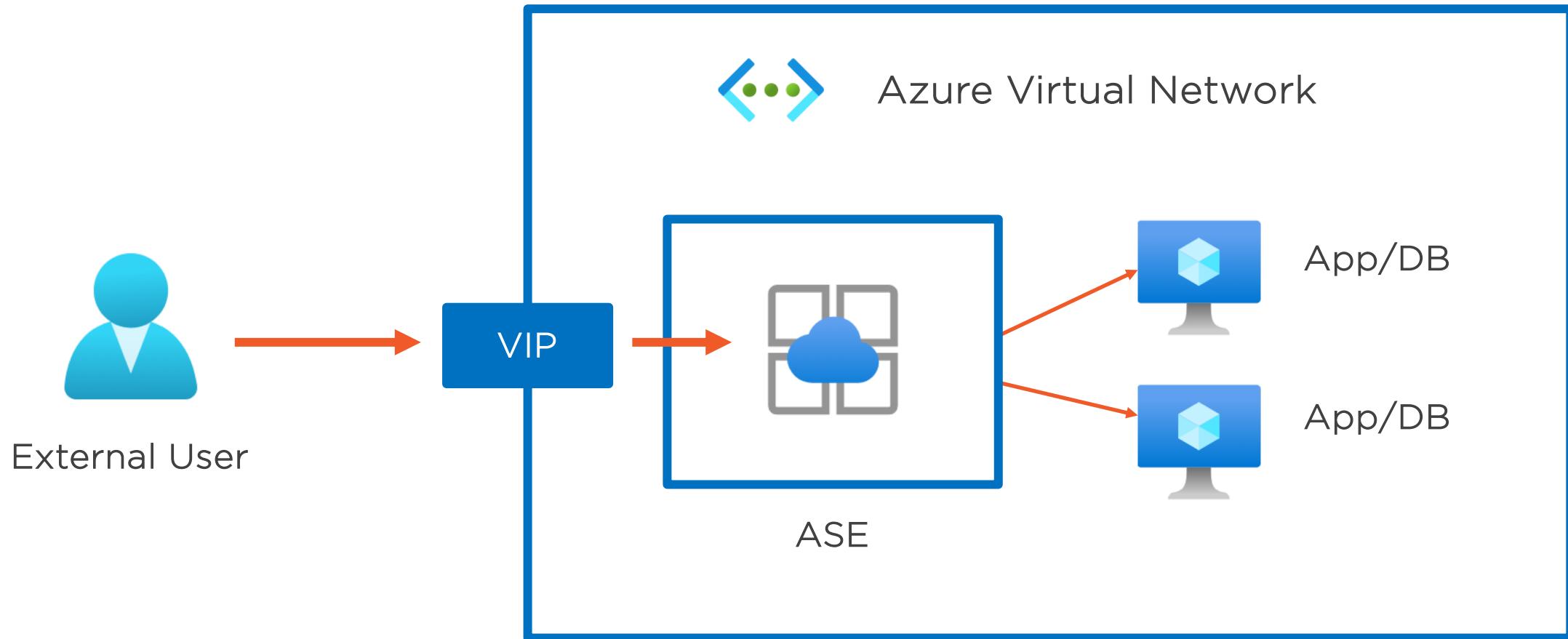
Apps can connect over VPN to on-premises resources



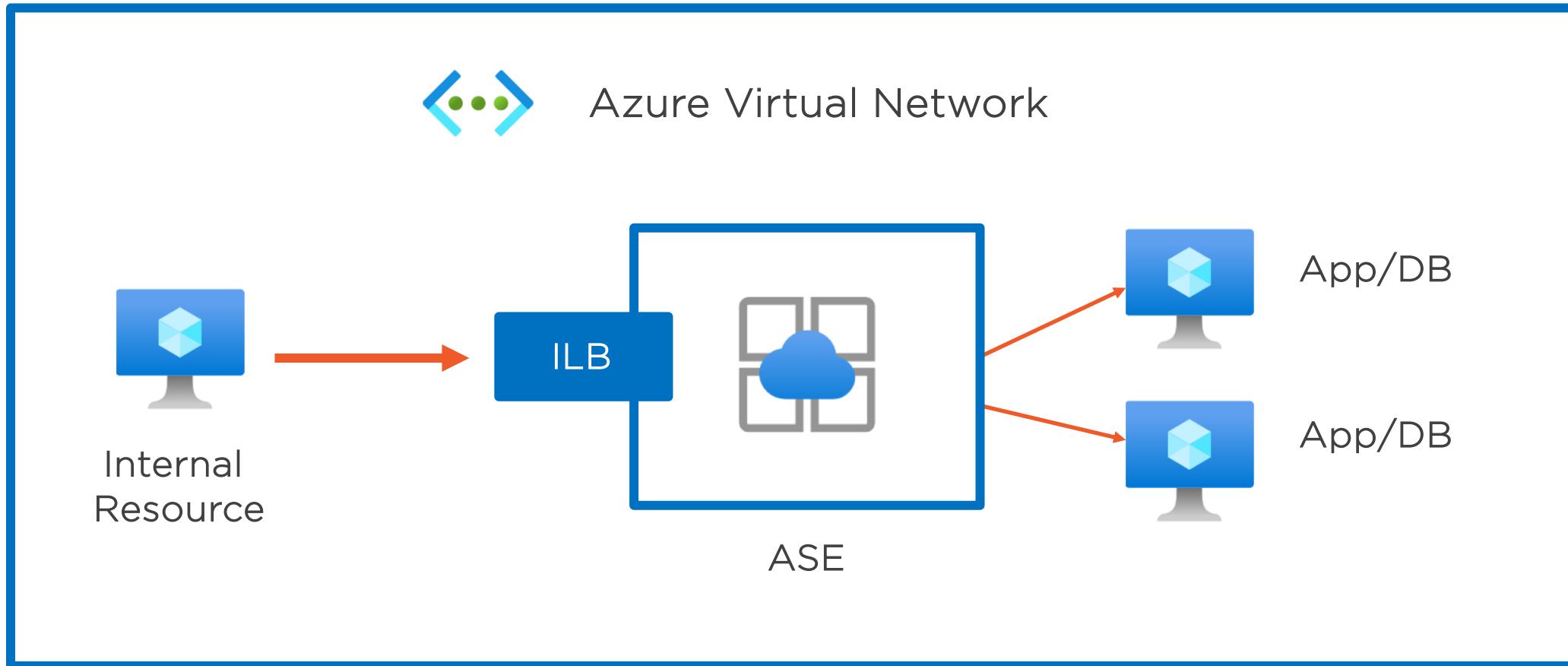
# External App Service Environment (ASE)



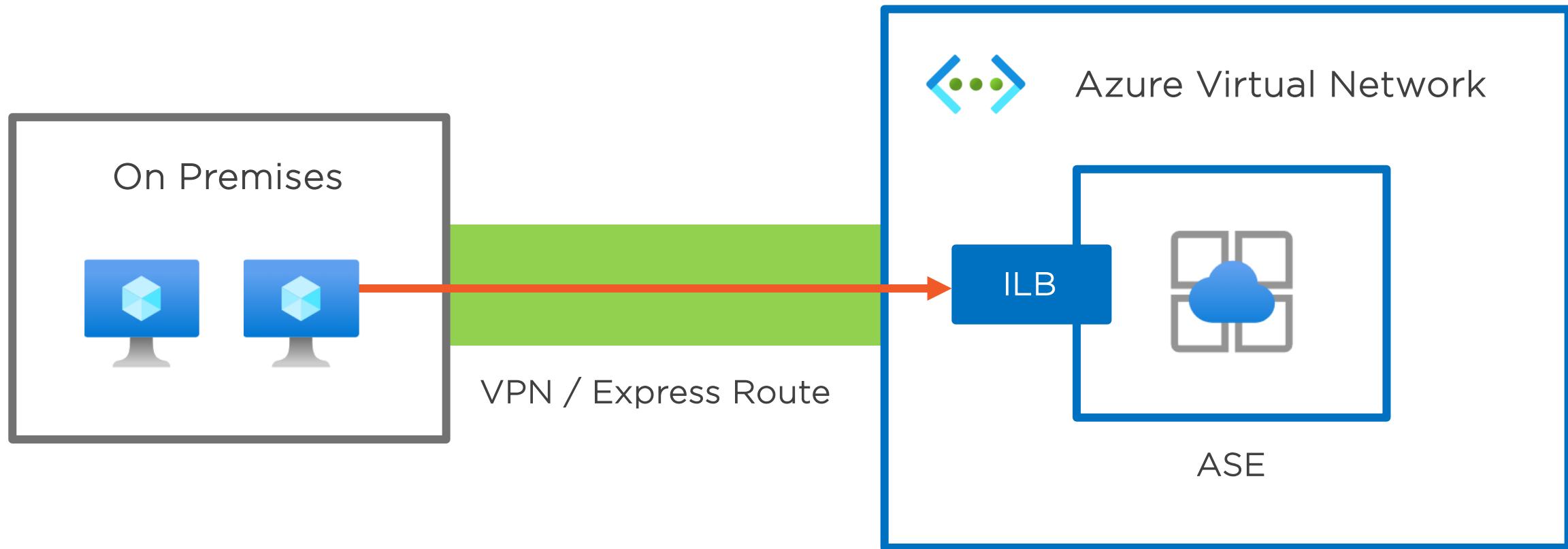
# External App Service Environment (ASE)



# Internal App Service Environment (ASE)



# Internal App Service Environment (ASE)



# Configuring Azure App Service

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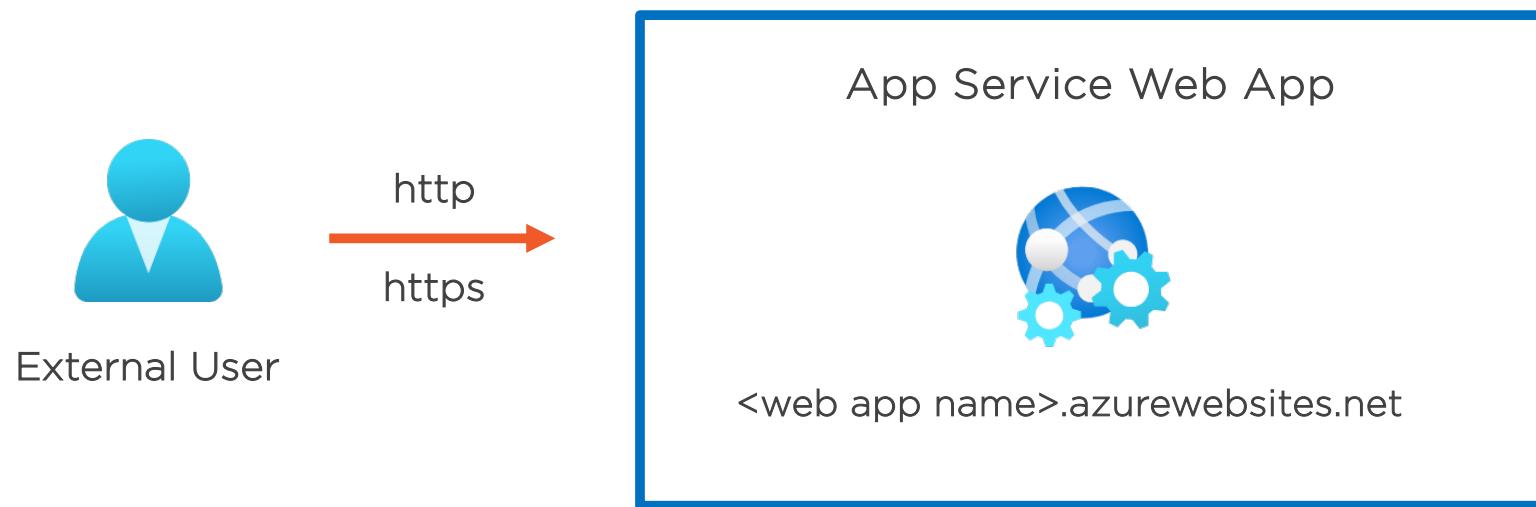
# What Will Be Covered



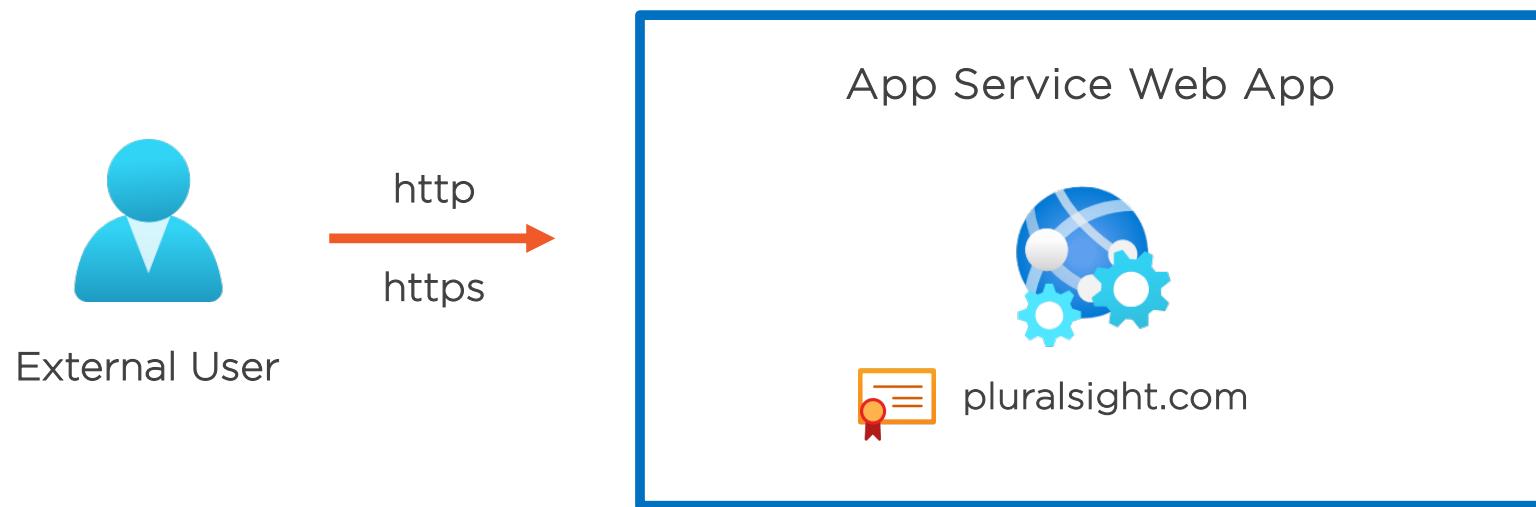
**Securing a Web App with SSL**  
**Configuring a Database Connection String**  
**Enabling Diagnostic Logging**  
**Deploying Code to App Service Web Apps**



# Securing a Web App with SSL



# Securing a Web App with SSL



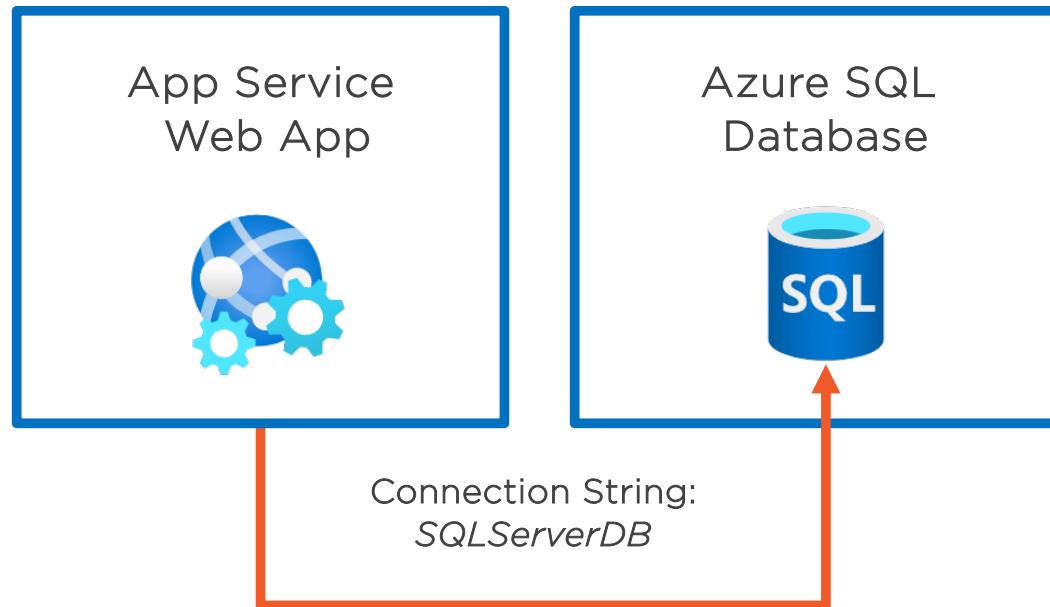
# Secure a Domain with SSL/TLS Binding

## Considerations

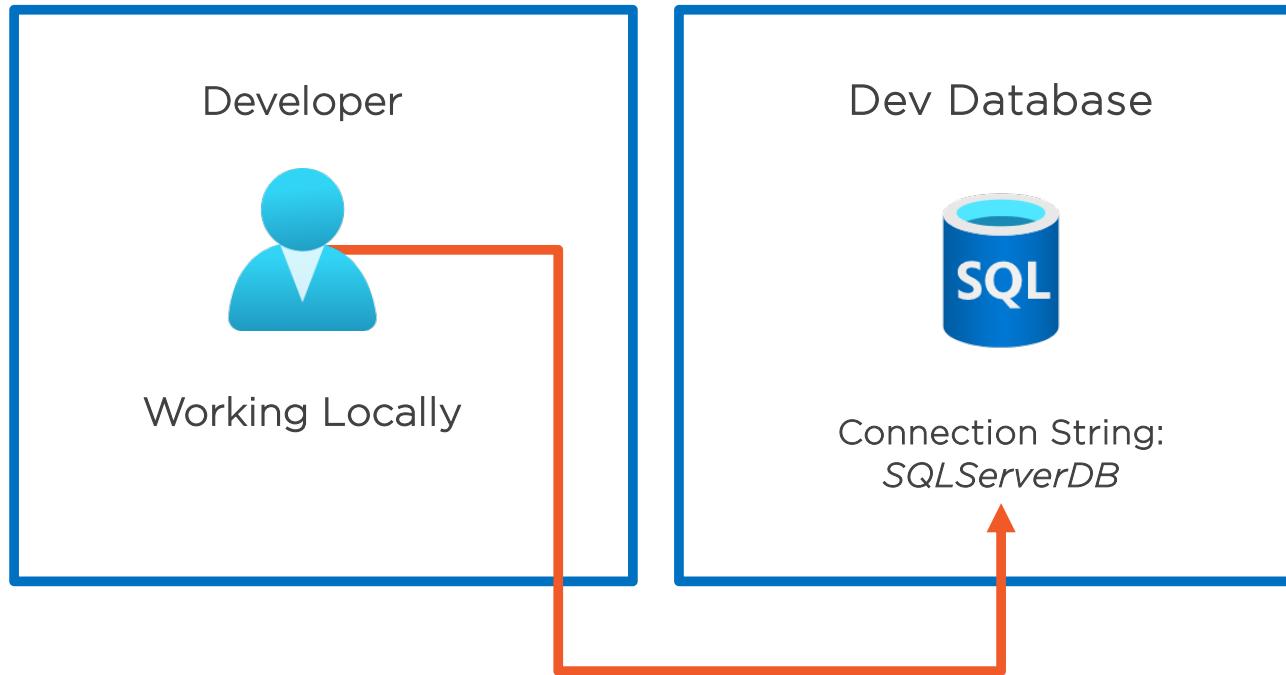
- Use Basic, Standard, Premium, or Isolated plan types
- Public vs. private certificates
- Managed vs. un-managed certificates
- You can enforce HTTPS and TLS versions



# Configuring a Database Connection String



# Configuring a Database Connection String



# Enabling Diagnostic Logging

**Application logging**

**Web server logging**

**Detailed error  
messages**

**Failed request  
tracing**

**Deployment logging**



# Deploying code to App Service Web Apps

## Configuring continuous deployment

- App Service pulls code from GitHub, Bitbucket, and Azure Repos
- Authorize Azure App Service
- Enable continuous deployment
- Disable continuous deployment



# Scaling Azure App Service

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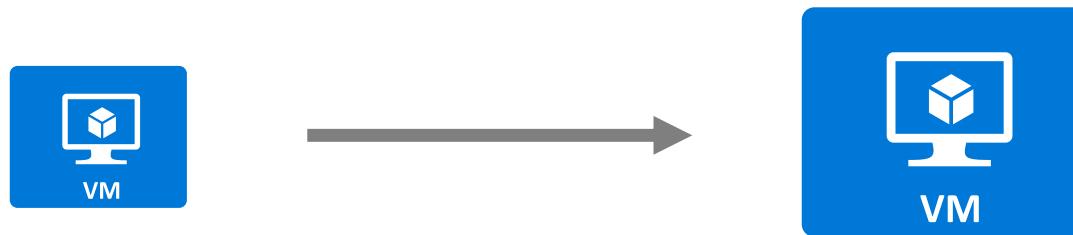
# What Will Be Covered



- Understanding vertical and horizontal scaling**
- Manually scaling App Service**
- Scaling on a schedule**
- Implementing autoscaling in App Service**



# Scaling Up Vertically



Virtual machine

Standard\_A1\_v2

1 vCore

2 GB RAM

Virtual machine

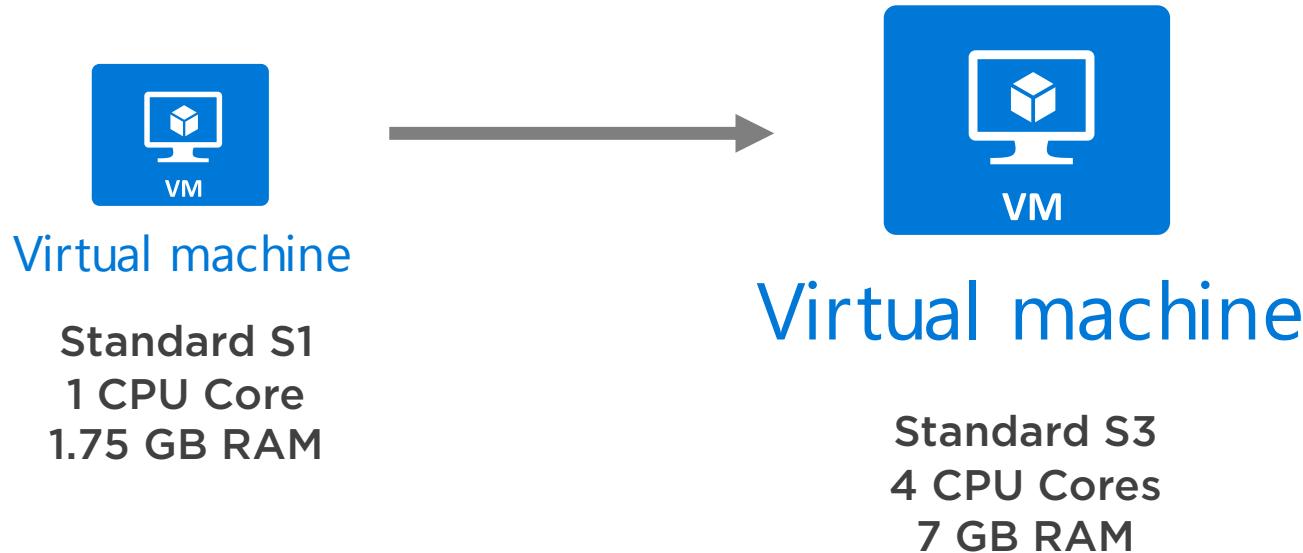
Standard\_A8m\_v2

8 vCore

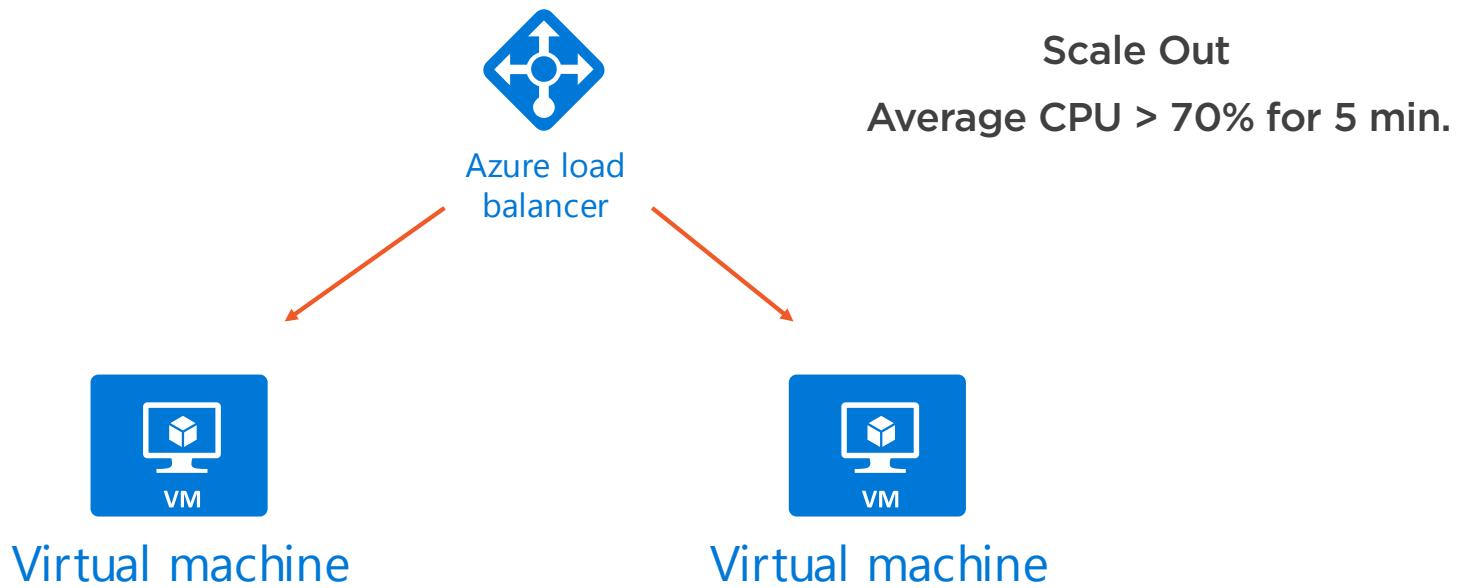
64 GB RAM



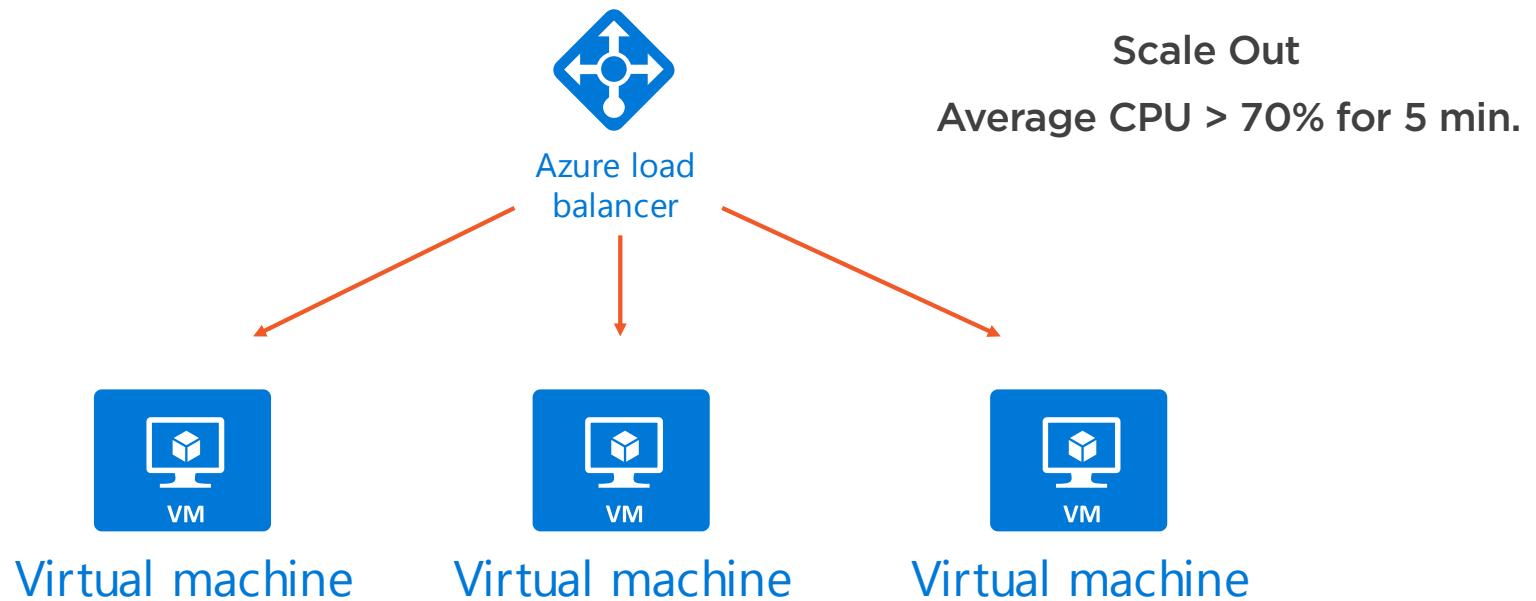
# Scaling Up Vertically



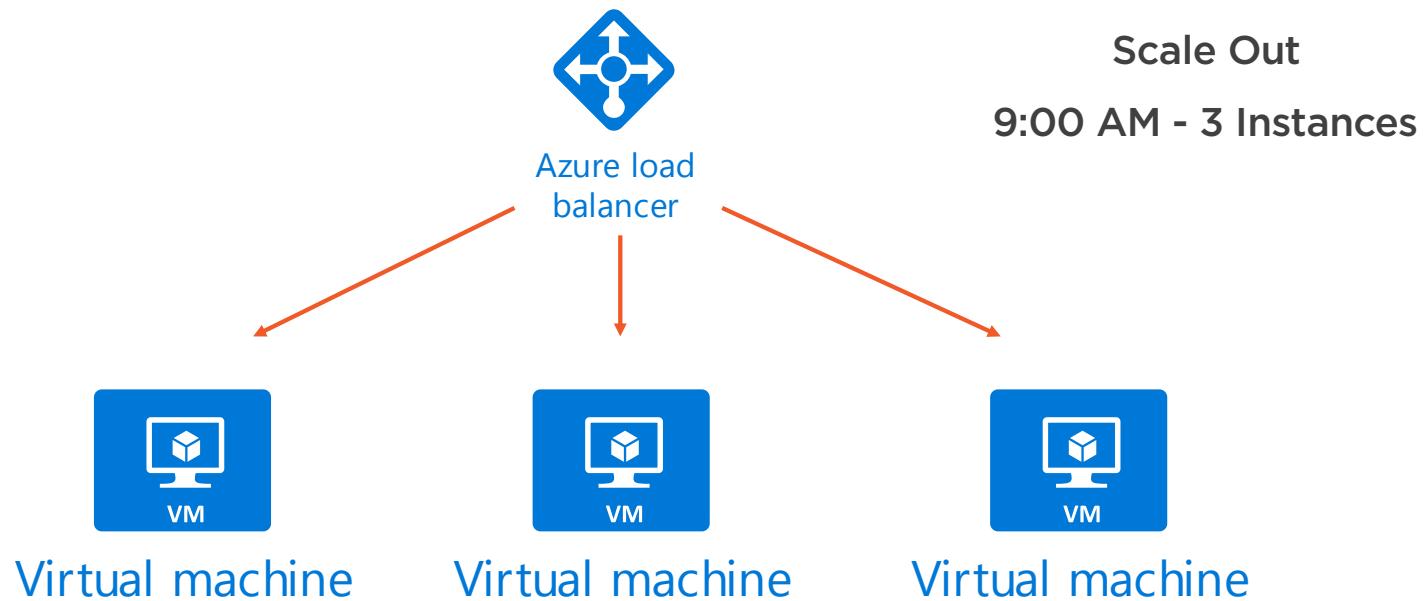
# Scaling Out Horizontally



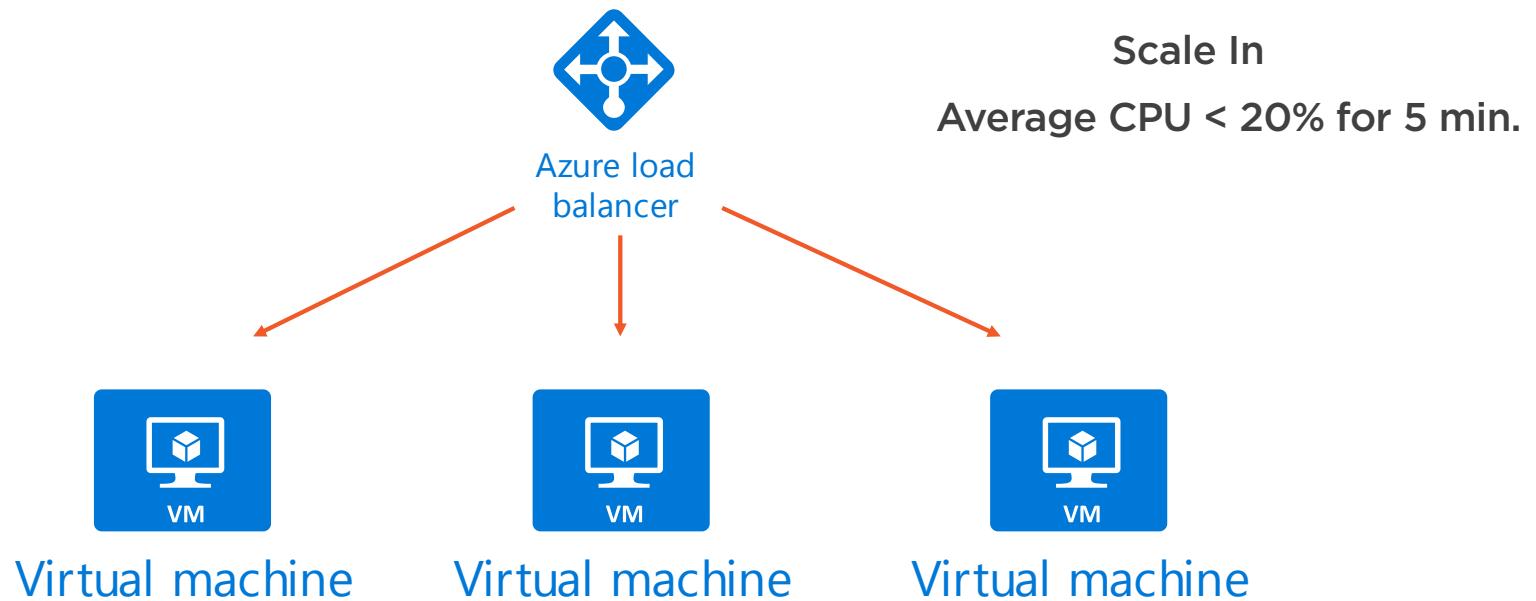
# Scaling Out Horizontally



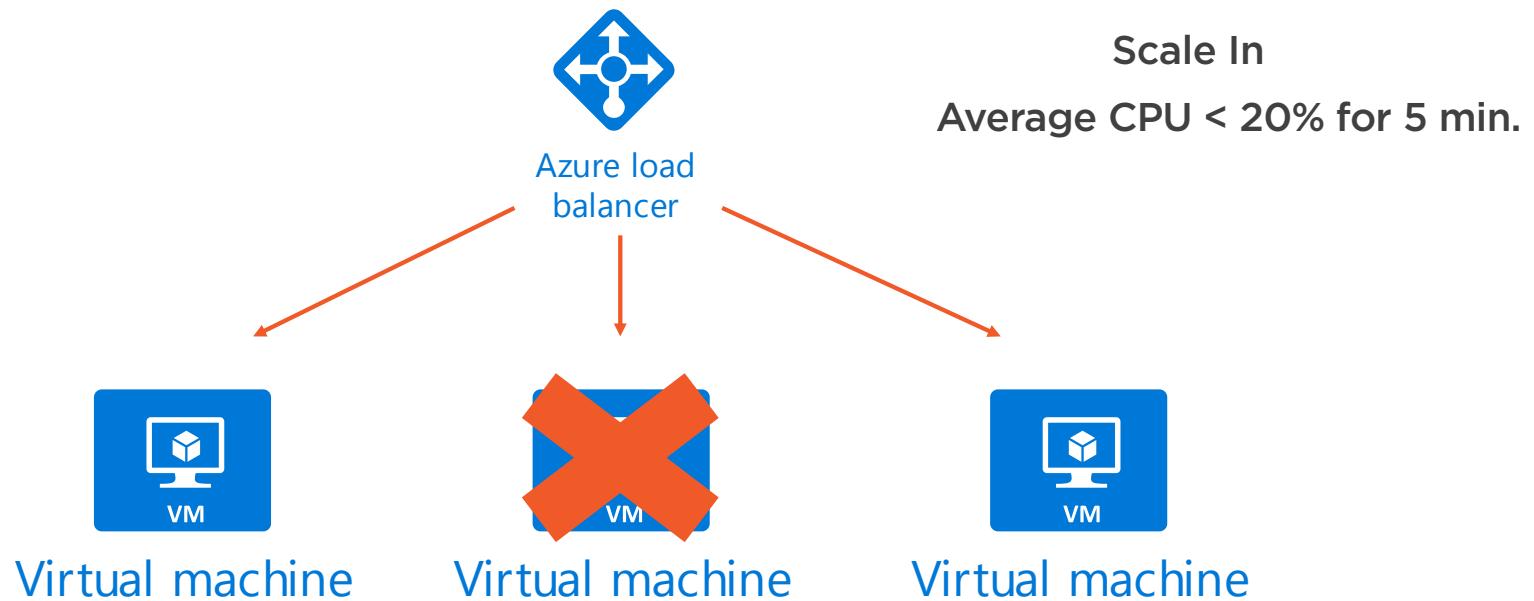
# Scaling Out Horizontally



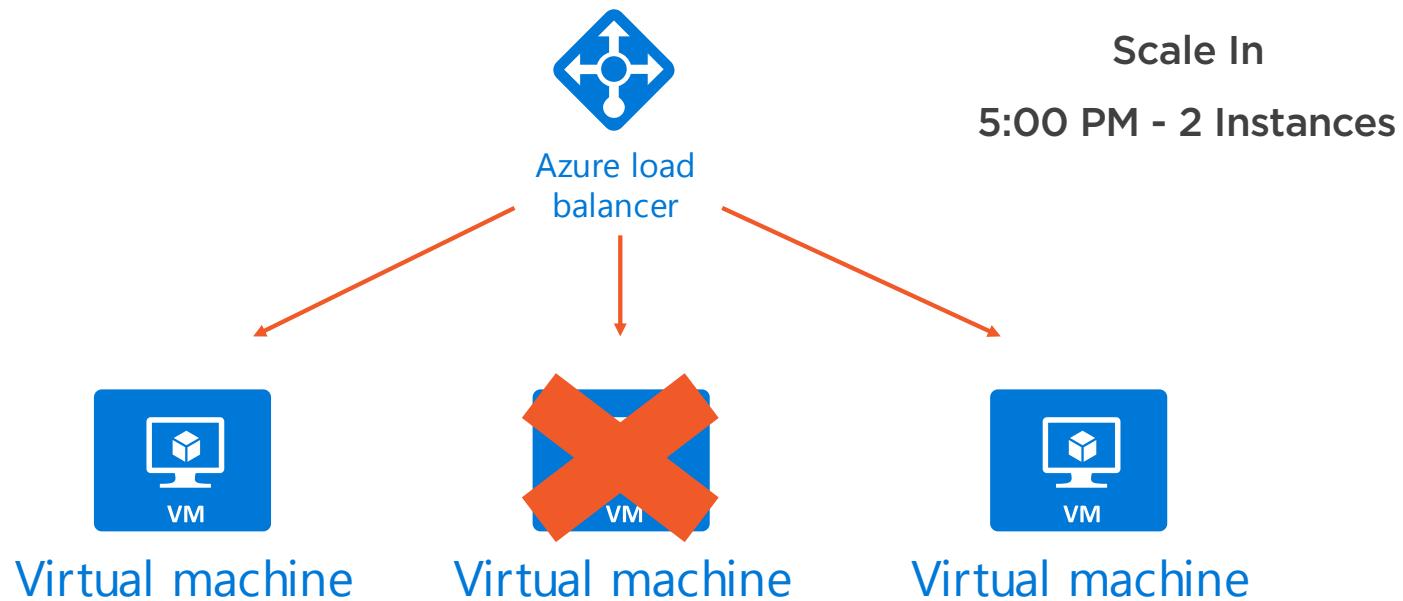
# Scaling In



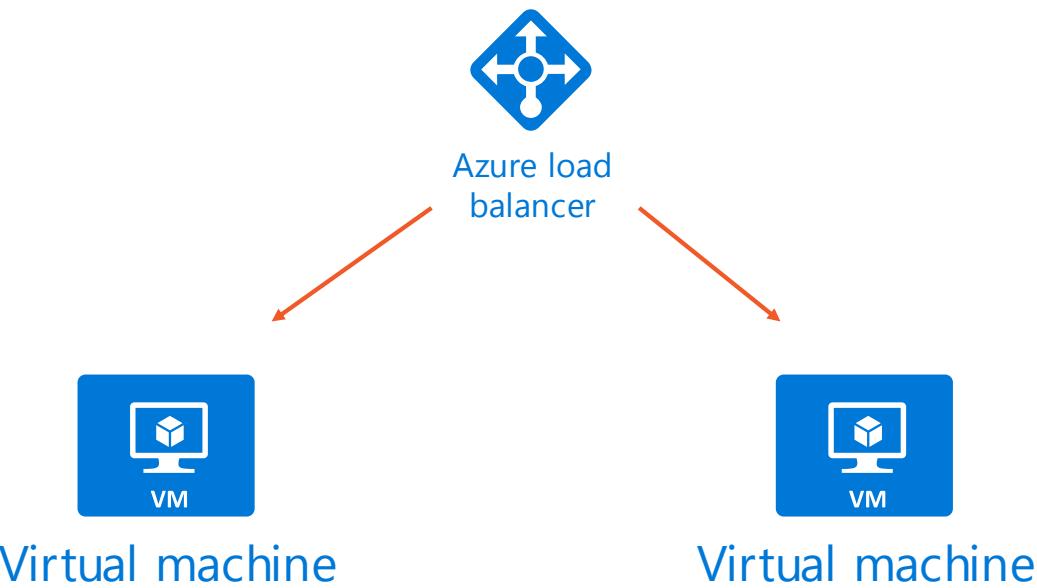
# Scaling In



# Scaling In



# Scaling In



Auto scale is available for  
standard, premium, and  
isolated pricing tiers



# Designing Autoscaling Rules

## Autoscale Profile

Minimum, maximum, and default values for number of instances.

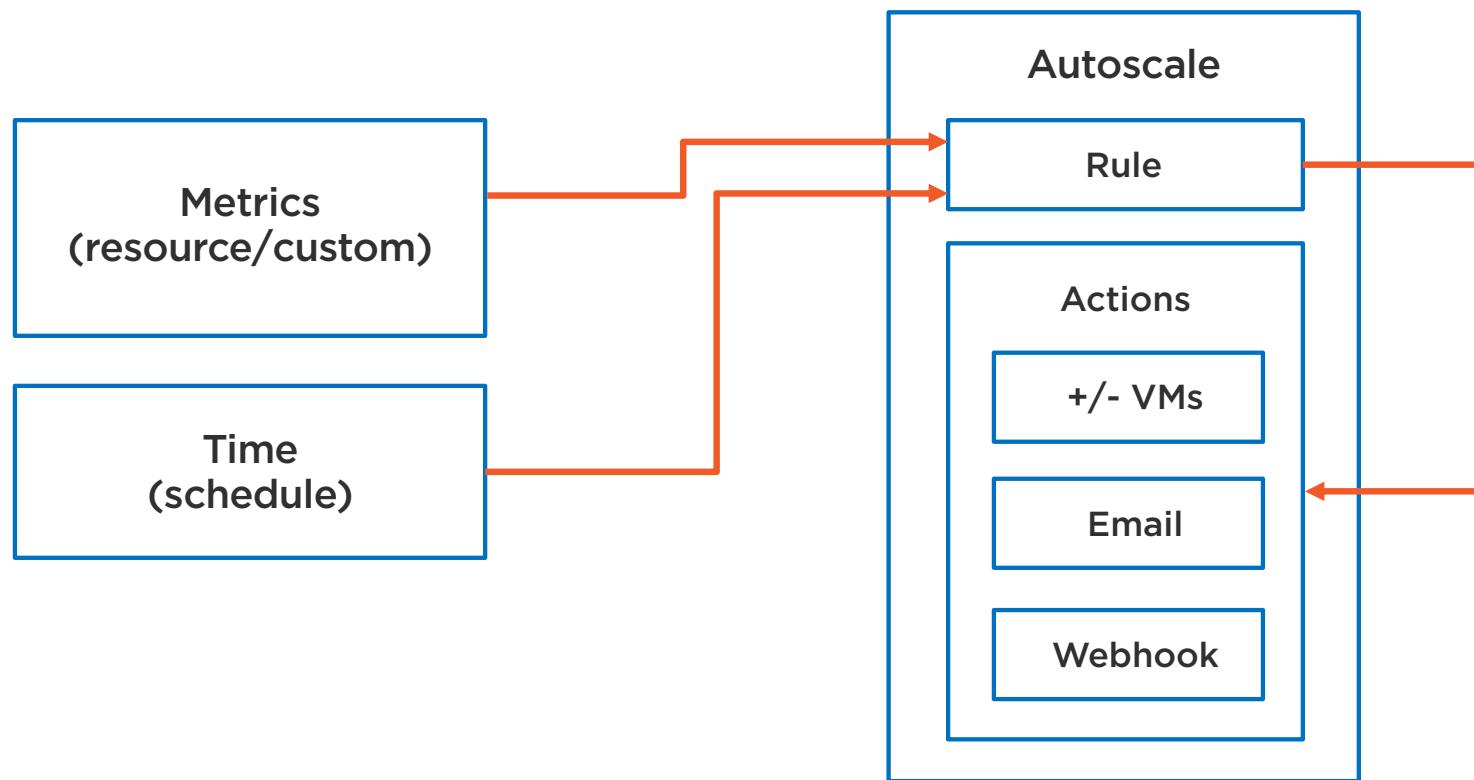
Capacity Settings

Rules

Notifications



# Designing Autoscaling Rules



# Microsoft Azure Developer: Implement Azure Functions

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## INTRODUCING AZURE FUNCTIONS



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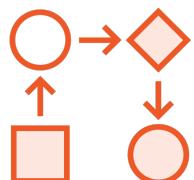
# AZ-204 Implement Azure Functions Skills



**Implement function triggers by using data operations, timers, and webhooks**



**Implement input and output bindings for a function**



**Implement Azure Durable Functions**



# Getting Started



**What are Azure Functions?**



**Key terminology: e.g. “Serverless”, “Function App”**



**Create an Azure Function App in the Azure Portal**



# Azure Functions

A “serverless application platform”

A simple way to run small pieces of code (“functions”) in the cloud

A “Functions as a Service” (FaaS) platform



# Serverless

Delegate server management responsibility to the cloud provider

Automatic scaling to meet demand

Billed only while your code is running



# Azure Function App

One or more related Azure Functions, that are developed, deployed and hosted as a group



# Azure Functions Choices

---



# Choice of Programming Languages

C#

Java

JavaScript

Python

PowerShell

...others



# Choice of Programming Languages

C#

Java

JavaScript

Python

PowerShell

...others



# Hosting Choices

Azure Functions usually run in a “Service plan” on Azure App Service

Consumption Plan

Serverless  
Automatic scale  
5 min limit

App Service Plan

Traditional pricing  
model

Premium Plan

Speed  
Security  
Reserved instances

Docker container

On premises  
In any cloud

Locally

Development and  
testing



# Development Environment Choices

Azure Portal

**Learning and experiments**

Visual Studio

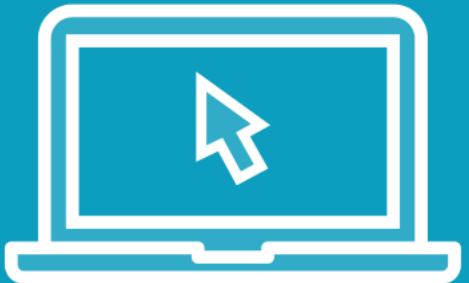
**Windows and C#**

Azure  
Functions Core  
Tools

**Cross-platform CLI**  
**Visual Studio Code**



Demo



**Create an Azure Function App in the  
Azure Portal**



Benefit from serverless computing by hosting Azure Functions in the consumption plan





## Try it yourself

Visit the Azure Portal and  
create an Azure Function  
App



# Implementing Function Triggers

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# Azure Function Triggers

**Objective:** “implement function triggers by using data operations, timers, and webhooks”

**HTTP Request  
Trigger**  
(webhooks)

**Timer  
Trigger**  
(scheduled tasks)

**Blob Storage  
Trigger**  
(data operation)



# Azure Function Triggers

Every Azure Function has exactly one trigger

The trigger is the event that causes the function to run



# Azure Function Trigger Types



**HTTP Request Trigger – use for APIs and webhooks**



**Timer Trigger – use for scheduled tasks**



**Queue Trigger – run in response to a message on a queue**



**Cosmos DB Trigger – run when a document is created or updated**



**Blob Trigger – run when a new file is uploaded to Blob Storage**

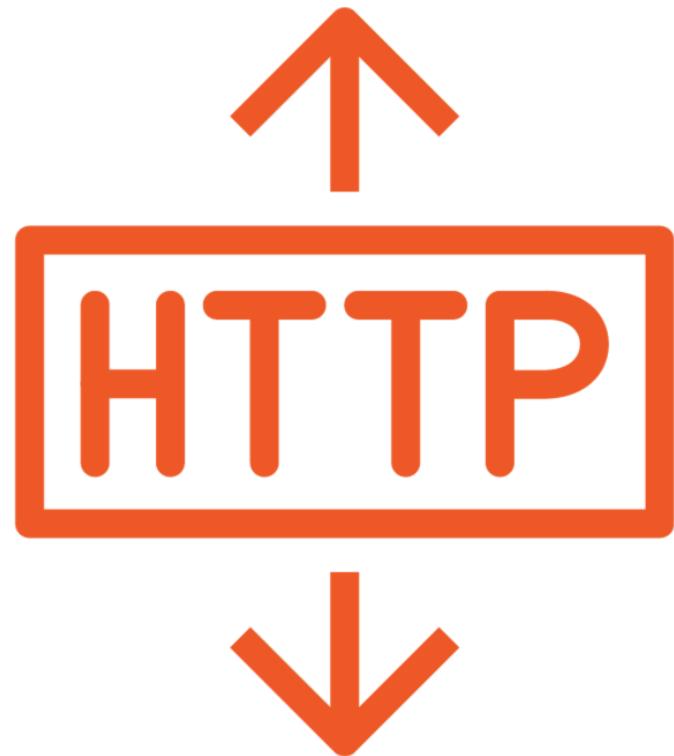


There are many other Azure Function triggers available

e.g. Event Grid, Microsoft Graph



# HTTP Request Trigger



**Implement APIs or respond to webhooks**

**Customization**

- HTTP methods – e.g. GET or POST
- Route

**Secured via authorization key**

- Anonymous: no key required
- Function: key per function
- Admin: key per function app



# Timer Trigger



**Run scheduled tasks**

**CRON expression**

- Determines when your function should run



# Demo Recap



HTTP request, timer, and blob storage triggers



Additional trigger types – Queue and Cosmos DB

{JSON}

function.json – defines all triggers and bindings used by an Azure Function





## Try it yourself

Create some functions in the Azure Portal using various trigger types. e.g. Azure Storage Queue trigger



# Implementing Input and Output Bindings

---



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# Overview

## Input Bindings

Get data into our functions

## Output Bindings

Send messages,  
add document to  
a database

## Azure Functions Core Tools

Develop locally



# Azure Function Bindings

A binding is a connection to data

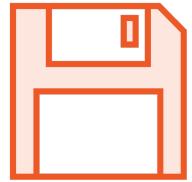
**Input** bindings provide read-access to data

**Output** bindings let us write to an external system

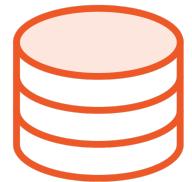
Functions can have multiple input and output bindings



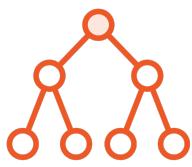
# Azure Function Input Binding Types



**Blob Storage binding – read contents of a file in Blob Storage**



**Cosmos DB binding – look up a document in a Cosmos DB database**



**Microsoft Graph binding – access OneDrive**



# Azure Functions Output Bindings



**Blob Storage binding – Create a new file in Blob Storage**



**Queue Storage binding – Post a message to a queue**



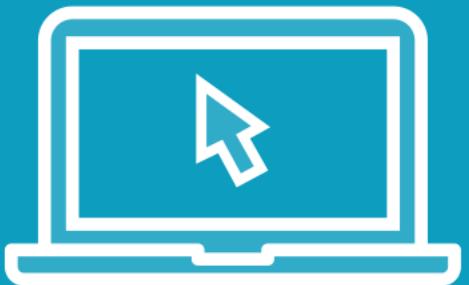
**Cosmos DB binding – Create a new document in a database**



**Many others – Event Hub, Service Bus, SendGrid, Twilio, etc**



Demo



**HTTP request trigger**  
**Cosmos DB input binding**



# Development Environment

Azure Functions  
Core Tools

Visual Studio  
Code

Azure Functions  
VS Code  
Extension

Azure Storage  
Emulator

Azure Cosmos DB  
Emulator



Demo



Azure Storage Queue output binding



Input and output bindings  
are defined in function.json





## Try it yourself

Create some functions  
yourself and use a few  
different input and output  
bindings



# Implementing Azure Durable Functions

---



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# Azure Durable Functions

An extension to Azure Functions

Create stateful, serverless workflows (“orchestrations”)



# Three Types of Function

## Client (“Starter”) Function

Initiate a new orchestration

Use any trigger

## Orchestrator Function

Defines the steps in the workflow

Handle errors

## Activity Function

Implements a step in the workflow

Use any bindings



# Use C# or JavaScript for Durable Functions



# Orchestration Patterns

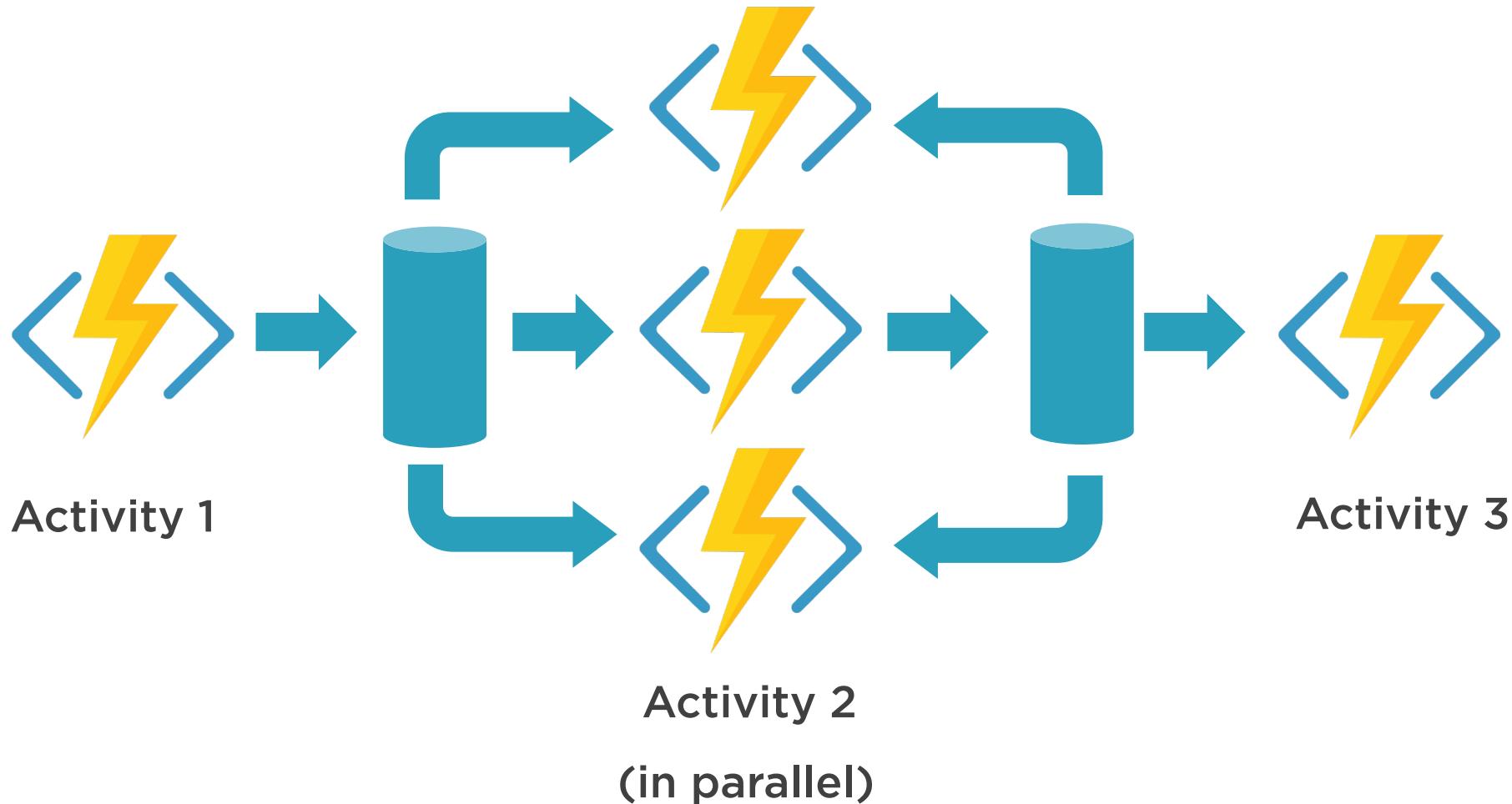
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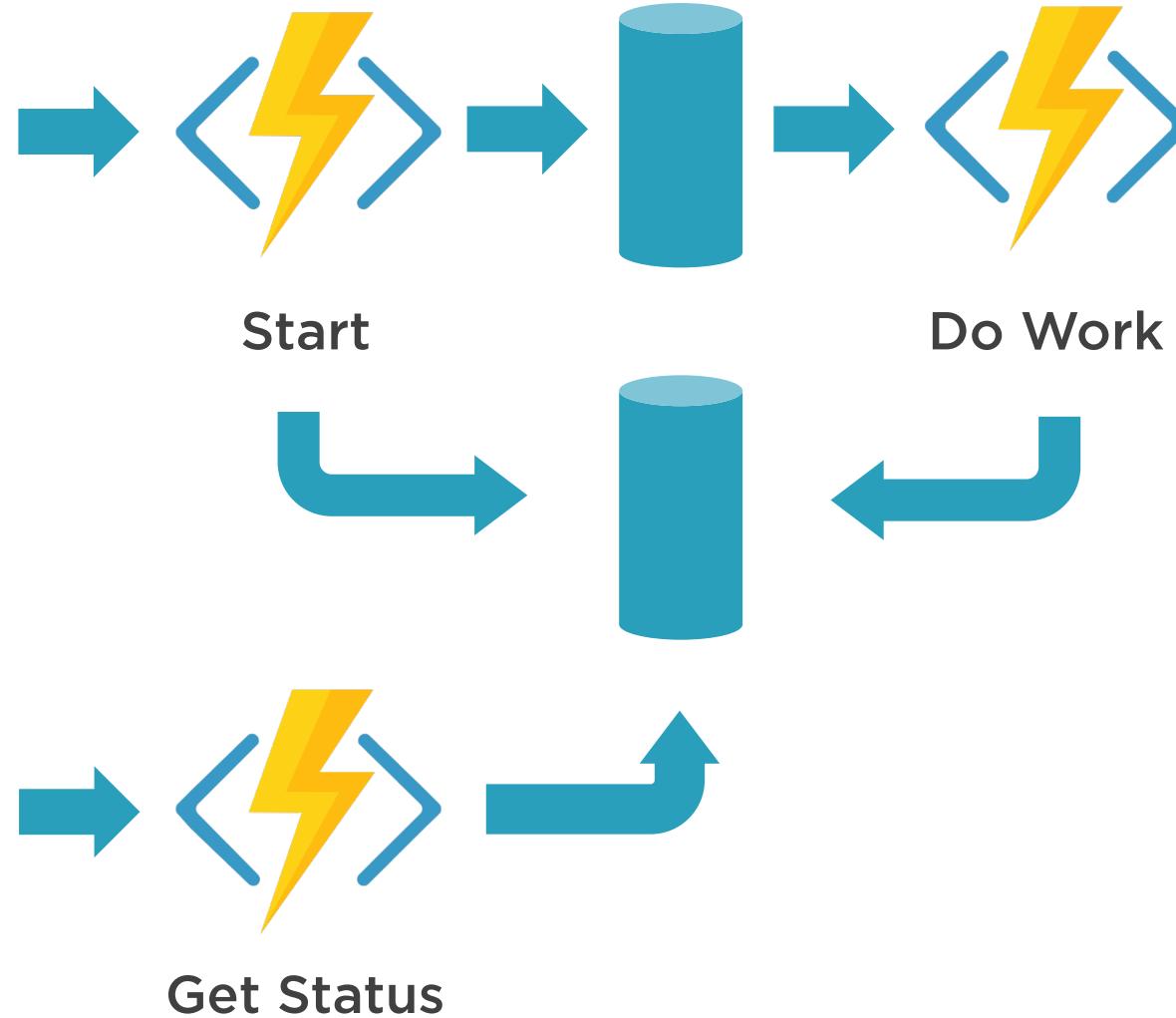
# Function Chaining



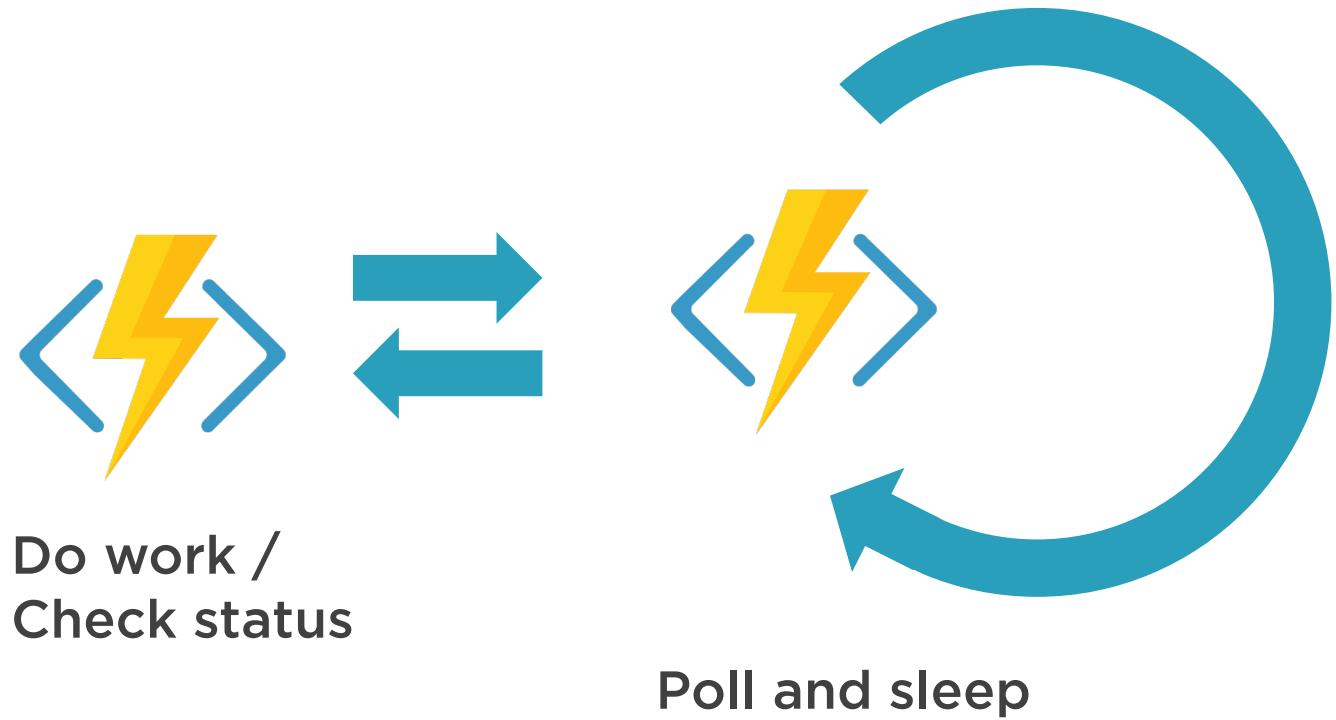
# Fan-out Fan-in



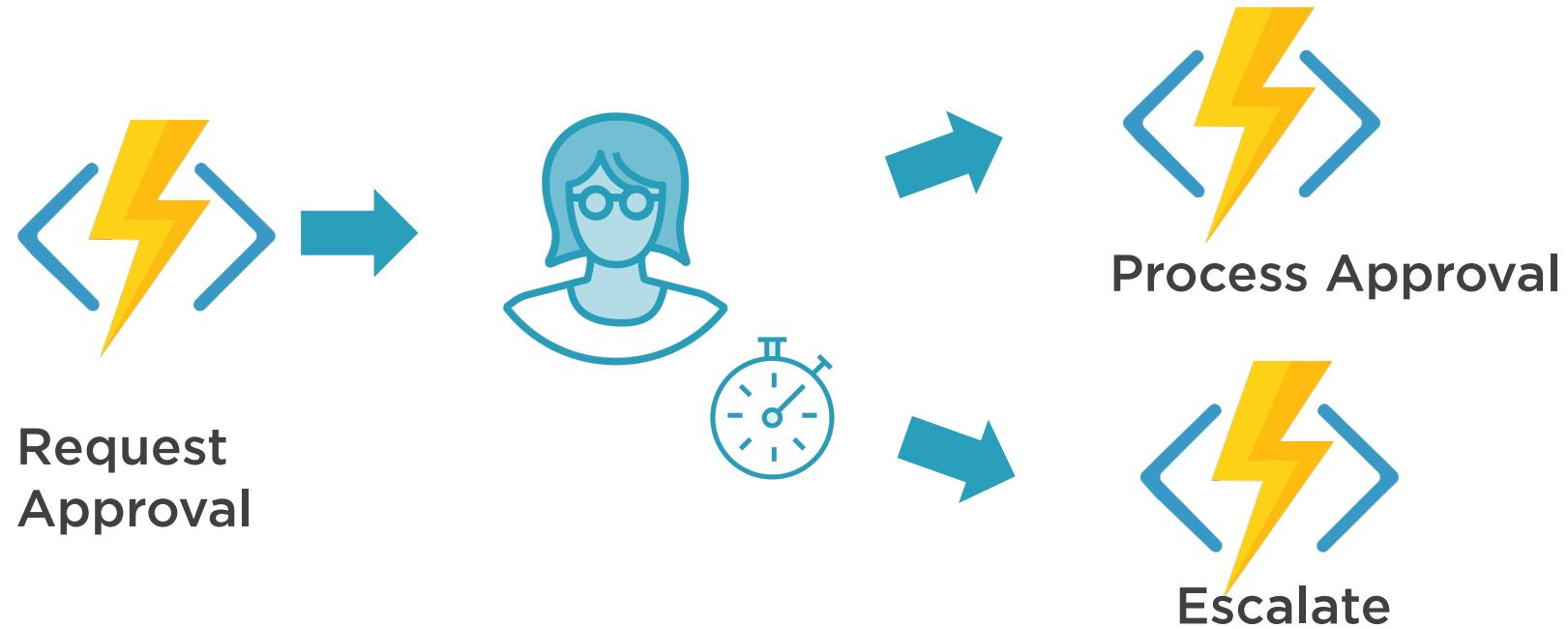
# Asynchronous HTTP APIs



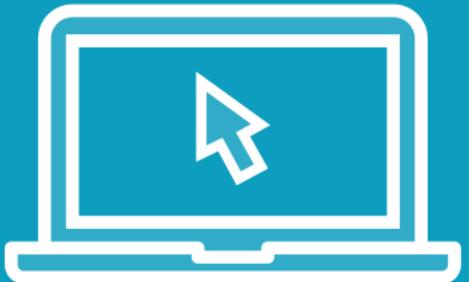
# Monitor



# Human Interaction



Demo



Create a Durable Functions workflow



Demo



**Test Durable Functions orchestration**



Durable Functions are a  
great way to implement  
serverless workflows



Sub-orchestrations allow  
one orchestration to trigger  
another orchestration



# Going Deeper

## Azure Functions Fundamentals

by Mark Heath

Discover how Azure Functions allows you to easily write serverless code in your language of preference to handle events at scale, with minimal overhead and cost.

## Azure Durable Functions Fundamentals

by Mark Heath

Durable Functions enables you to create reliable stateful workflows with Azure Functions. This course teaches you how to implement "fan-out fan-in" patterns, pause waiting for human interaction, and how to debug, deploy, and monitor your workflows.



# Implementing Custom Handlers

---



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# Supported Programming Languages

C#

Java

JavaScript

Python

PowerShell

...others

What about **languages** that aren't currently supported? e.g. Rust or Go

Or **runtimes** that aren't currently supported? e.g. Deno



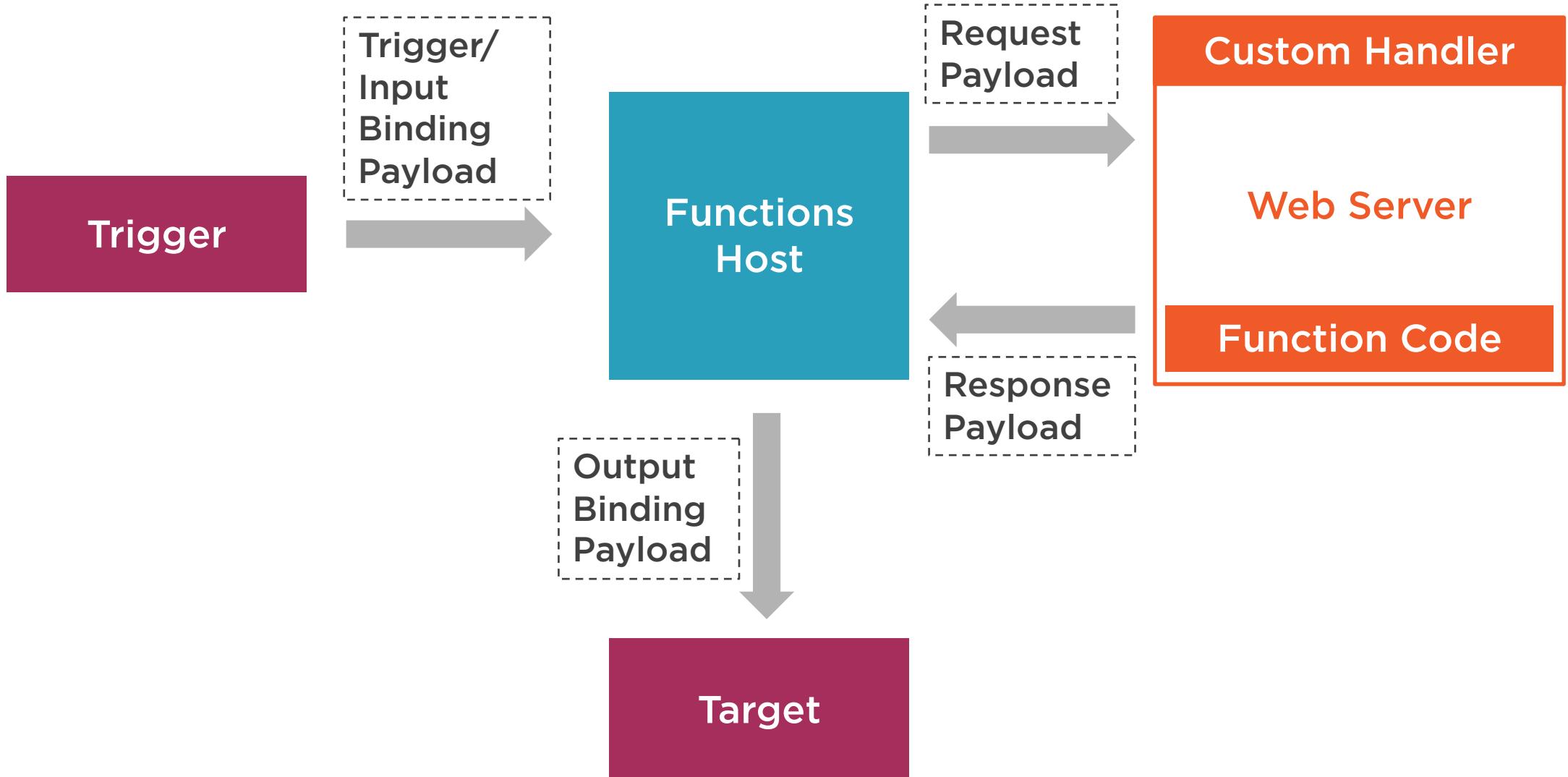
# Custom Handlers

Implement Azure Functions using your language or runtime of choice

Won't often be necessary, but a useful option to know about



# Custom Handlers



# Creating a Custom Handler

- 1 Create a Function App, with `func init` selecting “Custom” as the language
- 2 Create an Azure Function
- 3 Create a web server using your custom language of choice
- 4 Compile your custom handler (e.g. `go build handler.go`)
- 5 Update `host.json` (`defaultExecutablePath` and `enableForwardingHttpRequest`)
- 6 Test locally (e.g. `func start`) or publish to Azure



# host.json

```
{  
  "version": "2.0",  
  "logging": {  
    "applicationInsights": {  
      "samplingSettings": {  
        "isEnabled": true,  
        "excludedTypes": "Request"  
      }  
    }  
  },  
  "extensionBundle": {  
    "id": "Microsoft.Azure.Functions.ExtensionBundle",  
    "version": "[1.*, 2.0.0)"  
  },  
  "customHandler": {  
    "description": {  
      "defaultExecutablePath": "",  
      "workingDirectory": "",  
      "arguments": []  
    }  
  }  
}
```



# Quickstart: Create a Go or Rust function in Azure using Visual Studio Code

12/04/2020 • 10 minutes to read • 

Select your function language: Other (Go/Rust) ▾

In this article, you use Visual Studio Code to create a [custom handler](#) function that responds to HTTP requests. After testing the code locally, you deploy it to the serverless environment of Azure Functions.

Custom handlers can be used to create functions in any language or runtime by running an HTTP server process. This article supports both [Go](#) and [Rust](#).

Completing this quickstart incurs a small cost of a few USD cents or less in your Azure account.

## Configure your environment

Before you get started, make sure you have the following requirements in place:

[Go](#) [Rust](#)

- An Azure account with an active subscription. [Create an account for free ↗](#).

Is this page helpful?

 Yes  No

In this article

[Configure your environment](#)

[Create your local project](#)

[Create and build your function](#)

[Configure your function app](#)

[Run the function locally](#)

[Sign in to Azure](#)

[Compile the custom handler for Azure](#)

[Publish the project to Azure](#)

[Run the function in Azure](#)

[Clean up resources](#)

[Next steps](#)



{

```
"version": "2.0",
"logging": {
    "applicationInsights": {
        "samplingSettings": {
            "isEnabled": true,
            "excludedTypes": "Request"
        }
    }
},
"extensionBundle": {
    "id": "Microsoft.Azure.Functions.ExtensionBundle",
    "version": "[1.*, 2.0.0)"
},
"customHandler": {
    "description": {
        "defaultExecutablePath": "handler.exe", // or just "handler" on Linux
        "workingDirectory": "",
        "arguments": []
    },
    "enableForwardingHttpRequest": true,
}
}
```

# host.json



# Custom Handler Function Route

The web server should listen on /api/FunctionName



# Exam Alert: Develop Azure Compute Solutions

---

## PREPARING FOR THE EXAM



**David Tucker**

TECHNICAL ARCHITECT & CTO CONSULTANT

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# Objectives for the Exam

---

# Develop Azure Compute Solutions

**25-30%**

**Implement IaaS  
Solutions**

**Create Azure App  
Service Web Apps**

**Implement Azure  
Functions**

# Implement IaaS Solutions

- Provision virtual machines (VM's)**
- Configure, validate, and deploy ARM templates**
- Create container images for solutions**
- Publish an image to the Azure Container Registry**
- Run containers by using Azure Container Instance**

**Azure Kubernetes Service  
(AKS) is out of scope for this  
certification exam.**

# Create Azure App Service Web Apps

- Create an Azure App Service Web App**
- Enable diagnostics logging**
- Deploy code to a web app**
- Configure web app settings including SSL, API, and connection strings**
- Implement autoscaling rules, including scheduled autoscaling, and scaling by operational or system metrics**

# Implement Azure Functions

- Create and deploy Azure Functions apps**
- Implement input and output bindings for a function**
- Implement function triggers by using data operations, timers, and webhooks**
- Implement Azure Durable Functions**
- Implement custom handlers**

# Review Implementing IaaS Solutions

---

# Be Sure to Review

**Managed Identities**  
(System and User)

**Backup & Restore  
Approaches**

**Accelerated  
Networking**

**When Not to Use  
an Azure VM**

# Review Creating Azure App Service Web Apps

---

# Azure App Service

- Understand capabilities of each pricing tier**
- Know the order of steps to create and deploy an application**
- Fully understand deployment slots and slot swapping**
- Know how to configure scaling and which tiers support which options**
- Know what use cases require the isolated tier**
- Understand the process of deploying containers**

# Reviewing App Service Tiers

**Free (F)**

**Shared (D)**

**Basic (B)**

**Standard (S)**

**Premium (P)**

**Isolated (I)**

# Additional Items to Review

**Accessing Logs**  
(Historical and Real-time)

**Review CLI Commands**  
(Arguments not required)

**Azure App Service  
Environment (ASE)**

**Custom Warm-up  
for Deployment Slots**

# Review Implementing Azure Functions

---

# Azure Functions

- Understand the configuration of input and output bindings**
- Know the role they fill architecturally**
- Review integrations with other services**
- Know what use cases Durable Functions are the best fit for**
- Know how to access function metrics and logging information**

# Durable Functions App Patterns

**Function  
Chaining**

**Fan-out /  
Fan-in**

**Async HTTP  
API's**

**Monitoring**

**Human  
Interaction**

**Aggregator  
(Stateful Entities)**

## Example Scenarios

---

## Scenario 1



**Sylvia's company is in the process of moving multiple web apps to Azure**

**The web applications themselves are deployed as containers**

**Application demand varies, and they have struggled with uptime in the past**

**What is the most cost effective approach Sylvia's company could take?**

## Scenario 2



**Edward has created a document processing service for his company**

**After his app uploads a document to blob storage, it calls an API**

**The API triggers the document processing on a VM**

**Is this the most efficient and cost effective approach for this solution?**

## Scenario 3



**Cindy's company provides a digital asset management SaaS solution**

**They are trying to find more cost effective ways to process large videos**

**Cindy has read about Durable Functions and believes this could be a solution**

**Is this problem solved by using Durable Functions?**

## Scenario 4



**William's company currently runs a fantasy football platform**

**Currently they perform multiple actions on a VM when a new user is added**

**William is afraid to move it to a single Azure function due to a possible timeout**

**Is this problem solved by using Durable Functions?**

## Scenario 5



**Oscar's company is deploying a new web application using App Service**

**Oscar will be deploying the app using the CLI**

**Oscar will be deploying into a brand new account that is currently empty**

**What is the correct order of the steps Oscar will need to follow?**

# Scenario 5

`az appservice create`

Select 3

`az appservice plan create`

`az webapp create`

`az group create`

`az webapp deploy`

`az appservice plan deploy`

## Scenario 6



**James's company has multiple Windows VM's deployed in a VNet**

**They need high-speed communication to analyze shared streaming data**

**Currently they are experiencing higher than desired lag between their VM's**

**Which solution could reduce the latency between VM's?**

# Scenario 6

**Azure Front Door**

**App Service  
Environment (ASE)**

**Accelerated Networking**

**VNet Peering**

# Scenario Answers

---

## Scenario 1



**Sylvia's company is in the process of moving multiple web apps to Azure**

**The web applications themselves are deployed as containers**

**Application demand varies, and they have struggled with uptime in the past**

**What is the most cost effective approach Sylvia's company could take?**

**Solution: Azure App Service for Containers - Standard Tier with Linux Runtime**

## Scenario 2



**Edward has created a document processing service for his company**

**After his app uploads a document to blob storage, it calls an API**

**The API triggers the document processing on a VM**

**Is this the most efficient and cost effective approach for this solution?**

**Solution: No - Use an Azure Function with a trigger based on Blob Storage**

## Scenario 3



**Cindy's company provides a digital asset management SaaS solution**

**They are trying to find more cost effective ways to process large videos**

**Cindy has read about Durable Functions and believes this could be a solution**

**Is this problem solved by using Durable Functions?**

**Solution: No - processing of large files is not an identified use case.**

## Scenario 4



**William's company currently runs a fantasy football platform**

**Currently they perform multiple actions on a VM when a new user is added**

**William is afraid to move it to a single Azure function due to a possible timeout**

**Is this problem solved by using Durable Functions?**

**Solution: Yes - function chaining is a valid Durable Functions use case**

## Scenario 5



**Oscar's company is deploying a new web application using App Service**

**Oscar will be deploying the app using the CLI**

**Oscar will be deploying into a brand new account that is currently empty**

**What is the correct order of the steps Oscar will need to follow?**

# Scenario 5

`az appservice create`

`az appservice plan create`

`az webapp create`

`az group create`

`az webapp deploy`

`az appservice plan deploy`

Select 3

`az group create`

`az appservice plan create`

`az webapp create`

## Scenario 6



**James's company has multiple Windows VM's deployed in a VNet**

**They need high-speed communication to analyze shared streaming data**

**Currently they are experiencing higher than desired lag between their VM's**

**Which solution could reduce the latency between VM's?**

# Scenario 6

Azure Front Door

**App Service  
Environment (ASE)**

Accelerated Networking

VNet Peering

# Microsoft Azure Developer: Develop Solutions with Azure Cosmos DB Storage

---

## CREATING COSMOS DB CONTAINERS



**David Tucker**  
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# Objectives

- Select the appropriate API and SDK for a solution**
- Perform operations on data and Cosmos DB containers**
- Set the appropriate consistency level for operations**
- Implement partitioning schemes and partition keys**
- Manage change feed notifications**

# NoSQL Databases

---

# Database Approaches

**Relational Databases**

**NoSQL Databases**

# NoSQL Differences

## Relational Databases

Fixed schema

Table based structure

Vertical scaling and manual sharding for scalability

Provides ACID guarantees (atomicity, consistency, isolation, durability)

Data normalization

## NoSQL Databases

Fluid schema

Multiple structures (key-value, graph, document, wide-column)

Horizontal scaling and data partitioning for scalability

Provides BASE (basically available, soft state, eventual consistency) semantics

Non-normalized data

“If your transactional volumes are reaching extreme levels, such as many thousands of transactions per second, you should consider a distributed NoSQL database.”

**Microsoft, Cosmos DB Documentation**

# Cosmos DB Capabilities

---

“Azure Cosmos DB is Microsoft's globally distributed, multi-model database service.”

**Microsoft, Cosmos DB Documentation**



## Azure Cosmos DB

- Provides extremely low latency** (single digit millisecond)
- Provides SLA for throughput, latency, availability, and consistency**
- Support multi-region replication at any point**
- Provides five-nines of high-availability for both reads and writes**
- Enables elastic scalability**
- Pricing is for the throughput you provision\***
- Supports multiple consistency options**

# Additional Cosmos DB Features

**Integrated Analytics**

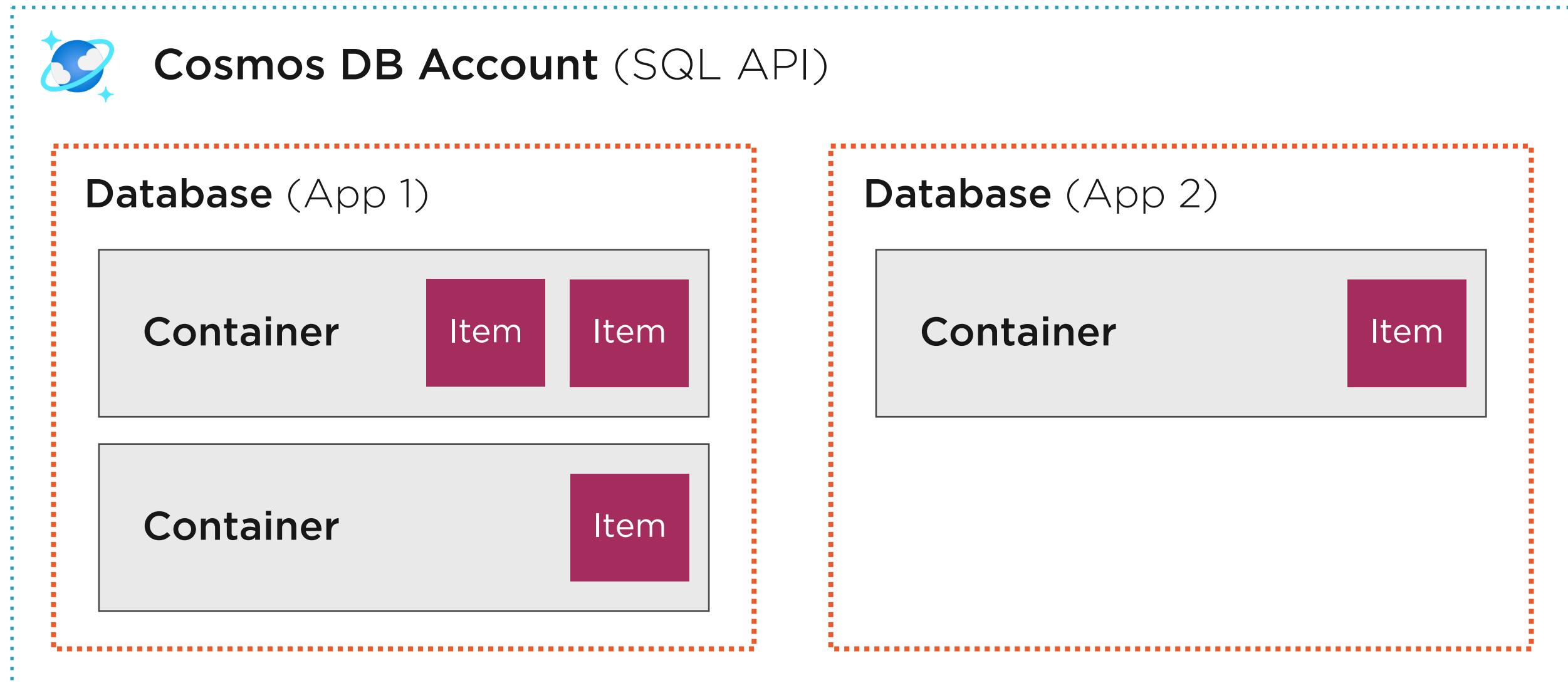
**Region Support**

**Schema-agnostic**

**Automatic Indexing**

**Supports Multiple  
SDK's**

# Cosmos DB Organization



# Supported Cosmos DB API's

---

# Supported Cosmos DB API's

**SQL**

**Cassandra**

**MongoDB**

**Gremlin**

**Azure Table**

# Cassandra API Use Cases

**You want to leverage the Cassandra Query Language (CQL) to query data**

**You want to be able to leverage existing Cassandra tools**

**You have existing Cassandra databases that you want to migrate to the cloud**

**You want to store data in a wide-column format** (two dimensional key-value store)

# MongoDB API Use Cases

**You want to leverage MongoDB API to query data**

**You want to be able to leverage existing MongoDB tools**

**You have existing MongoDB databases that you want to migrate to the cloud**

**You want to store data as JSON documents**

# Gremlin API Use Cases

**You need to store graph relationships between data**

**Can leverage Apache Tinkerpop's Gremlin language for querying relationships**

# Azure Table API Use Cases

**You have experience with Azure Table Storage**

**You have applications and data to migrate from Azure Table Storage**

**You want to query data using OData or LINQ queries**

# SQL API Use Cases

**You want to leverage a SQL-like language to query data**

**You want to store data as JSON documents**

**If no other use cases fit, choose the SQL API**

# Database Entity

**SQL**  
Database

**Cassandra**  
Keyspace

**MongoDB**  
Database

**Gremlin**  
Database

**Azure Table**  
Not Applicable\*

# Container Entity

**SQL**  
Container

**Cassandra**  
Table

**MongoDB**  
Collection

**Gremlin**  
Graph

**Azure Table**  
Table

# Creating a Cosmos DB Container

---

```
# create a sql api cosmos db account
az cosmosdb create --name pluralsight --resource-group pluralsight

# create a sql database
az cosmosdb sql database create --account-name pluralsight
--name sampledb

# create a sql database container
az cosmosdb sql container create --resource-group pluralsight
--account-name pluralsight --database-name sampledb
--name samplecontainer --partition-key-path "/employeeid"
```

# Creating a Cosmos DB Container using the CLI

Azure CLI

# Demo

**Creating a Cosmos DB account for the  
SQL API**

**Creating a Cosmos DB database**

**Creating a Cosmos DB container**

**Inserting items into the container**

**Querying the container**

# Selecting an SDK for Cosmos DB

---

## Selecting an SDK

**When using the SQL API, utilize the latest  
Cosmos DB SDK for your platform**

**When using MongoDB, Cassandra, and  
Gremlin use current SDK's for those API's**

**When leveraging the Azure Table API,  
leverage the current Table Storage SDK**

# Cosmos DB Performance

---



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# Traditional Database Scaling

**Vertical Scaling**

**Horizontal Scaling**

## Request Unit (RU)

**With Cosmos DB, a Request Unit encapsulates many of the resources needed for the database into a single unit. As a baseline, one RU is equal to a 1kb item read operation from a Cosmos DB container.**

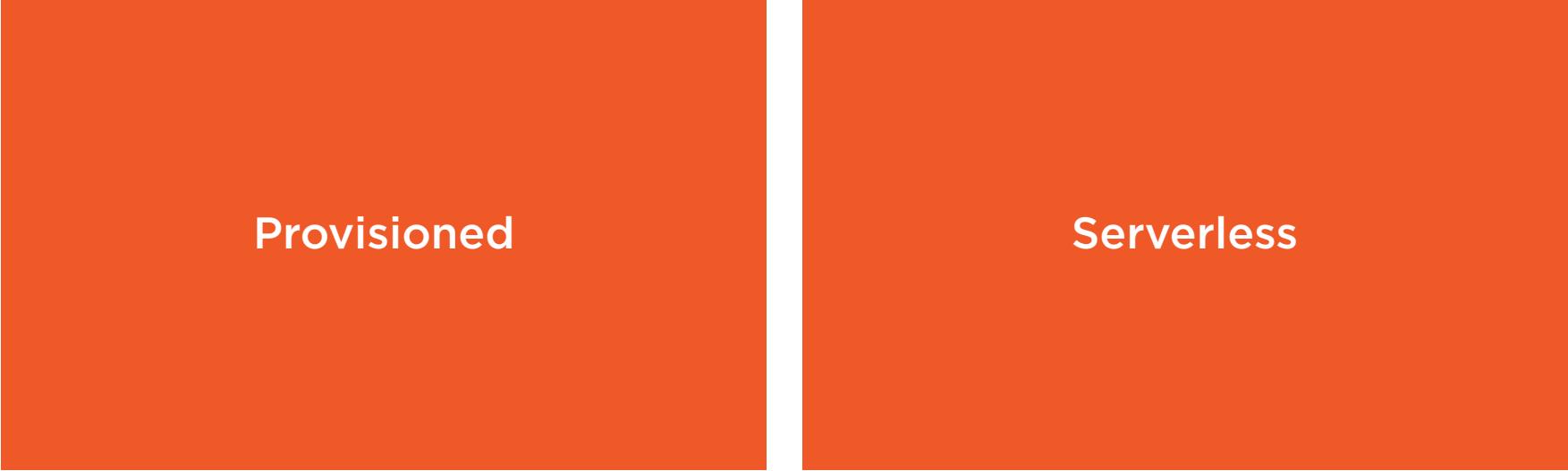
# Resources Encapsulated in RU's

**Processing  
Power** (CPU)

**Memory**

**IOPS**  
(Input/Output  
Operations Per  
Second)

# Managing Cosmos DB Throughput



**Provisioned**

**Serverless**



## Provisioned Throughput

**Ideal for always-on production implementation**

**Can be configured at the database or container**

**Throughput is evenly distributed to partitions**

**Requires 10 RU's per GB of storage**

**Once RU's are consumed for a partition, future requests will be rate limited**

**By default, it requires a manual scaling approach to acquire more RU's**

## Autoscaling (Provisioned)

With provisioned throughput, you can specify a maximum RU throughout amount, and Cosmos DB will ensure that your data is available up to that throughput amount. The minimum throughput is calculated as 10% of the maximum.



## Cosmos DB Serverless

**Pay only for the request units consumed and storage used**

**Ideal for off and on workloads such as development workloads**

**Currently in preview**

**Maximum of 5,000 RU's**

**Requires a new account type**

**Currently supports the SQL (Core) API**

## Best Practices

**Use a partition strategy to evenly spread throughput on partitions**

**Provision throughput at the container for predictable performance**

**Use the serverless account type for development workloads**

**Understand the link between consistency types and the amount of RU's consumed**

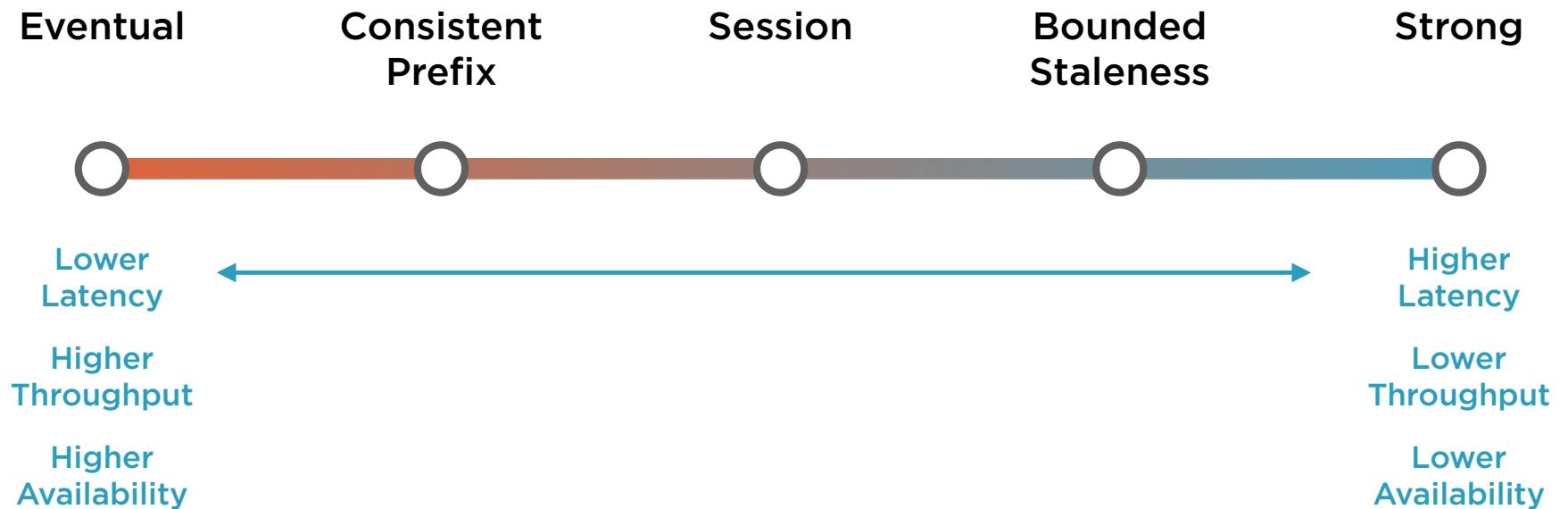
# Data Consistency Levels

---

“Distributed databases that rely on replication for high availability, low latency, or both, must make a fundamental tradeoff between the read consistency, availability, latency, and throughput.”

**Microsoft Cosmos DB Documentation**

# Consistency Level Spectrum



# Consistency Levels

***Strong consistency*** guarantees that reads get the most recent version of an item

***Bounded staleness*** guarantees that a read has a max lag (either versions or time)

***Session consistency*** guarantees that a client session will read its own writes

***Consistent prefix consistency*** guarantees that updates are returned in order

***Eventual consistency*** provides no guarantee for order

# Consistency Levels for SQL API's

**Account Default**

**Request-specific  
Level**

# Consistency Levels and API's

**For Gremlin and Azure Table API's, Cosmos DB uses account default consistency level**

**For Cassandra writes, the account default consistency level is used**

**For Cassandra reads, the client consistency is mapped to a Cosmos DB level**

**For MongoDB, the write concern uses the account default consistency level**

**For MongoDB, the read concern will use a mapping to a Cosmos DB level**

## Throughput Considerations

**Both strong and bounded staleness reads will consume twice the normal amount of request units for a request, as Cosmos DB will need to query two replicas to meet the criteria of the consistency level.**

# Partitioning Data in Cosmos DB

---

# Understanding Cosmos DB Partitions

**Logical Partition**

**Physical Partition**

**Partition Key**

**Replica Set**

# Logical Partition

A logical partition is a set of items within a container that share the same partition key. A container can have as many logical partitions as it needs, but each partition is limited to 20GB of storage. Logical partitions are managed by Cosmos DB, but their use is governed by your partition key strategy.

“A container is scaled by distributing data and throughput across **physical partitions**. Internally, one or more logical partitions are mapped to a single physical partition. They are entirely managed by Azure Cosmos DB.”

**Microsoft Cosmos DB Documentation**

## Replica Set

A physical partition contains multiple replicas of the data, known as a replica set. By having this data replicated, you enable your storage to be durable and fault tolerant. These replica sets are managed by Cosmos DB.

## Partition Key

**Serves as the means of routing your request to the correct partition**

**Made up of both the key and the value of the defined partition key**

**Should be a value that does not change for the item**

**Should have many different values represented in the container**

“Azure Cosmos DB uses hash-based partitioning to spread logical partitions across physical partitions. Azure Cosmos DB hashes the partition key value of an item. Then, Azure Cosmos DB allocates the key space of partition key hashes evenly across the physical partitions.”

**Microsoft Cosmos DB Documentation**

## Strategy Considerations

- Throughput is distributed evenly across all of your physical partitions**
- Multi-item transactions require triggers or stored procedures**
- You will want to minimize cross-partition queries for heavier workloads**
- Decide upon a partition key strategy before creating your container**

# Partition Key Scenario

```
{  
    employeeId: 'b1af4910-b40fe0a',  
    firstName: 'David',  
    lastName: 'Tucker',  
    email: 'david@globomantics.com',          Partition Key  
    office: 'USTN1',  
    department: 'development',  
    reportsTo: 'b1af4910-b40fe0a'  
}
```

# Server-side Programming with Cosmos DB

---



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# Server-side Capabilities

**Cosmos DB provides a robust approach for executing code in response to actions taken on the data stored in Cosmos DB. While in some cases these mirror traditional database constructs, they are fundamentally different in implementation and have unique limitations.**

# Cosmos DB Server-side Concepts

**Stored Procedures**

**Triggers**

**User Defined  
Functions (UDF's)**

**Change Feed**



## Server-side Execution Environment

**Stored procedures, triggers, and UDF's are executed within the database engine**

**These are supported when using the SQL API**

**Supports JavaScript**

**Can be created and managed via the portal and via the SDK**

# Stored Procedures



**Stored procedure must be defined in JavaScript**

**Executes on a single partition, and it only has access to that partition**

**Partition key must be provided with the execution request**

**Supports a transaction model as all statements will be removed if it fails**



## Triggers

**Triggers must be defined in JavaScript**

**Triggers can be executed either before  
(pre) or after (post) data is written**

**Pre triggers can handle data  
transformation and validation**

**Post triggers can handle aggregation and  
change notifications**

**Triggers are not guaranteed to execute, as  
they have to be specified in a request**

**Errors in either the pre or post trigger will  
result in data being rolled back**

# User Defined Functions



**User defined functions must be defined in JavaScript**

**Enables you to define a custom function that can be leveraged in a query**

**Enables encapsulation of common logic in query conditions**

# Change Feed Processing

While all other server-side programming approaches enable execution on the Cosmos DB engine, change feed processing enables you to react to data changes using server-side code outside of the Cosmos DB engine.

## Change Feed



- Enables you to be notified for any insert and update on your data
- Deletes are not directly supported, but you can leverage a soft-delete flag
- A change will appear exactly once in the change feed
- Reading data from the database will consume throughput
- Partition updates will be in order, but between partitions there is no guarantee
- Is not supported for the Azure Table API

# Change Feed Approaches

Azure Functions

Change Feed Processor

# Using Change Feed with Azure Functions

---

# Demo

**Creating an Azure Function app for use  
with change feed notifications**

**Creating a function utilizing the template  
for change feed notifications**

# Verifying Change Feed Capability

---

# Demo

**Verifying change feed execution on new data**

**Reviewing functionality for data deletion and change feed notifications**

# Cleaning Up

---

# Microsoft Azure Developer: Develop Solutions with Blob Storage

---

## UNDERSTANDING AZURE BLOB STORAGE



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Learn for the exam  
AZ-204: Developing Solutions  
for Microsoft Azure



# AZ-204 Exam Objectives

## **Develop solutions that use Blob Storage**

Interact with data using the appropriate SDK

Set and retrieve properties and metadata

Implement data archiving and retention

Implement hot, cool, and archive storage

Move items in Blob Storage between storage accounts or containers



# Course Structure

## Understanding Azure Blob Storage

### Interacting with Data Using the Azure SDK for .NET

Interact with data using the appropriate SDK

## Setting and Retrieving Properties and Metadata

Set and retrieve properties and metadata

## Implementing Data Archiving and Retention

Implement data archiving and retention

Implement hot, cool, and archive storage

## Moving Items Between Storage Accounts and Containers

Move items in Blob storage between storage accounts or containers



# Azure Blob Storage Overview

Object storage for the cloud

Store unstructured data

Text files

Text

Log

Binary files

Images/videos

Virtual disks

Accessible via REST API over HTTP/HTTPS

Access Blob Storage

Azure  
Portal

Azure Powershell  
Azure CLI

Azure Storage client library  
.NET Java Python Node.js



# Understand Storage Accounts, Containers, and Blobs

## Storage Account

storagepluralsight

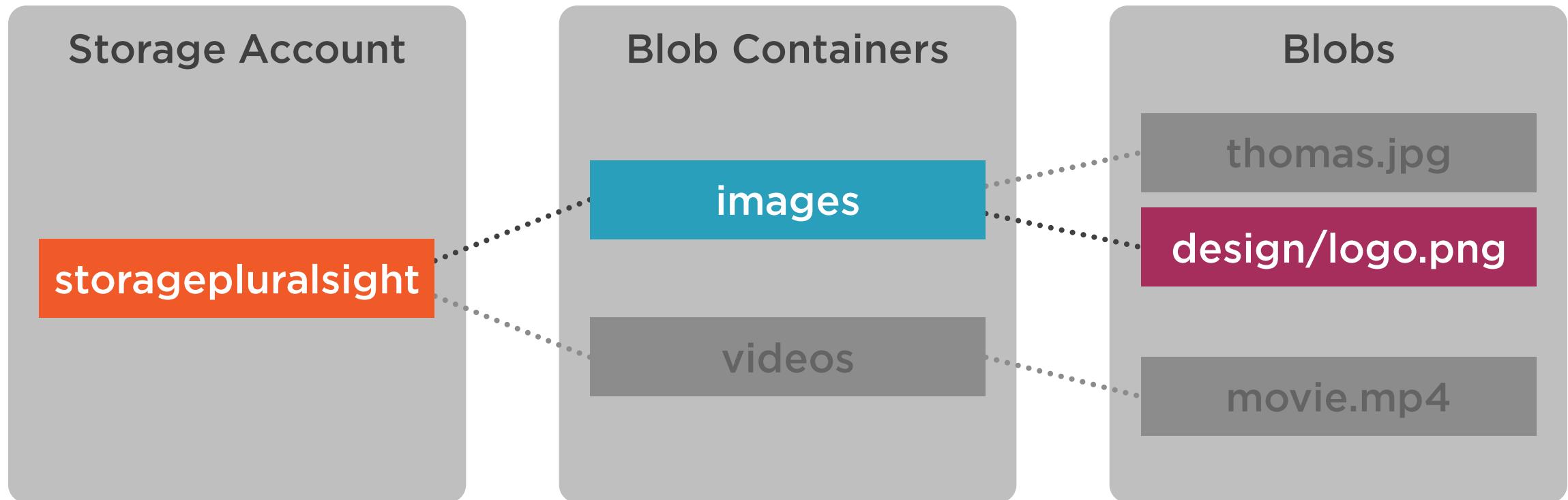
Name must be **unique** across all  
Azure Storage Accounts

- Must be between 3 and 24 characters long
- Must contain only lower-case letters and numbers

<https://storagepluralsight.blob.core.windows.net>



# Understand Storage Accounts, Containers, and Blobs

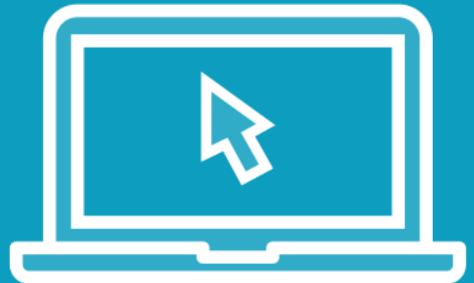


<https://storagepluralsight.blob.core.windows.net/images/design/logo.png>

<https://storagepluralsight.blob.core.windows.net/images?comp=list>



Demo



**Create a Storage Account  
and upload blobs**



```
az storage account create  
  --name storagepluralsight01  
  --resource-group pluralsight  
  [--location westeurope]  
  [--sku Standard_RAGRS]  
  [--kind StorageV2]
```

Create a Storage Account  
Use the Azure CLI



```
New-AzStorageAccount
```

```
  -Name storagepluralsight01
  -ResourceGroupName pluralsight
  -Location westeurope
  -SkuName Standard_RAGRS
  [-Kind StorageV2]
```

Create a Storage Account

Use Azure Powershell



# Authorize Requests to Blob Storage

**Shared Key  
(Storage Account Key)**

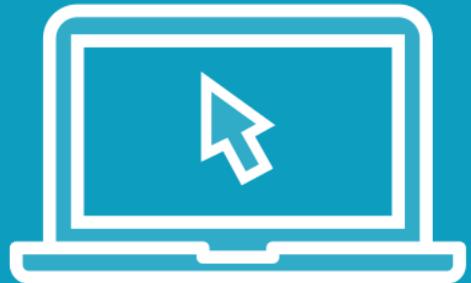
**Shared Access Signature  
(SAS)**

**Azure Active Directory**

**Anonymous public  
read access**



Demo

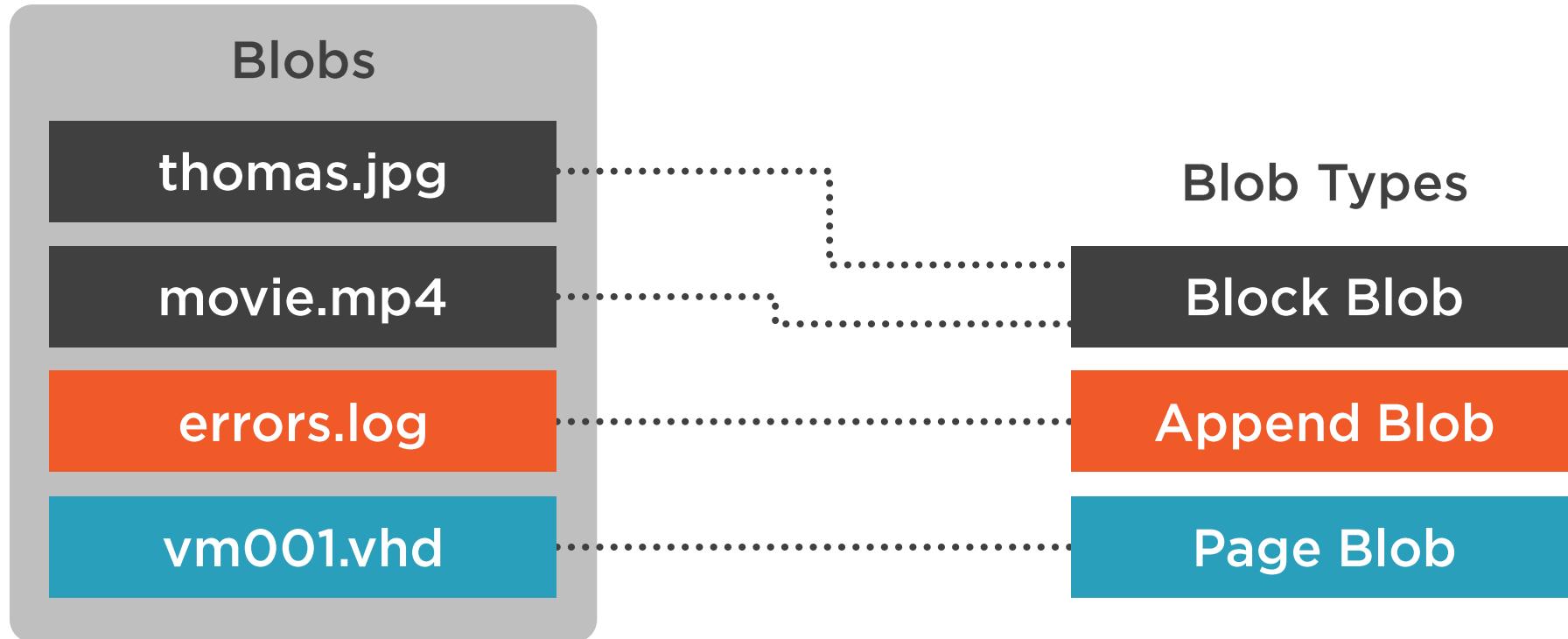


**Authorize requests with a Shared Access Signature (SAS)**

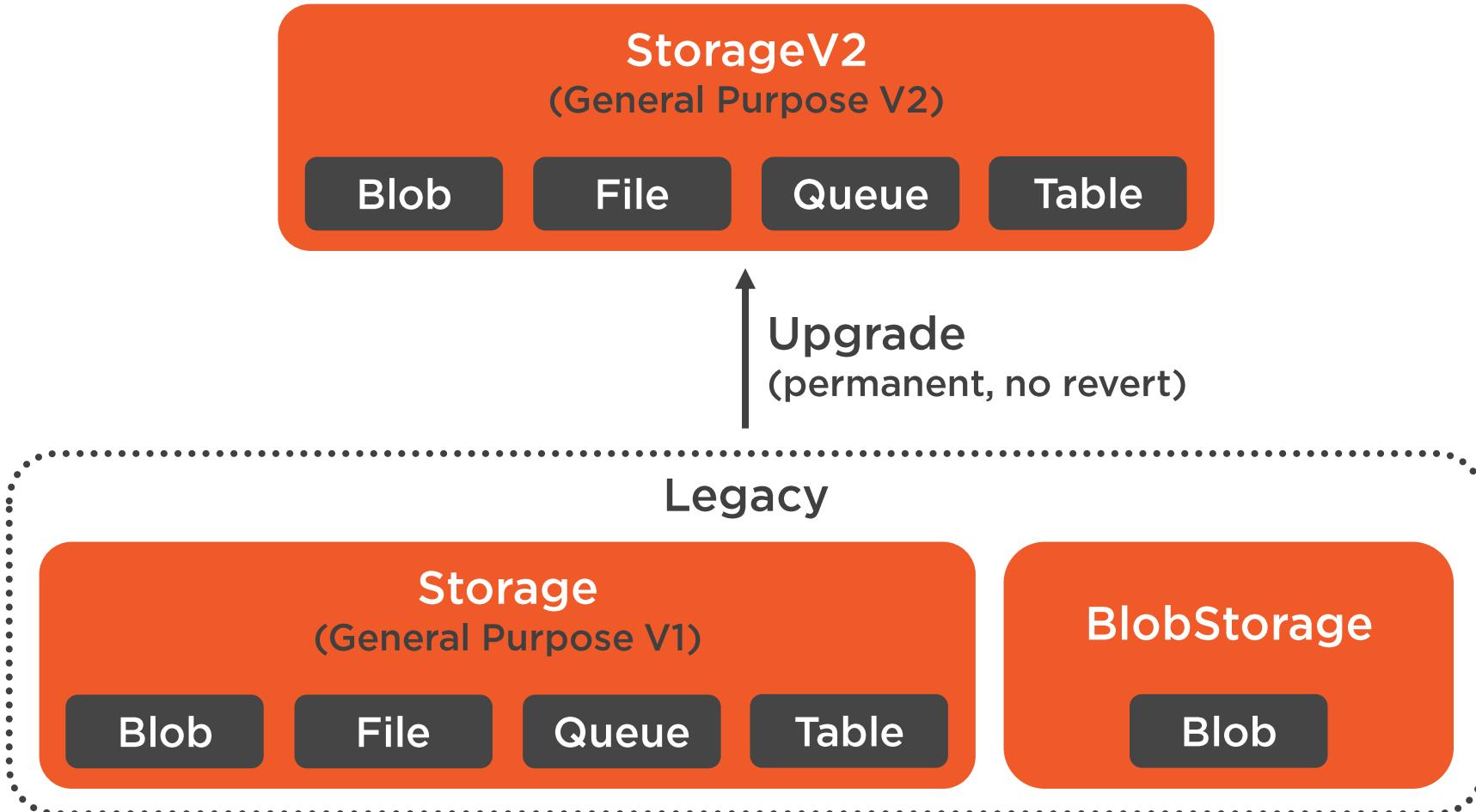
**Configure anonymous public read access**



# Know the Different Blob Types



# Know the Storage Account Kinds



# Know the Storage Account Kinds

**Standard performance**  
(Magnetic drives)

**StorageV2**  
(General Purpose V2)

Blob

File

Queue

Table

Block

Append

Page

**Premium performance**  
(Solid state drives)

Blob  
Page

**StorageV2**  
(General Purpose V2)

Blob  
Block  
Append

**BlockBlobStorage**

File

**FileStorage**

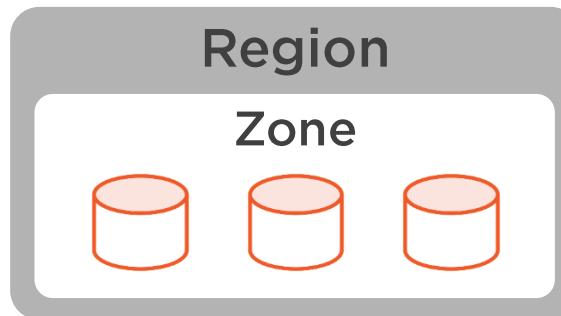


Data at rest is encrypted with  
Storage Service Encryption



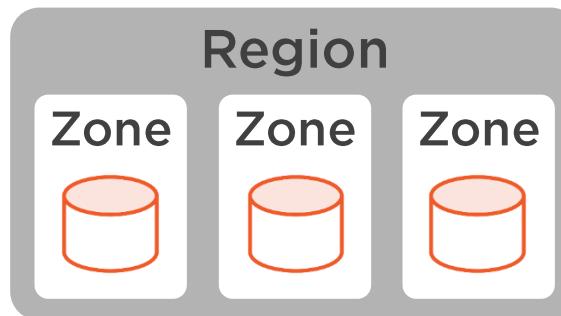
# Choose a Replication Strategy

**Locally redundant storage (LRS)**



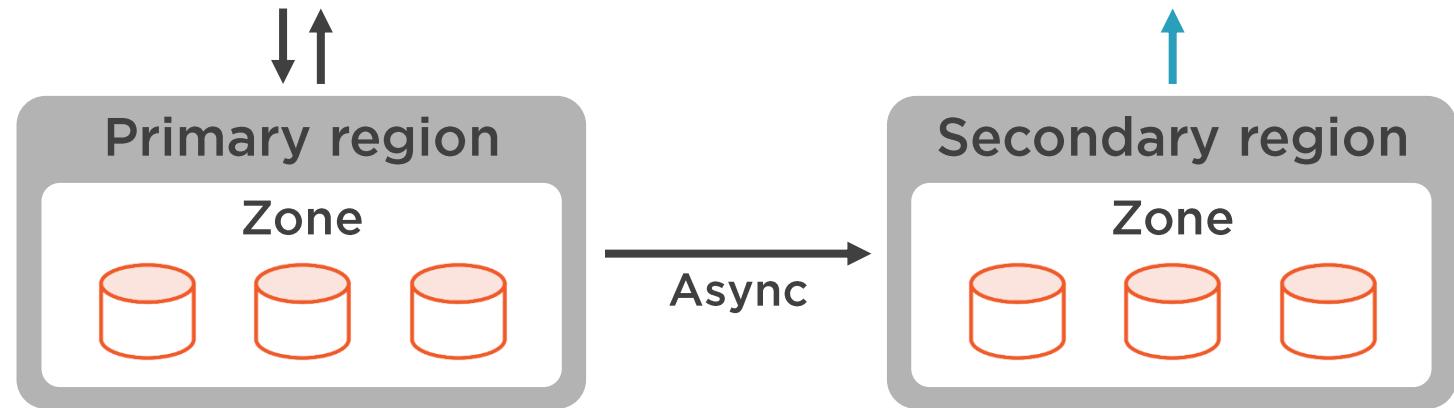
**Zone-redundant storage (ZRS)**

**Not supported  
in all regions**

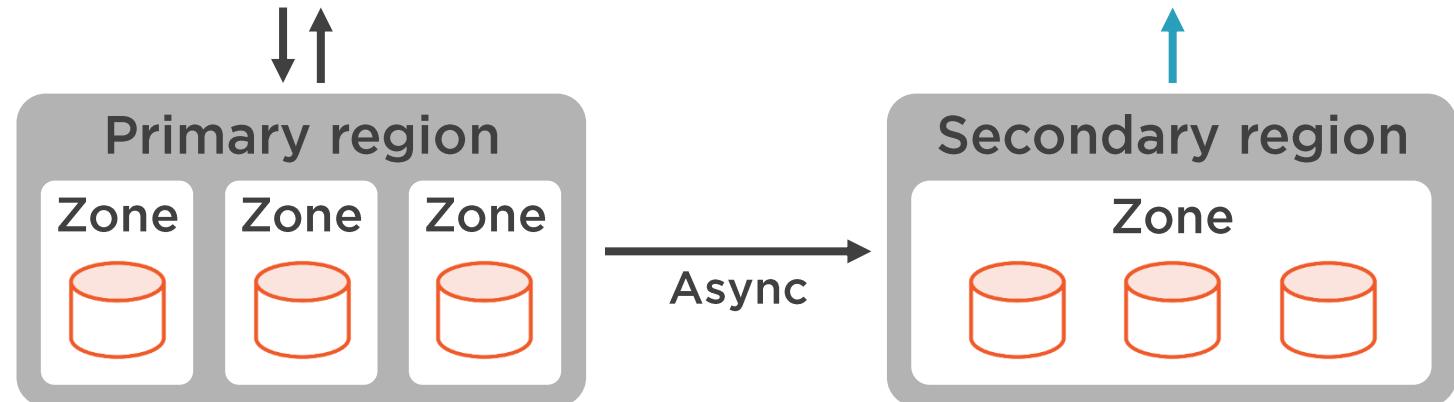


# Choose a Replication Strategy

Geo-redundant storage (GRS)  
**(RA-GRS)**



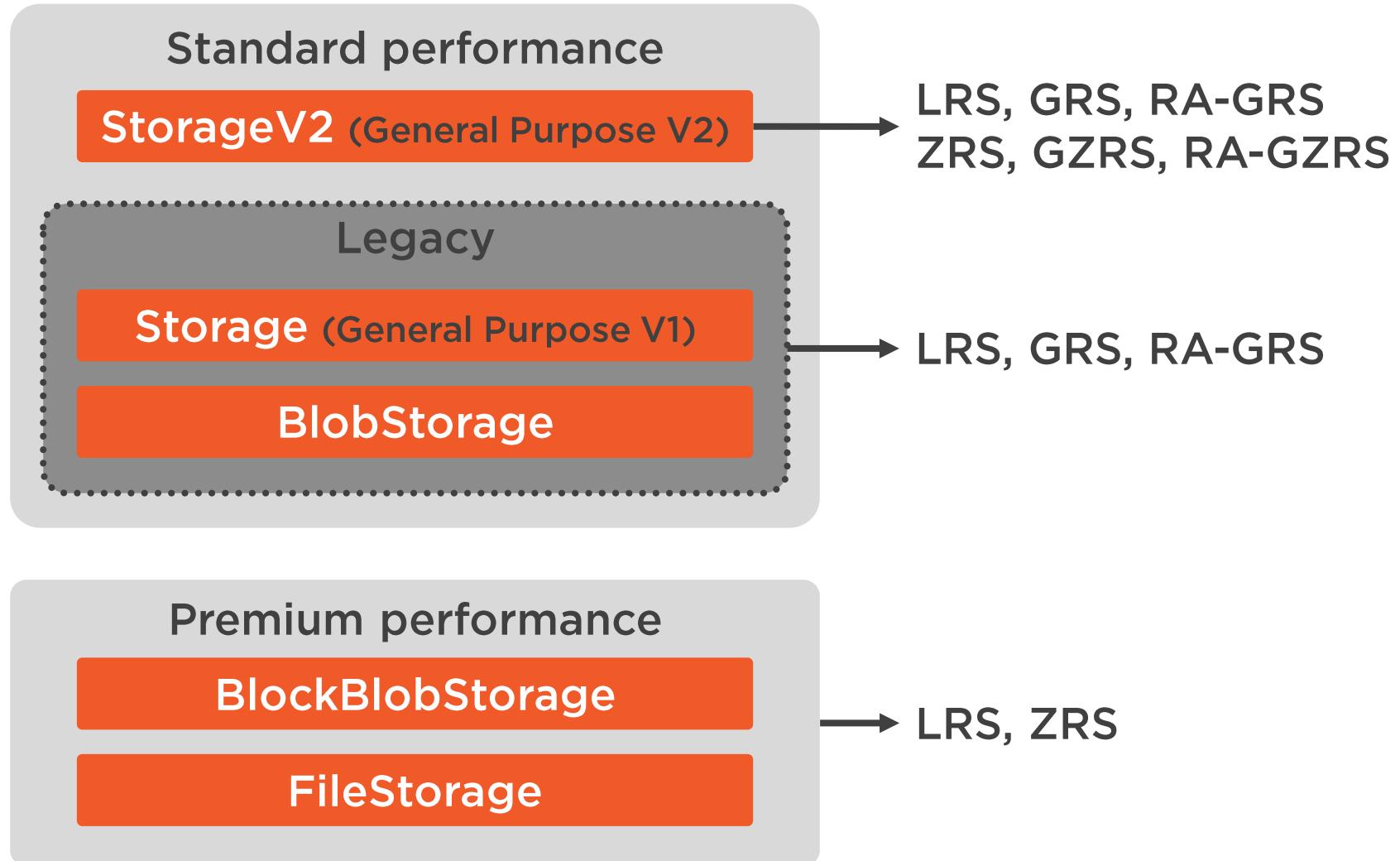
Geo-zone-redundant storage (GZRS)  
**(RA-GZRS)**



<https://<storageaccountname>-secondary.blob.core.windows.net>



# Storage Accounts and Replication Strategies



Next Up

---

Interacting with Data Using  
the Azure SDK for .NET



# Interacting with Data Using the Azure SDK for .NET

---



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# Use an Azure SDK

.NET

Java

JavaScript /  
TypeScript

Python

C++

Android / iOS

<https://azure.github.io/azure-sdk>



# Use an Azure SDK



# Use an Azure SDK

Azure SDK for .NET

<https://github.com/Azure/azure-sdk-for-net>

Collection of client libraries

Azure.<service-category>.<service-name>

Azure.Storage.Blobs  
NuGet package

Azure.Storage.Queue  
NuGet package



# Understand the .NET Client Library

Azure.Storage.Blobs  
NuGet package

BlobServiceClient

BlobContainerClient

BlobClient

Storage Account

storagepluralsight

Blob Containers

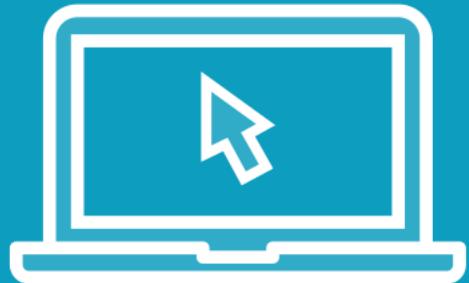
images

Blobs

logo.png



# Demo



## Use the .NET client library for Blob Storage

- Create a Blob Container
- Upload, list, and download Blobs



Next up

---

Setting and Retrieving  
Properties and Metadata



# Setting and Retrieving Properties and Metadata

---



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# Understand Properties and Metadata

## Blob Container

System properties

ETag

LastModified

User-defined metadata

String-based key-value pairs

## Blob

System properties

ETag

LastModified

Content-Type

Content-Length

x-ms-blob-type

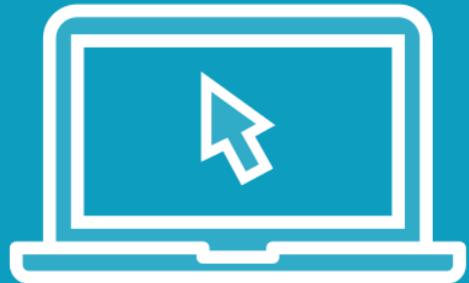
User-defined metadata

String-based key-value pairs

Properties and metadata are set and retrieved via HTTP headers



## Demo

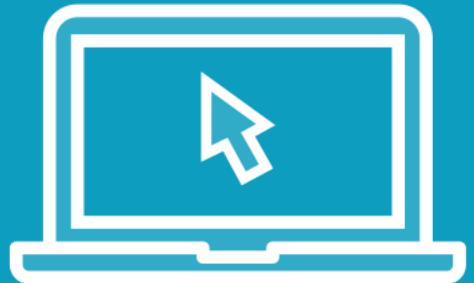


### Look at properties and metadata

- In the Azure Portal
- In the HTTP response headers of a Blob



# Demo



**Set and retrieve properties  
and metadata in .NET**



Next up

---

## Implementing Data Archiving and Retention



# Implementing Data Archiving and Retention

---



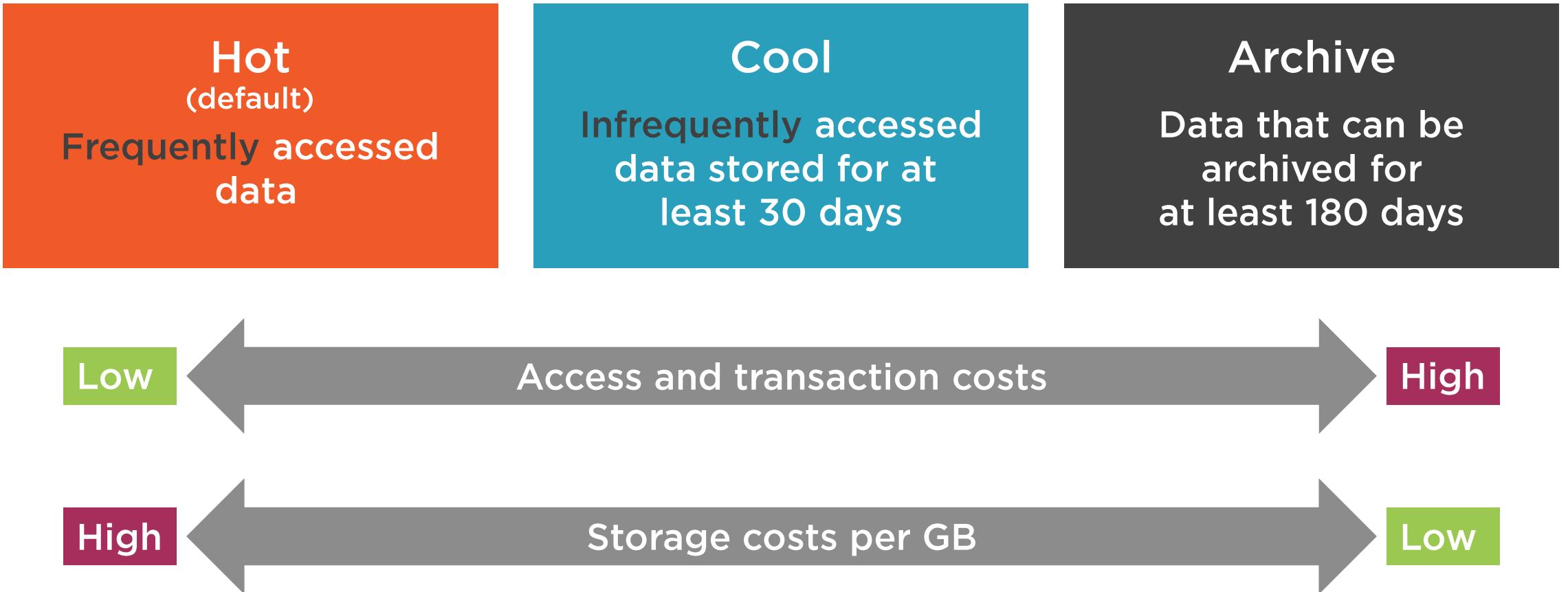
**Thomas Claudius Huber**

SOFTWARE DEVELOPER

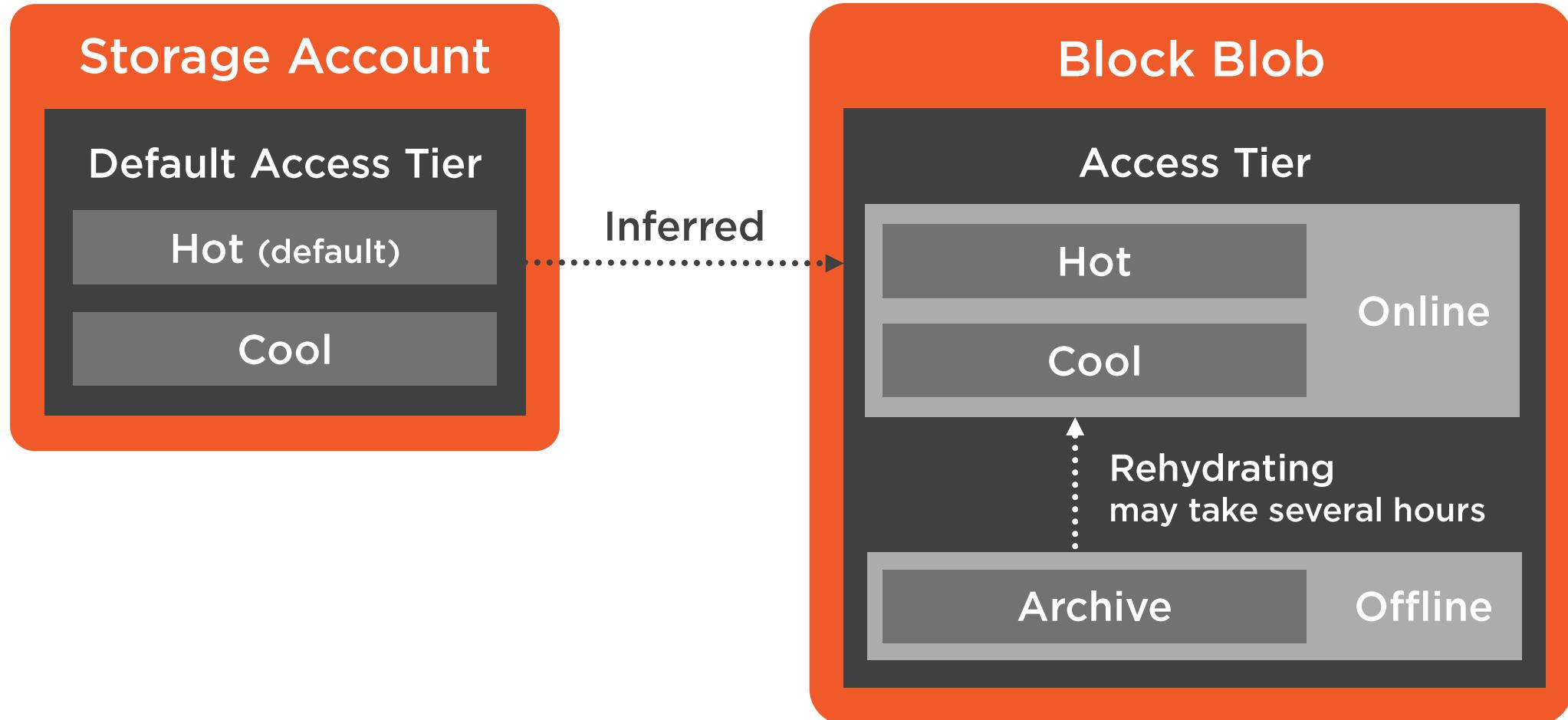
@thomasclaudiush [www.thomasclaudiushuber.com](http://www.thomasclaudiushuber.com)



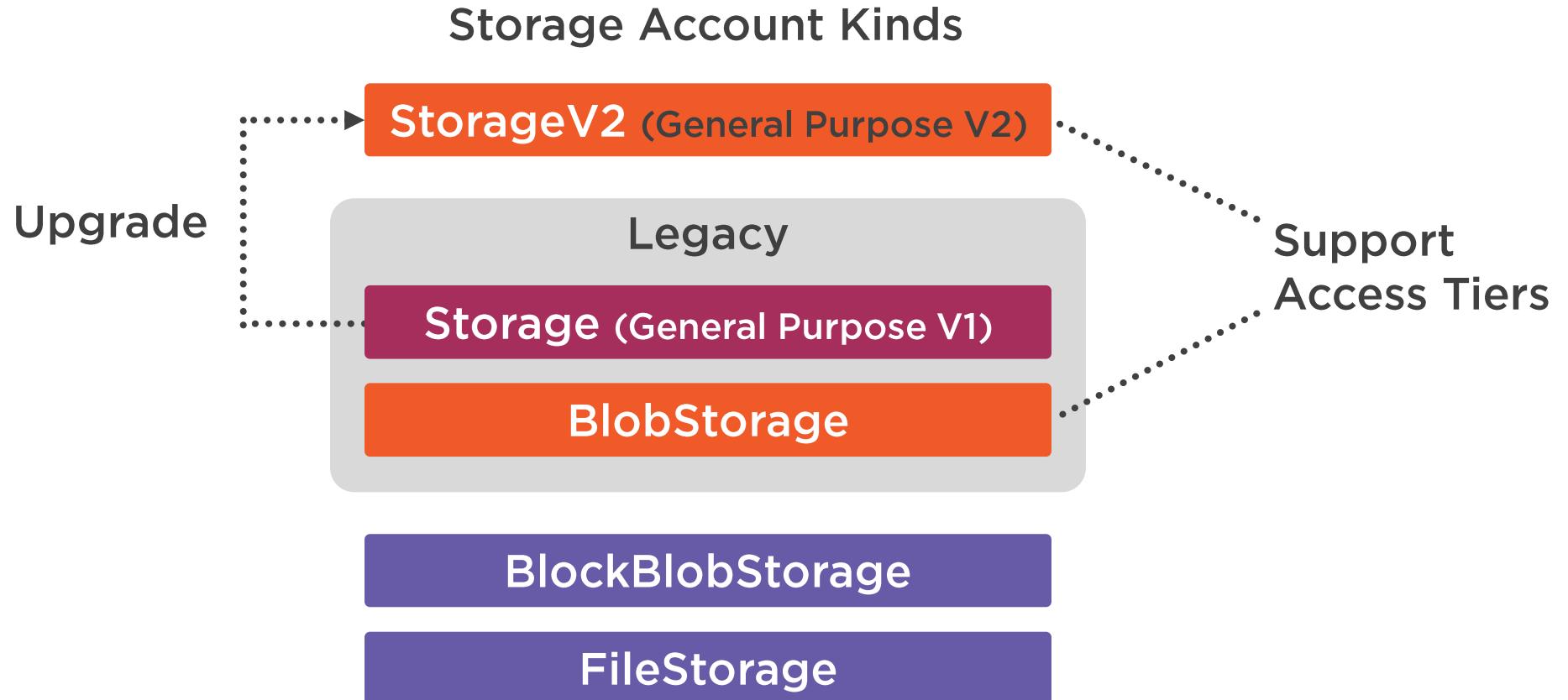
# Understand the Access Tiers for Block Blobs



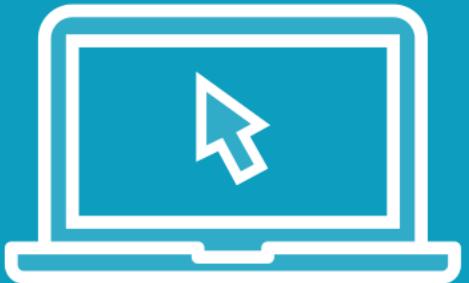
# Understand the Access Tiers for Block Blobs



# Understand the Access Tiers for Block Blobs



Demo



**Set the access tier of a Blob  
in the Azure Portal**



```
await blobClient.SetAccessTierAsync(AccessTier.Cool);
```

Set the Access Tier of a Block Blob

**Use .NET**

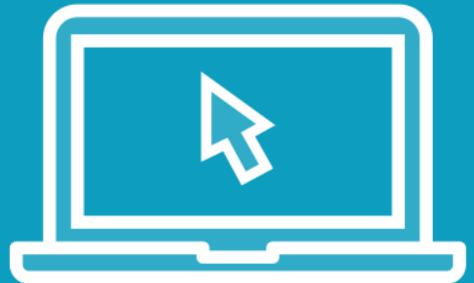


```
az storage blob set-tier  
  --account-key 1234567890  
  --account-name storagepluralsight01  
  --container-name images  
  --name thomas.jpg  
  --tier Cool
```

Set the Access Tier of a Block Blob  
**Use Azure CLI**



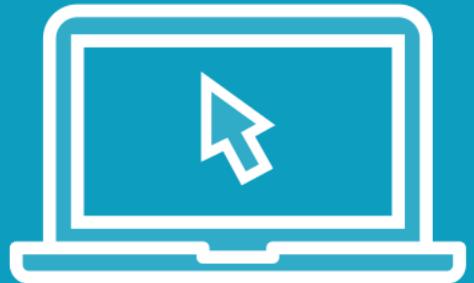
# Demo



**Manage the Blob lifecycle  
with rules**



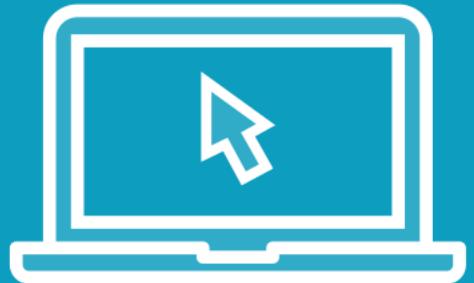
Demo



**Turn on soft delete for Blobs**



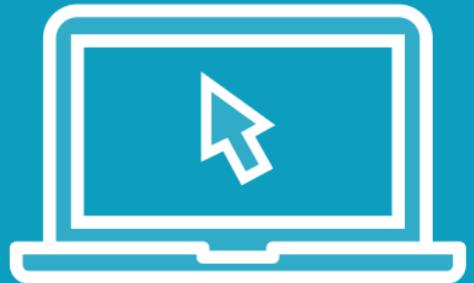
Demo



**Understand snapshots and versions**



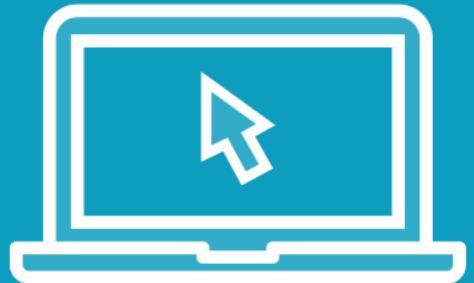
Demo



Work with leases



Demo



**Work with immutable Blob Storage**



Next up

---

Moving Items between  
Storage Accounts and Containers



# Moving Items between Storage Accounts and Containers

---



**Thomas Claudius Huber**

SOFTWARE DEVELOPER

@thomasclaudiush [www.thomasclaudiushuber.com](http://www.thomasclaudiushuber.com)



# Move Items in Blob Storage



**Copy items  
from source  
to target**



**Delete the source**



# Tools to Copy Items in Blob Storage

Azure CLI

AzCopy

.NET client library



# Copy a Blob with the Azure CLI

```
az storage blob copy start  
  --source-account-name storagepluralsight01  
  --source-account-key 00000000  
  --source-container images  
  --source-blob thomas.jpg  
  --account-name storagepluralsight02  
  --account-key 00000000  
  --destination-container pictures  
  --destination-blob thomas.jpg
```



# Copy a Container with the Azure CLI

```
az storage blob copy start-batch  
  --source-account-name storagepluralsight01  
  --source-account-key 00000000  
  --source-container images  
  
  --account-name storagepluralsight02  
  --account-key 00000000  
  --destination-container pictures
```



# AzCopy Command-line Utility

```
azcopy copy  
" <source-path>"  
" <target-path>"
```



# AzCopy Command-line Utility

```
azcopy copy  
" <source-path>"  
" <target-path>"  
--recursive=true
```



# Upload a Local Folder

```
azcopy copy
```

```
"C:\Documents" ← Prefixes blobs with "Documents"
```

```
"https://storagepluralsight01.blob.core.windows.net/  
[container]?[SAS]"
```

```
--recursive=true
```



# Upload a Local Folder

```
azcopy copy
```

```
"C:\Documents\*"
```



Does NOT prefix blobs with "Documents"

```
"https://storagepluralsight01.blob.core.windows.net/  
[container]?[SAS]"
```

```
--recursive=true
```



# Copy a Single Blob

```
azcopy copy
```

```
"https://storagepluralsight01.blob.core.windows.net/  
[container]/[blob]?[SAS]"
```

```
"https://storagepluralsight02.blob.core.windows.net/  
[container]/[blob]?[SAS]
```



# Copy Blobs between Containers

```
azcopy copy
```

```
"https://storagepluralsight01.blob.core.windows.net/  
[container]?[SAS]"
```

```
"https://storagepluralsight02.blob.core.windows.net/  
[container]?[SAS]"
```

```
--recursive=true
```



# Copy Containers between Storage Accounts

```
azcopy copy
```

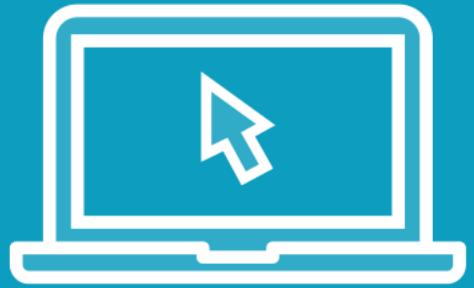
```
"https://storagepluralsight01.blob.core.windows.net/  
?[SAS]"
```

```
"https://storagepluralsight02.blob.core.windows.net/  
?[SAS]
```

```
--recursive=true
```



Demo



**Copy Blobs with AzCopy**



## What's Next?



### Develop solutions that use Blob Storage

- Interact with data using the appropriate SDK
- Set and retrieve properties and metadata
- Implement data archiving and retention
- Implement hot, cool, and archive storage
- Move items in Blob Storage between storage accounts or containers

**Take the next course in the AZ-204 path**



# Microsoft Azure Developer: Develop Solutions with Blob Storage



**Thomas Claudius Huber**

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# Exam Alert: Develop for Azure Storage

---

## PREPARING FOR THE EXAM



**David Tucker**  
TECHNICAL ARCHITECT & CTO CONSULTANT  
 @\_daviddtucker\_ [daviddtucker.net](http://daviddtucker.net)

# Objectives for the Exam

---

# Develop for Azure Storage

**15-20%**

**Develop Solutions that Use  
Cosmos DB Storage**

**Develop Solutions that use  
Blob Storage**

# Develop Solutions that Use Cosmos DB Storage

- Select the appropriate API and SDK for a solution**
- Implement partitioning schemes and partition keys**
- Perform operations on data and Cosmos DB containers**
- Set the appropriate consistency level for operations**
- Manage change feed notifications**

# Develop Solutions that use Blob Storage

- Move items in Blob Storage between storage accounts or containers**
- Set and retrieve properties and metadata**
- Perform operations on data by using the appropriate SDK**
- Implement storage policies, and data archiving and retention**

# Review Solutions that Use Cosmos DB Storage

---

## Cosmos DB Areas of Focus

**Be able to select an API for Cosmos DB based on scenario**

**Be able to select a consistency level for Cosmos DB based on a scenario**

**Understand server-side execution code (triggers, stored procedures, UDF's, change feed notifications)**

**Understand how to implement a partition key strategy for a scenario and keys to use**

**Select redundancy options based on a scenario**

# Supported Cosmos DB API's

**SQL**

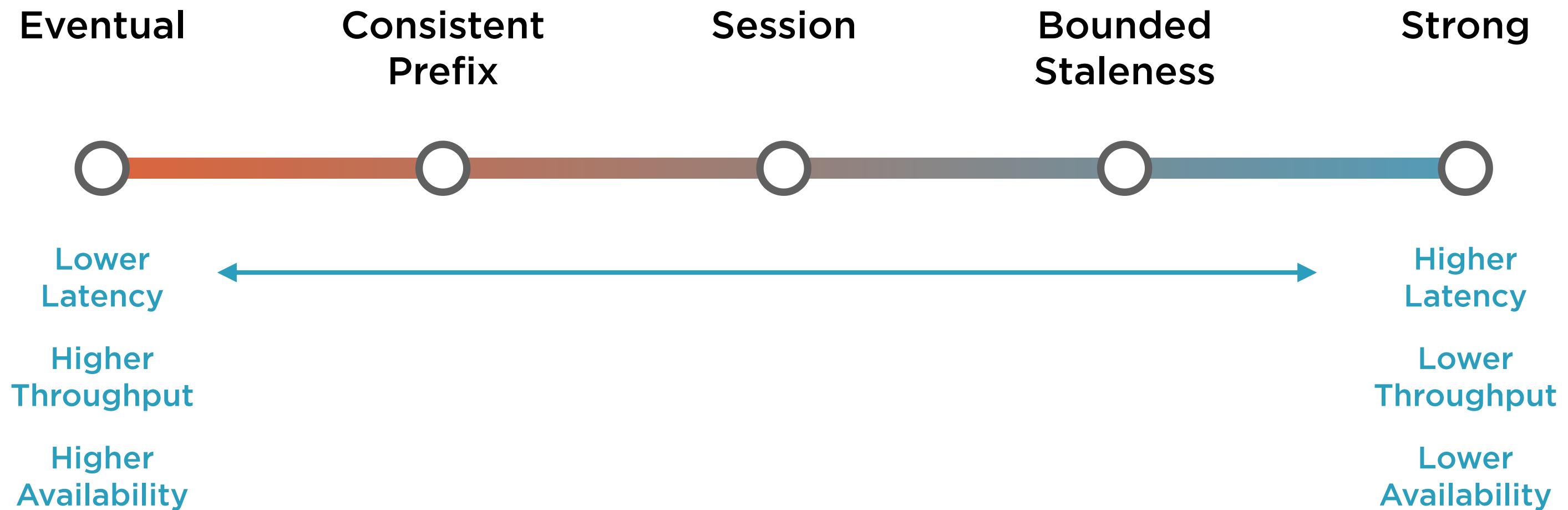
**Cassandra**

**MongoDB**

**Gremlin**

**Azure Table**

# Consistency Level Spectrum



# Cosmos DB Server-side Concepts

**Stored Procedures**

**Triggers**

**User Defined  
Functions (UDF's)**

**Change Feed**

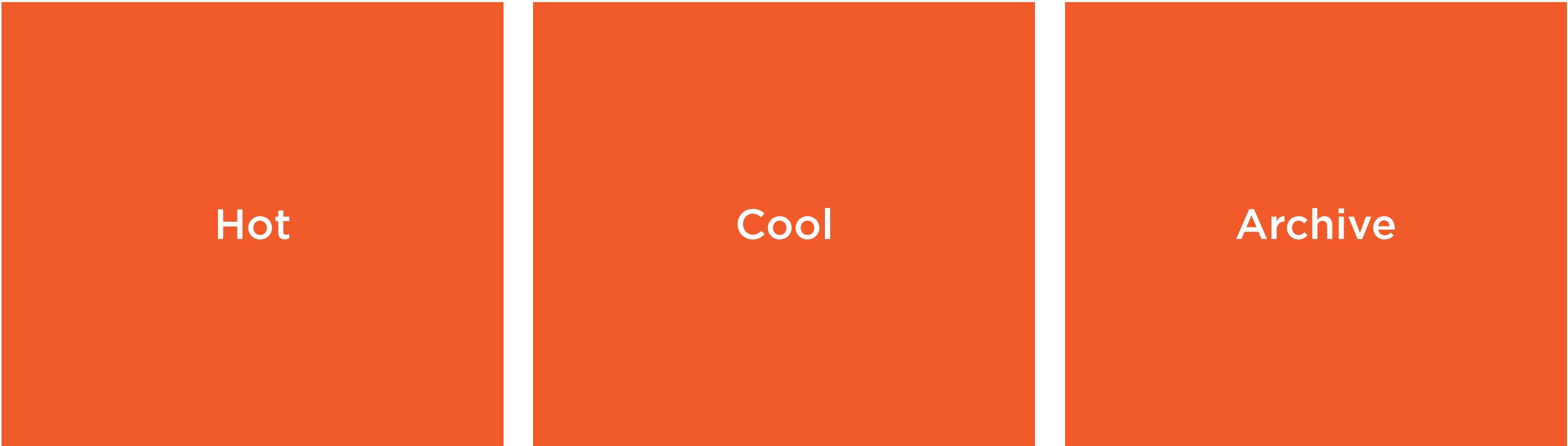
# Review Solutions that Use Blob Storage

---

## Blob Storage Areas of Focus

- Know steps for copying data between storage accounts
- Review differences between V1 and V2 storage account
- Examine capabilities of change feed notifications for blob storage
- Understand archive lifecycle and data access tiers
- Apply knowledge of data redundancy options to scenarios

# Data Access Tiers



Hot

Cool

Archive

# Data Rehydration Priorities



**Standard Priority**



**High Priority**

# Data Redundancy

**Locally Redundant  
Storage (LRS)**

**Zone-redundant  
Storage (ZRS)**

**Geo-redundant  
storage (GRS)**

**Geo-zone-redundant  
Storage (GZRS)**

**Read-access  
Geo-redundant  
Storage (RA-GRS)**

**Read-access  
Geo-zone-redundant  
Storage (RA-GZRS)**

# Additional Areas to Review

Using AZCopy

Migrating from  
V1 to V2

Triggering Azure  
Functions

Rehydration  
Duration

## Example Scenarios

---

## Scenario 1



**Sylvia's company is building a new internal app on Azure**

**She will be storing all application data in Cosmos DB using the SQL API**

**Based on requirements, most recent writes must always be read**

**What should Sylvia set as the default consistency level for the container?**

## Scenario 2



**Edward has created a document processing service for his company**

**There is a rule to move documents into archive storage after 180 days**

**He has now been requested to retrieve a group of documents from the archive**

**What amount of time will it take Edward to retrieve the documents?**

## Scenario 3



**Cindy's company works with sensitive data that is stored in Blob Storage**

**The account is a general purpose V2 storage account**

**She wants to record any modifications to the data or its metadata**

**She needs to be sure that this information is processed in order**

**How would she best achieve this?**

## Scenario 4



**William's company currently runs a fantasy football platform**

**He is currently storing all of their app data in Cosmos DB using the SQL API**

**It is essential that users do not see player trade data out of order**

**What is the most cost effective consistency level for William?**

## Scenario 5



**Oscar's company sells a collection of products for home maintenance**

**Oscar has been tasked with building a product recommendation engine**

**He is planning to leverage Cosmos DB to store purchases**

**Which API should Oscar leverage with Cosmos DB for this solution?**

## Scenario 6



**James's company is building a workflow tool for their manufacturing facilities**

**They plan to store workflow data in Cosmos DB with the SQL API**

**James wants to be sure that he reads writes that are no older than 10 seconds**

**Which default consistency level should he set for the database?**

## Scenario 7



**Elaine's company performs ML analysis on media files**

**They are moving to Azure from their own data centers**

**Their data strategy requires that files are replicated in multiple physical regions**

**What is the most cost effective data redundancy approach that meets this?**

# Scenario Answers

---

# Scenario 1



**Sylvia's company is building a new internal app on Azure**

**She will be storing all application data in Cosmos DB using the SQL API**

**Based on requirements, most recent writes must always be read**

**What should Sylvia set as the default consistency level for the container?**

**Solution: Strong consistency**

## Scenario 2



**Edward has created a document processing service for his company**

**There is a rule to move documents into archive storage after 180 days**

**He has now been requested to retrieve a group of documents from the archive**

**What amount of time will it take Edward to retrieve the documents?**

**Solution:** In most cases it will take between 1 and 15 hours with standard priority. High priority may take longer than an hour.



## Scenario 3

**Cindy's company works with sensitive data that is stored in Blob Storage**

**The account is a general purpose V2 storage account**

**She wants to record any modifications to the data or its metadata**

**She needs to be sure that this information is processed in order**

**How would she best achieve this?**

**Solution: Change feed support in Azure Blob Storage**

## Scenario 4



**William's company currently runs a fantasy football platform**

**He is currently storing all of their app data in Cosmos DB using the SQL API**

**It is essential that users do not see player trade data out of order**

**What is the most cost effective consistency level for William?**

**Solution: Consistent Prefix**

## Scenario 5



**Oscar's company sells a collection of products for home maintenance**

**Oscar has been tasked with building a product recommendation engine**

**He is planning to leverage Cosmos DB to store purchases**

**Which API should Oscar leverage with Cosmos DB for this solution?**

**Solution: Gremlin (graph database)**

## Scenario 6



James's company is building a workflow tool for their manufacturing facilities

They plan to store workflow data in Cosmos DB with the SQL API

James wants to be sure that he reads writes that are no older than 10 seconds

Which default consistency level should he set for the database?

**Solution: Bounded staleness (10 second interval)**

## Scenario 7



**Elaine's company performs ML analysis on media files**

**They are moving to Azure from their own data centers**

**Their data strategy requires that files are replicated in multiple physical regions**

**What is the most cost effective data redundancy approach that meets this?**

**Solution: Geo-Redundant Storage (GRS)**

# Microsoft Azure Developer: Implement User Authentication and Authorization

---

## SECURE AZURE STORAGE



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# Overview



## Ways to Secure Azure Storage

**RBAC and Azure Storage**

**Shared Access Signatures and Stored Access Policies**

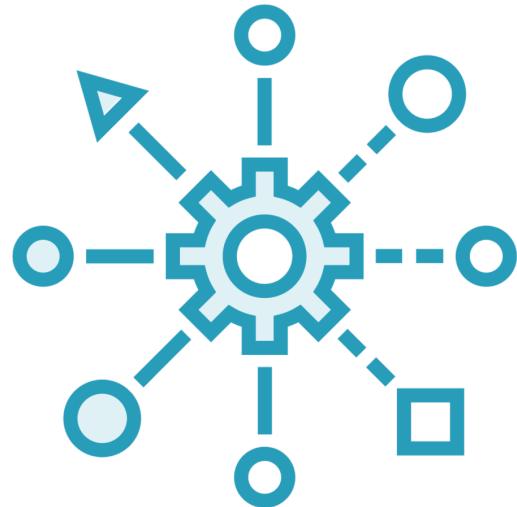


# Ways to Secure Azure Storage

---



# Securing Azure Storage



Management Plane



Data Plane



Encryption



# Management Plane: RBAC



```
[  
  {  
    "assignableScopes": [  
      "/"  
    ],  
    "description": "Lets you manage storage accounts, including accessing storage acc  
"id": "/subscriptions/99c78eeb-0693-461b-918e-f12d39f84b83/providers/Microsoft.Au  
"name": "17d1049b-9a84-46fb-8f53-869881c3d3ab",  
    "permissions": [  
      {  
        "actions": [  
          "Microsoft.Authorization/*/read",  
          "Microsoft.Insights/alertRules/*",  
          "Microsoft.Insights/diagnosticSettings/*",  
          "Microsoft.Network/virtualNetworks/subnets/joinViaServiceEndpoint/action",  
          "Microsoft.ResourceHealth/availabilityStatuses/read",  
          "Microsoft.Resources/deployments/*",  
          "Microsoft.Resources/subscriptions/resourceGroups/read",  
          "Microsoft.Storage/storageAccounts/*",  
          "Microsoft.Support/*"  
        ],  
        "dataActions": [],  
        "notActions": [],  
        "notDataActions": []  
      },  
      {"roleName": "Storage Account Contributor",  
       "roleType": "BuiltInRole",  
       "type": "Microsoft.Authorization/roleDefinitions"  
     }  
  }  
]
```

Role Definition



# Role Assignment

**Attach role definition to a security principal on a scope**

**Example:**

Sahil (security principal) is attached  
“Storage account contributor” (role definition)  
to “storage account sahilstorage123” (scope)

**Multiple role assignments are additive**

**Deny assignments can block access**

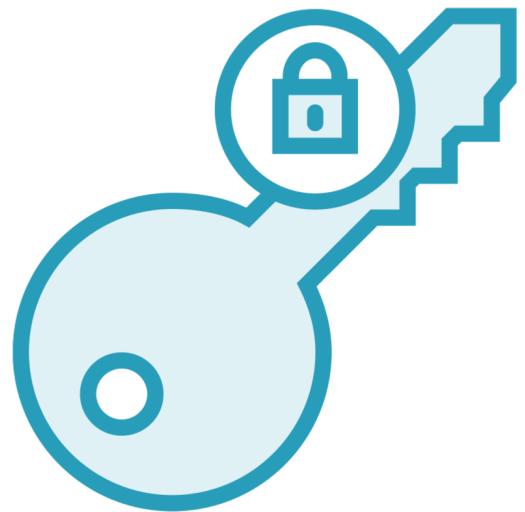
Security  
Principal

Role Definition

Scope



# Data Plane



Keys



Shared Access  
Signature



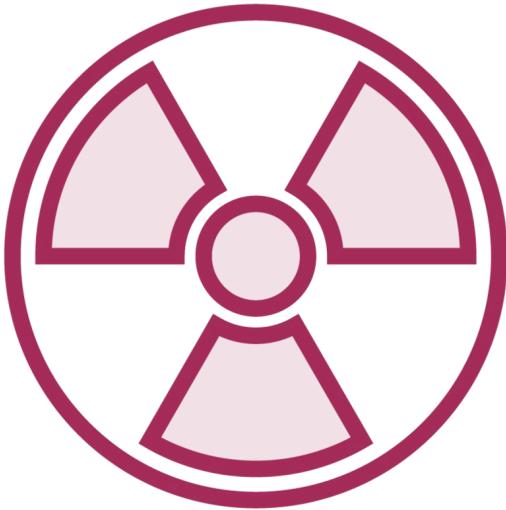
Azure AD



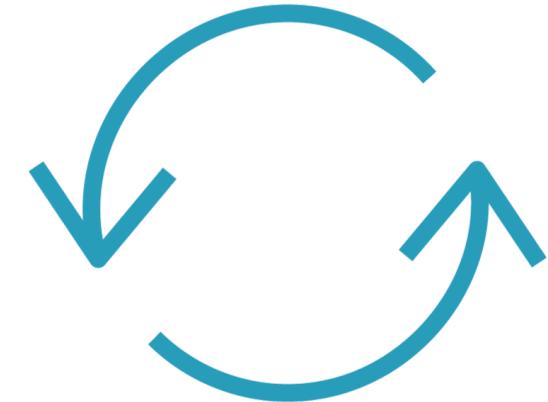
# Storage Account Access Keys



A Pair



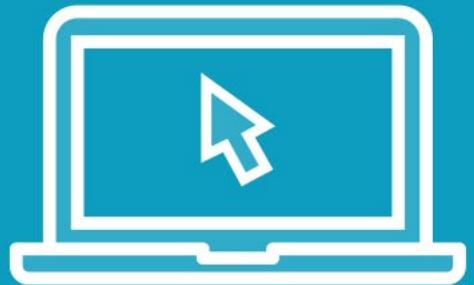
Root



Rotate



Demo



## RBAC in Azure Storage



# Shared Access Signatures

---



# Shared Access Signatures (SAS)

Secure, delegated access, without sharing they key.

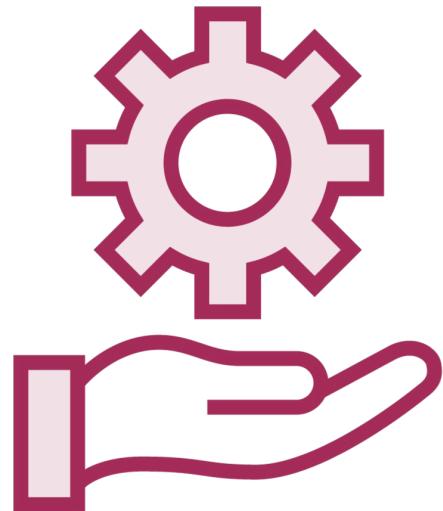
Control what the clients access, for how long, etc.



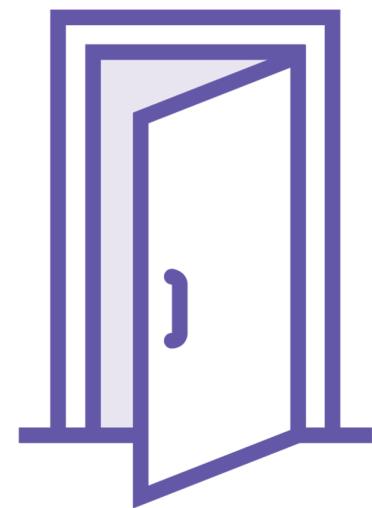
# Shared Access Signature



User delegation SAS



Service SAS



Account SAS



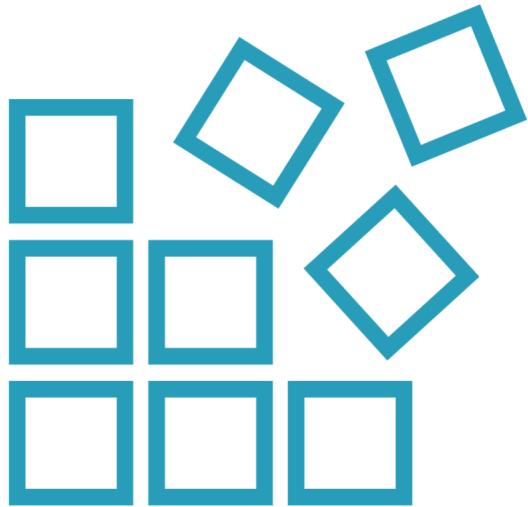
# A Typical SAS token

|                                    |  |
|------------------------------------|--|
| URL                                | <code>https://sahilstorage123.blob.core.windows.net/?</code>                           |
| signedVersion                      | <code>sv=2019-12-12&amp;</code>  |
| signedServices                     | <code>ss=bfqt&amp;</code>  |
| signedResourceType                 | <code>srt=s&amp;</code>  |
| signedPermission                   | <code>sp=rwdlacupx&amp;</code>   |
| signedExpiry<br>and<br>SignedStart | <code>se=2020-10-19T12:50:12Z&amp;</code><br><code>st=2020-10-19T04:50:12Z&amp;</code> |
| signedProtocol                     | <code>spr=https&amp;</code>  |
| signature                          | <code>sig=dXxX3I%2F1LdINzu9oLUOixzgESdIVhXNXIgTszZLv%2B28%3D</code>                    |

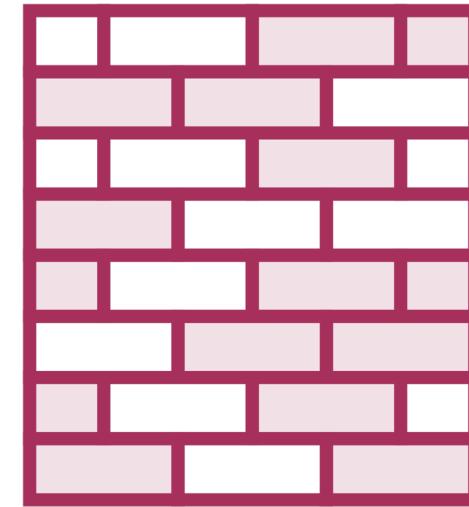
```
StringToSign = accountname + "\n" +
    signedpermissions + "\n" +
    signedservice + "\n" +
    signedresourcetype + "\n" +
    signedstart + "\n" +
    signedexpiry + "\n" +
    signedIP + "\n" +
    signedProtocol + "\n" +
    signedversion + "\n"
```



# Kinds of SAS



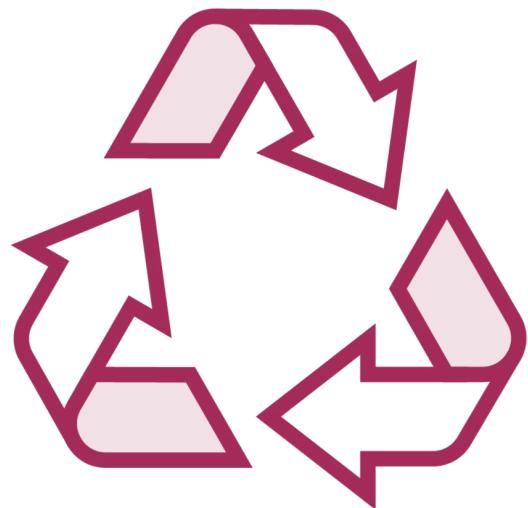
Ad-Hoc



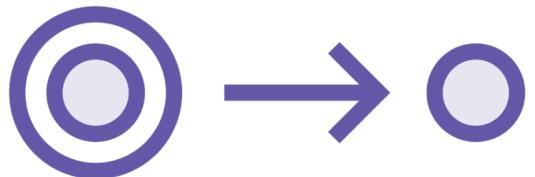
**Service SAS with Stored Access Policy**



# Stored Access Policy



Reused by  
Multiple SAS



Defined on  
Resource  
Container



Permissions &  
Validity Period



Service Level  
SAS only



# Stored Access Policy

<https://sahilstorage123.blob.core.windows.net/?>

sv=2019-12-12&

ss=bfqt&

srt=s&

sp=rwdlacupx&

se=2020-10-19T12:50:12Z&

st=2020-10-19T04:50:12Z&

spr=https&

sig=dXxX3I%2F1LdINzu9oLUOixzgESdIVhXNXIgTszZLv%2B28%3D

<https://sahilstorage123.blob.core.windows.net/?>

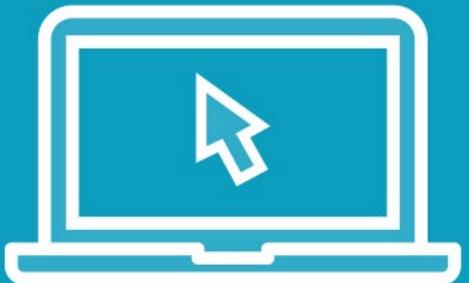
sr=c&

si=mypolicy&

sig=dXxX3I%2F1LdINzu9oLUOixzgESdIVhXNXIgTszZLv%2B28%3D



Demo



**Manage SAS based security for Azure Storage**



# Additional Resources

**Microsoft Azure Security Engineer: Configure Security for Storage**



# Summary



## Ways to Secure Azure Storage

**RBAC and Azure Storage**

**Shared Access Signatures and Stored Access Policies**



# Authenticate Using Azure AD

---



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# Important Concepts



## The Microsoft Identity Platform Modern Authentication

### Demo

- Register an App in Azure AD
- Authenticate Using Azure AD

### Additional Resources



# The Microsoft Identity Platform

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# The Microsoft Identity Platform

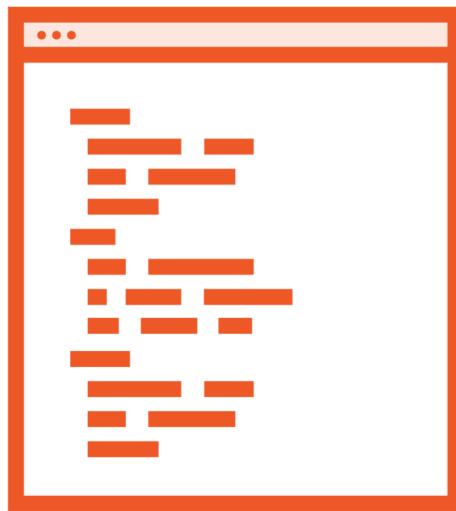
The Microsoft identity platform is an authentication service, open-source libraries, and application management tools.



# The Microsoft Identity Platform



Authentication Service



Open-Source Libraries



Application  
Management Tools

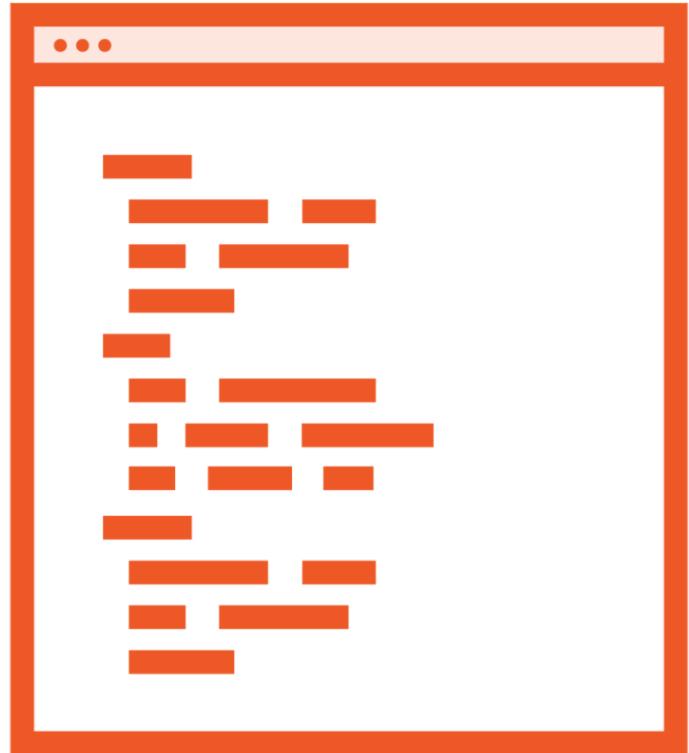




## Authentication Service

- Azure Active Directory
  - Azure AD Connect
  - ADFS
  - So much more..





## Open Source Libraries

- MSAL
- Microsoft.Identity.Web
- Open ID connect





## Application Management

- Gallery and non gallery apps
- Single Tenant and Multi Tenant apps
- Authorization
- Consent
- Logs
- And much more ..

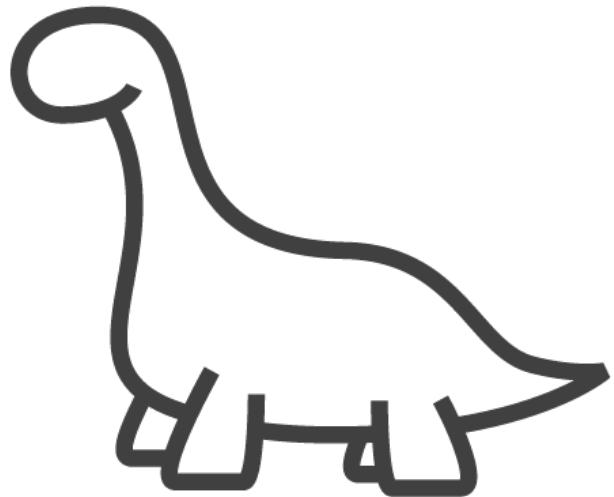


# Modern Authentication

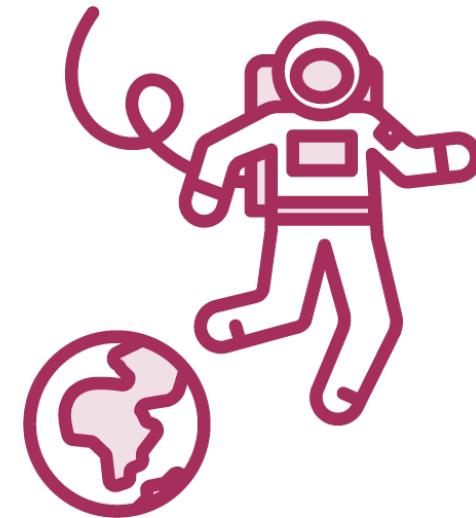
---



# Identity



Legacy



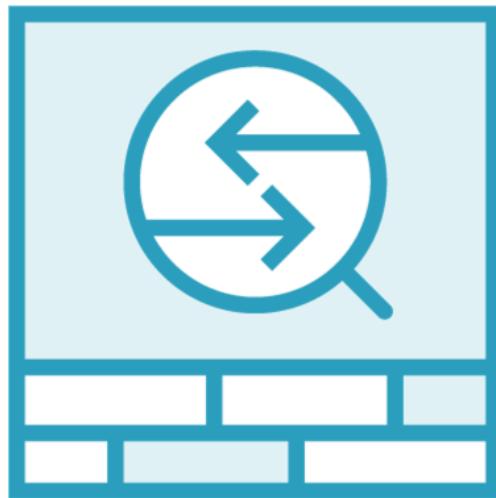
Modern



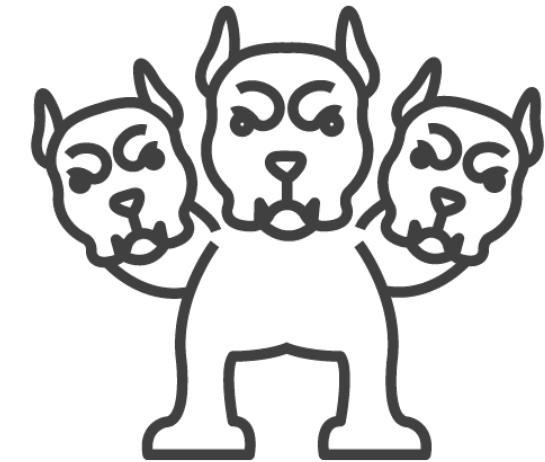
# Legacy



Basic



NTLM



Kerberos



# Modern Authentication



WS-\* and SAML



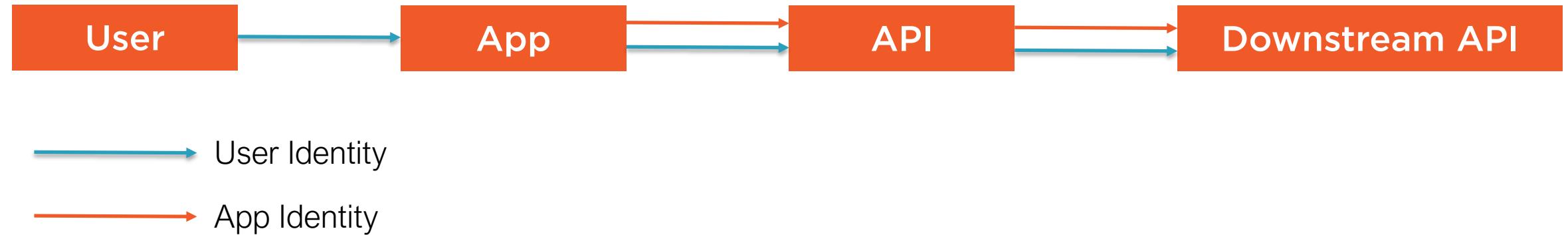
OAuth



OpenID Connect



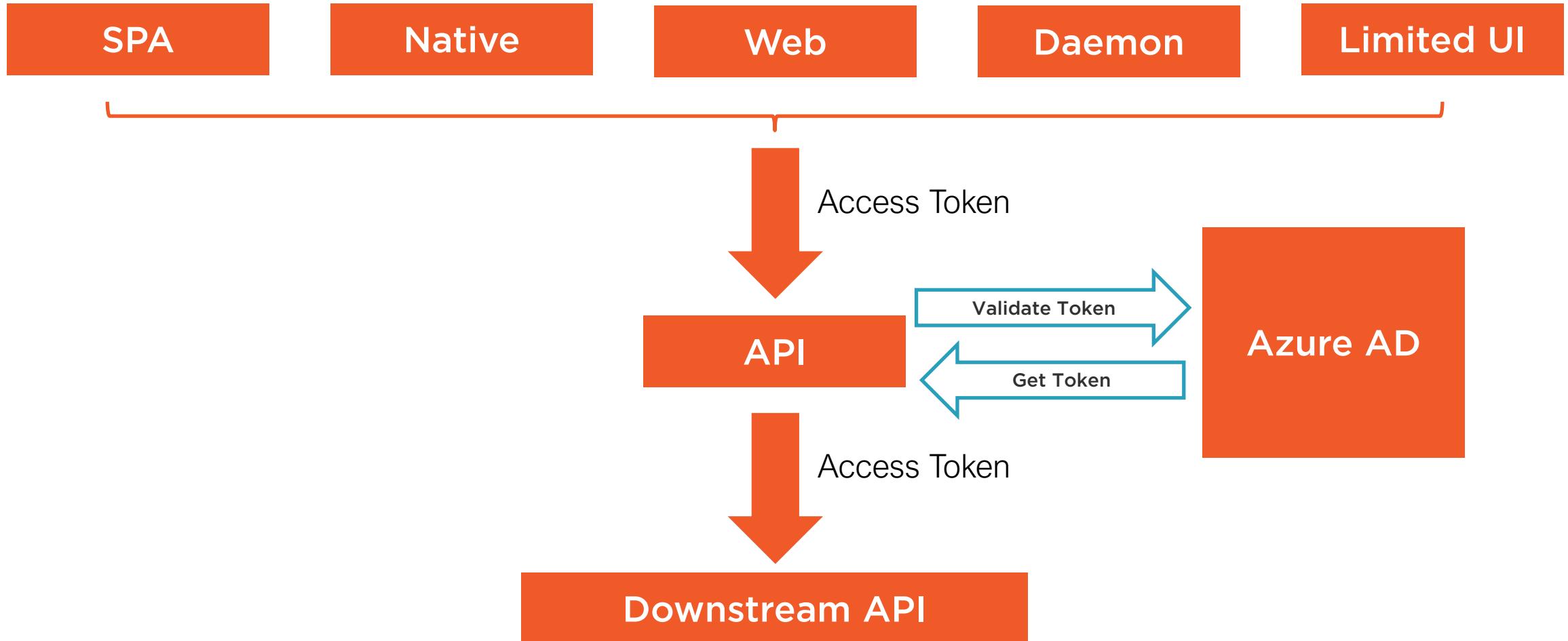
# Open ID Connect



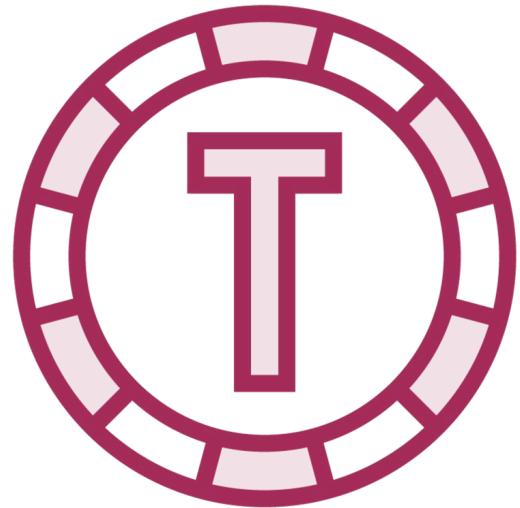
# OpenID Connect (App)



# OpenID Connect (API)



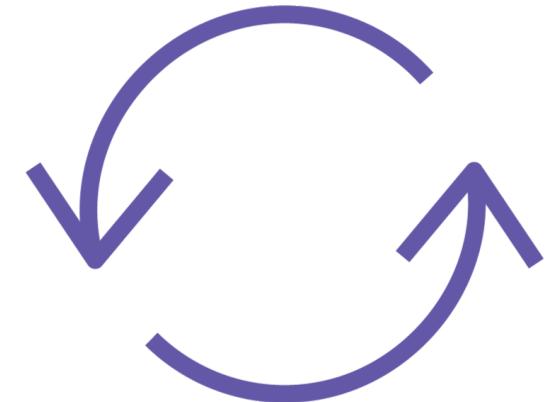
# Open ID Connect Tokens



Access Token



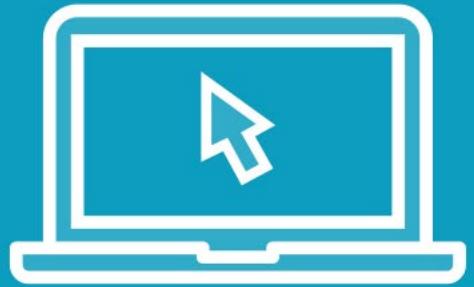
ID Token



Refresh Token



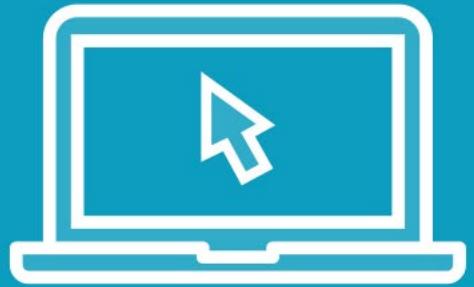
Demo



[Register an App in Azure AD](#)



Demo



**Authenticate Using Azure AD**



# Additional Resources

---



# Additional Resources

[Getting Started with Azure Active Directory for Developers](#)

[Microsoft Azure for Node.js Developers - Building Secure Services and Applications](#)

[Building Authorization in Azure Active Directory for Developers](#)

[Developing Web Applications and Web APIs Protected by Azure Active Directory](#)

[Developing Daemons and Services Protected by Azure Active Directory](#)

[Microsoft Azure Authentication Scenarios for Developers](#)



# Summary



## The Microsoft Identity Platform Modern Authentication

### Demo

- Register an App in Azure AD
- Authenticate Using Azure AD

### Additional Resources



# Authorization Using Azure AD

---



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@sahilmalik



# Important Concepts



## What Is Authorization?

### Demos

- App
- User

### Summary



# What Is Authorization?

---



# Authorization

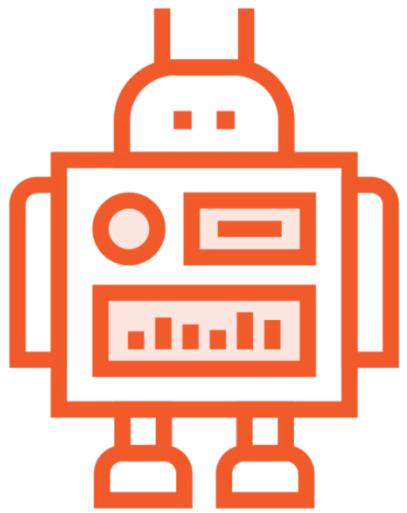
What you can do



Do not overengineer  
authorization



# Entities



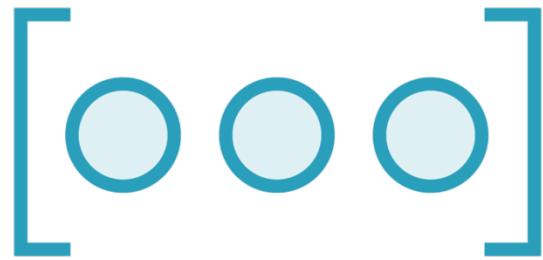
App



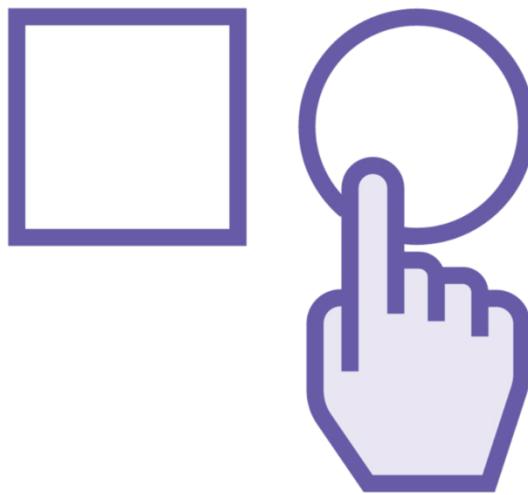
User



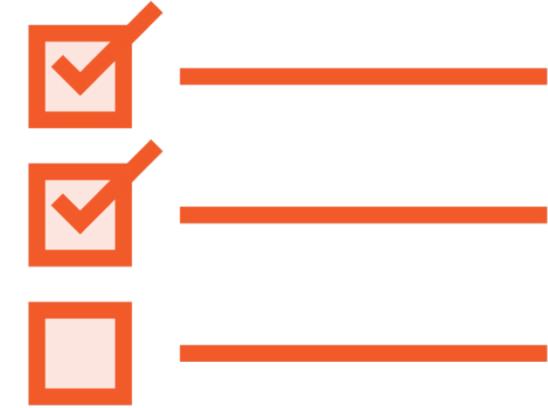
# Authorization



Groups



Custom Claims



App Roles



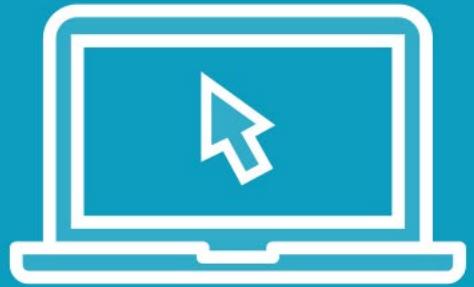
Demo



## Apps – Groups Based Authorization



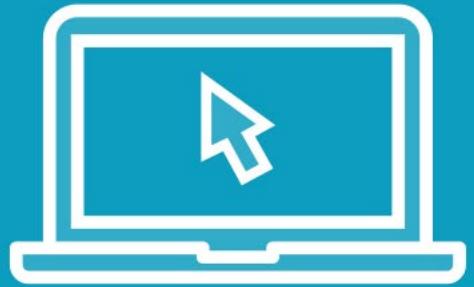
Demo



## Apps – Custom Claims



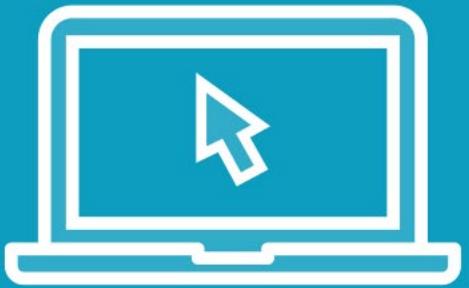
Demo



## Apps – App Roles



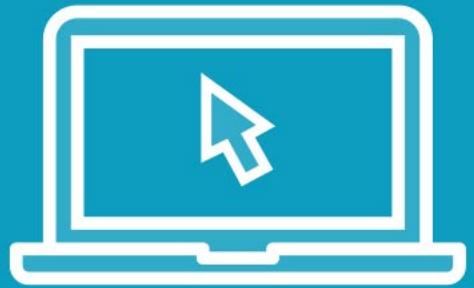
Demo



User - Groups Based Authorization



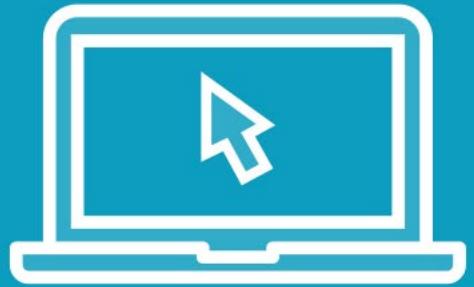
Demo



## User - Custom Claims



Demo



User - App Roles



# Summary



## What Is Authorization?

### Demos

- App
- User

### Summary



# Microsoft Azure Developer: Implement Secure Cloud Solutions

---

IMPLEMENT SOLUTIONS THAT INTERACT WITH  
MICROSOFT GRAPH



**Reza Salehi**  
CLOUD CONSULTANT

@zaalion



# Overview



**Introduction to Microsoft Graph**

**Using Microsoft Graph**

**Demo: Graph Explorer**

**Demo: Use Microsoft Graph in a .NET app**

- Using the Graph .NET SDK



# Introducing Microsoft Graph

---



# Microsoft Graph

Microsoft Graph is the gateway to data and intelligence in Microsoft 365, Windows 10 and Enterprise Mobility + Security.



# Microsoft Graph Can Work With

Office 365

Windows 10

Enterprise  
Mobility + Security

Excel

Calendar

Mail



# Microsoft Graph

Provides a unified programming model that you can use to access data in Microsoft 365, Windows 10, and Enterprise Mobility + Security.



Treat Office 365 information as  
data, query it and write to it!



Filter by title

Microsoft Graph documentation

## Explore

**Overview of Microsoft Graph**

Services in Microsoft Graph

## What's new

What's new highlights

API changelog

## &gt; Users you can reach

Microsoft Graph data connect

## &gt; Tutorials

Versioning and support

Terms of use

## Learn

Users

Groups

## &gt; Applications

## &gt; Calendar

## &gt; Cloud communications

Compliance (preview)

## &gt; Cross-device experiences

Customer booking (preview)

## &gt; Data access

## Devices and apps

Active Directory, Identity Manager, and Intune.

- Windows 10 services: activities, devices, notifications, Universal Print.
- Dynamics 365 Business Central.

Is this page helpful?

Yes   No

## In this article

Data and services powering the Microsoft 365 platform

## What's in Microsoft Graph?

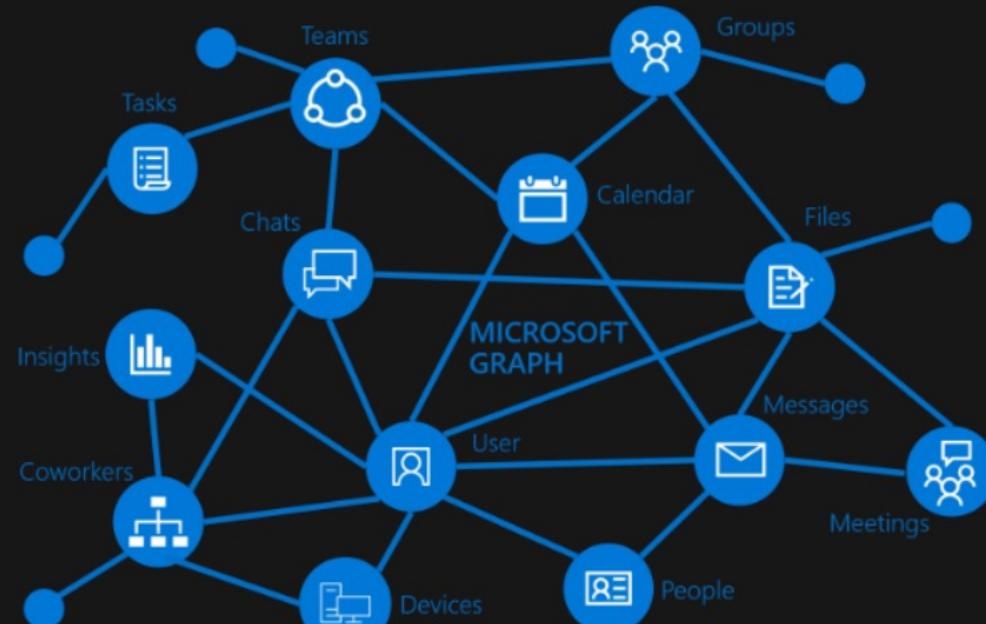
What can you do with Microsoft Graph?

Bring data from an external content source to Microsoft Graph (preview)

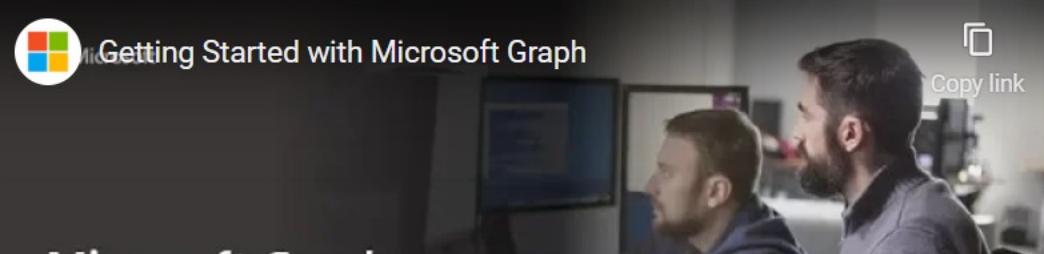
Access Microsoft Graph data at scale using Microsoft Graph data connect

When should I use Microsoft Graph API or data connect?

Next steps



## What can you do with Microsoft Graph?



# Microsoft Graph



Use a single endpoint, <https://graph.microsoft.com>, to access data and insights in the Microsoft cloud



Including Microsoft 365, Windows 10, and Enterprise Mobility + Security.



Use REST APIs or SDKs to access the endpoint and build apps that support Microsoft 365 scenarios



# Microsoft Graph

**Microsoft 365 core services**

**Enterprise Mobility + Security  
services**

**Windows 10 services**

**Dynamics 365 Business  
Central**



# Microsoft 365 Core Services

Bookings

Teams

OneDrive

OneNote

Outlook and  
Exchange

SharePoint



# Enterprise Mobility + Security Services

**Advanced Threat  
Analytics**

**Advanced Threat  
Protection**

**Azure Active  
Directory, Identity  
Manager, and  
Intune**



# Windows 10 Services

**Activities**

**Devices**

**Notifications**

**Universal Print**



# Dynamics 365 Business Central

**Management of financial data**

**Automation and securing of the supply chain**

**Sales management**

**Management of projects**

**Optimization of operations**

**Improved customer service**



# You Can Develop an App Which



**Looks at your next meeting and provides profile information of the attendees**



**Scans your calendar, and suggests time slots for the next meeting**



**Creates an automated bot for Microsoft Teams**



**Subscribes to changes in your calendar, sends an alert when you're spending too much time in meetings**



Filter by title

Microsoft Graph documentation

## Explore

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Microsoft Graph data connect

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Versioning and support

Terms of use

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Groups

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## &gt; Cloud communications

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## &gt; Cross-device experiences

Customer booking (preview)

## &gt; Data access

## Devices and apps

## Popular API requests

Check out some of these common scenarios for working with the Microsoft Graph API. The links take you to the [Graph Explorer](#).

| Operation                              | URL   |
|--|---|
| GET my profile                         | <a href="https://graph.microsoft.com/v1.0/me">https://graph.microsoft.com/v1.0/me</a>   |
| GET my files                           | <a href="https://graph.microsoft.com/v1.0/me/drive/root/children">https://graph.microsoft.com/v1.0/me/drive/root/children</a>   |
| GET my photo                           | <a href="https://graph.microsoft.com/v1.0/me/photo/\$value">https://graph.microsoft.com/v1.0/me/photo/\$value</a>   |
| GET my mail                            | <a href="https://graph.microsoft.com/v1.0/me/messages">https://graph.microsoft.com/v1.0/me/messages</a>   |
| GET my high importance email           | <a href="https://graph.microsoft.com/v1.0/me/messages?\$filter=importance%20eq%20'high'">https://graph.microsoft.com/v1.0/me/messages?\$filter=importance%20eq%20'high'</a>   |
| GET my calendar events                 | <a href="https://graph.microsoft.com/v1.0/me/events">https://graph.microsoft.com/v1.0/me/events</a>   |
| GET my manager                         | <a href="https://graph.microsoft.com/v1.0/me/manager">https://graph.microsoft.com/v1.0/me/manager</a>   |
| GET last user to modify file foo.txt   | <a href="https://graph.microsoft.com/v1.0/me/drive/root/children/foo.txt/lastModifiedByUser">https://graph.microsoft.com/v1.0/me/drive/root/children/foo.txt/lastModifiedByUser</a>   |
| GET Microsoft 365 groups I'm member of | <a href="https://graph.microsoft.com/v1.0/me/memberOf/\$/microsoft.graph.group?&amp;\$filter=groupTypes/any(a:a%20eq%20'unified')">https://graph.microsoft.com/v1.0/me/memberOf/\$/microsoft.graph.group?&amp;\$filter=groupTypes/any(a:a%20eq%20'unified')</a> |
| GET users in my organization           | <a href="https://graph.microsoft.com/v1.0/users">https://graph.microsoft.com/v1.0/users</a>   |
| GET groups in my organization          | <a href="https://graph.microsoft.com/v1.0/groups">https://graph.microsoft.com/v1.0/groups</a>   |
| GET people related to me               | <a href="https://graph.microsoft.com/v1.0/me/people">https://graph.microsoft.com/v1.0/me/people</a>   |

Is this page helpful?

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## In this article

[Data and services powering the Microsoft 365 platform](#)[What's in Microsoft Graph?](#)[What can you do with Microsoft Graph?](#)[Bring data from an external content source to Microsoft Graph \(preview\)](#)[Access Microsoft Graph data at scale using Microsoft Graph data connect](#)[When should I use Microsoft Graph API or data connect?](#)[Next steps](#)

[Filter by title](#)[Microsoft Graph documentation](#)[Explore](#)[Overview of Microsoft Graph](#)[Services in Microsoft Graph](#)[What's new](#)[What's new highlights](#)[API changelog](#)[Users you can reach](#)[Microsoft Graph data connect](#)[Tutorials](#)[Versioning and support](#)[Terms of use](#)[Learn](#)[Users](#)[Groups](#)[Applications](#)[Calendar](#)[Cloud communications](#)[Compliance \(preview\)](#)[Cross-device experiences](#)[Customer booking \(preview\)](#)[Data access](#)[Devices and apps](#)

# Bring data from an external content source to Microsoft Graph (preview)

Use Microsoft Graph *connectors* to bring data that is external to the Microsoft cloud into Microsoft Graph.

Examples of such data can be an organization's human resources database or product catalog, hosted on-premises or in the public or private clouds.

Microsoft Graph connectors create connections to external data sources, index the data, and store it as external custom items and files. Once indexed, those items can show up in Microsoft Search, and for apps that use the [Microsoft Search API](#).

## Access Microsoft Graph data at scale using Microsoft Graph data connect

Use Microsoft Graph *data connect* to access data on Microsoft Graph at scale, while allowing administrators granular consent and full control over their Microsoft Graph data. Data connect streamlines the delivery of this data to Microsoft Azure.

Using Azure tools, you can then build intelligent apps that:

- Find you the closest expert on a topic to you in your organization
- Automate knowledge base creation
- Analyze meeting requests to provide insights into conference room utilization
- Detect fraud with productivity and communication data

## When should I use Microsoft Graph API or data connect?

[Is this page helpful?](#)[Yes](#)[No](#)

### In this article

[Data and services powering the Microsoft 365 platform](#)[What's in Microsoft Graph?](#)[What can you do with Microsoft Graph?](#)[Bring data from an external content source to Microsoft Graph \(preview\)](#)[Access Microsoft Graph data at scale using Microsoft Graph data connect](#)[When should I use Microsoft Graph API or data connect?](#)[Next steps](#)

# Working with Microsoft Graph

---



Some Microsoft Graph APIs are  
only available with a work, school  
or developer account.



However, you can still test a subset of Graph APIs using free Microsoft accounts.



# Working with Microsoft Graph

**REST APIs**

**SDKs**



Filter by title

Microsoft Graph documentation

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| GET my photo                           | <a href="https://graph.microsoft.com/v1.0/me/photo/\$value">https://graph.microsoft.com/v1.0/me/photo/\$value</a>   |
| GET my mail                            | <a href="https://graph.microsoft.com/v1.0/me/messages">https://graph.microsoft.com/v1.0/me/messages</a>   |
| GET my high importance email           | <a href="https://graph.microsoft.com/v1.0/me/messages?\$filter=importance%20eq%20'high'">https://graph.microsoft.com/v1.0/me/messages?\$filter=importance%20eq%20'high'</a>   |
| GET my calendar events                 | <a href="https://graph.microsoft.com/v1.0/me/events">https://graph.microsoft.com/v1.0/me/events</a>   |
| GET my manager                         | <a href="https://graph.microsoft.com/v1.0/me/manager">https://graph.microsoft.com/v1.0/me/manager</a>   |
| GET last user to modify file foo.txt   | <a href="https://graph.microsoft.com/v1.0/me/drive/root/children/foo.txt/lastModifiedByUser">https://graph.microsoft.com/v1.0/me/drive/root/children/foo.txt/lastModifiedByUser</a>   |
| GET Microsoft 365 groups I'm member of | <a href="https://graph.microsoft.com/v1.0/me/memberOf/\$/microsoft.graph.group?&amp;\$filter=groupTypes/any(a:a%20eq%20'unified')">https://graph.microsoft.com/v1.0/me/memberOf/\$/microsoft.graph.group?&amp;\$filter=groupTypes/any(a:a%20eq%20'unified')</a> |
| GET users in my organization           | <a href="https://graph.microsoft.com/v1.0/users">https://graph.microsoft.com/v1.0/users</a>   |
| GET groups in my organization          | <a href="https://graph.microsoft.com/v1.0/groups">https://graph.microsoft.com/v1.0/groups</a>   |
| GET people related to me               | <a href="https://graph.microsoft.com/v1.0/me/people">https://graph.microsoft.com/v1.0/me/people</a>   |

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## Graph Explorer



Reza S  
zaalion@outlook.com



Sample queries History

Search sample queries

See more queries in the [Microsoft Graph API Reference docs](#).

### Getting Started (8)

GET my profile

GET my profile (beta)

GET my photo

GET my mail

GET all the items in my drive

GET items trending around me

GET my manager

GET my To Do task lists

GET

v1.0

https://graph.microsoft.com/v1.0/me/

Run query

Request body

{}

Request headers

Modify permissions (Preview)

Access token

When you use Microsoft Graph APIs, you agree to the [Microsoft APIs Terms of Use](#). View the [Microsoft Privacy Statement](#).

Response preview

Response headers

Code snippets

Toolkit component

Adaptive cards

Expand

Share

```
{  
    "@odata.context": "https://graph.microsoft.com/v1.0/$metadata#users/$entity",  
    "displayName": "Reza S",  
    "surname": "S",  
    "givenName": "Reza",  
    "id": "ada5975b273ab557",  
    "userPrincipalName": "zaalion@outlook.com",  
    "businessPhones": [],  
    "jobTitle": null,  
    "mail": null,  
    "mobilePhone": null,  
    "officeLocation": null,  
    "preferredLanguage": null  
}
```

# Microsoft Graph SDKs

|            |            |
|------------|------------|
| Android    | Java       |
| Angular    | PHP        |
| ASP.NET    | Python     |
| iOS        | Ruby       |
| JavaScript | PowerShell |
| Node.js    | Azure CLI  |



Microsoft recommends getting a free Microsoft 365 developer subscription by signing up for the Microsoft 365 Developer Program when building applications using Microsoft Graph.



Demo



Graph Explorer



Demo



Using the Graph .NET SDK



# Summary



**Introduction to Microsoft Graph**

**Using Microsoft Graph**

**Demo: Graph Explorer**

**Demo: Using the Graph .NET SDK**



# Manage Keys, Secrets, and Certificates by Using the Key Vault

---



**Reza Salehi**  
CLOUD CONSULTANT  
@zaalion



# Overview



**Implementing and Configuring Azure Key Vault**

**Soft-delete and Purge-protection**

**Azure Key Vault References for Function Apps and App Services**

**Demo: using Azure Key Vault**



# Microsoft Azure Key Vault

---



# Azure Key Vault

Is an Azure service which allows you to securely store and access secrets.



# Azure Key Vault Secret Types

## Keys

Cryptographic keys  
used in other Azure  
services such as  
Azure Disk Encryption

## Secrets

Any sensitive  
information including  
connection strings or  
passwords

## Certificates

x509 certificates used in  
HTTPS/SSL/TLS  
communications  
(encryption in transit)



# Azure Key Vault Pricing Tiers

**Standard**

Software-protected

**Premium**

Standard +  
HSM-protected



# Provisioning Azure Key Vault

Azure Portal

Programmatically  
PowerShell, Azure CLI,  
REST API, ARM





```
New-AzKeyVault -VaultName 'AZ204-Vault'  
-ResourceGroupName 'rg-204' -Location 'East US'
```

Provision Azure Key Vault in PowerShell



[Docs](#)[Documentation](#)[Learn](#)[Q&A](#)[Code Samples](#) Search[Sign in](#)[Azure](#) Product documentation ▾ [Architecture](#) ▾ [Learn Azure](#) ▾ [Develop](#) ▾ [Resources](#) ▾[Portal](#)[Free account](#)[Azure](#) / [Azure Templates](#) / [Key Vault](#) / [Vaults](#)[Bookmark](#) [Share](#)[Filter by title](#)[Latest](#)[Vaults](#)[Vaults/](#)[2019-09-01](#)[2018-02-14](#)[2016-10-01](#)[2015-06-01](#)[Kusto](#)[Logic](#)[Machine Learning](#)[Machine Learning Services](#)[Managed Identity](#)[Managed Network](#)[Management](#)[Maps](#)[MariaDB](#)[Media](#)[Migrate](#)[MySQL](#)

# Microsoft.KeyVault vaults

10/05/2020 • 6 minutes to read •

API Versions: [Latest](#) ▾

## Template format

To create a Microsoft.KeyVault/vaults resource, add the following JSON to the resources section of your template.

JSON

[Copy](#)

```
{  
  "name": "string",  
  "type": "Microsoft.KeyVault/vaults",  
  "apiVersion": "2019-09-01",  
  "location": "string",  
  "tags": {},  
  "properties": {  
    "tenantId": "string",  
    "sku": {  
      "family": "A",  
      "name": "string"  
    },  
    "accessPolicies": [  
      {  
        "tenantId": "string",  
        "objectId": "string",  
        "applicationId": "string",  
        "permissions": {  
          "keys": [  
            "get",  
            "list",  
            "wrapKey",  
            "unwrapKey",  
            "create",  
            "update",  
            "delete",  
            "recover",  
            "purge",  
            "getSecret",  
            "listSecrets",  
            "setSecret",  
            "deleteSecret"  
          ],  
          "certificates": [  
            "get",  
            "list",  
            "create",  
            "update",  
            "delete",  
            "recover",  
            "purge",  
            "getIssuedCertificate",  
            "listIssuedCertificates"  
          ],  
          "secrets": [  
            "get",  
            "list",  
            "set",  
            "delete",  
            "recover",  
            "purge",  
            "getDeleteOperationStatus",  
            "listDeleteOperations"  
          ]  
        }  
      }  
    ]  
  }  
}
```

[Is this page helpful?](#)[Yes](#) [No](#)[In this article](#)[Template format](#)[Property values](#)[Quickstart templates](#)

**Version**

Azure CLI (Latest)

Filter by title

Secrets

**Overview**

backup

delete

download

list

list-deleted

list-versions

purge

recover

restore

set

set-attributes

show

show-deleted

&gt; backup

&gt; network-rule

&gt; private-endpoint-connection

&gt; private-link-resource

&gt; restore

&gt; role

## Global Parameters

Is this page helpful?

Yes No

## In this article

## Commands

az keyvault secret backup

az keyvault secret delete

az keyvault secret download

az keyvault secret list

az keyvault secret list-deleted

az keyvault secret list-versions

az keyvault secret purge

az keyvault secret recover

az keyvault secret restore

**az keyvault secret set**

az keyvault secret set -a attributes

az keyvault secret show

az keyvault secret show-deleted

# az keyvault secret set

Edit

Create a secret (if one doesn't exist) or update a secret in a KeyVault.

Azure CLI

Copy

```
az keyvault secret set --name  
    --vault-name  
    [--description]  
    [--disabled {false, true}]  
    [--encoding {ascii, base64, hex, utf-16be, utf-16le, utf-8}]  
    [--expires]  
    [--file]  
    [--not-before]  
    [--subscription]  
    [--tags]  
    [--value]
```

## Required Parameters

**--name -n**

Name of the secret.

**--vault-name**

Name of the Vault.

# Configuring Authentication for Azure Key Vault

**Option 1**

**Use Azure AD  
App Registration**

**Option 2**

**Use  
Managed Identity**

**Option 3**

**Use Key Vault  
References**



# Demo



## Provisioning an Azure Key Vault resource

- Azure portal
- PowerShell



Demo



## Configuring a client application to use Azure Key Vault

- Managed Identity (formerly MSI)



# Key Vault References for App Service and Azure Functions

---



```
using Azure.Security.KeyVault.Secrets;  
...  
string kvUri = "https://kv-identitydemo-02.vault.azure.net";  
SecretClient client = new SecretClient(new Uri(kvUri), new  
DefaultAzureCredential());  
string secret = client.GetSecretAsync("secretmessage")Result.Value;
```

Code to Read a Key Vault Secret



Use Key Vault references to move  
app setting values to  
Azure Key Vault  
with no code changes.



The screenshot shows the Visual Studio 2019 interface with the following details:

- File Bar:** File, Edit, View, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help.
- Search Bar:** Search (Ctrl+Q)
- Current Project:** KeyVault-func-identity
- Toolbars:** Standard, Debug, Task List, Solution Explorer, Properties, Task List, Live Share.
- Code Editor:** Shows the `local.settings.json` file content:

```
1  {
2      "IsEncrypted": false,
3      "Values": {
4          "AzureWebJobsStorage": "UseDevelopmentStorage=true",
5          "FUNCTIONS_WORKER_RUNTIME": "dotnet",
6          "SecretPass" : "Password!@#"
7      }
8 }
```
- Solution Explorer:** Displays the solution structure:
  - Solution 'KeyVault-func-identity' (1 of 1 p)
  - KeyVault-func-identity
    - Connected Services
    - Dependencies
    - Properties
    - .gitignore
    - host.json
    - KVReferences.cs
    - local.settings.json
    - ShowSecretMessage.cs
- Status Bar:** Visual Studio 2019 update, Version 16.7.6 is downloaded and ready to install.
- Bottom Navigation:** Ready, Add to Source Control, Notifications (4).

## Microsoft Azure

Search resources, services, and docs (G+/-)

[Home](#) > [Key vaults](#) > kv-app-sec-demo | Secrets[Create a resource](#)[Home](#)[Dashboard](#)[All services](#)[FAVORITES](#)[Resource groups](#)[Storage accounts](#)[Key vaults](#)[Function App](#)[Network security groups](#)[SQL databases](#)[Virtual machines](#)[Cognitive Services](#)[Azure Active Directory](#)[Front Doors](#)[App Services](#)[Virtual networks](#)[API Management services](#)

## kv-app-sec-demo | Secrets

Key vault



Search (Ctrl+/-)

[Generate/Import](#) [Refresh](#) [Restore Backup](#)[Overview](#)[Activity log](#)[Access control \(IAM\)](#)[Tags](#)[Diagnose and solve problems](#)[Events \(preview\)](#)[Settings](#)[Keys](#)[Secrets](#)[Certificates](#)[Access policies](#)[Networking](#)[Properties](#)[Locks](#)[Export template](#)

| Name     | Type | Status    | Expiration Date |
|----------|------|-----------|-----------------|
| mySecret |      | ✓ Enabled |                 |

**Microsoft Azure**

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



Home &gt; App Services &gt; app-kvref | Identity

**app-kvref | Identity**

App Service

Search (Ctrl+ /)

**Deployment**

Quickstart

Deployment slots

Deployment Center

**Settings**

Configuration

Authentication / Authorization

Application Insights

Identity

Backups

Custom domains

TLS/SSL settings

Networking

Scale up (App Service plan)

Scale out (App Service plan)

**System assigned** **User assigned**

A system assigned managed identity enables Azure resources to authenticate to cloud services (e.g. Azure Key Vault) without storing credentials in code. Once enabled, all necessary permissions can be granted via Azure role-based-access-control. The lifecycle of this type of managed identity is tied to the lifecycle of this resource. Additionally, each resource (e.g. Virtual Machine) can only have one system assigned managed identity. [Learn more about Managed identities.](#)

Save

Discard

Refresh

Got feedback?

Status

Off

On

Object ID

b0e0fbaf-7795-4afc-8c4a-64380e6c6ef6



Role assignments

[Show the Azure RBAC roles assigned to this managed identity](#)

This resource is registered with Azure Active Directory. You can control its access to services like Azure Resource Manager, Azure Key Vault, etc. [Learn more](#)

zaalion@outlook.com  
ZAALION (DEFAULT DIRECTORY)

Microsoft Azure

Search resources, services, and docs (G+/-)



Home &gt; Key vaults &gt; kv-app-sec-demo | Access policies



## kv-app-sec-demo | Access policies

Key vault

Search (Ctrl+ /)

Save

Discard

Refresh

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Events (preview)

### Settings

Keys

Secrets

Certificates

Access policies

Networking

Properties

Locks

Export template

### Enable Access to:

- Azure Virtual Machines for deployment ⓘ
- Azure Resource Manager for template deployment ⓘ
- Azure Disk Encryption for volume encryption ⓘ

[+ Add Access Policy](#)

### Current Access Policies

| Name                         | Email                  | Key Permissions  | Secret Permissions | Certificate Permissions |
|------------------------------|------------------------|--|--------------------|-------------------------|
| <strong>APPLICATION</strong> |                        |  |                    |                         |
| app-kvref                    |                        | <input type="button" value="0 selected"/> <input type="button" value="Get"/> <input type="button" value="0 selected"/>         |                    |                         |
| <strong>USER</strong>        |                        |  |                    |                         |
| Reza Tester                  | zaalion_outlook.com... | <input type="button" value="9 selected"/> <input type="button" value="7 selected"/> <input type="button" value="15 selected"/> |                    |                         |



Create a resource

Home

Dashboard

All services

FAVORITES

Resource groups

Storage accounts

Key vaults

Function App

Network security groups

SQL databases

Virtual machines

Cognitive Services

Azure Active Directory

Front Doors

App Services

Virtual networks

API Management services

Cost Management + Billi...

Web Application Firewall...

Blueprints

Application gateways

## app-kvref | Configuration

Search (Ctrl+ /)

Refresh Save Discard

Application settings

General settings

Path mappings

### Application settings

Application settings are encrypted at rest and transmitted over an encrypted channel. You can choose to display them in plain text in your browser by using the controls below. Application Settings are exposed as environment variables for access by your application at runtime. [Learn more](#)

[New application setting](#) [Hide values](#) [Advanced edit](#) [Filter](#)

| Name     | Value   | Source              | Deployment... |
|----------|---|---------------------|---------------|
| mySecret | @Microsoft.KeyVault(VaultName=kv-app-sec-demo;SecretName=mySecret;) | Key vault Reference |               |

### Connection strings

Connection strings are encrypted at rest and transmitted over an encrypted channel.

[New connection string](#) [Show values](#) [Advanced edit](#) [Filter](#)

| Name                               | Value | Type | Deployment... | Delete | Edit |
|------------------------------------|-------|------|---------------|--------|------|
| (no connection strings to display) |       |      |               |        |      |

app-kvref | Identity - Microsoft A x Use Key Vault references - Azure x +

docs.microsoft.com/en-us/azure/app-service/app-service-key-vault-references

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- Create PHP app
- Create Java app
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- ▼ How-To guides
  - > Configure app
  - > Deploy to Azure
  - > Map custom domain
- ▼ Secure app
  - Add SSL cert
  - > Authenticate users
    - Advanced auth
    - Restrict access
  - Use a managed identity
- Reference secrets from Key Vault
- Use SSL cert in code
- Configure TLS mutual authentication
- Encrypt site data

restrictions.

## Reference syntax

A Key Vault reference is of the form `@Microsoft.KeyVault({referenceString})`, where `{referenceString}` is replaced by one of the following options:

| Reference string   | Description   |
|--|---|
| <code>SecretUri=secretUri</code>   | The <b>SecretUri</b> should be the full data-plane URI of a secret in Key Vault, including a version, e.g., <a href="https://myvault.vault.azure.net/secrets/mysecret/ec96f02080254f109c51a1f14cdb1931">https://myvault.vault.azure.net/secrets/mysecret/ec96f02080254f109c51a1f14cdb1931</a> |
| <code>VaultName=vaultName;SecretName=secretName;SecretVersion=secretVersion</code> | The <b>VaultName</b> should be the name of your Key Vault resource. The <b>SecretName</b> should be the name of the target secret. The <b>SecretVersion</b> should be the version of the secret to use.   |

For example, a complete reference with Version would look like the following:

```
@Microsoft.KeyVault(SecretUri=https://myvault.vault.azure.net/secrets/mysecret/ec96f02080254f109c51a1f14cdb1931)
```

Alternatively:

```
@Microsoft.KeyVault(VaultName=myvault;SecretName=mysecret;SecretVersion=ec96f02080254f109c51a1f14cdb1931)
```

Is this page helpful?

Yes No

In this article

- Granting your app access to Key Vault
- Reference syntax
- Source Application Settings from Key Vault
- Troubleshooting Key Vault References

Download PDF

## Source Application Settings from Key Vault

# Using Key Vault References

Move the configuration to Key Vault

Create a system-assigned identity for your App

Update the configuration values with the KV reference syntax

Deploy your App Service or Azure Function

Give GET KV SECRETS access to the app identity

Verify your application functionality



```
# syntax 1  
@Microsoft.KeyVault(VaultName=az204vault;SecretName=blobConnectionString;  
SecretVersion= fd44a02080254f109c51a1f14cdb2014)
```

```
# syntax  
2@Microsoft.KeyVault(SecretUri=https://az204vault.vault.azure.net/secrets  
/blobConnectionString/fd44a02080254f109c51a1f14cdb2014)
```

## Azure Key Vault References Syntax



No code change is required!



Demo



**Configuring a client application to use  
Azure Key Vault**  
- Key Vault References



# Protect Azure Key Vault Using Soft-delete and Purge Protection

---



# Azure Key Vault Soft-delete

Allows recovery of the deleted vaults and key vault objects (keys, secrets and certificates).



Soft delete is enabled by  
default for all new  
Key Vaults.





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Soft-delete

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# Azure Key Vault soft-delete overview

09/30/2020 • 7 minutes to read •

## Important

You must enable soft-delete on your key vaults immediately. The ability to opt out of soft-delete will be deprecated by the end of the year, and soft-delete protection will automatically be turned on for all key vaults. See full details [here](#)

Key Vault's soft-delete feature allows recovery of the deleted vaults and deleted key vault objects (for example, keys, secrets, certificates), known as soft-delete. Specifically, we address the following scenarios: This safeguard offer the following protections:

- Once a secret, key, certificate, or key vault is deleted, it will remain recoverable for a configurable period of 7 to 90 calendar days. If no configuration is specified the default recovery period will be set to 90 days. This provides users with sufficient time to notice an accidental secret deletion and respond.
- Two operations must be made to permanently delete a secret. First a user must delete the object which puts it into the soft-deleted state. Second, a user must purge the

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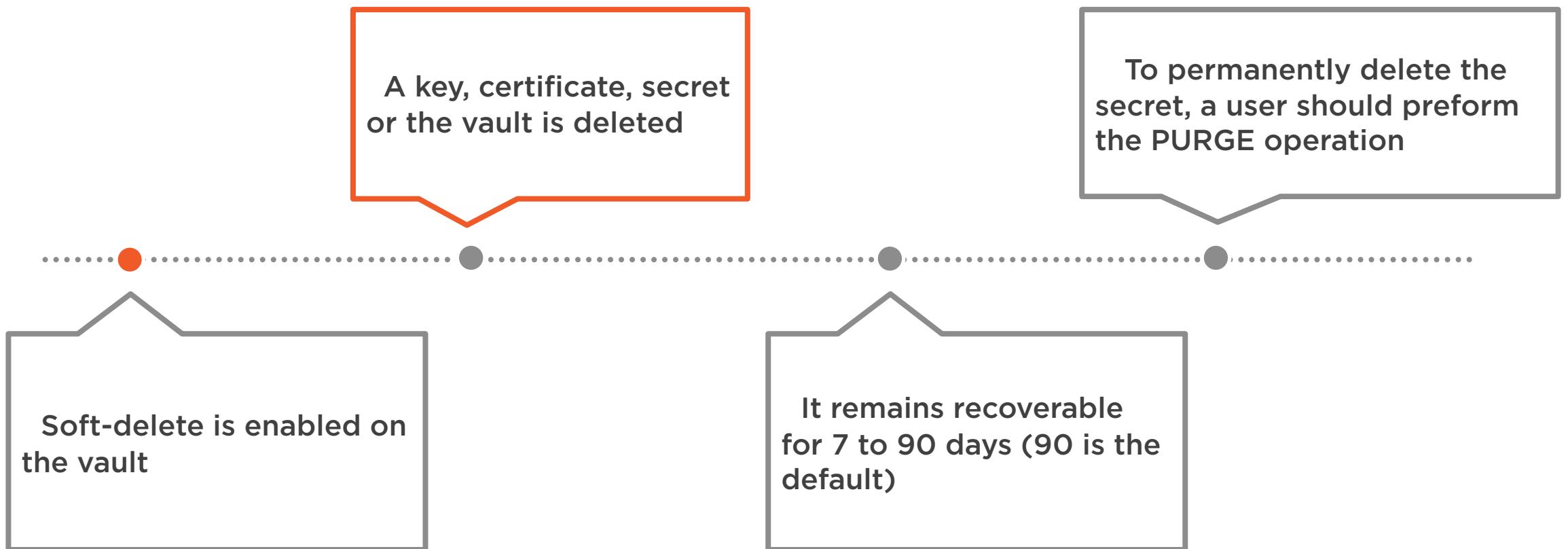
## In this article

Supporting interfaces

Scenarios

Next steps

# Azure Key Vault Soft-delete



# Azure Key Vault Purge Protection

When purge protection is enabled, a vault or an object in the deleted state cannot be purged until the retention period has passed.



# Configuring Soft-delete and Purge Protection

Azure Portal

Programmatically

PowerShell, Azure CLI, ARM



Microsoft Azure

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

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Home &gt; Key vaults &gt;



## Create key vault

Pricing tier

Standard



### Recovery options

Soft delete protection will automatically be enabled on this key vault. This feature allows you to recover or permanently delete a key vault and secrets for the duration of the retention period. This protection applies to the key vault and the secrets stored within the key vault.

To enforce a mandatory retention period and prevent the permanent deletion of key vaults or secrets prior to the retention period elapsing, you can turn on purge protection. When purge protection is enabled, secrets cannot be purged by users or by Microsoft.

Soft-delete

Enabled

Days to retain deleted vaults \*

90

Purge protection

 Disable purge protection (allow key vault and objects to be purged during retention period) Enable purge protection (enforce a mandatory retention period for deleted vaults and vault objects)[Review + create](#)

&lt; Previous

Next : Access policy &gt;

```
($resource = Get-AzResource -ResourceId (Get-AzKeyVault  
-VaultName "AZ-204-Vault").ResourceId).Properties | Add-Member  
-MemberType "NoteProperty" -Name "enableSoftDelete" -Value "true"
```

```
Set-AzResource -resourceid $resource.ResourceId  
-Properties $resource.Properties
```

Enable Azure Key Vault Soft-delete for an Existing Vault in PowerShell



```
New-AzKeyVault -Name AZ204-Vault  
-ResourceGroupName rg-204 -Location eastus  
-EnableSoftDelete "true"
```

Enable Azure Key Vault Purge Protection for a  
New Vault in PowerShell



```
($resource = Get-AzResource -ResourceId (Get-AzKeyVault  
-VaultName "AZ-204-Vault").ResourceId).Properties | Add-Member  
-MemberType "NoteProperty" -Name "enablePurgeProtection"  
-Value "true"
```

```
Set-AzResource -resourceid $resource.ResourceId  
-Properties $resource.Properties
```

# Enable Azure Key Vault Purge Protection for Existing Vault in PowerShell



Demo



**Working with Azure Key Vault  
soft-delete and purge protection**



Demo



**Using Azure Key Vault keys for  
Storage Service Encryption (SSE)**



# Develop Code That Uses Azure Key Vault

---



Demo



**Working with Azure Key Vault keys and certificates using the .NET SDK**



# Summary



**Implementing and Configuring Azure Key Vault**

**Soft-delete and Purge-protection**

**Azure Key Vault References for Function Apps and App Services**





# Exam AZ-204: Developing Solutions for Microsoft Azure

In response to the coronavirus (COVID-19) situation, Microsoft is implementing several temporary changes to our training and certification program. [Learn more.](#)

The content of this exam was updated on May 18, 2020. Please download the skills measured document below to see what changed.

Candidates for this exam should have subject matter expertise designing, building, testing, and maintaining cloud applications and services on Microsoft Azure.

Responsibilities for an Azure Developer include participating in all phases of cloud development from requirements definition and design, to development, deployment, and maintenance. performance tuning, and monitoring.

Azure Developers partner with cloud solution architects, cloud DBAs, cloud administrators, and clients to implement solutions.

A candidate for this exam should have 1-2 years professional development experience and experience with Microsoft Azure. In addition, the role should have ability programming in a language supported by Azure and proficiency in Azure SDKs, Azure PowerShell, Azure CLI, data storage options, data connections, APIs, app authentication and authorization, compute and container deployment, debugging, performance tuning, and monitoring.

Part of the requirements for: [Microsoft Certified: Azure Developer Associate](#)

Related exams: none

Important: [See details](#)

[Go to Certification Dashboard](#)

Schedule exam

- create and implement shared access signatures
- register apps and use Azure Active Directory to authenticate users
- control access to resources by using role-based access controls (RBAC)

### **Implement secure cloud solutions**

- secure app configuration data by using the App Configuration and KeyVault API
- manage keys, secrets, and certificates by using the KeyVault API
- implement Managed Identities for Azure resources

## **Monitor, troubleshoot, and optimize Azure solutions (10-15%)**

### **Integrate caching and content delivery within solutions**

- develop code to implement CDNs in solutions
- configure cache and expiration policies for FrontDoor, CDNs, or Redis Caches Store and retrieve data in Azure Redis Cache

### **Instrument solutions to support monitoring and logging**

- configure instrumentation in an app or service by using Application Insights
- analyze log data and troubleshoot solutions by using Azure Monitor
- implement Application Insights Web Test and Alerts
- implement code that handles transient faults



Thank you!



# Manage Keys, Secrets, and Certificates by Using the Key Vault

---



**Reza Salehi**  
CLOUD CONSULTANT  
@zaalion



# Overview



**Implementing and Configuring Azure Key Vault**

**Soft-delete and Purge-protection**

**Azure Key Vault References for Function Apps and App Services**

**Demo: using Azure Key Vault**



# Microsoft Azure Key Vault

---



# Azure Key Vault

Is an Azure service which allows you to securely store and access secrets.



# Azure Key Vault Secret Types

## Keys

Cryptographic keys  
used in other Azure  
services such as  
Azure Disk Encryption

## Secrets

Any sensitive  
information including  
connection strings or  
passwords

## Certificates

x509 certificates used in  
HTTPS/SSL/TLS  
communications  
(encryption in transit)



# Azure Key Vault Pricing Tiers

**Standard**

Software-protected

**Premium**

Standard +  
HSM-protected

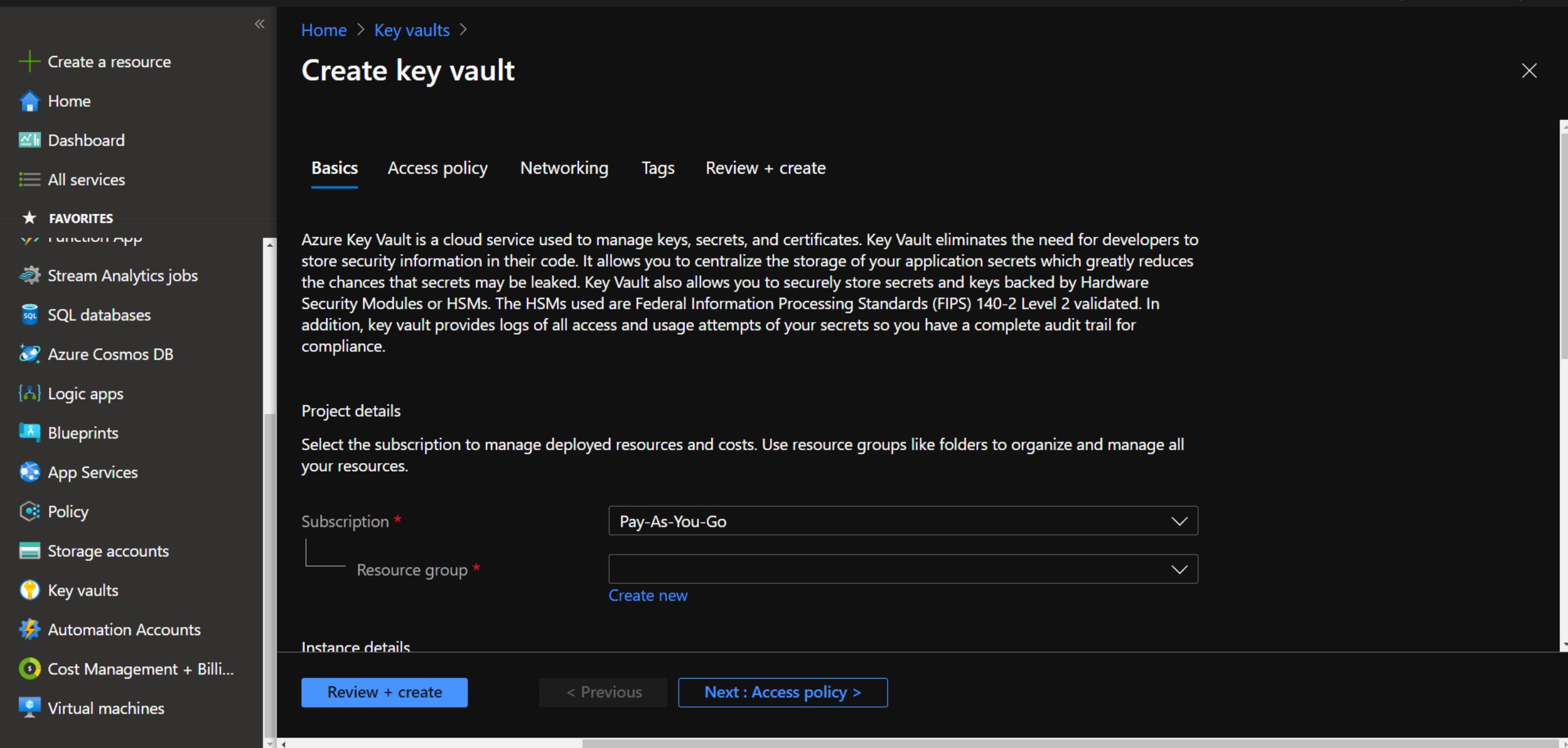


# Provisioning Azure Key Vault

Azure Portal

Programmatically  
PowerShell, Azure CLI,  
REST API, ARM





```
New-AzKeyVault -VaultName 'AZ204-Vault'  
-ResourceGroupName 'rg-204' -Location 'East US'
```

Provision Azure Key Vault in PowerShell



## Microsoft.KeyVault vaults

10/05/2020 • 6 minutes to read • 

Latest ▾

## Template format

To create a Microsoft.KeyVault/vaults resource, add the following JSON to the resources section of your template.

Is this page helpful?

Yes No

## In this article

## Template format

- Vaults**
- > Vaults/
- > 2019-09-01
- > 2018-02-14
- > 2016-10-01
- > 2015-06-01
- > Kusto
- > Logic
- > Machine Learning
- > Machine Learning Services
- > Managed Identity
- > Managed Network
- > Management
- > Maps
- > MariaDB
- > Media
- > Migrate
- > MySQL

150

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Is this page helpful?

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## In this article

## Commands

[az keyvault secret backup](#)[az keyvault secret delete](#)[az keyvault secret download](#)[az keyvault secret list](#)[az keyvault secret list-deleted](#)[az keyvault secret list-versions](#)[az keyvault secret purge](#)[az keyvault secret recover](#)[az keyvault secret restore](#)**az keyvault secret set**[az keyvault secret set-attributes](#)[az keyvault secret show](#)[az keyvault secret show-deleted](#)

&gt; Global Parameters

## Version

Azure CLI (Latest)

Filter by title

Secrets

## Overview

backup

delete

download

list

list-deleted

list-versions

purge

recover

restore

set

set-attributes

show

show-deleted

&gt; backup

&gt; network-rule

&gt; private-endpoint-connection

&gt; private-link-resource

&gt; restore

&gt; role

# az keyvault secret set

Edit

Create a secret (if one doesn't exist) or update a secret in a KeyVault.

Azure CLI

Copy

```
az keyvault secret set --name  
    --vault-name  
    [--description]  
    [--disabled {false, true}]  
    [--encoding {ascii, base64, hex, utf-16be, utf-16le, utf-8}]  
    [--expires]  
    [--file]  
    [--not-before]  
    [--subscription]  
    [--tags]  
    [--value]
```

## Required Parameters

**--name -n**

Name of the secret.

**--vault-name**

Name of the Vault.

# Configuring Authentication for Azure Key Vault

**Option 1**

**Use Azure AD  
App Registration**

**Option 2**

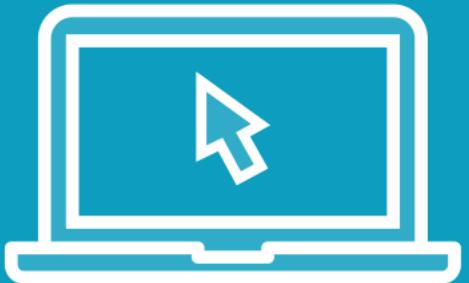
**Use  
Managed Identity**

**Option 3**

**Use Key Vault  
References**



# Demo

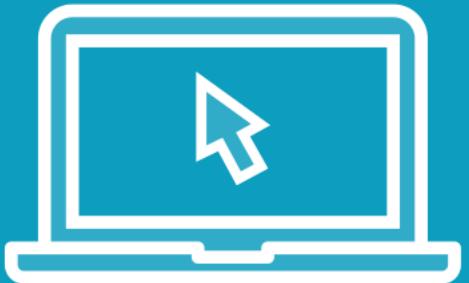


## Provisioning an Azure Key Vault resource

- Azure portal
- PowerShell



Demo



## Configuring a client application to use Azure Key Vault

- Managed Identity (formerly MSI)



# Key Vault References for App Service and Azure Functions

---



```
using Azure.Security.KeyVault.Secrets;  
...  
string kvUri = "https://kv-identitydemo-02.vault.azure.net";  
SecretClient client = new SecretClient(new Uri(kvUri), new  
DefaultAzureCredential());  
string secret = client.GetSecretAsync("secretmessage")Result.Value;
```

Code to Read a Key Vault Secret



Use Key Vault references to move  
app setting values to  
Azure Key Vault  
with no code changes.



The screenshot shows the Visual Studio 2019 interface with the following details:

- File Bar:** File, Edit, View, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help.
- Search Bar:** Search (Ctrl+Q).
- Current Project:** KeyVault-func-identity.
- Toolbars:** Standard, Debug, Task List, Solution Explorer, Properties, Task List, Live Share.
- Code Editor:** Shows the `local.settings.json` file content:

```
1  {
2      "IsEncrypted": false,
3      "Values": {
4          "AzureWebJobsStorage": "UseDevelopmentStorage=true",
5          "FUNCTIONS_WORKER_RUNTIME": "dotnet",
6          "SecretPass" : "Password!@#"
7      }
8 }
```
- Solution Explorer:** Displays the project structure:
  - Solution 'KeyVault-func-identity' (1 of 1 p)
  - KeyVault-func-identity
    - Connected Services
    - Dependencies
    - Properties
    - .gitignore
    - host.json
    - KVReferences.cs
    - local.settings.json
    - ShowSecretMessage.cs
- Status Bar:** Visual Studio 2019 update, Version 16.7.6 is downloaded and ready to install.
- Bottom Navigation:** Ready, Add to Source Control, Notifications (4).



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Microsoft Azure

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Home &gt; Key vaults &gt; kv-app-sec-demo | Secrets



kv-app-sec-demo | Secrets

Key vault

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+ Generate/Import    Refresh    ⌛ Restore Backup

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Home

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All services

FAVORITES

Resource groups

Storage accounts

Key vaults

Function App

Network security groups

SQL databases

Virtual machines

Cognitive Services

Azure Active Directory

Front Doors

App Services

Virtual networks

API Management services

| Name     | Type | Status    | Expiration Date |
|----------|------|-----------|-----------------|
| mySecret |      | ✓ Enabled |                 |

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Events (preview)

Settings

Keys

Secrets

Certificates

Access policies

Networking

Properties

Locks

Export template

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**app-kvref | Identity**

App Service

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**Deployment**

Quickstart

Deployment slots

Deployment Center

**Settings**

Configuration

Authentication / Authorization

Application Insights

Identity

Backups

Custom domains

TLS/SSL settings

Networking

Scale up (App Service plan)

Scale out (App Service plan)

**System assigned** User assigned

A system assigned managed identity enables Azure resources to authenticate to cloud services (e.g. Azure Key Vault) without storing credentials in code. Once enabled, all necessary permissions can be granted via Azure role-based-access-control. The lifecycle of this type of managed identity is tied to the lifecycle of this resource. Additionally, each resource (e.g. Virtual Machine) can only have one system assigned managed identity. [Learn more about Managed identities.](#)

Save

Discard

Refresh

Got feedback?

Status

Off

On

Object ID

b0e0fbaf-7795-4afc-8c4a-64380e6c6ef6



Role assignments

[Show the Azure RBAC roles assigned to this managed identity](#)

This resource is registered with Azure Active Directory. You can control its access to services like Azure Resource Manager, Azure Key Vault, etc. [Learn more](#)



## kv-app-sec-demo | Access policies

### Key vault

 Search (Ctrl+/  
) Save Discard Refresh[Overview](#)[Activity log](#)[Access control \(IAM\)](#)[Tags](#)[Diagnose and solve problems](#)[Events \(preview\)](#)

### Settings

[Keys](#)[Secrets](#)[Certificates](#)[Access policies](#)[Networking](#)[Properties](#)[Locks](#)[Export template](#)

### Enable Access to:

 Azure Virtual Machines for deployment ⓘ Azure Resource Manager for template deployment ⓘ Azure Disk Encryption for volume encryption ⓘ[+ Add Access Policy](#)

### Current Access Policies

| Name                         | Email                  | Key Permissions                   | Secret Permissions                | Certificate Permissions            |
|------------------------------|------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| <strong>APPLICATION</strong> |                        |                                   |                                   |                                    |
| app-kvref                    |                        | <input type="button"/> 0 selected | <input type="button"/> Get        | <input type="button"/> 0 selected  |
| <strong>USER</strong>        |                        |                                   |                                   |                                    |
| Reza Tester                  | zaalion_outlook.com... | <input type="button"/> 9 selected | <input type="button"/> 7 selected | <input type="button"/> 15 selected |



app-kvref | Identity - Microsoft A x Use Key Vault references - Azure x +

docs.microsoft.com/en-us/azure/app-service/app-service-key-vault-references

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  - > Deploy to Azure
  - > Map custom domain
- ▼ Secure app
  - Add SSL cert
  - > Authenticate users
    - Advanced auth
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- Reference secrets from Key Vault
- Use SSL cert in code
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restrictions.

## Reference syntax

A Key Vault reference is of the form `@Microsoft.KeyVault({referenceString})`, where `{referenceString}` is replaced by one of the following options:

| Reference string   | Description   |
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| <code>SecretUri=secretUri</code>   | The <b>SecretUri</b> should be the full data-plane URI of a secret in Key Vault, including a version, e.g., <a href="https://myvault.vault.azure.net/secrets/mysecret/ec96f02080254f109c51a1f14cdb1931">https://myvault.vault.azure.net/secrets/mysecret/ec96f02080254f109c51a1f14cdb1931</a> |
| <code>VaultName=vaultName;SecretName=secretName;SecretVersion=secretVersion</code> | The <b>VaultName</b> should be the name of your Key Vault resource. The <b>SecretName</b> should be the name of the target secret. The <b>SecretVersion</b> should be the version of the secret to use.   |

For example, a complete reference with Version would look like the following:

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```

Alternatively:

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```

Is this page helpful?

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In this article

- Granting your app access to Key Vault
- Reference syntax
- Source Application Settings from Key Vault
- Troubleshooting Key Vault References

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## Source Application Settings from Key Vault

# Using Key Vault References

Move the configuration to Key Vault

Create a system-assigned identity for your App

Update the configuration values with the KV reference syntax

Deploy your App Service or Azure Function

Give GET KV SECRETS access to the app identity

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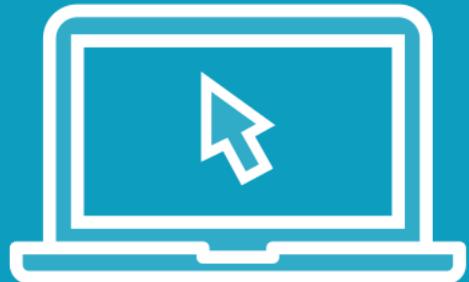
## Azure Key Vault References Syntax



No code change is required!



Demo



**Configuring a client application to use  
Azure Key Vault**  
- Key Vault References



# Protect Azure Key Vault Using Soft-delete and Purge Protection

---



# Azure Key Vault Soft-delete

Allows recovery of the deleted vaults and key vault objects (keys, secrets and certificates).



Soft delete is enabled by  
default for all new  
Key Vaults.





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Soft-delete

[Download PDF](#)

# Azure Key Vault soft-delete overview

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## ⓘ Important

You must enable soft-delete on your key vaults immediately. The ability to opt out of soft-delete will be deprecated by the end of the year, and soft-delete protection will automatically be turned on for all key vaults. See full details [here](#)

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Is this page helpful?

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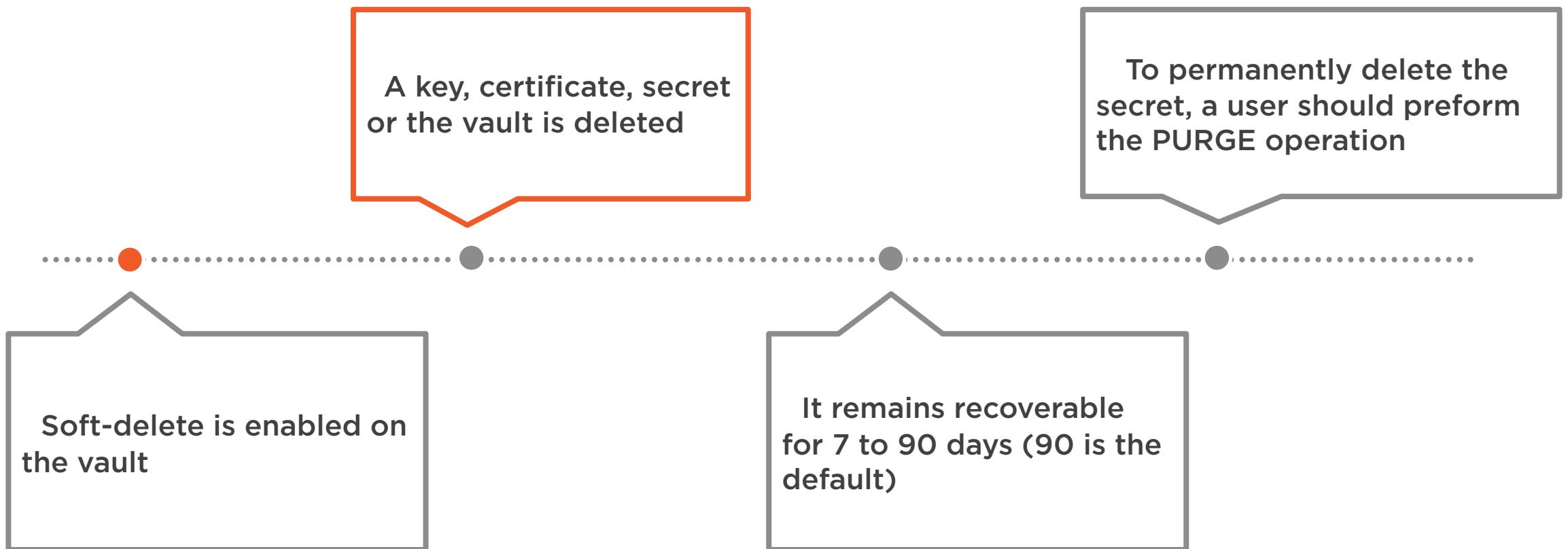
## In this article

Supporting interfaces

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# Azure Key Vault Soft-delete



# Azure Key Vault Purge Protection

When purge protection is enabled, a vault or an object in the deleted state cannot be purged until the retention period has passed.



# Configuring Soft-delete and Purge Protection

Azure Portal

Programmatically

PowerShell, Azure CLI, ARM



Microsoft Azure

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Home &gt; Key vaults &gt;



## Create key vault

Pricing tier

Standard



### Recovery options

Soft delete protection will automatically be enabled on this key vault. This feature allows you to recover or permanently delete a key vault and secrets for the duration of the retention period. This protection applies to the key vault and the secrets stored within the key vault.

To enforce a mandatory retention period and prevent the permanent deletion of key vaults or secrets prior to the retention period elapsing, you can turn on purge protection. When purge protection is enabled, secrets cannot be purged by users or by Microsoft.

Soft-delete

Enabled

Days to retain deleted vaults \*

90

Purge protection

 Disable purge protection (allow key vault and objects to be purged during retention period) Enable purge protection (enforce a mandatory retention period for deleted vaults and vault objects)[Review + create](#)

&lt; Previous

Next : Access policy &gt;

```
($resource = Get-AzResource -ResourceId (Get-AzKeyVault  
-VaultName "AZ-204-Vault").ResourceId).Properties | Add-Member  
-MemberType "NoteProperty" -Name "enableSoftDelete" -Value "true"
```

```
Set-AzResource -resourceid $resource.ResourceId  
-Properties $resource.Properties
```

Enable Azure Key Vault Soft-delete for an Existing Vault in PowerShell



```
New-AzKeyVault -Name AZ204-Vault  
-ResourceGroupName rg-204 -Location eastus  
-EnableSoftDelete "true"
```

Enable Azure Key Vault Purge Protection for a  
New Vault in PowerShell



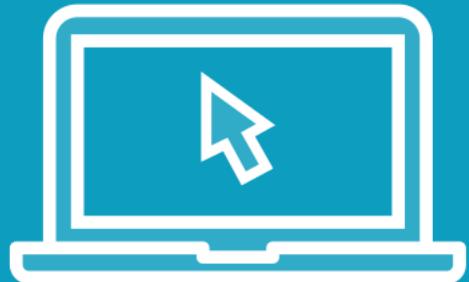
```
($resource = Get-AzResource -ResourceId (Get-AzKeyVault  
-VaultName "AZ-204-Vault").ResourceId).Properties | Add-Member  
-MemberType "NoteProperty" -Name "enablePurgeProtection"  
-Value "true"
```

```
Set-AzResource -resourceid $resource.ResourceId  
-Properties $resource.Properties
```

# Enable Azure Key Vault Purge Protection for Existing Vault in PowerShell



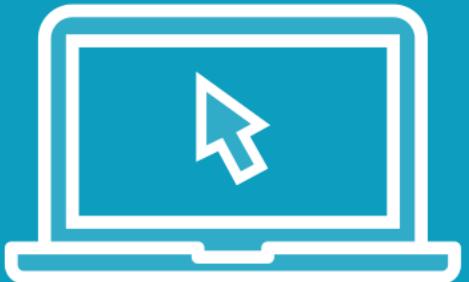
Demo



**Working with Azure Key Vault  
soft-delete and purge protection**



Demo



## Using Azure Key Vault keys for Storage Service Encryption (SSE)



# Summary



**Implementing and Configuring Azure Key Vault**

**Soft-delete and Purge-protection**

**Azure Key Vault References for Function Apps and App Services**





# Exam AZ-204: Developing Solutions for Microsoft Azure

In response to the coronavirus (COVID-19) situation, Microsoft is implementing several temporary changes to our training and certification program. [Learn more.](#)

The content of this exam was updated on May 18, 2020. Please download the skills measured document below to see what changed.

Candidates for this exam should have subject matter expertise designing, building, testing, and maintaining cloud applications and services on Microsoft Azure.

Responsibilities for an Azure Developer include participating in all phases of cloud development from requirements definition and design, to development, deployment, and maintenance. performance tuning, and monitoring.

Azure Developers partner with cloud solution architects, cloud DBAs, cloud administrators, and clients to implement solutions.

A candidate for this exam should have 1-2 years professional development experience and experience with Microsoft Azure. In addition, the role should have ability programming in a language supported by Azure and proficiency in Azure SDKs, Azure PowerShell, Azure CLI, data storage options, data connections, APIs, app authentication and authorization, compute and container deployment, debugging, performance tuning, and monitoring.

Part of the requirements for: [Microsoft Certified: Azure Developer Associate](#)

Related exams: none

Important: [See details](#)

[Go to Certification Dashboard](#)

Schedule exam

- create and implement shared access signatures
- register apps and use Azure Active Directory to authenticate users
- control access to resources by using role-based access controls (RBAC)

### Implement secure cloud solutions

- secure app configuration data by using the App Configuration and KeyVault API
- manage keys, secrets, and certificates by using the KeyVault API
- implement Managed Identities for Azure resources

## Monitor, troubleshoot, and optimize Azure solutions (10-15%)

### Integrate caching and content delivery within solutions

- develop code to implement CDNs in solutions
- configure cache and expiration policies for FrontDoor, CDNs, or Redis Caches Store and retrieve data in Azure Redis Cache

### Instrument solutions to support monitoring and logging

- configure instrumentation in an app or service by using Application Insights
- analyze log data and troubleshoot solutions by using Azure Monitor
- implement Application Insights Web Test and Alerts
- implement code that handles transient faults



Thank you!



# Exam Alert: Implement Azure Security

---

## PREPARING FOR THE EXAM



**David Tucker**  
TECHNICAL ARCHITECT & CTO CONSULTANT  
 @\_daviddtucker\_ [daviddtucker.net](http://daviddtucker.net)

# Objectives for the Exam

---

# Implement Azure Security

**20-25%**

**Implement User Authentication  
and Authorization**

**Implement Secure Cloud  
Solutions**

# Implement User Authentication and Authorization

- Authenticate and authorize users by using the Microsoft Identity platform**
- Authenticate and authorize users and apps by using Azure Active Directory**
- Create and implement shared access signatures**

# Implement Secure Cloud Solutions

**Secure app configuration data by using the App Configuration in Azure Key Vault**

**Develop code that uses keys, secrets, and certificates in Azure Key Vault**

**Implement solutions that interact with Microsoft Graph**

# Review User Authentication and Authorization

---

# Areas of Focus

**Microsoft Identity  
Platform Concepts**

**Azure AD  
App Manifests**

**Azure Role-based  
Access Control**

**Azure Storage Shared  
Access Signatures**

**Mutual TLS  
Authentication**

# Microsoft Identity Platform

A modern identity platform consisting of several components that enable developers to integrate identity into their custom applications while also integrating with Microsoft API's.

# Microsoft Identity Platform Components

**Standards-based  
Auth Service**

**Open-source  
Libraries**

**Application  
Management Portal**

**App Configuration  
API and Powershell**

**Developer  
Content**

# Microsoft Identity Platform Standards

**Authentication**  
OpenID Connect

**Authorization**  
OAuth 2.0

# Microsoft Identity Platform Concepts

- Understand auth flows for single-page app, desktop app, mobile app, daemon app**
- Understand how the Microsoft Identity Platform uses JSON Web Tokens (JWT's)**
- Understand the tools you can leverage to integrate the platform with your apps**
- Know how to configure your applications to properly leverage the platform**

# Azure AD App Manifest

The definition of an application object within the Microsoft Identity platform which includes all configuration for allowed authentication and authorization integrations.

## App Manifest

```
{  
  "id": "058477a1-5d5f-45e7-bc71-66c059a58eff",  
  "name": "SampleSPA",  
  ...  
  "allowPublicClient": true,  
  "groupMembershipClaims": "All",  
  "oauth2AllowIdTokenImplicitFlow": true,  
  "oauth2AllowImplicitFlow": true,  
  "oauth2Permissions": [],  
  "oauth2RequirePostResponse": false,  
  ...  
}
```

**appRoles**

**groupMembershipClaims**

**optionalClaims**

**oauth2AllowImplicitFlow**

**oauth2Permissions**

**signInAudience**

App Manifest  
Attributes to Review

# Core Azure RBAC Concepts

**Security Principal**

**Role Definition**

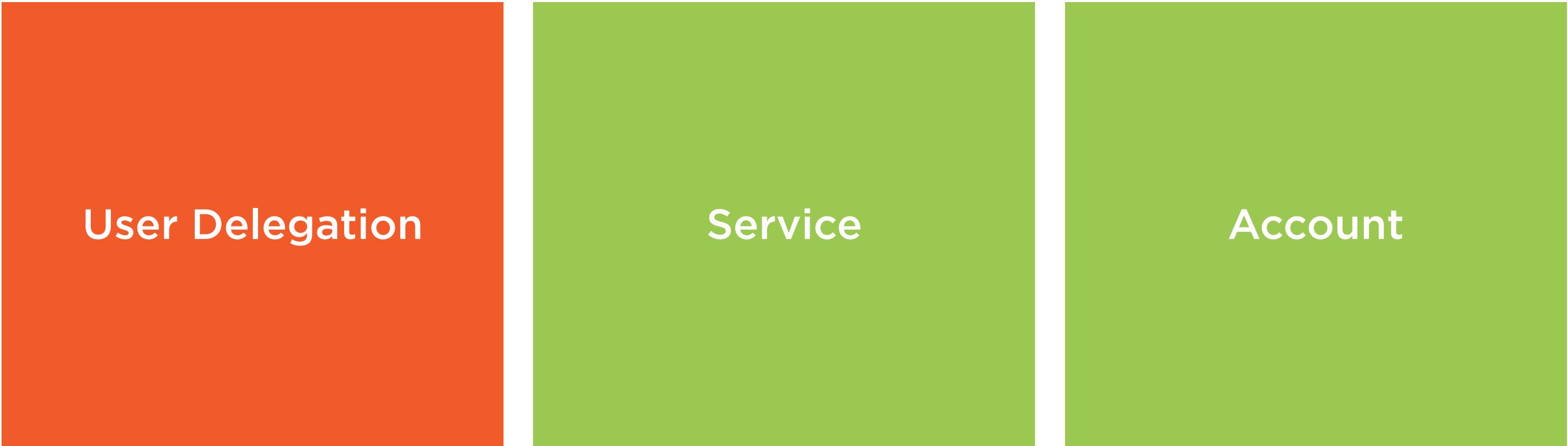
**Scope**

**Role Assignments**

**“A **shared access signature** (SAS) provides secure delegated access to resources in your storage account without compromising the security of your data.”**

**Microsoft Azure Documentation**

# Shared Access Signature Types



User Delegation

Service

Account

# Azure Storage SAS Forms



**Ad hoc SAS**



**Service SAS** (with  
stored access policy)

# SAS Best Practices

- Always use HTTPS when creating or distributing an SAS
- Use user delegation SAS whenever possible
- Define a stored access policy for a service specific SAS
- Use near-term expiration on ad hoc, service, or account SAS
- Follow least-privilege access for resources to be accessed

**Not supported on free or shared tiers**

**Certificate is the **X-ARR-ClientCert** header**

**Certificate value is Base64 encoded**

**App code is required to validate certificate**

Azure App Service  
Mutual TLS Auth

# Scenario Understanding

**Review different use cases for authentication approaches**

**Understand the order to implement different approaches**

**Know limits of services and service tiers**

**Be able to spot poor security implementations**

# Review Secure Cloud Solutions

---

# Areas of Focus

**Microsoft Graph**

**Azure Key Vault**

# Microsoft Graph

**Add a Microsoft Graph is the gateway to data and intelligence in Microsoft 365.** It provides a unified programmability model that you can use to access the tremendous amount of data in Microsoft 365, Windows 10, and Enterprise Mobility + Security.

*Citation:* Microsoft Documentation

**Identity and Access Management**

**Productivity**

**Collaboration**

**People and Workspace Intelligence**

**Device Management**

**Security**

**Cross-device Experiences**

**User Notifications**

**Usage Reports**

**Education**

**Business Applications**

**Microsoft Graph Services**

# Integrating with Microsoft Graph

- Register an application with Azure AD**
- Leverage the Microsoft Identity Platform authorize endpoint with defined scopes**
- User signs in with credentials and accepts the scopes**
- App receives an authorization code**
- Authorization code can be used to get a token from the token endpoint**
- Token can be leveraged to access Microsoft Graph**

# Azure Key Vault Deletion Protection

**Soft-delete**

**Purge Protection**

```
# Create a Key Vault using PowerShell  
New-AzKeyVault -Name 'Sample-Vault' -ResourceGroupName  
'SampleResourceGroup' -Location 'East US'
```

```
# Create a Key Vault using Azure CLI  
az keyvault create --name "Sample-Vault2" --resource-group  
"SampleResourceGroup" --location eastus
```

## Creating an Azure Key Vault

### PowerShell and CLI Commands

# Example Scenarios

---

# Scenario 1



**Sylvia's company is building a prototype for a new internal React web application**

**One of the requirements is that users can manage their profile information**

**The user's Microsoft 365 profile will be leveraged**

**Sylvia plans to use Azure AD for identity**

**How can she accomplish this approach?**

## Scenario 2



**Edward currently has a .NET Core application running as a Function app**

**He is storing a connection string for Cosmos DB in his application settings**

**He wants to avoid redeployments for his Function app**

**What is the most efficient approach he can take to improve security?**

## Scenario 3



**Cindy's company is implementing a new App Service app in Node.js**

**The app will leverage Mutual TLS for authentication**

**Cindy is responsible for writing the code to validate the client certificate**

**How can she access the certificate that the client has used for the request?**

## Scenario 4



**William is creating an application that will use Azure AD for authentication**

**He wants to allow users from his company's directory to login**

**He wants to retrieve group membership for groups assigned to the app**

**How should William configure his app manifest for these requirements?**

## App Manifest

```
{  
  "id": "058477a1-5d5f-45e7-bc71-66c059a58eff",  
  "name": "SampleSPA",  
  ...  
  "allowPublicClient": true,  
  "groupMembershipClaims": [REDACTED],  
  "oauth2Permissions": [],  
  "signInAudience": [REDACTED],  
  ...  
}
```

## Scenario 5



**Oscar's is creating an application to track customer rebates**

**Part of the application is storing the customer submitted receipt images**

**The app currently uses an account SAS that is stored in app configuration**

**How can Oscar ensure the most secure access to storage resources?**

## Scenario 6



**James's company processes healthcare data for billing analysis**

**They have a requirement that all data must be encrypted using managed keys**

**They require leveraging hardware encryption (HSM) for key storage**

**James has moved all encryption keys to Azure Key Vault (standard tier)**

**Does his approach meet the criteria?**

# Scenario Answers

---

## Scenario 1



**Sylvia's company is building a prototype for a new internal React web application**

**One of the requirements is that users can manage their profile information**

**The user's Microsoft 365 profile will be leveraged**

**Sylvia plans to use Azure AD for identity**

**How can she accomplish this approach?**

**Solution: Utilize Microsoft Graph with the Microsoft Graph Toolkit and MSAL v2**

## Scenario 2



**Edward currently has a .NET Core application running as a Function app**

**He is storing a connection string for Cosmos DB in his application settings**

**He wants to avoid redeployments for his Function app**

**What is the most efficient approach he can take to improve security?**

**Solution: Utilize an Azure Key Vault Reference for the Cosmos DB connection**

## Scenario 3



**Cindy's company is implementing a new App Service app in Node.js**

**The app will leverage Mutual TLS for authentication**

**Cindy is responsible for writing the code to validate the client certificate**

**How can she access the certificate that the client has used for the request?**

**Solution: Access the X-ARR-ClientCert header and decode the Base64 string**

## Scenario 4



**William is creating an application that will use Azure AD for authentication**

**He wants to allow users from his company's directory to login**

**He wants to retrieve group membership for groups assigned to the app**

**How should William configure his app manifest for these requirements?**

## App Manifest

```
{  
  "id": "058477a1-5d5f-45e7-bc71-66c059a58eff",  
  "name": "SampleSPA",  
  ...  
  "allowPublicClient": true,  
  "groupMembershipClaims": "ApplicationGroup",  
  "oauth2Permissions": [],  
  "signInAudience": "AzureADMyOrg",  
  ...  
}
```

## Scenario 5



Oscar's is creating an application to track customer rebates

Part of the application is storing the customer submitted receipt images

The app currently uses an account SAS that is stored in app configuration

How can Oscar ensure the most secure access to storage resources?

**Solution:** Utilize a user-delegation SAS, which uses Azure AD credentials

## Scenario 6



**James's company processes healthcare data for billing analysis**

**They have a requirement that all data must be encrypted using managed keys**

**They require leveraging hardware encryption (HSM) for key storage**

**James has moved all encryption keys to Azure Key Vault (standard tier)**

**Does his approach meet the criteria?**

**Solution: No. He will need to utilize the Premium Tier for Azure Key Vault**

# Microsoft Azure Developer: Integrate Caching and Content Delivery

---

CONFIGURING CACHE AND EXPIRATION POLICIES  
IN AZURE CDN



**James Millar**

FREELANCE SOFTWARE DEVELOPER

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Demo



**Deploy a simple web app**

**Configure a new CDN endpoint**



# How Caching Works

---



# What Is a Content Delivery Network?



**Globally distributed network**

**Reduced asset load times**

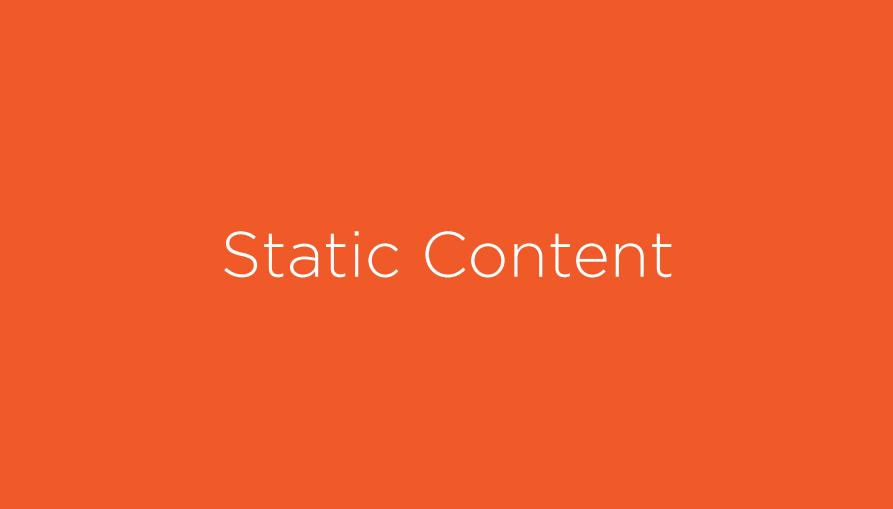
**Reduced hosting bandwidth**

**Increased availability and redundancy**

**Protection from denial-of-service attacks**

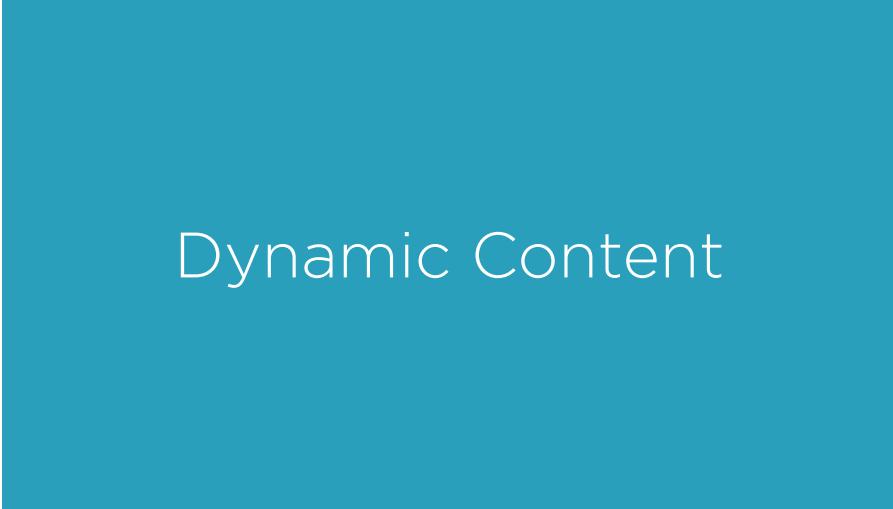


# Content Types



Static Content

Images  
CSS files  
JS files

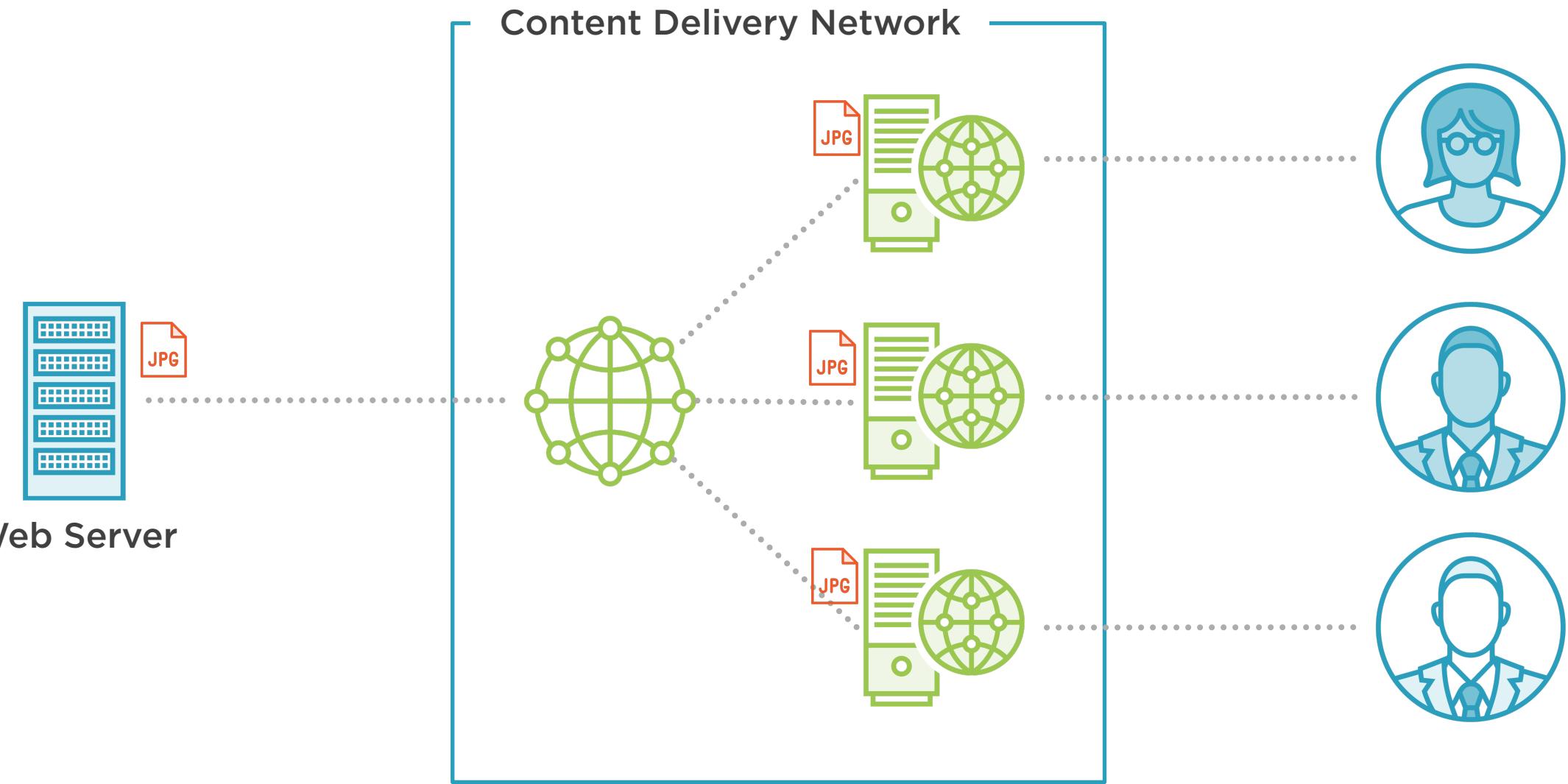


Dynamic Content

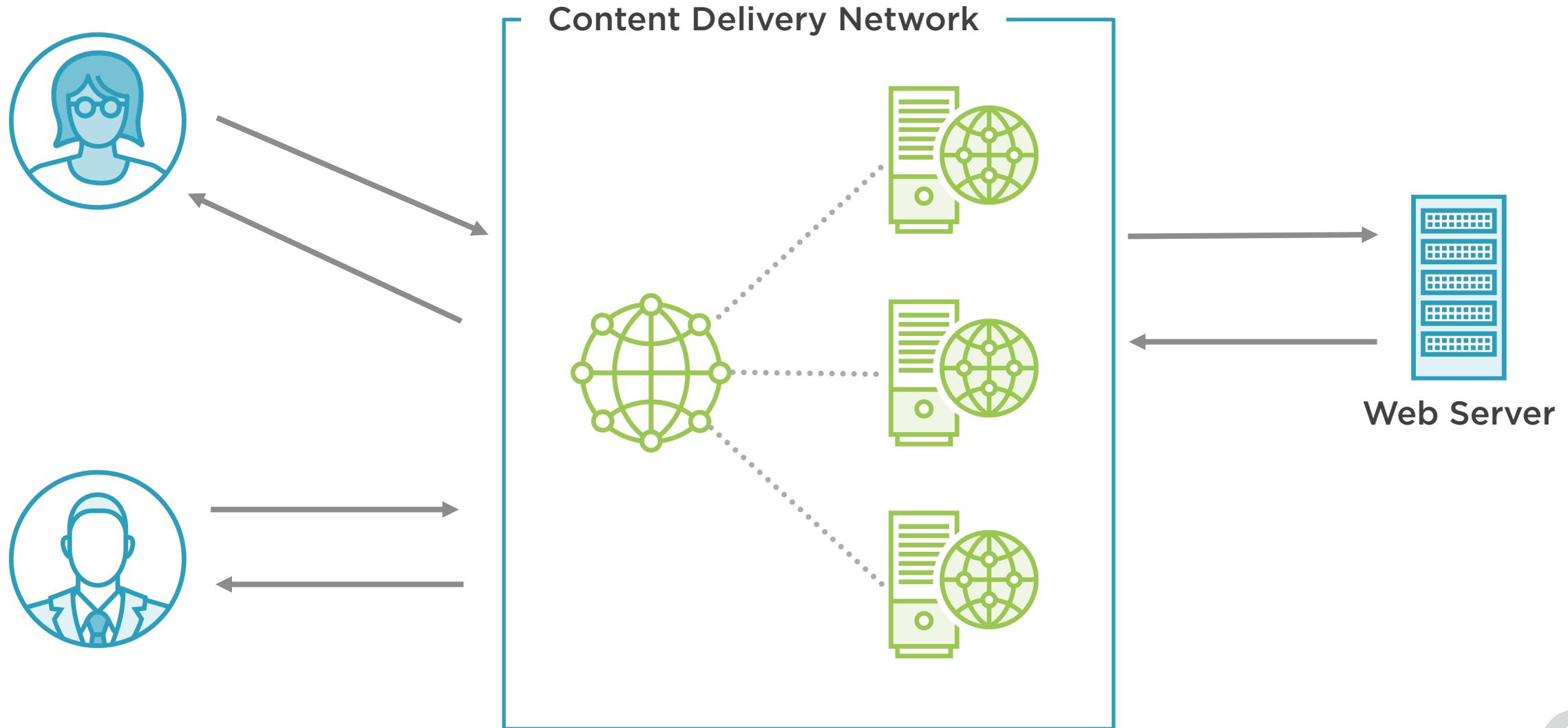
Changes on user interaction  
Dashboards  
Query results



# Content Distribution



# Request and Response Lifecycle

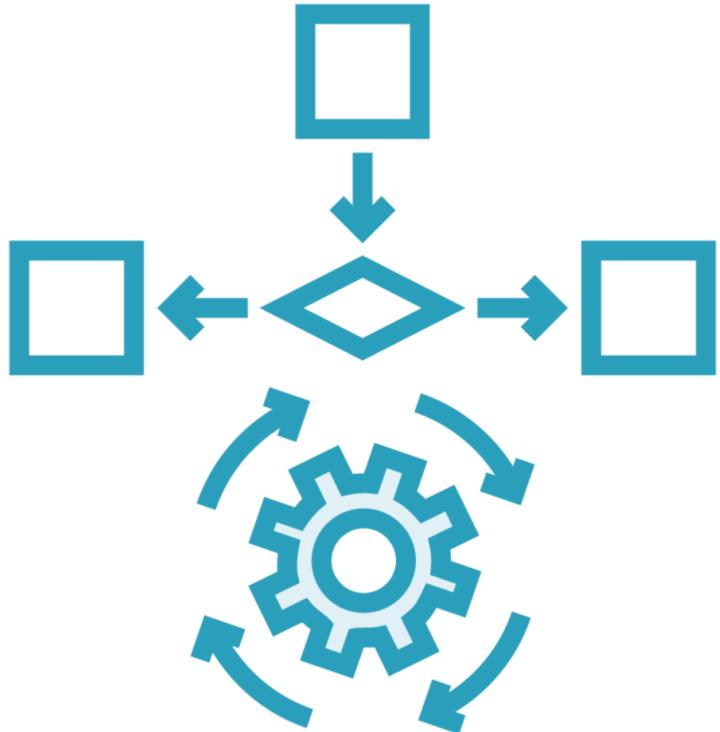


# Understanding Azure CDN Caching

---



# Caching Rules



## 3 types of caching rule

- Azure CDN Standard (Verizon)
- Azure CDN Standard (Akamai)

## Azure CDN (Microsoft)

- Standard rules engine

## Azure CDN Premium (Verizon)

- Premium rules engine



# Caching Rules

Global

**Only one per endpoint**  
**Overrides cache headers**

Custom

**One or many rules**  
**Extension or path**  
**Override global rule**

Query String

**Ignore query strings**  
**Bypass query strings**  
**Cache every unique URL**



## Demo



### Configure caching rules for Azure CDN

- Global caching rule
- Custom caching rule
- Query string caching



# Up Next: Configuring Cache and Expiration Policies for Azure Redis Cache

---



# Configuring Cache and Expiration Policies for Azure Redis Cache

---



**James Millar**

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# Azure Redis Cache Pricing Tiers

Basic

**Minimal feature set**  
**No SLA**  
**Development and test**

Standard

**2 Replicated nodes**  
**99.9% availability**  
**53 GB of memory**  
**20,000 clients**

Premium

**Redis cluster**  
**Low latency**  
**99.95% availability**  
**40,000 clients**

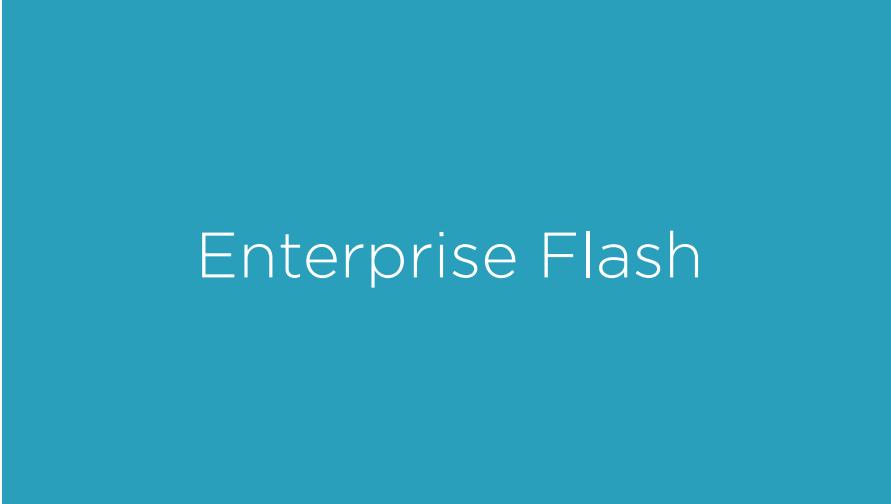


# Azure Redis Cache Pricing Tiers



Enterprise

**Full Redis feature set**  
**99.99% availability**



Enterprise Flash

**Fast non-volatile storage**



You can scale up, but you  
cannot scale down!

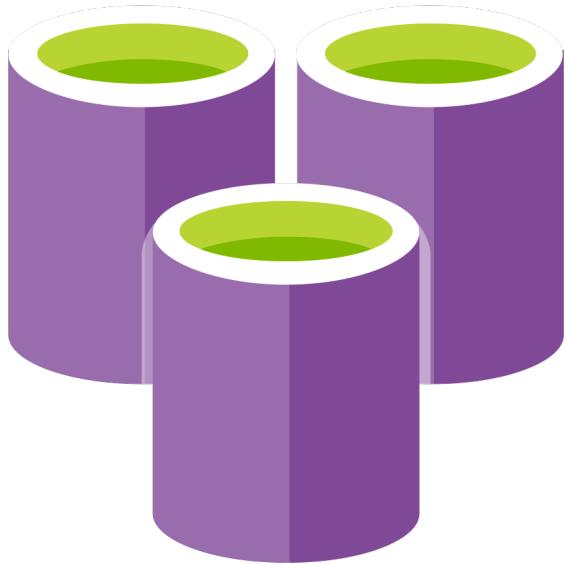


# Understanding Default Caching Behaviour

---



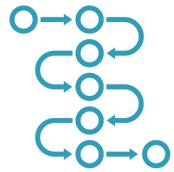
# Understand Caching



**Improve performance and scalability**  
**Move frequently accessed data closer**  
**Faster response times**



# When Should We Cache?



Repeatedly accessed data



Data source performance



Data contention



Physical location



# Managing Lifetime in Redis Cache



- No default expiration**
- Content exists until it's removed**
- Must set TTL manually**



# Calculating Cache Duration

Rate of Change

**Long expiry for static data**  
**Short expiry for volatile data**

Risk of Outdated Data

**Lower TTL to match data change**



```
_cache.StringSet("myKey", "my Value", new TimeSpan(3, 0, 0));
```

## Setting Expiration Times for Redis Cache

**By default, values will not expire**



Demo



## Configuring Redis Cache Expiration



# Redis Cache Best Practices

---



# Best Practices



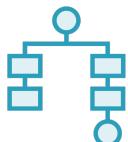
**Watch out for data loss**



**Set expiry times to manage content lifetime**



**Add jitter to spread database load**



**Avoid caching large objects**



**Host Redis in the same region as your application**



# Up Next:

## Implementing Application Caching Patterns

---



# Implementing Application Caching Patterns

---



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# The Benefits of Caching

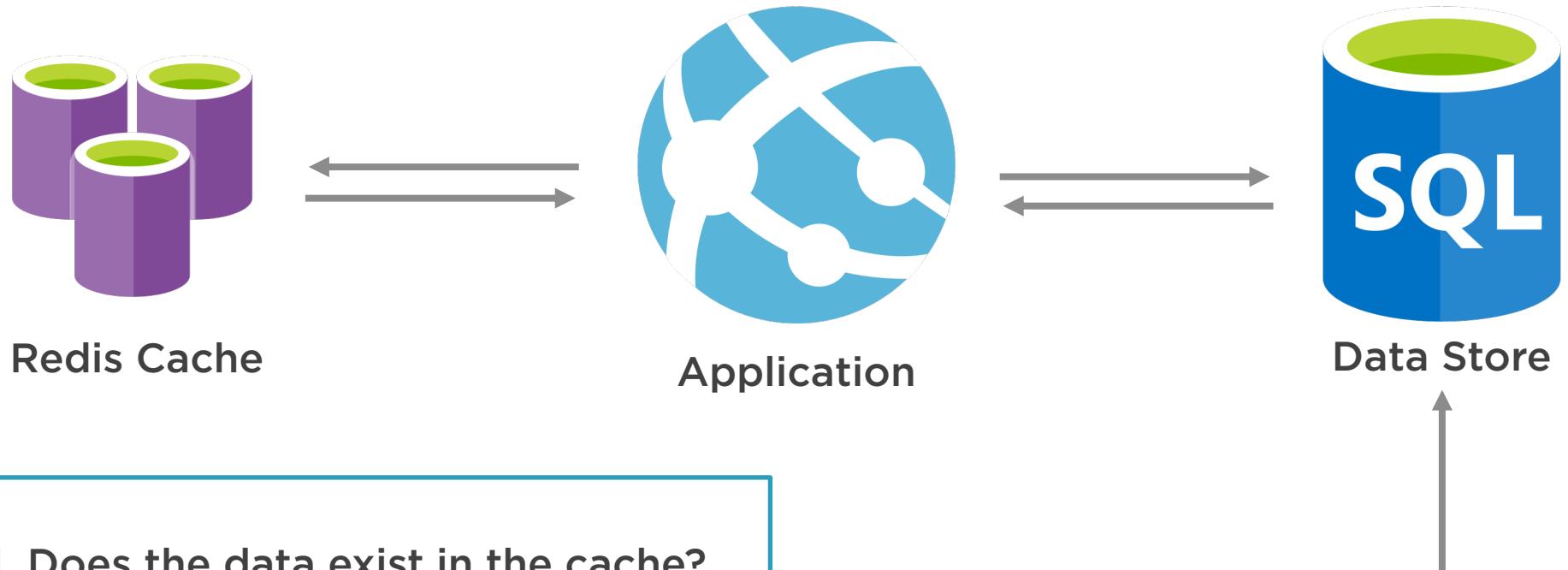
Performance

Scalability

Resilience



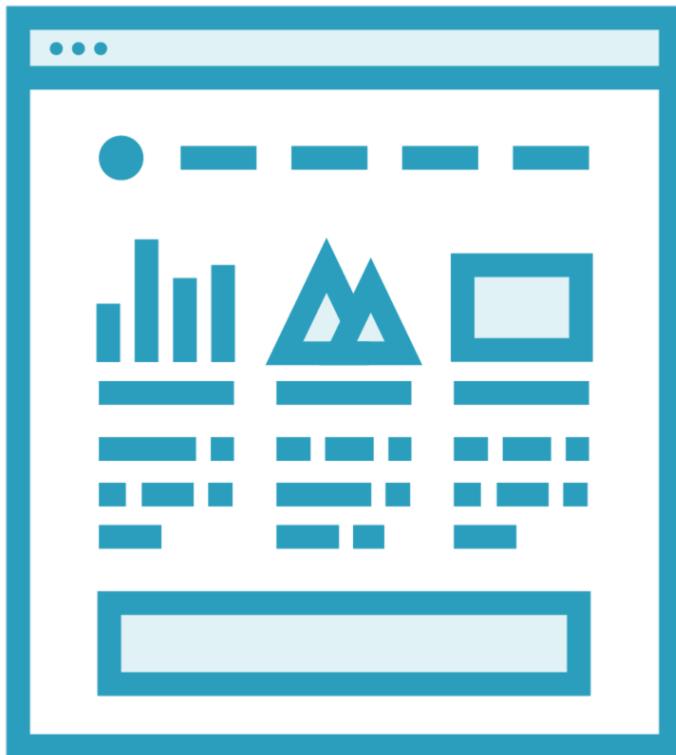
# Cache-aside Pattern



1. Does the data exist in the cache?
2. If not, retrieve from the data store
3. Store a copy in the cache



# Content Cache Pattern



**Cache static content**

- Images
- Templates
- Style sheets

**Reduces server load**

**Redis Output Cache Provider for ASP.NET**



# User Session Caching Pattern



**Maintain application state**

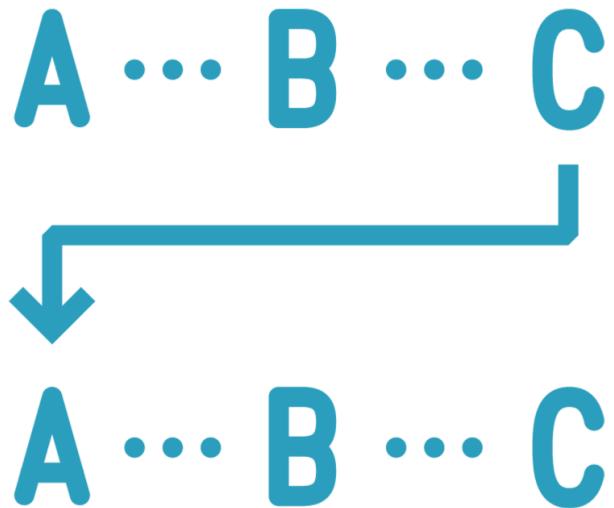
- Shopping cart

**Session cookies or local storage**

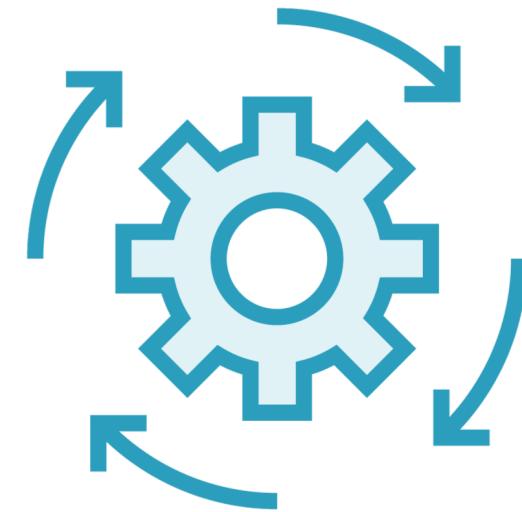
- Limited data storage
- Slow performance



# Advanced Patterns



Job and Message Queuing



Distributed Transactions



# Configuring Redis Cache

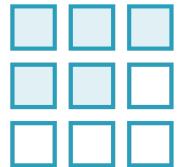
---



# Estimating Cache Size

[1,2,3]

**Number of concurrent cached objects**



**Size of cached objects**



**Number of cache requests**



**Cache expiration policy**



```
Redis-benchmark -q -n 100000
```

## Benchmarking Redis Cache

**Cannot run from the Azure portal**

**Create a virtual machine that contains the Redis CLI**



Demo



**Creating resilient connections**

**Defining custom retry policies**



# Securing Redis Cache

---



# Encryption in Transit



**Use TLS 1.2**  
**TLS 1.1 supported for compatibility**  
**HTTP connections disabled by default**



# Encryption at Rest



**In memory data is not encrypted**

**Premium tiers**

- Data persistence is encrypted



Demo



**Configuring secure connections**



# Microsoft Azure Developer: Instrument Solutions for Monitoring and Logging

---

INTRODUCTION TO AZURE MONITOR AND APPLICATION  
INSIGHTS



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MICROSOFT MVP & SOFTWARE DEVELOPER

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# Course Overview



**Understand Azure Monitor structure and Application Insights capabilities**

**Configure instrumentation with Application Insights in the ASP .NET Core apps**

**Implement Application Insights Web Test and Alerts**

**Implement code that handles transient faults**

**Summary**



# Module Overview



- Understand Azure Monitor structure**
- Understand Azure Application Insights capabilities**
- Configure Azure Application Insights in the Azure Portal**
- Configure instrumentation in the ASP .NET Core apps**
- Analyze log data and troubleshoot solutions**

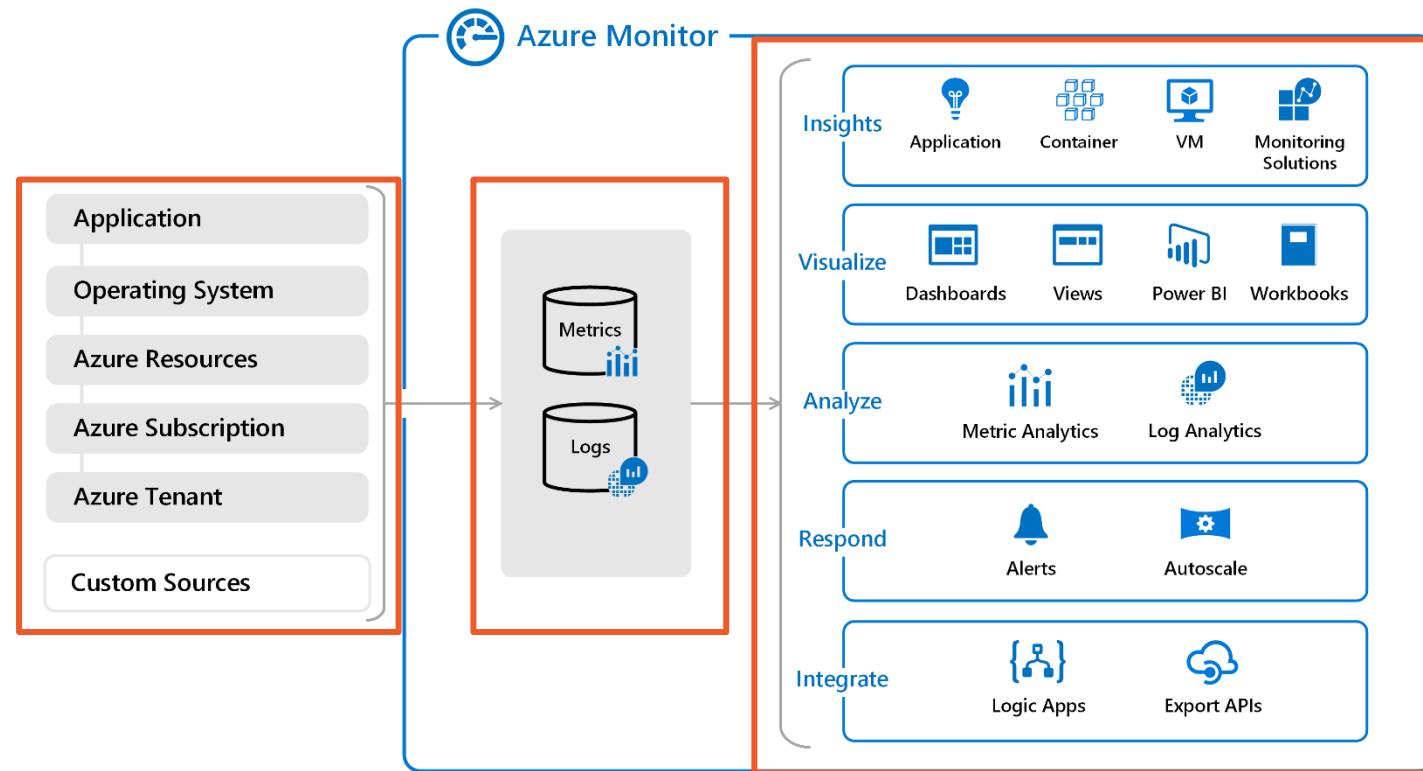


# Azure Monitor Structure

---



# Azure Monitor Structure



# Metrics

Metrics are numerical values that describe some aspect of a system at a particular time.

Example of metrics can be CPU or memory usage value.



# Logs

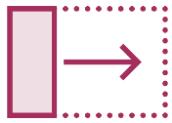
Logs are events that occurred within the system.

They can contain different kinds of data and may be structured or free form text with a timestamp.

Example of the logs can be information about exception thrown during application execution.



# Azure Monitor capabilities



Correlate infrastructure issues



Detect and diagnose issues across applications and dependencies



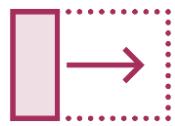
Support operations with smart alerts and automated actions



Create visualizations with Azure dashboards and workbooks



# What Data Does Azure Monitor Collect?



**Data about the performance and functionality of the application's source code**



**Data about the operating system on which your application is running**



**Data about the operation of an Azure resources**



**Data about the operation of tenant-level Azure services, such as Azure Active Directory**



Azure Monitor can collect log data from any REST client what allows to create custom monitoring scenarios, including on-premises solutions



# Monitoring Application Performance with Azure Application Insights

---



# Azure Application Insights

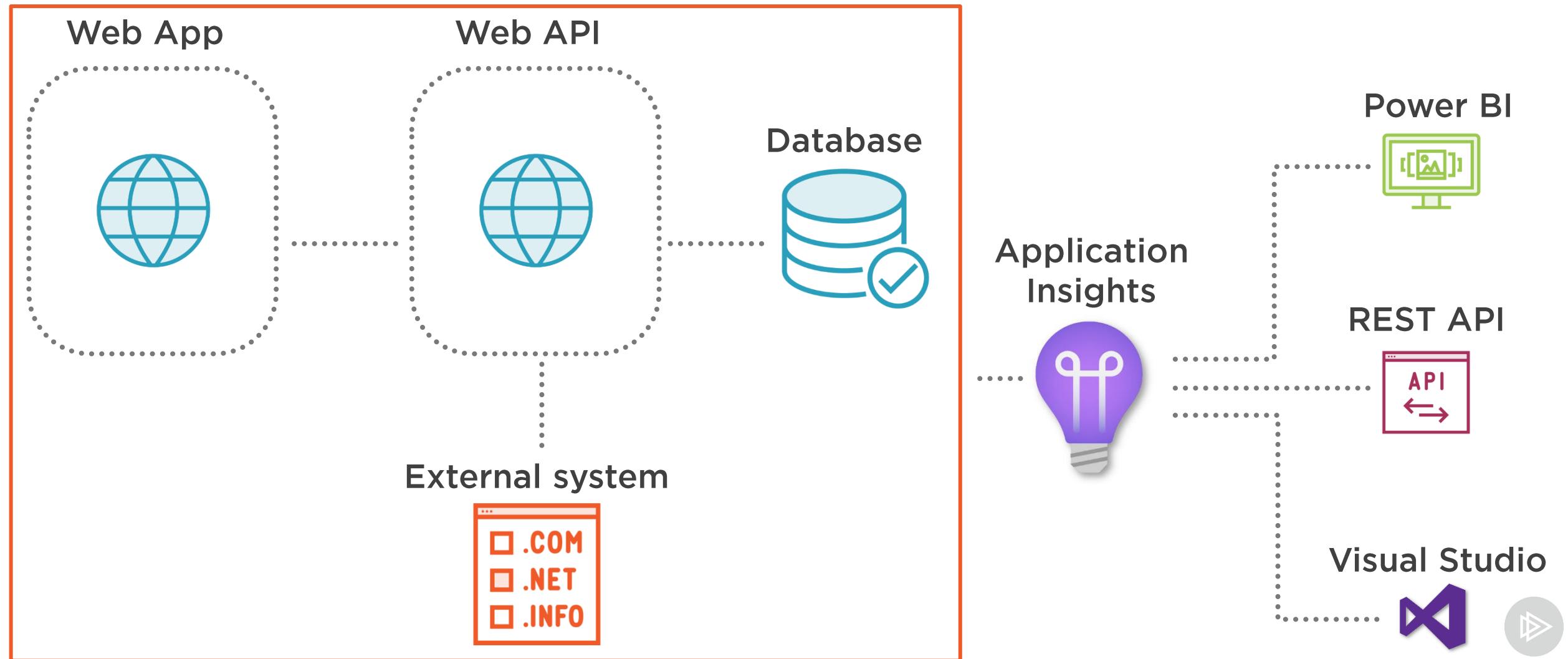


**Application Insights is an extensible Application Performance Management (APM) service for developers and DevOps professionals**

**It is a part of the Azure Monitor**



# Azure Application Insights



# Application Insights Capabilities



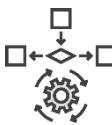
Check performance of server machines like CPU or memory usage



Detect thrown exceptions in the application's source code



Add custom events and metrics in the client or server code, to track business events



Collect request rates, response times, and failure rates



Collect page views and load performance - reported by the user's browser



# Application Insights SDKs

ASP.NET

ASP.NET Core

Java EE

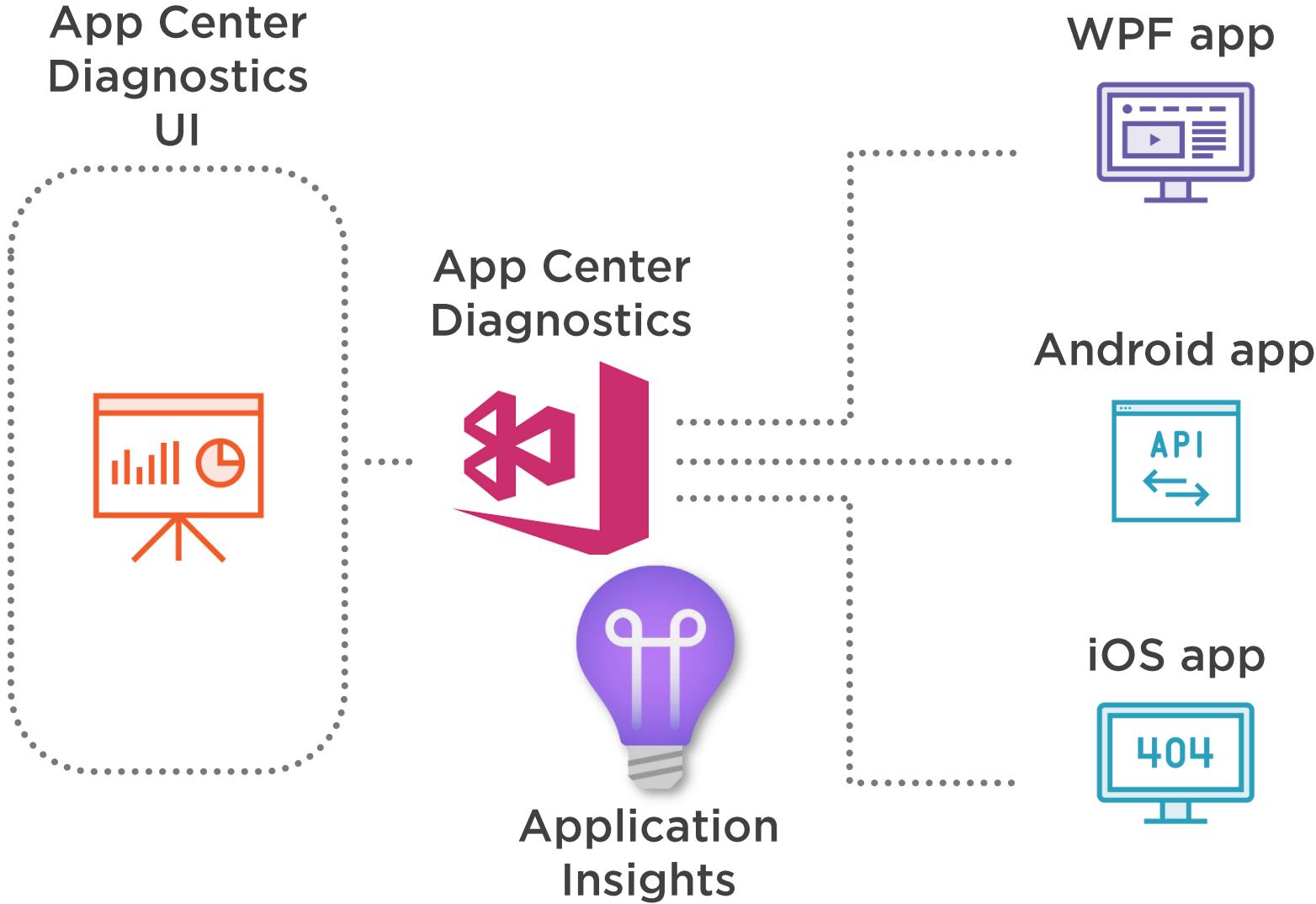
Node.JS

React

Python



# Mobile and Desktop Apps Support



How can I see collected  
telemetry from my  
applications?



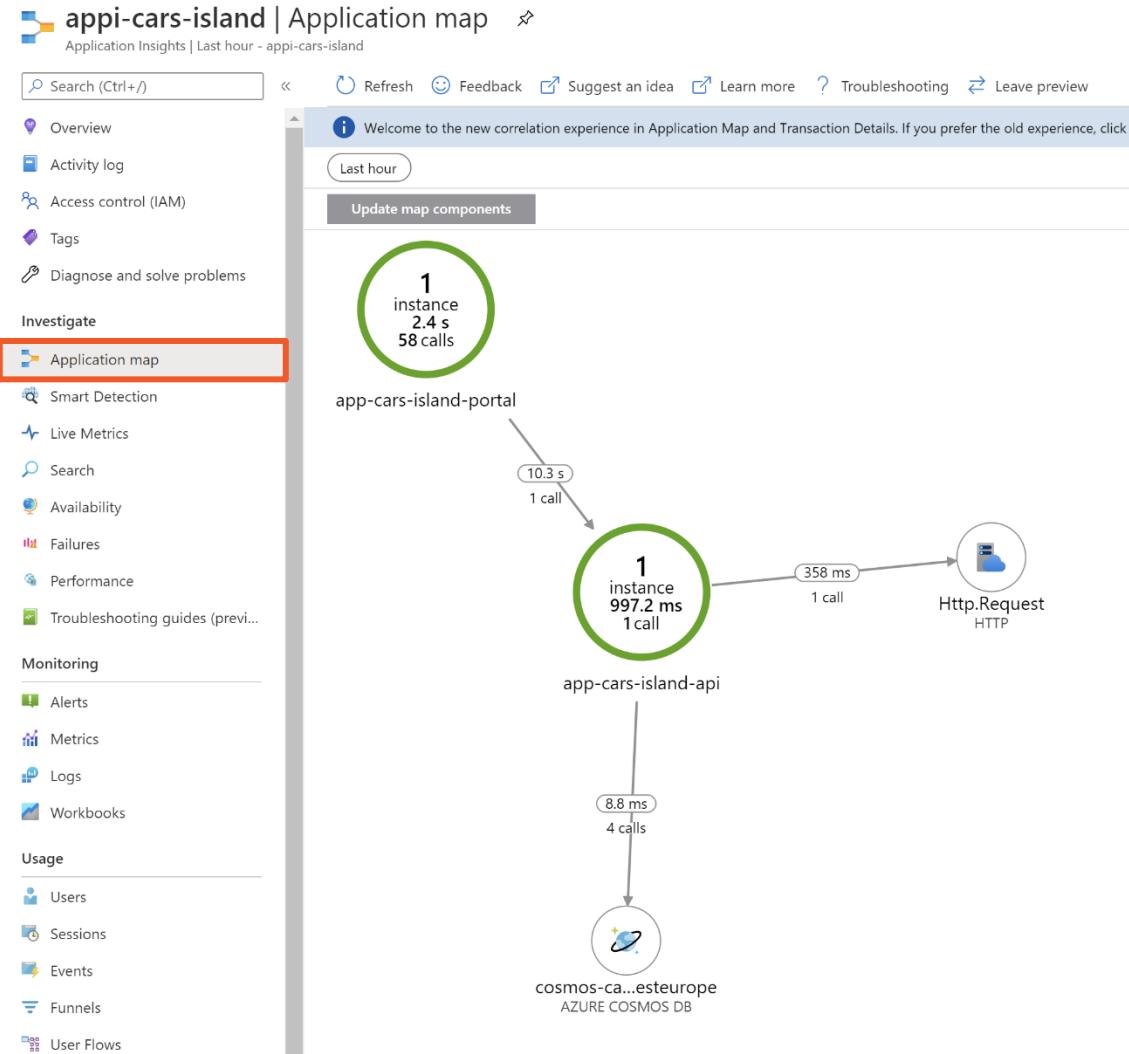
**Smart Detection  
automatically warns  
you of potential  
performance  
problems and failure  
anomalies in your web  
applications**

The screenshot shows the Microsoft Application Insights Smart Detection interface. The left sidebar has a red border around the 'Smart Detection' item, which is highlighted in blue. The main area displays three detected anomalies:

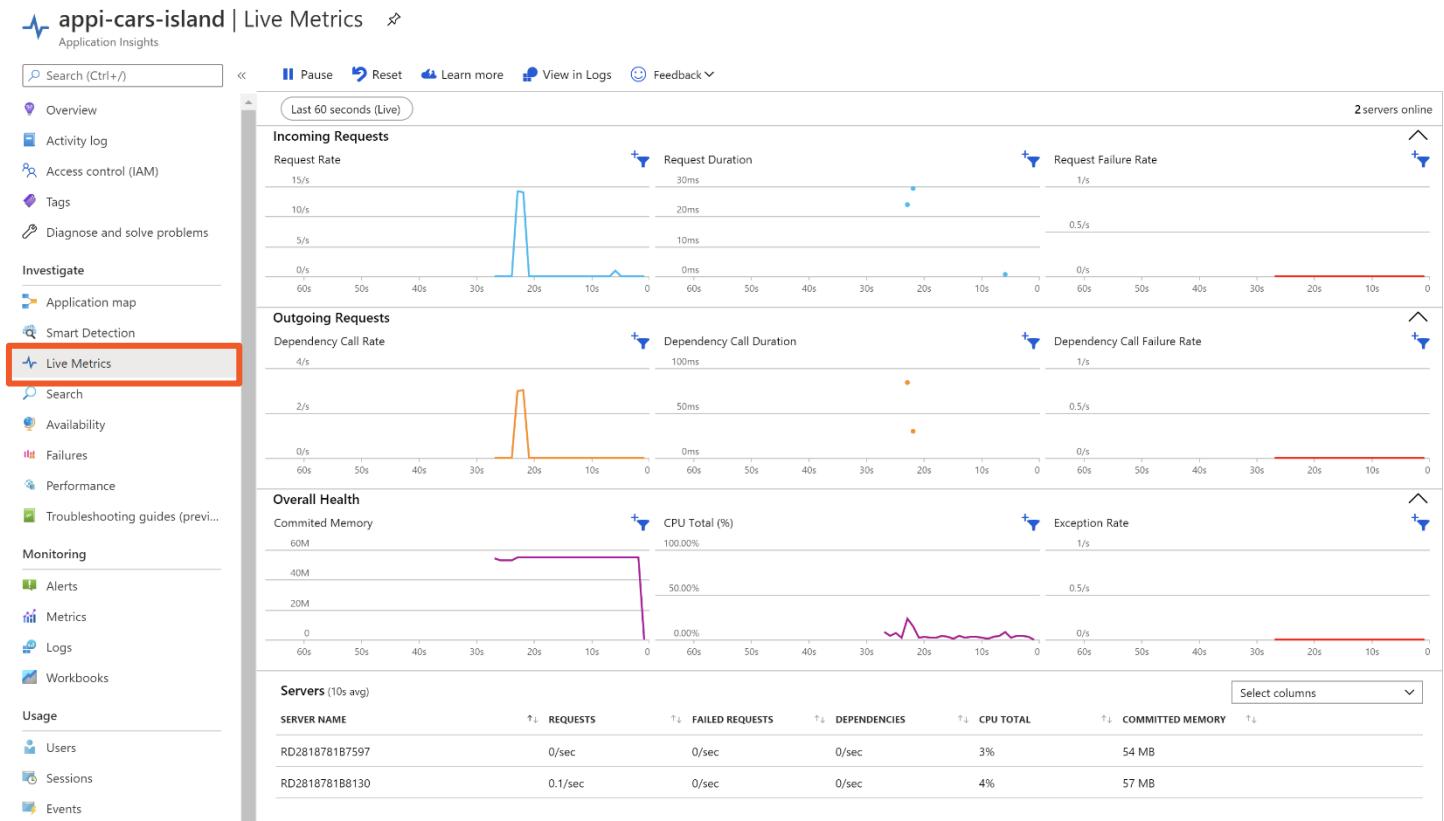
- Abnormal rise in exception volume**  
When: 7/28 5:30 AM - 7/29 5:29 AM  
What: 450% increase in 'System.Web.HttpException' volume compared to the previous 7 days  
Note: Data provided by 1 user was potentially compromised due to this insecure data transmission
- Insecure form data transmission detected**  
When: 7/9 5:30 AM - 7/10 5:29 AM  
What: 2 operations or forms in your application submit data to insecure (non-HTTPS) URLs  
Note: Data provided by 1 user was potentially compromised due to this insecure data transmission
- Potentially insecure URL access detected**  
When: 7/9 5:30 AM - 7/10 5:29 AM  
What: 2 URLs were accessed by both HTTP and HTTPS protocols  
Note: 4 users accessed multiple URLs using HTTP instead of HTTPS



**Application Map helps  
spot performance  
bottlenecks or failure  
hotspots across all  
components of the  
distributed application**



Live Metrics tab provides real time information about application performance



**Failures tab provides details about issues detected inside your applications like exceptions and server errors**

The screenshot shows the Microsoft Application Insights interface for the application 'appi-cars-island'. The title bar reads 'appi-cars-island | Failures'. The left sidebar contains a navigation menu with the following items:

- Search (Ctrl+ /)
- Refresh
- View in Logs
- Analyze with Workbooks
- Feedback

Below the search bar, the sidebar has two main sections: 'Overview' and 'Investigate'. Under 'Investigate', the following items are listed:

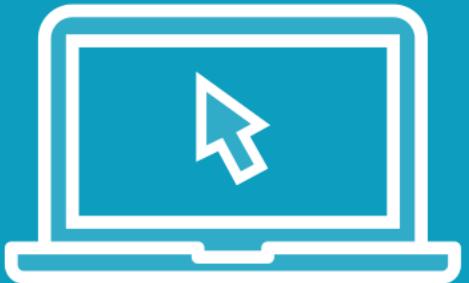
- Application map
- Smart Detection
- Live Metrics
- Search
- Availability
- Failures** (this item is highlighted with a red rectangle)
- Performance
- Troubleshooting guides (previ...)

The main content area is titled 'Overall' and displays three sections:

- Top 3 response codes**: A chart showing the top response codes.
- Top 3 exception types**: A chart showing the top exception types, with 'ArgumentNullException' at the top.
- Top 3 failed dependencies**: A chart showing the top failed dependencies.



# Demo

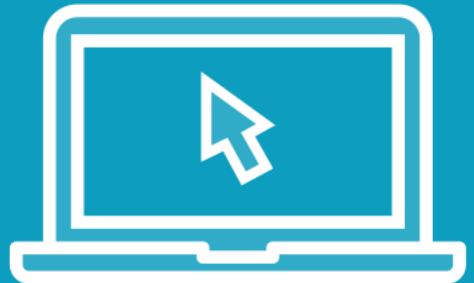


## Create Application Insights resource in the Azure portal

- Overview of the Application Insights tab
- Instrumentation key



# Demo

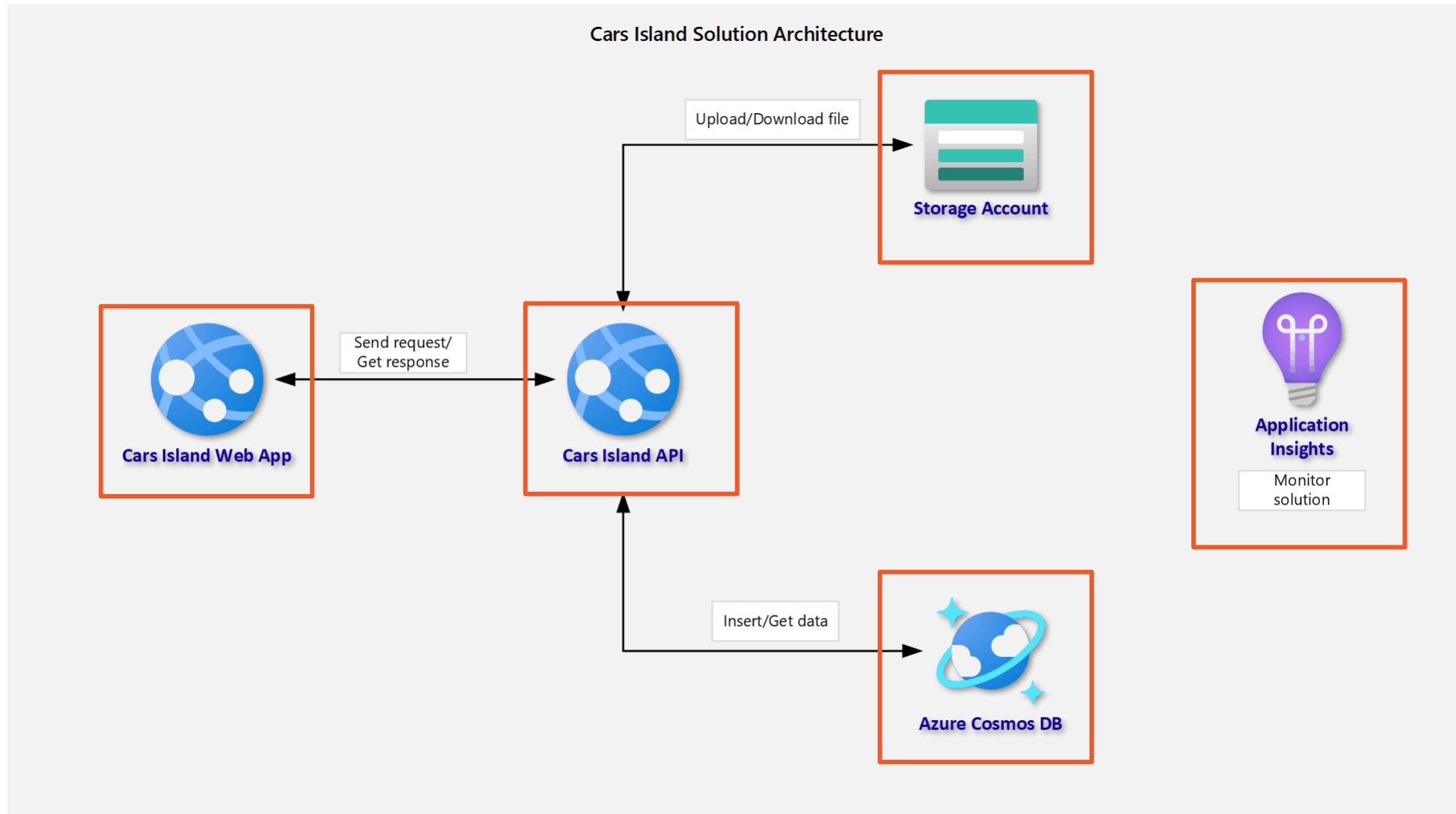


## Add instrumentation to the ASP .NET Core applications

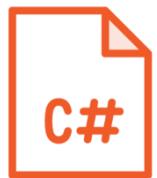
- Integrate ASP .NET Core API application
- Integrate ASP .NET Core Blazor web application



# Solution Architecture



# Before We Begin



Source code link: [github.com/Daniel-Krzyczkowski/Pluralsight](https://github.com/Daniel-Krzyczkowski/Pluralsight)



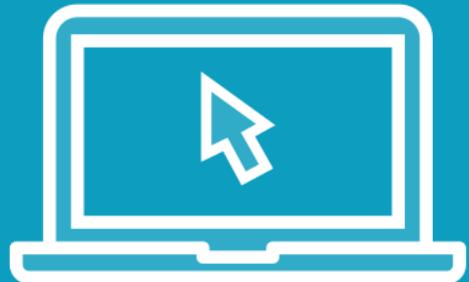
We will use Visual Studio 2019 (16.5.x)



Solution requires the .NET Core 3.1



## Demo



### Analyze logs and solve issues

- Analyze logs and detect issues in the ASP .NET Core application
- Fix bugs in the source code



# Summary



Azure Monitor as a tool to monitor performance and issues related to applications and services

Application Insights as an extensible Application Performance Management service

Analyze log data and troubleshoot solutions with Application Insights



# Implement Alerts and Handle Transient Faults

---



**Daniel Krzyczkowski**  
MICROSOFT MVP & SOFTWARE DEVELOPER  
@DKrzyczkowski [www.techmindfactory.com](http://www.techmindfactory.com)



# Module Overview



**Set up recurring tests to monitor availability and responsiveness of your web apps**

**Receive alerts when your app is not available**

**React on the transient failures in the code to make your solution more resilient**

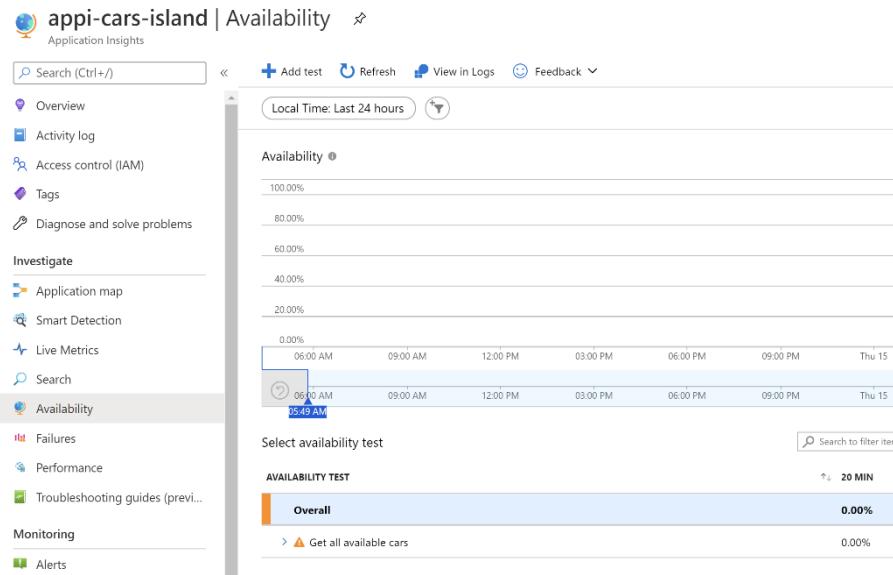


# Monitor Availability with Azure Application Insights Web Test and Alerts

---



# Azure Application Insights Web Tests



**With Azure Application Insights you can set up recurring tests to monitor availability and responsiveness of your web apps and web services**



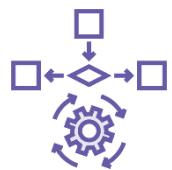
# Types of Availability Tests:



**URL ping test** - a single URL test that you can create in the Azure portal



**Custom Track Availability Tests** - send information about availability of an application using `TrackAvailability()` method from the SDK



**Multi-step web test** - A recording of a sequence of web requests, which can be played back to test more complex scenarios



# Azure Application Insights Web Tests

get all available cars-appli-cars-island ✎

Rules management

Save Discard Disable Delete

Edit the details below to modify the alert rule.  
When defining the alert rule, check that your inputs do not contain any sensitive content.

**Scope**  
Select the target resource you wish to monitor.

Resource Hierarchy  
get all available cars-appli-cars-island Visual Studio Enterprise > rg-cars-island

[Go to webtest for more details]

**Condition**  
Configure when the alert rule should trigger by selecting a signal and defining its logic.

Condition name  
 Whenever the average failed locations is greater than or equal to 3 count

Select condition  
You can only define one availability test signal per alert rule. To alert on more signals, please create additional alert rules.

**Action group**  
Send notifications or invoke actions when the alert rule triggers, by selecting or creating a new action group. [Learn more](#)

Action group name Contains actions  
Availability tests owner 1 Email

Select action group

**Alert rule details**  
Provide details on your alert rule so that you can identify and manage it later.

Alert rule name get all available cars-appli-cars-island

Description Automatically created alert rule for availability test "get all available cars-appli-cars-island"

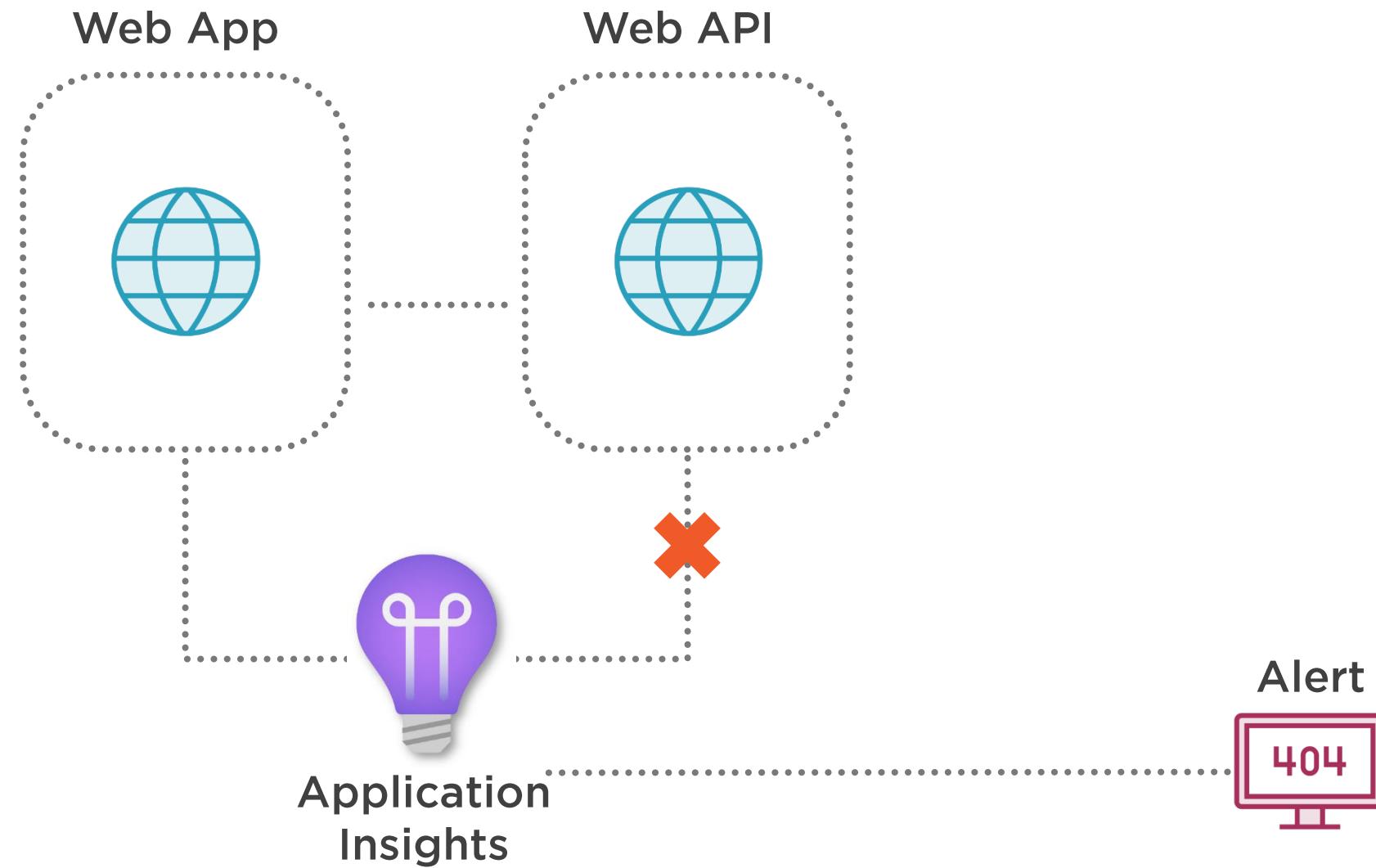
Save alert rule to resource group rg-cars-island

Severity \* Sev 1

Azure Application Insights can alert you if your application isn't responding, or if it responds too slowly during the availability tests



# Azure Application Insights Alerts



# An Action Group

Collection of notification preferences defined by the owner of an Azure subscription.

Azure Monitor and Service Health alerts use action groups to notify users that an alert has been triggered.



# Azure Application Insights Action Groups

Edit action group

Save changes Delete action group

This is a summary of your action group. Please review to ensure the information is correct and consider [Azure Alerts Pricing](#) and the [Azure Privacy Statement](#).

**Basics**

|                   |                          |
|-------------------|--------------------------|
| Subscription      | Visual Studio Enterprise |
| Resource group    | rg-cars-island           |
| Action group name | Availability tests owner |
| Display name *    | Availability             |

**Notifications**

| Notification type            | Name       | Status     | Selected |
|------------------------------|------------|------------|----------|
| Email/SMS message/Push/Voice | Send email | Subscribed | Email    |

**Actions**

| Action type | Name                 | Selected |
|-------------|----------------------|----------|
|             | <input type="text"/> |          |

**Each action is made up of the following properties:**

- **Type: notification or action performed**
- **Name: unique identifier of the group**
- **Action: additional action like Webhook**



# Azure Application Insights Alert



**⚠ An Azure Monitor alert is activated for get all available cars-appli-cars-island**

The availability test `get all available cars-appli-cars-island` has failed at 3 locations within the last 5 minutes.

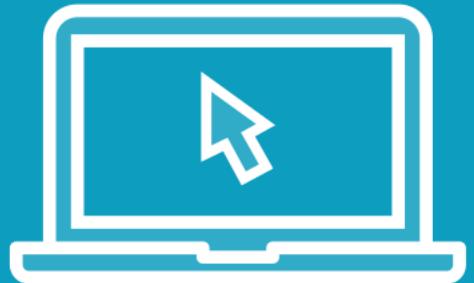
[View application availability >](#)

|                   |   |
|-------------------|---|
| Time of alert     | October 19, 2020 4:53 UTC                             |
| Availability test | <code>get all available cars-appli-cars-island</code> |
| Subscription      | f5-4435-bd89-   |
| Condition         | 1 or more failed locations                            |
| Failed locations  | 3   |
| Period            | 5 minutes   |

**Once there is a failure, new alert is sent to the target group**



# Demo



## Configure Application Insights Availability Tests and Alerts

- Setup availability test
- Create action group
- Receive and investigate alert



# Implement Code That Handles Transient Faults

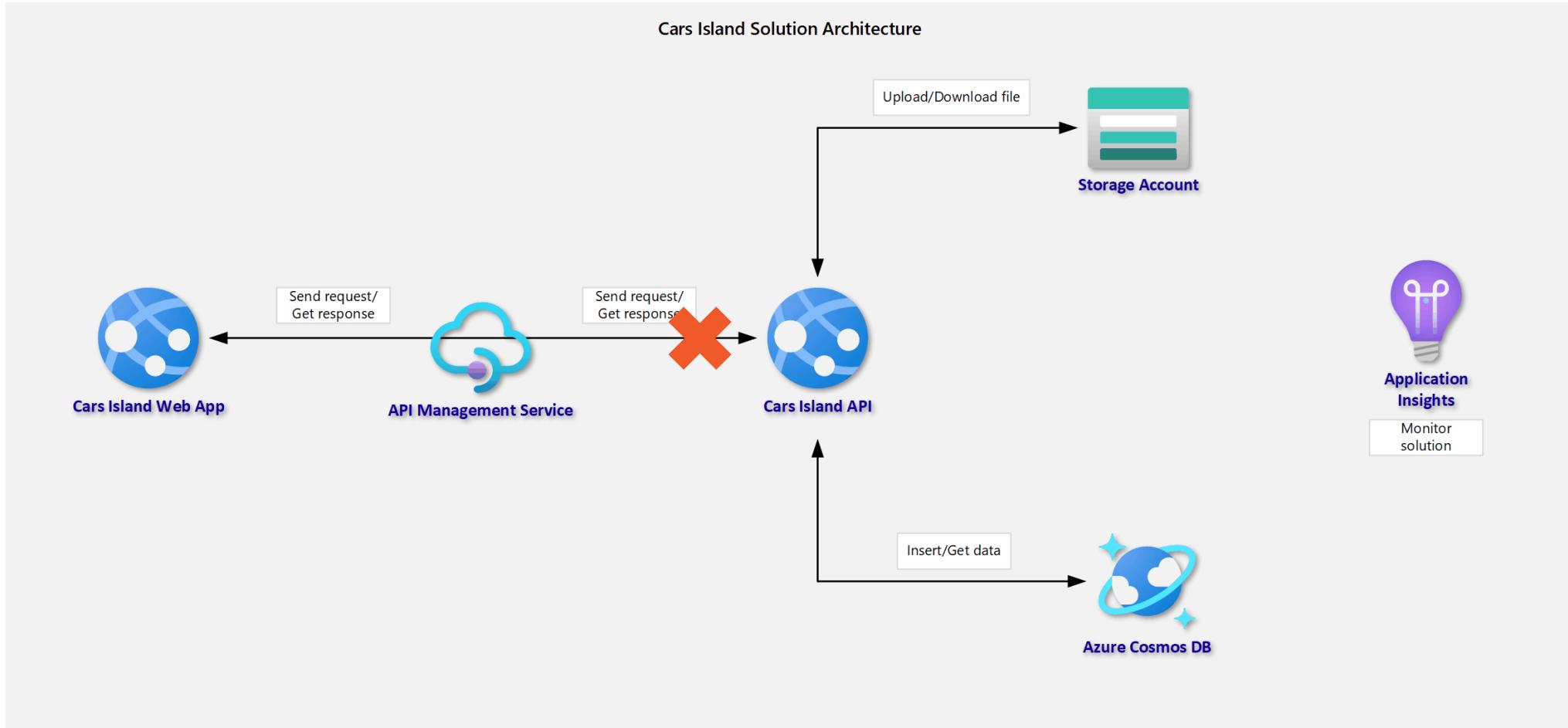
---



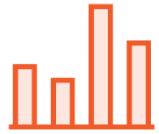
Transient faults include the momentary loss of network connectivity to components and services, the temporary unavailability of a service, or timeouts that arise when a service is busy



# Transient Faults



# Transient Faults Challenges



The application must be able to detect faults when they occur, and determine if these faults are likely to be transient



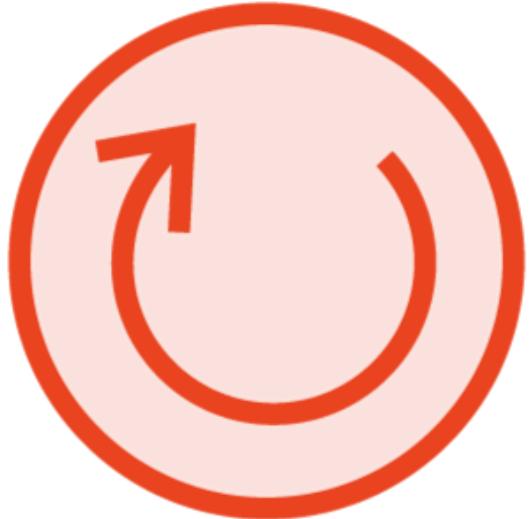
The application must be able to retry the operation if it determines that the fault is likely to be transient



The application must use an appropriate strategy for the retries. This strategy specifies the number of times it should retry



# Resiliency in the Source Code



## Polly open-source library

- Retry
- Timeout
- Circuit breaker



# The Retry Policy



**Send the request to the specific service again, after some time**



**Wait before sending the next request**



**Configure retry times and time interval between requests**



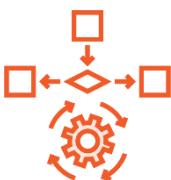
# The Circuit Breaker Policy



Service is unavailable and cannot respond to a request



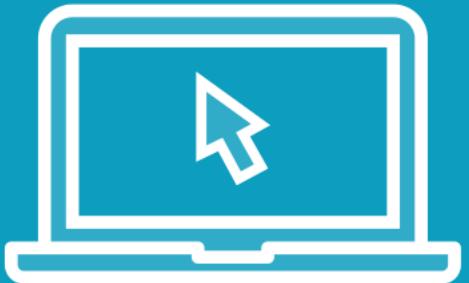
Avoid sending request for some time



When the circuit is opened, no request is sent until it is closed again



## Demo



### Implement code that handles transient failures

- Implement handling transient failures in the ASP .NET Core web app using Polly library
- Retry policy
- Circuit breaker policy



# Summary



**Setup availability tests with Azure Application Insights**

**Configure action groups to receive alerts**

**Implement code that handle transient faults with Polly library**



# Thank you!

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**Daniel Krzyczkowski**  
MICROSOFT MVP & SOFTWARE DEVELOPER  
@DKrzyczkowski [www.techmindfactory.com](http://www.techmindfactory.com)



# Exam Alert: Monitor, Troubleshoot, and Optimize Azure Solutions

---

## PREPARING FOR THE EXAM



**David Tucker**  
TECHNICAL ARCHITECT & CTO CONSULTANT  
 @\_daviddtucker\_ [daviddtucker.net](http://daviddtucker.net)

# Objectives for the Exam

---

# Monitor, Troubleshoot, and Optimize

**15-20%**

**Integrate Caching and Content Delivery within Solutions**

**Instrument Solutions to Support Monitoring and Logging**

# Integrate Caching and Content Delivery within Solutions

**Configure cache and expiration policies for Azure Redis Cache**

**Implement secure and optimized application cache patterns including data sizing, connections, encryption, and expiration**

# Instrument Solutions to Support Monitoring and Logging

**Configure an app or service to use Application Insights**

**Analyze and troubleshoot solutions by using Azure Monitor**

**Implement Application Insights web tests and alerts**

# Review Caching and Content Delivery

---

# Areas of Focus

Azure Redis Cache  
Overview

Service  
Tiers

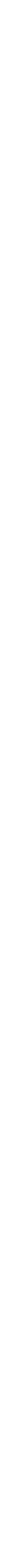
Encryption  
Configuration

Data  
Deletion

Additional  
Configuration

**“Azure Cache for Redis** is a fully managed, in-memory cache that enables high-performance and scalable architectures. Use it to create cloud or hybrid deployments that handle millions of requests per second at sub-millisecond latency.”

**Microsoft Azure Documentation**



- User session storage for distributed apps**
- Database caching**
- Content caching**
- Distributed transactions**
- Message broker**

Common Azure Cache for Redis Use Cases

# Cache Tier Considerations

**Cache  
Size**

**Network  
Performance**

**Number of Client  
Connections**

# Azure Cache for Redis Tiers

**Basic**

**Standard**

**Premium**

**Enterprise**

**Enterprise  
Flash**

# Encryption for Azure Redis Cache

**Azure Redis Cache uses encryption by default**

**Supported encryption:**

- TLS 1.0 (soon to be deprecated)
- TLS 1.1 (soon to be deprecated)
- TLS 1.2

**Encryption can be disabled via the portal or API**

# Removing Items from Azure Redis Cache

**Scheduled Deletion  
(TTL)**

**Manual Deletion**

**Eviction**

# Eviction Policy Options

**volatile-lru** (default)  
**allkeys-lru**  
**noeviction**  
**volatile-random**  
**allkeys-random**  
**volatile-ttl**

**Set the maxmemory-reserved setting**

**Reuse client connections whenever possible**

**Utilize Redis pipelining**

**Store smaller values**

Configuration Best Practices

# Review Monitoring and Logging

---

# Areas of Focus

**Enabling App  
Service Logging**

**Transient  
Faults**

**Configuring  
Docker Containers**

**Web Test  
Alerts**

```
# Configuring Web Server Logging to the Filesystem
az webapp log config --name sampleWebApp
--resource-group sampleResourceGroup
--web-server-logging filesystem
```

```
# Configuring App Logging to Azure Blob Storage (Windows Only)
az webapp log config --name sampleWebApp
--resource-group sampleResourceGroup
--application-logging azureblobstorage
```

## Configuring Web App Logging

### Azure App Service

```
# Configuring Container Logging to the File System (Linux Only)
az webapp log config --name sampleWebApp
--resource-group sampleResourceGroup
--docker-container-logging filesystem
```

## Configuring Web App Logging for Docker Azure App Service

```
# Tail logs from App Service app  
az webapp log tail --name sampleWebApp  
--resource-group sampleResourceGroup  
  
# Tail and Filter logs from an App Service app  
az webapp log tail --name sampleWebApp  
--resource-group sampleResourceGroup --filter Error
```

## Live Log Tracing for a Web App

### Azure App Service

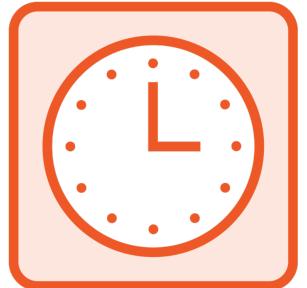
# **Transient Fault**

**Any fault that is likely self-correcting and is caused by a temporary loss of connection or unavailability of a service that an application is dependent upon.**

# Dealing with Transient Faults

- Applications should log transient faults**
- A retry strategy should be in place where needed**
- Retry logic is already built into most SDK interactions**
- Implement architectural patterns that help with transient faults**
  - Retry pattern
  - Circuit Breaker pattern

# Docker Environment Variables for App Service



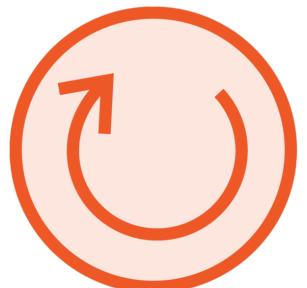
## **WEBSITES\_CONTAINER\_START\_TIME\_LIMIT**

This will set the amount of time the platform will wait before it restarts your container.



## **WEBSITES\_ENABLE\_APP\_SERVICE\_STORAGE**

If this value is not set or if it is set to **true**, the `/home` directory will be shared across container instances and files will persist.



## **WEBSITE\_WEBDEPLOY\_USE\_SCM**

If you want to deploy your container-based web application using WebDeploy/MSDeploy, this value must be set to **false**.

## Application Insights Web Test

You can utilize Application Insights to monitor the availability and responsiveness of web applications that have been deployed on the platform. This monitoring is configurable with multiple test types for web applications.

# Web Test Types

**URL Ping** - ping a single URL to test for availability

**Multi-step Web** - sequence of web requests to validate more complex scenarios

**Custom** - you can create a custom app to track availability for Application Insights

## Example Scenarios

---

## Scenario 1



**Sylvia is using Azure Redis Cache for an internal web application**

**She is using the default settings for a standard tier cache**

**She is noticing that some keys are never expiring from the cache**

**Some keys remain in the cache even though they are older and rarely used**

**What should she set the cache eviction policy for to remedy this?**

## Scenario 2



**Edward is deploying a web application using Azure App Service**

**Due to previous downtime, he wants to be notified if the site isn't available**

**He wants to check that the home page returns a 200 status**

**What type of web test should he configure for Application Insights?**

## Scenario 3



**Cindy has deployed a container-based app using App Services**

**She is attempting to access her logs from the command line**

**She finds that currently there aren't any web server logs that she can access**

**What Azure CLI command should she run to enable logging for the container?**

```
> az [REDACTED]  
    --name myWebApp  
    --resource-group myResourceGroup  
    --docker-container-logging [REDACTED]
```



## Scenario 4

**William's company will be implementing a cache for application content**

**They plan to use Azure Redis Cache**

**William estimates 50 GB for the cache**

**The cache needs to have replication and failover**

**The application will leverage Azure Private Link for the cache connection**

**What is the most cost-effective pricing tier for this set of requirements?**

## Scenario 5



**Oscar's is creating a container-based application on App Service**

**App Service is having trouble launching his container fully**

**Oscar expects that the service is not waiting long enough before evaluation**

**How can Oscar enable this behavior on Web App for Containers?**

## Scenario 6



**James's company is using Azure Redis Cache for a complex data set**

**Currently the cache is using the default configuration for the Premium tier**

**James is noticing keys are being deleted based on when they were last used**

**How should James configure eviction to use remaining TTL instead?**

# Scenario Answers

---



## Scenario 1

**Sylvia is using Azure Redis Cache for an internal web application**

**She is using the default settings for a standard tier cache**

**She is noticing that some keys are never expiring from the cache**

**Some keys remain in the cache even though they are older and rarely used**

**What should she set the cache eviction policy for to remedy this?**

**Solution: Set the eviction policy to allkeys-lru**

## Scenario 2



**Edward is deploying a web application using App Services**

**Due to previous downtime, he wants to be notified if the site isn't available**

**He wants to check that the home page returns a 200 status**

**What type of web test should he configure for Application Insights?**

**Solution: Utilize a URL Ping web test for Application Insights**

## Scenario 3



**Cindy has deployed a container-based app using App Services**

**She is attempting to access her logs from the command line**

**She finds that currently there aren't any web server logs that she can access**

**What Azure CLI command should she run to enable logging for the container?**

```
> az webapp log config  
    --name myWebApp  
    --resource-group myResourceGroup  
    --docker-container-logging filesystem
```



## Scenario 4

William's company will be implementing a cache for application content

They plan to use Azure Redis Cache

William estimates 50 GB for the cache

The cache needs to have replication and failover

The application will leverage Azure Private Link for the cache connection

What is the most cost-effective pricing tier for this set of requirements?

**Solution:** He should utilize the Standard tier

## Scenario 5



**Oscar's is creating a container-based application on App Service**

**App Service is having trouble launching his container fully**

**Oscar expects that the service is not waiting long enough before evaluation**

**How can Oscar enable this behavior on Web App for Containers?**

**Solution:** He should set the env variable WEBSITES\_CONTAINER\_START\_TIME\_LIMIT to the needed start time value

## Scenario 6



**James's company is using Azure Redis Cache for a complex data set**

**Currently the cache is using the default configuration for the Premium tier**

**James is noticing keys are being deleted based on when they were last used**

**How should James configure eviction to use remaining TTL instead?**

**Solution: He should utilize the volatile-ttl eviction policy**

# Microsoft Azure Developer: Develop Event-based Solutions

---

IMPLEMENT AZURE EVENT GRID SOLUTIONS



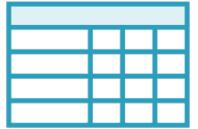
**Matthew Soucoup**

PRINCIPAL

@codemillmatt codemillmatt.com



# Event Types



**Discrete:** report state changes and are actionable. (Event Grid)



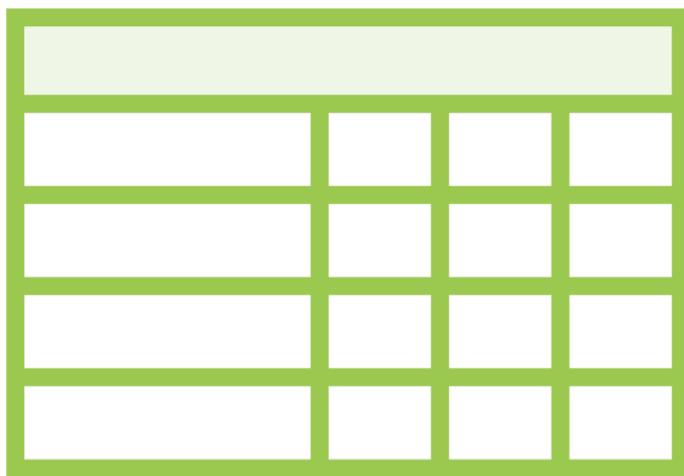
**Series:** report a condition, time-ordered, and analyzable. (Event Hub)



**User notification:** prompt user or their device for attention. (Notification Hub)



# Azure Event Grid



**Event-based architectures (pub/sub)**

**Publishers emit and subscribers consume**

- Azure and/or custom

**Support many subscribers to one publisher**

**Filter events**

**Scalable up and down**

**Pay for what you use**



```
az provider register --namespace Microsoft.EventGrid  
az provider show --namespace Microsoft.EventGrid --query "registrationState"
```

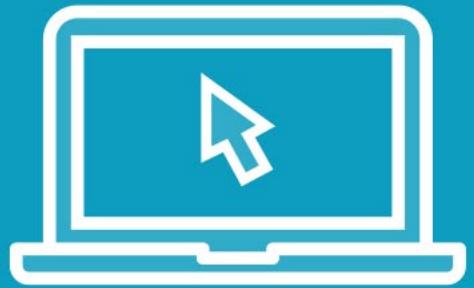
## Register Event Grid Provider

**Need to enable provider for Azure subscription**

**Registration takes a while**



# Demo



## Enable Azure Event Grid

- Azure CLI
- Azure portal



# Pub/Sub Concepts

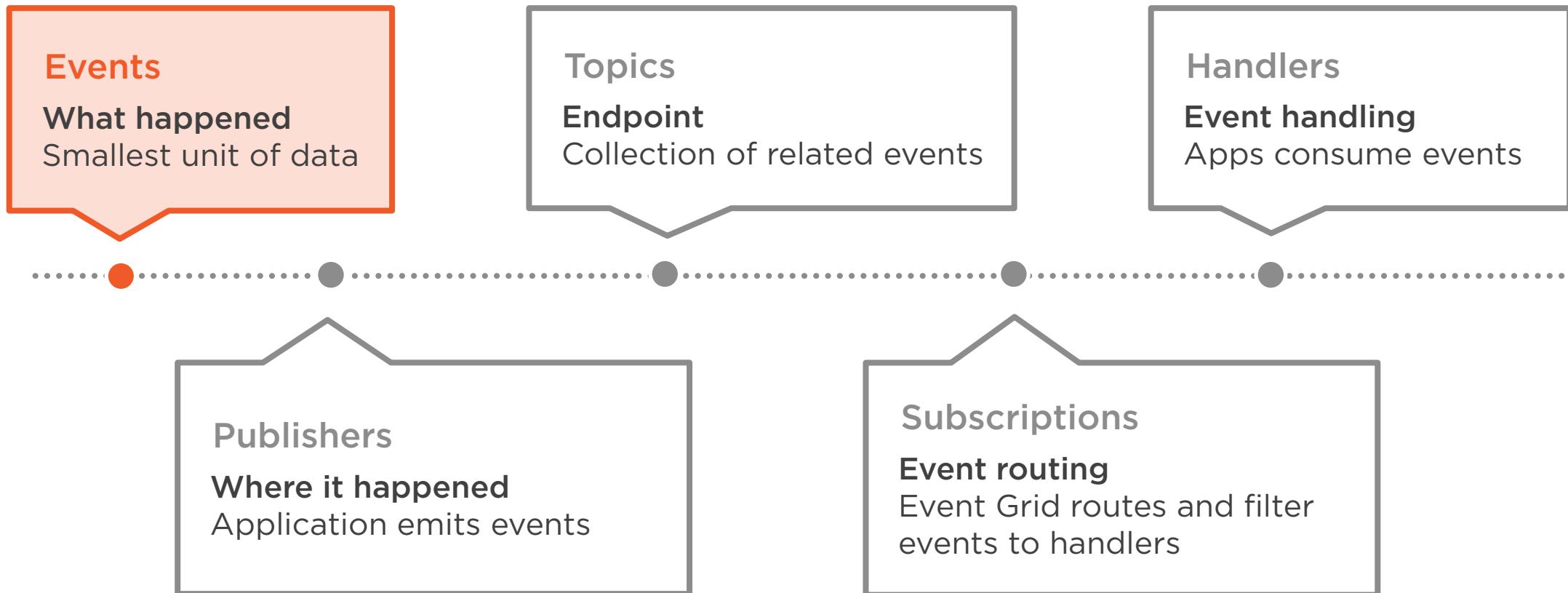
**Event signifies  
something changed**

**Publisher has no  
expectation of what  
happens with event**

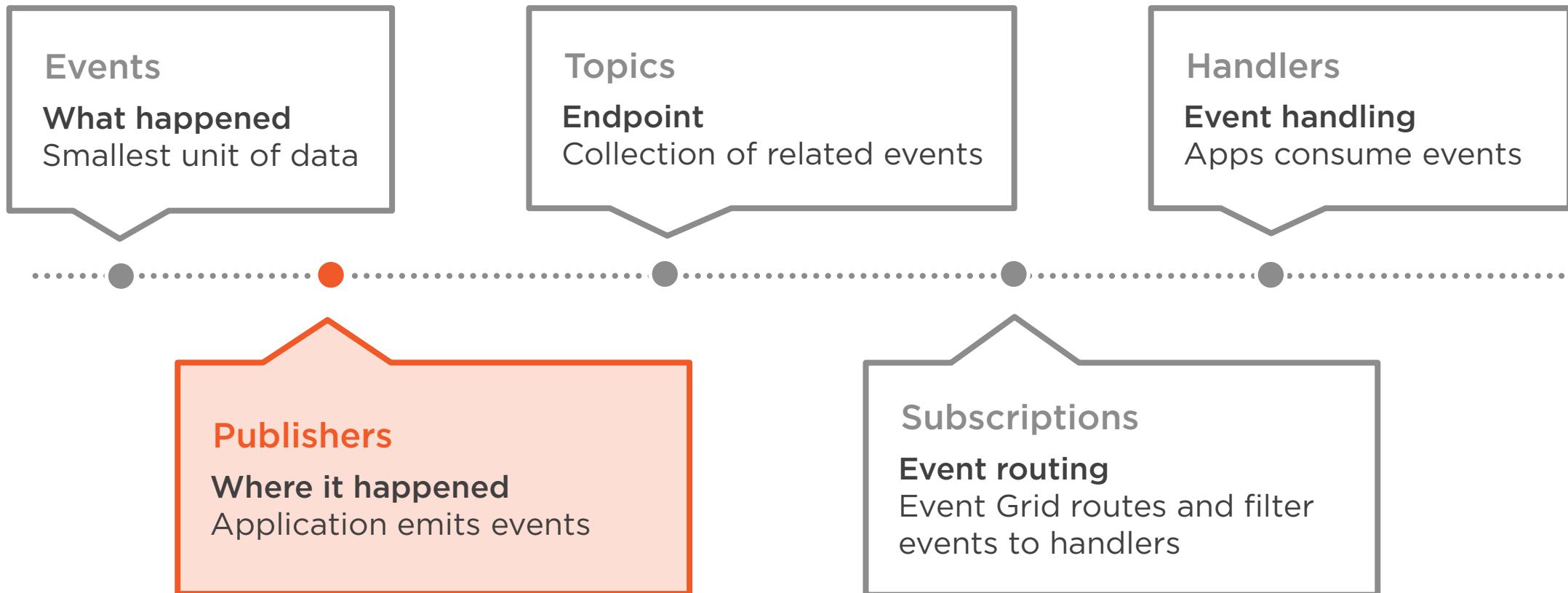
**Subscriber  
determines what to  
do with event**



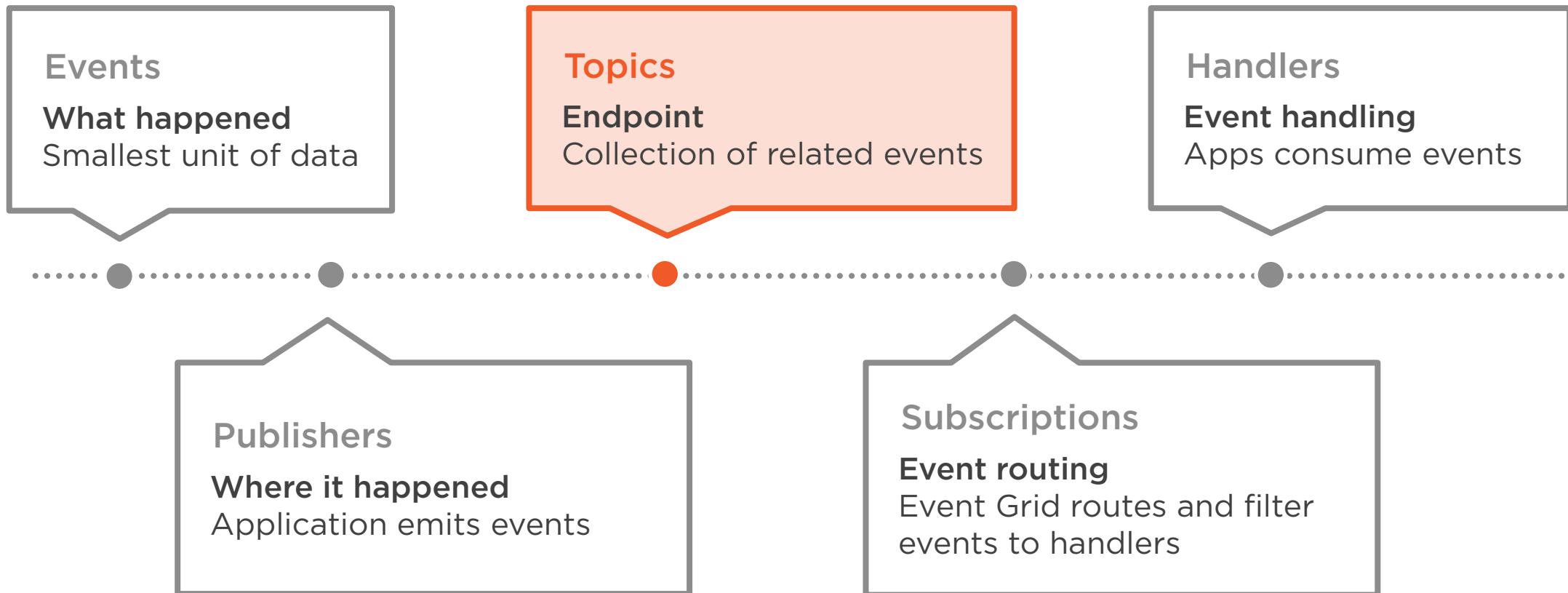
# Event Grid Terminology



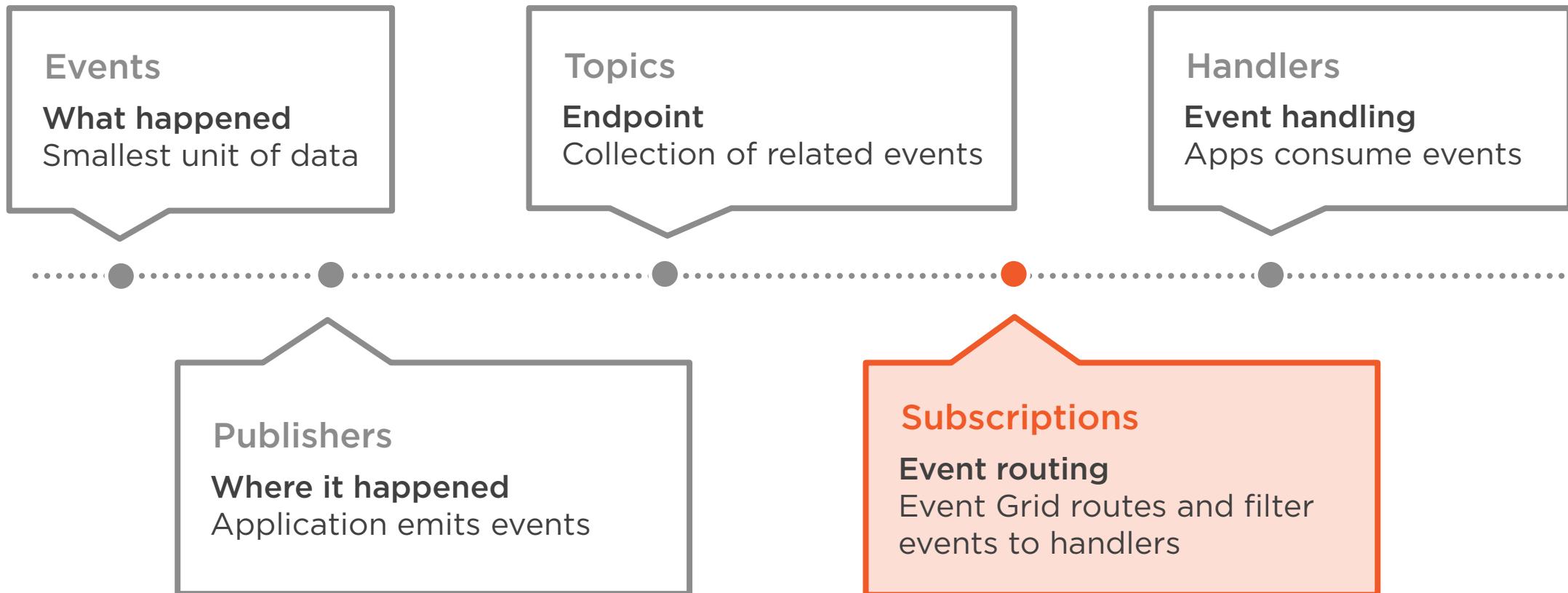
# Event Grid Terminology



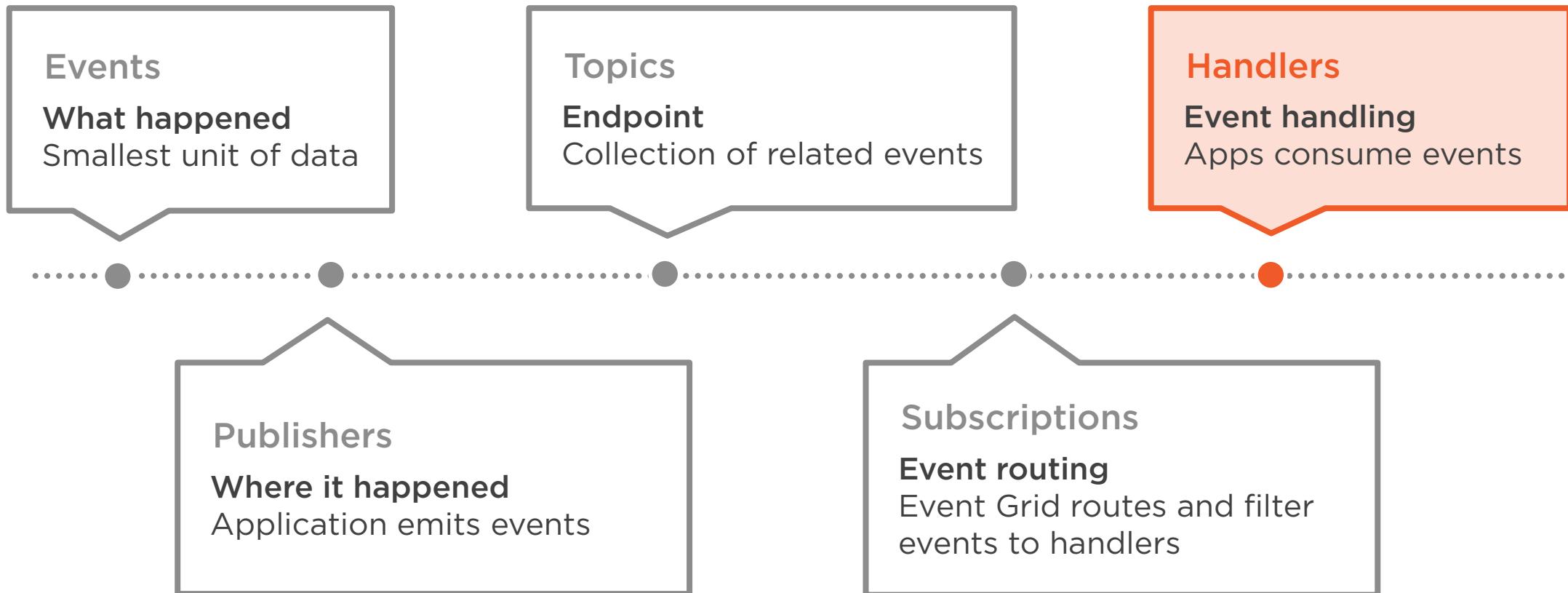
# Event Grid Terminology



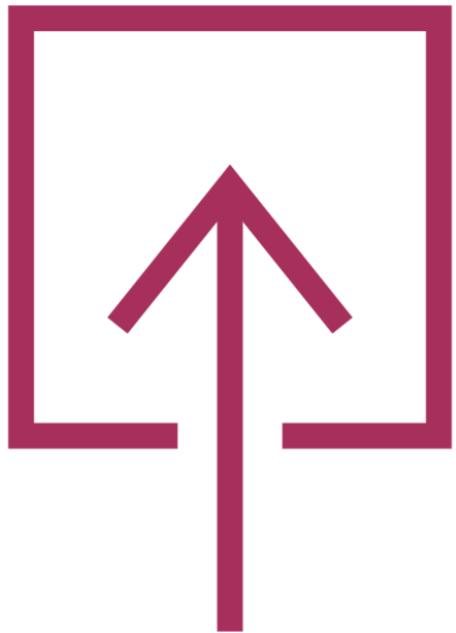
# Event Grid Terminology



# Event Grid Terminology



# Azure Event Publishers



**App Configuration**  
**App Service**  
**Blob Storage**  
**Communication Services**  
**Container Registry**  
**Event Hubs**  
**IoT Hub**  
**Key Vault**



# Azure Event Publishers



Machine Learning

Maps

Media Services

Resource groups

Service Bus

SignalR

Subscriptions



# Custom Topics



User defined



Same message  
schema as  
Azure topics



Can send custom info  
with message



# Event Handlers

Azure Functions

Event Hubs

Service Bus

Storage Queues

Webhooks



# Workflow



Create topic



Send publisher events

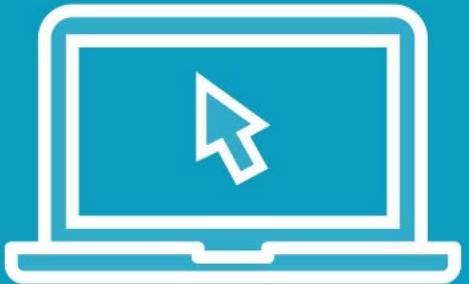


Add subscriber info with  
filtering

**Every event has same  
metadata schema. The data  
property contains event  
specific information.**



# Demo

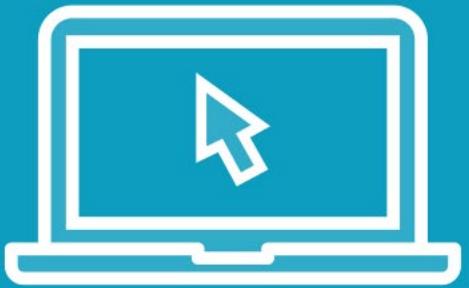


## Built-in Azure events

- Create Azure storage topic
- Create subscription with filters
- Handle with Azure Function



# Demo



## Custom topics

- Create with portal
- Invoke and consume with .NET SDK



## Summary



### Event-based architectures

- Pub/sub

### Event signifies something changed

- Publisher doesn't care what happens
- Up to subscriber to implement

Event Grid can filter, support multiple subscribers, and highly scalable

Need to enable per subscription

Many built-in Azure services support

Can create custom events and topics



# Up Next:

## Implement Azure Event Hub Solutions

---



# Implement Azure Event Hubs Solutions

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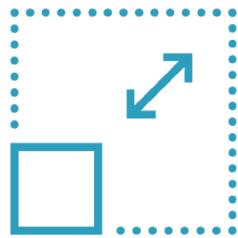
**Matthew Soucoup**

PRINCIPAL

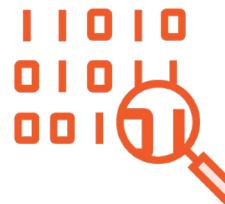
@codemillmatt codemillmatt.com



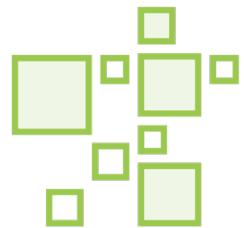
# Azure Event Hubs



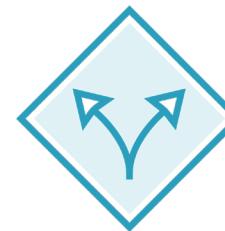
**Scalable event processing service**



**Big data scenarios**



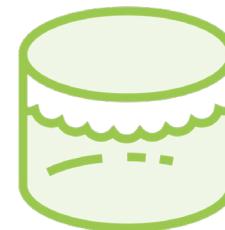
**Millions of events / second**



**Decouples sending and receiving data**



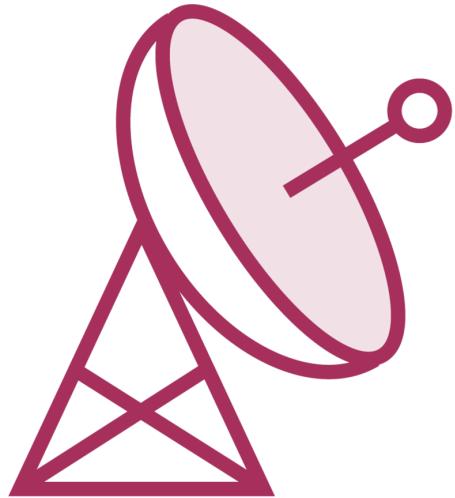
**Integration with Azure and non-Azure services**



**Capture events to Azure blob storage or data lake**



# Scenarios



Telemetry



Data archival



Transaction  
processing



Anomaly  
detection



# Components

**Namespace**

Container for  
Event Hubs

**Event producers**

Send data to  
Event Hubs

**Partitions**

Bucket of  
messages

**Consumer groups**

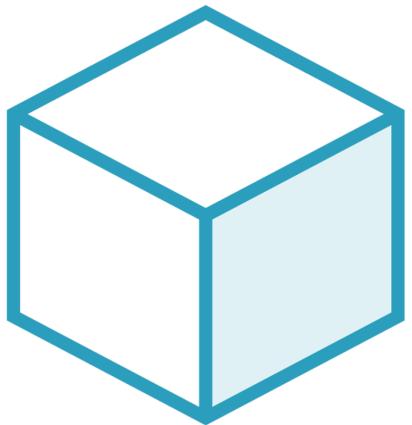
View of an  
Event Hub

**Subscribers**

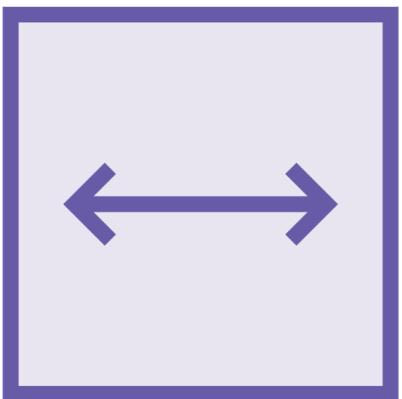
Reads data from  
Event Hubs



# Event Hubs Namespace



Scoping  
container



Contains one or  
more Event Hubs



Options apply  
to all



Throughput  
units



```
az eventhubs namespace create --resource-group <GROUP NAME> --location <LOCATION> /  
--name <NAMESPACE NAME> /  
--sku Standard
```

# Event Hubs Namespace Creation

**Azure Command Line Interface (CLI)**

**SKU can be Standard or Basic**



```
az eventhubs eventhub create --name <EVENT HUB NAME> /  
--namespace <NAMESPACE NAME> /  
--message-retention 3  
--partition-count 4  
-g <GROUP NAME>
```

## Event Hubs Creation

**Namespace must be created before**

**Message retention 1 - 7 days**

**Partition count 2 - 32**



# Demo



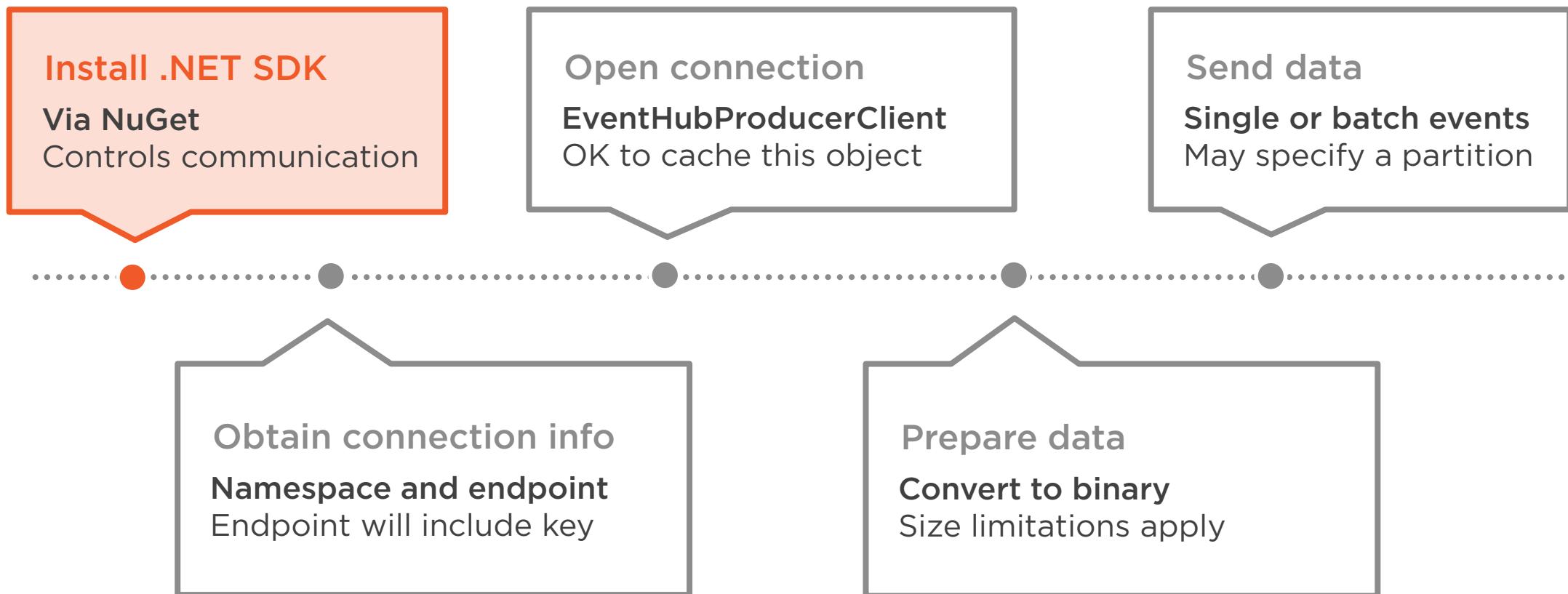
## Create an Azure Event Hub

- Namespace
- Event Hub

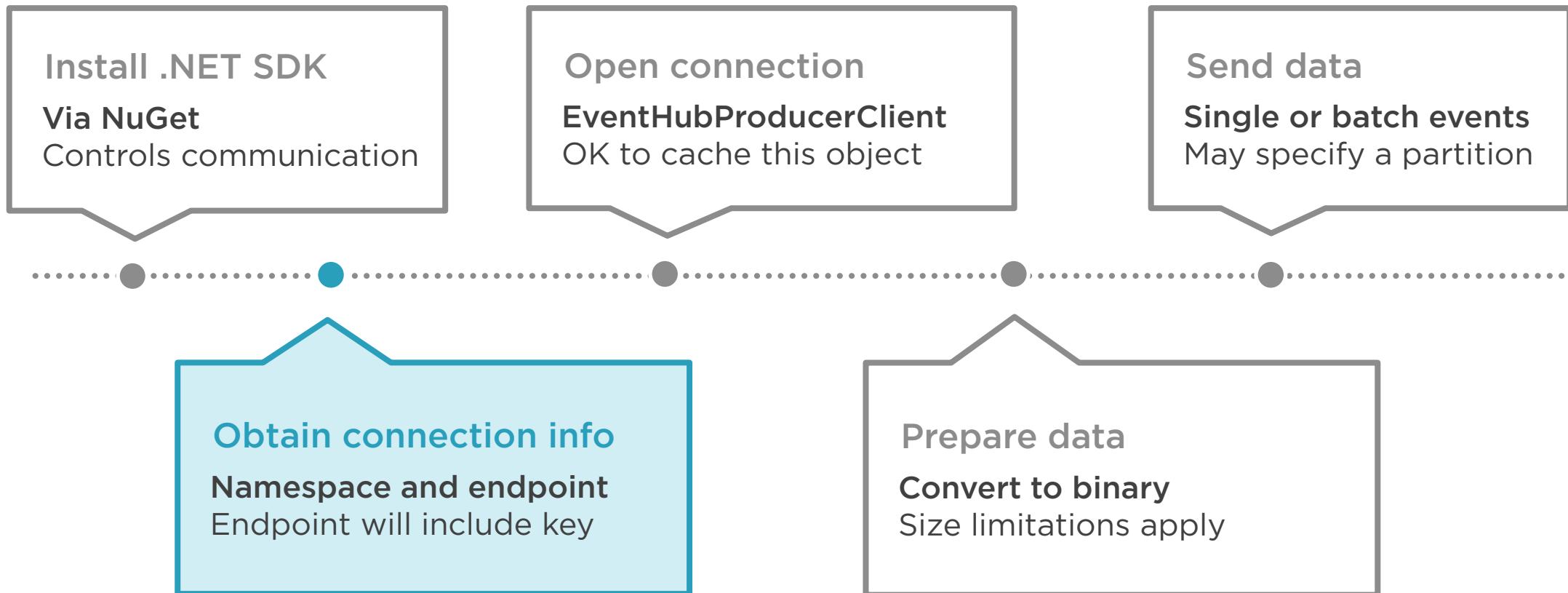
**Explore namespace and hub in portal**



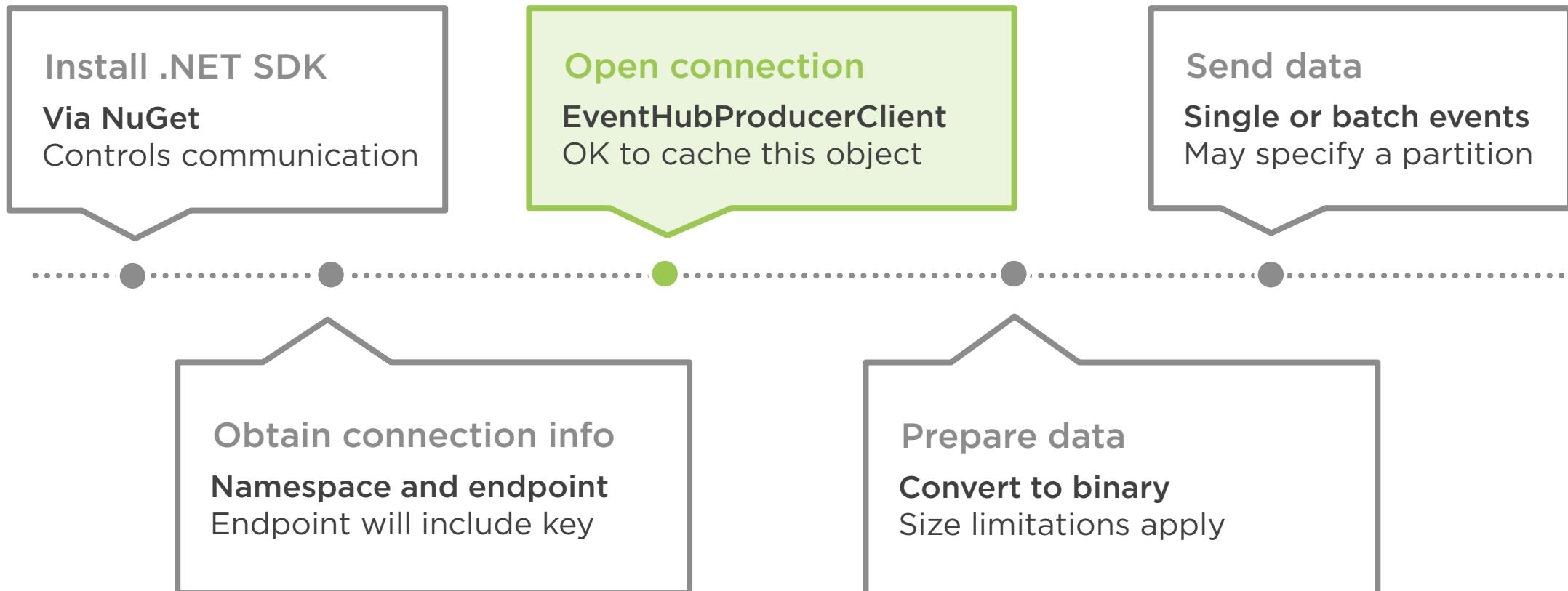
# Send Events to Event Hub



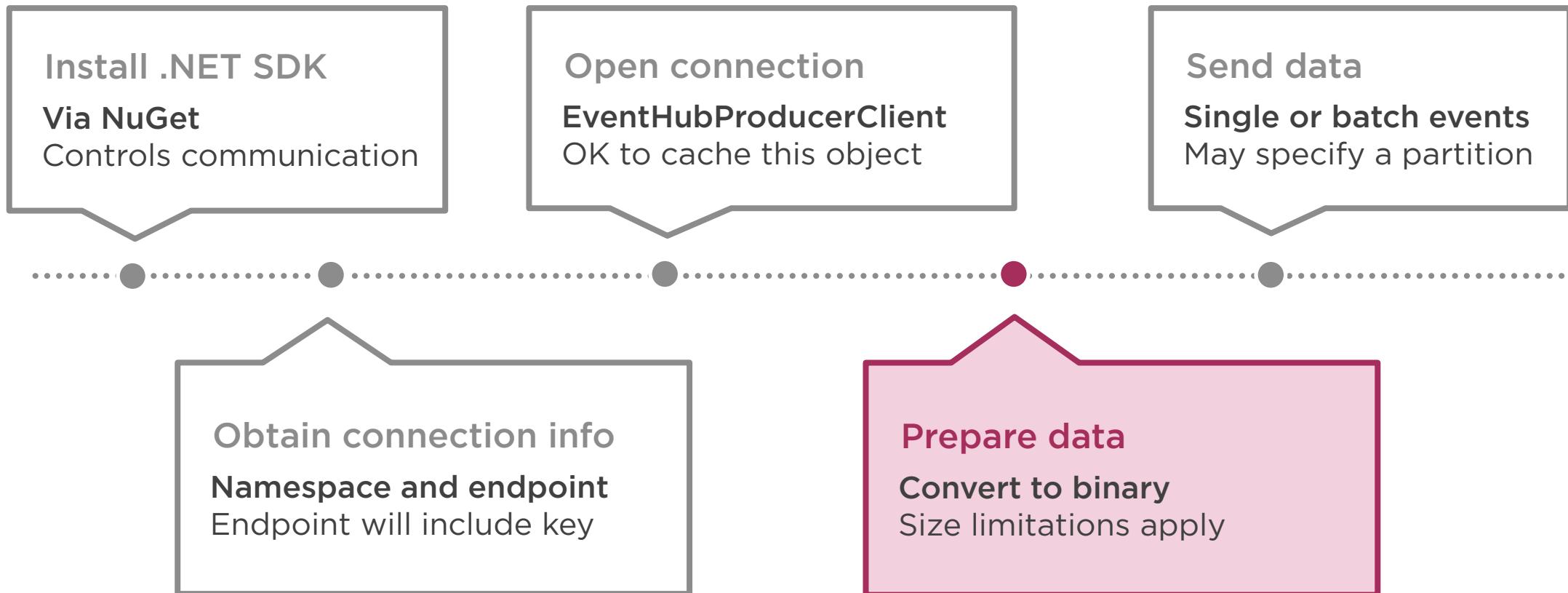
# Send Events to Event Hub



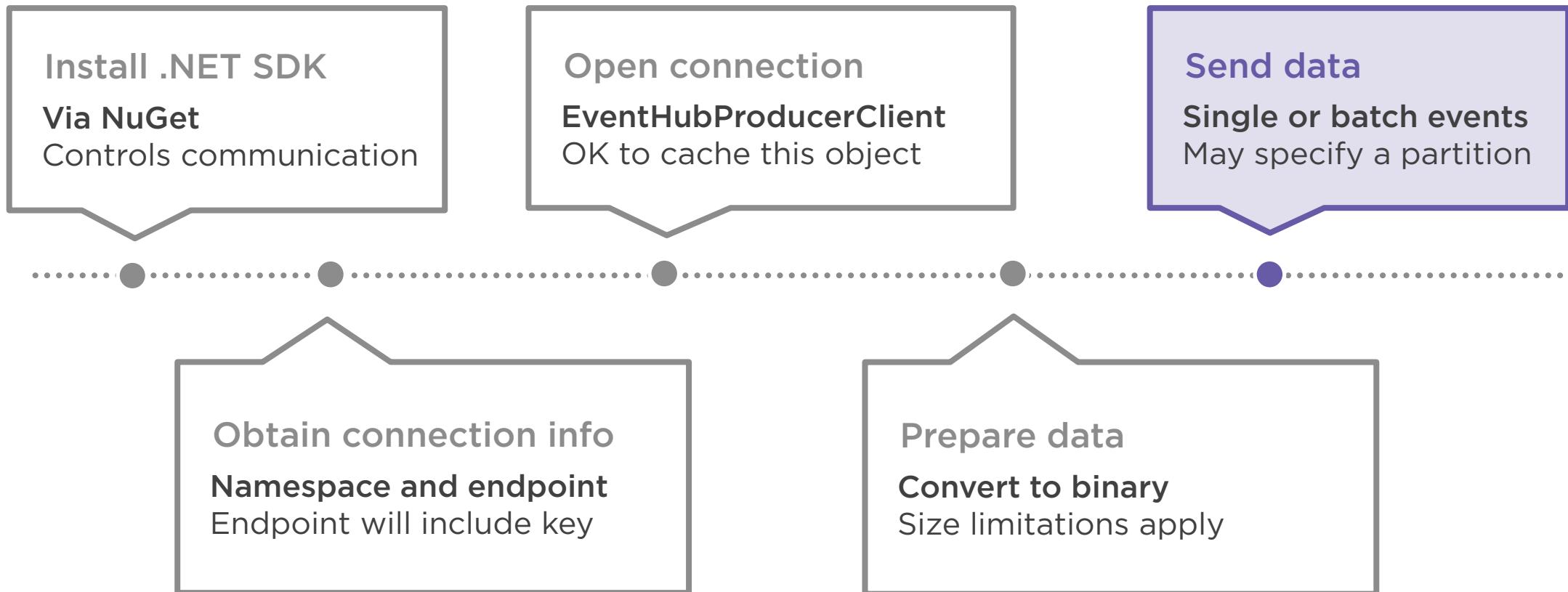
# Send Events to Event Hub



# Send Events to Event Hub



# Send Events to Event Hub



# Partitions



**Like a bucket for event messages**

**Hold events time-ordered as they arrive**

**Events not deleted once read**

**Event Hubs decides which partition events are sent to**

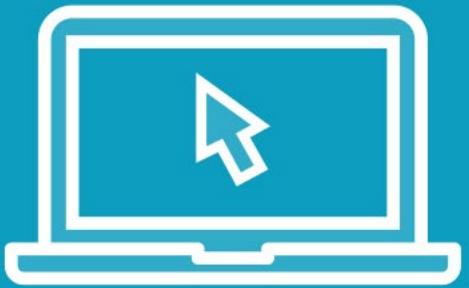
- Can specify partition with partition key

**Maximum 32 partitions**

**Create as many as expected concurrent subscribers**



# Demo

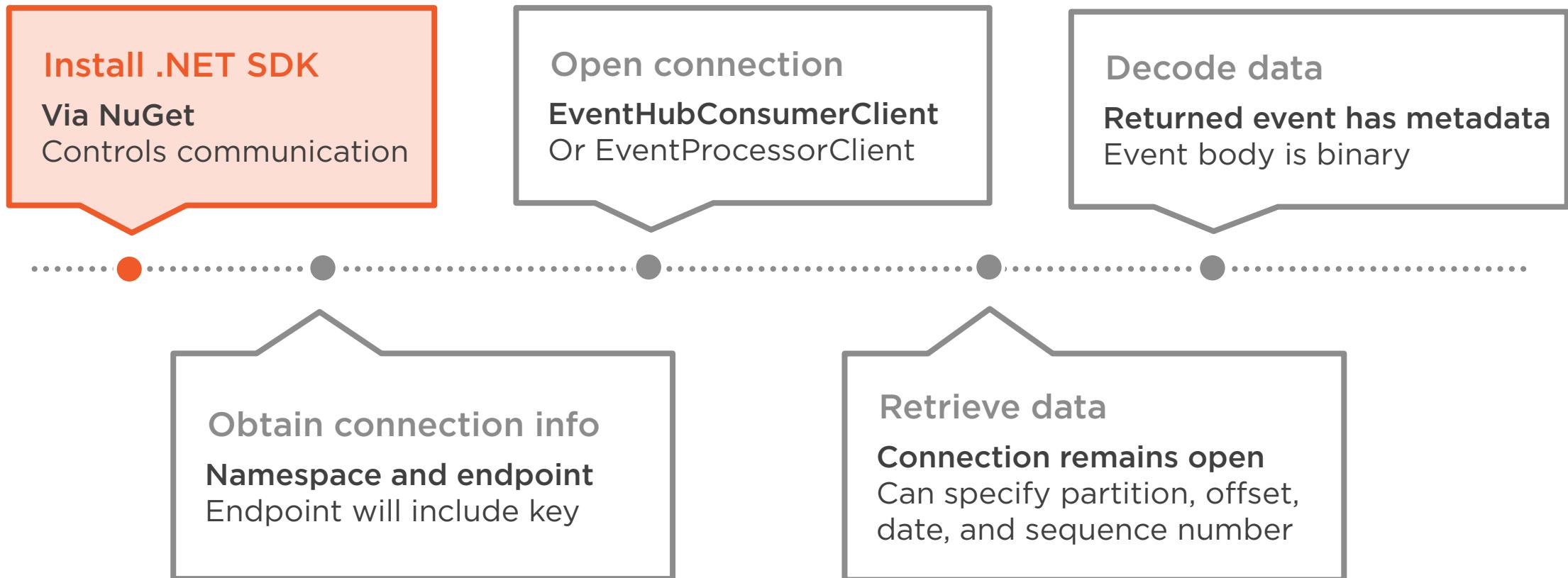


## **Send events to Event Hubs**

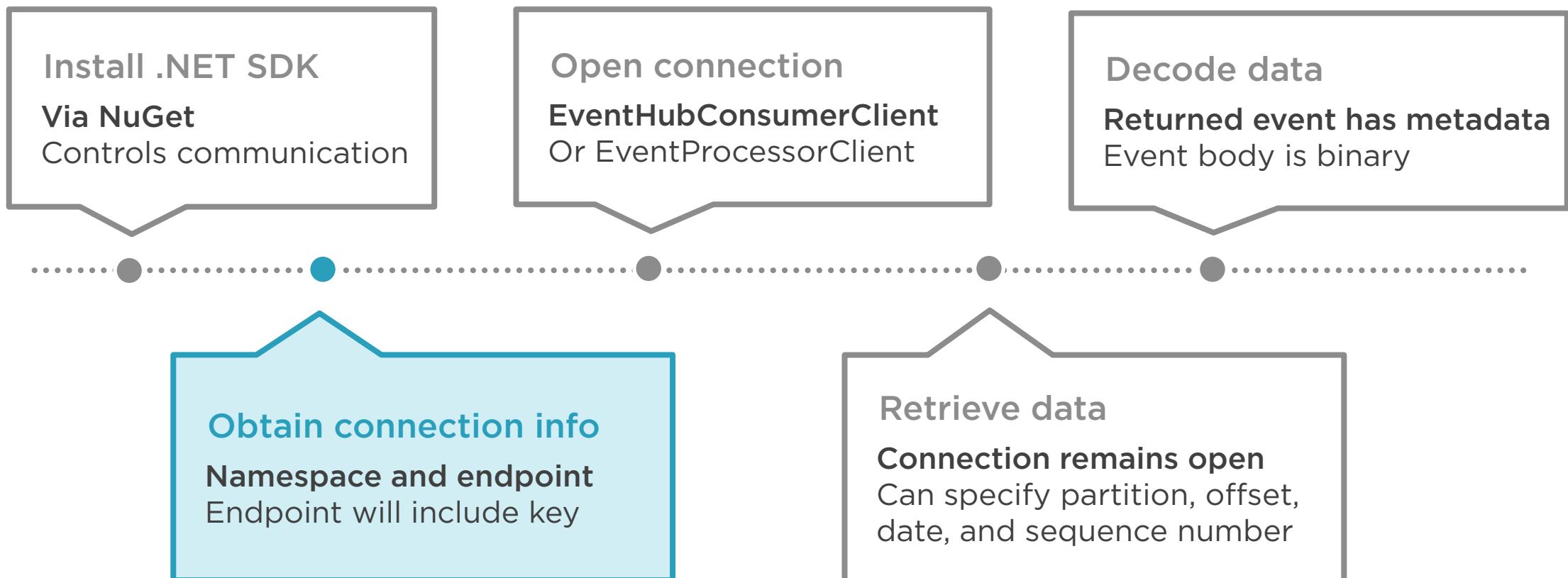
- .NET SDK
- Preparing data
- Random partitions
- Single partition



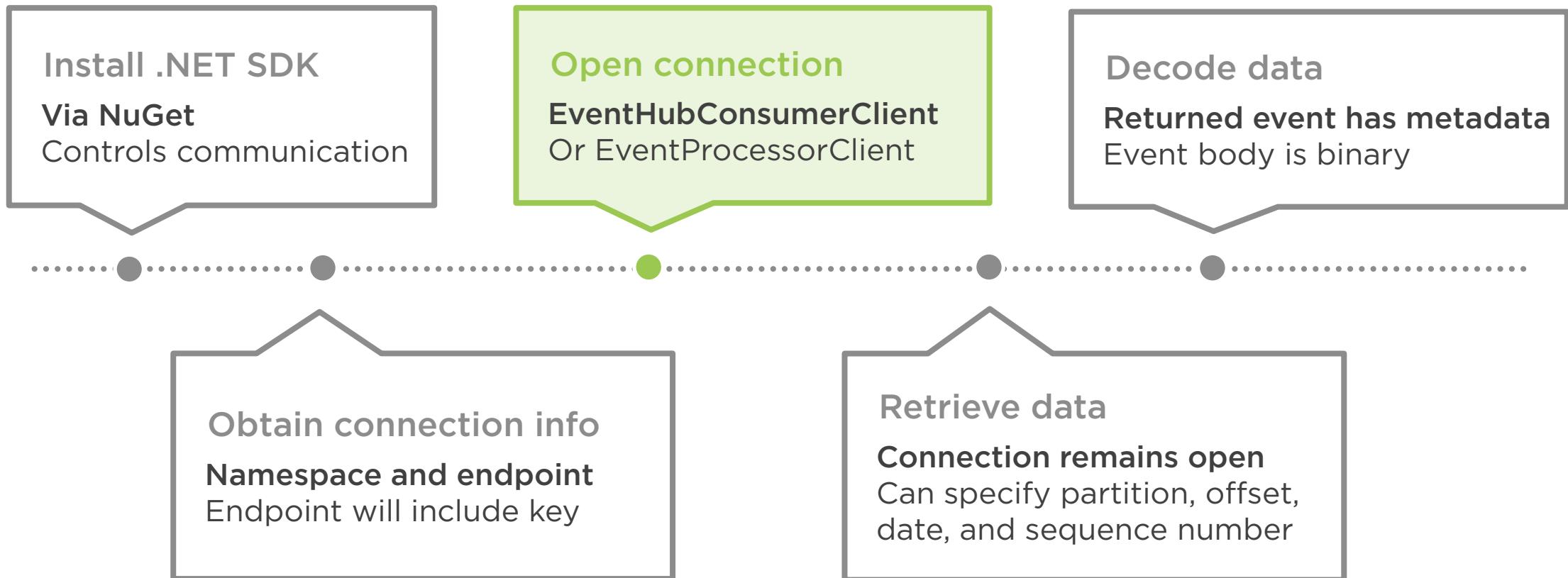
# Read Events from Event Hub



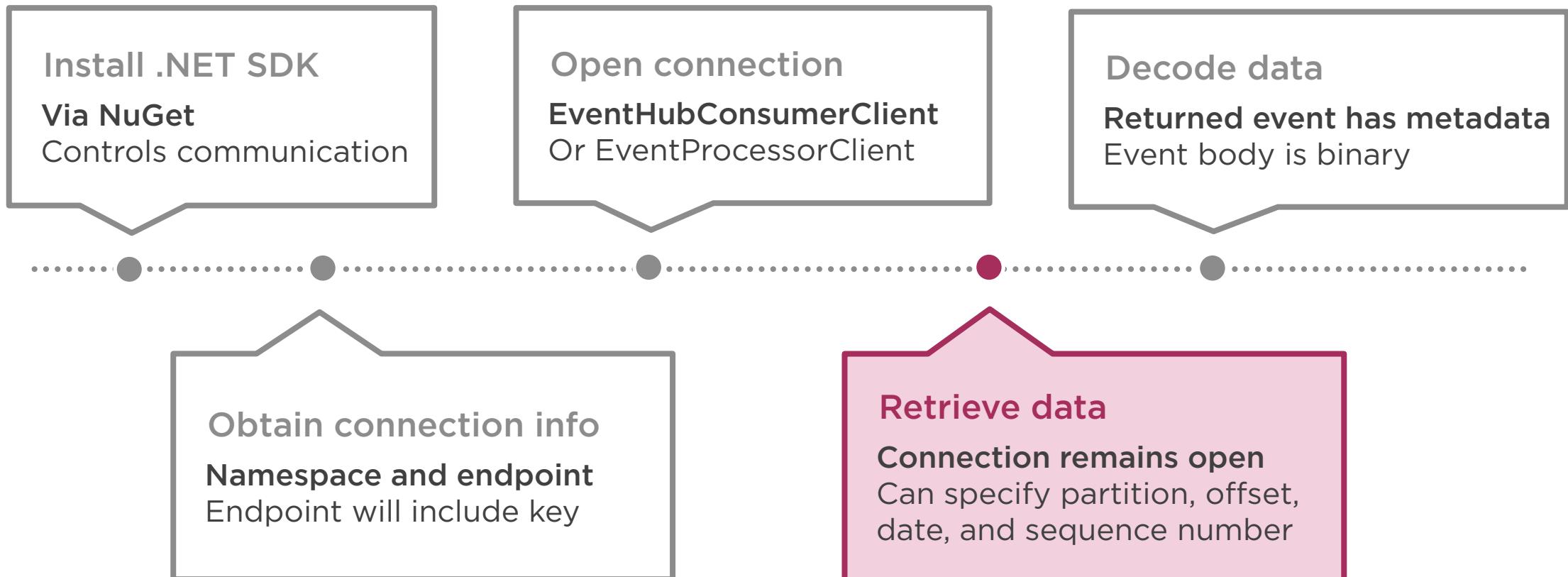
# Read Events from Event Hub



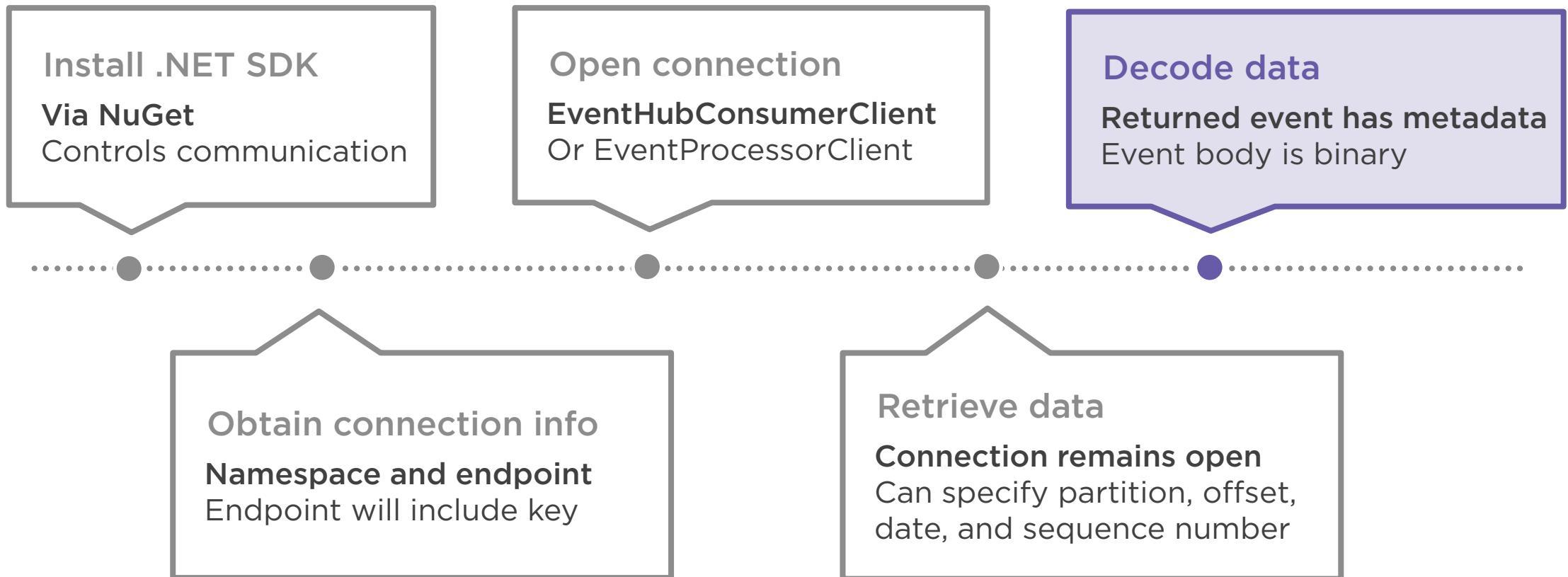
# Read Events from Event Hub



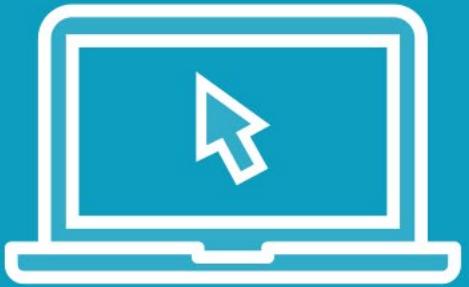
# Read Events from Event Hub



# Read Events from Event Hub



# Demo



## Read events from Event Hub

- .NET SDK
- Read all events
- Read partition info
- Read specific events



# Summary



**Azure Event Hubs meant for big data**

**Decouples sending and receiving data**

**Namespaces hold multiple Event Hubs**

**Events go into a partition**

- Can specify a the same one

**Use the .NET SDK to help**



Up Next:  
Implement Azure Notification Hubs Solutions

---



# Implement Azure Notification Hubs Solutions

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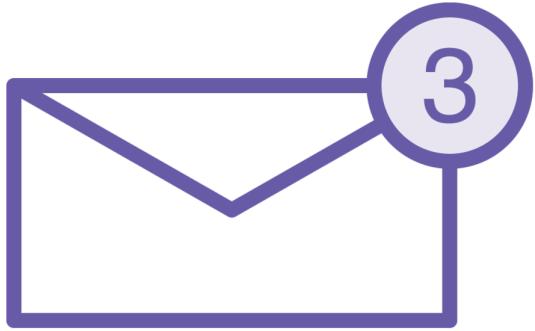
**Matthew Soucoup**

PRINCIPAL

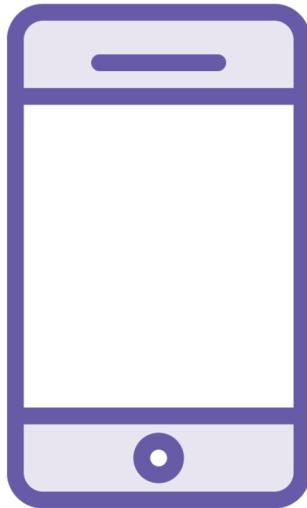
@codemillmatt codemillmatt.com



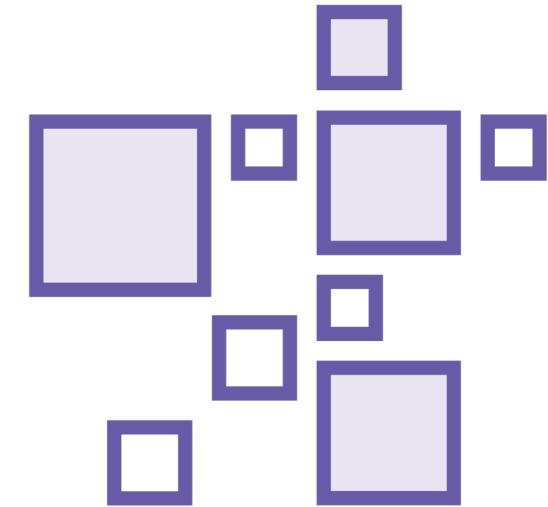
# Azure Notification Hubs (ANH)



**Send push  
notifications - app to  
user messages**



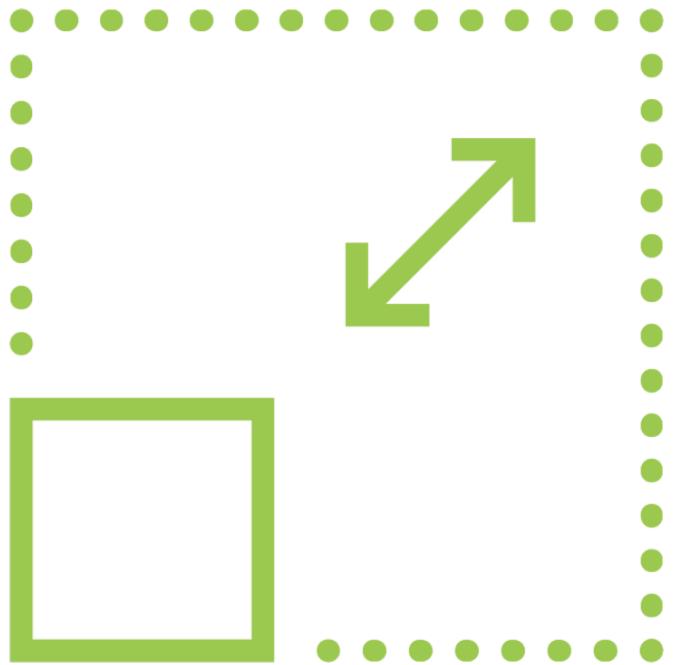
**Send to multiple  
platforms - iOS,  
Android, and Windows**



**ANH provides  
abstraction over  
platform notification  
services**



# Azure Notification Hubs Features



## Cross-platform

- Front-end and back-end

## Multiple delivery formats

- Push to user
- Push to device
- Localization
- Silent push

## Telemetry

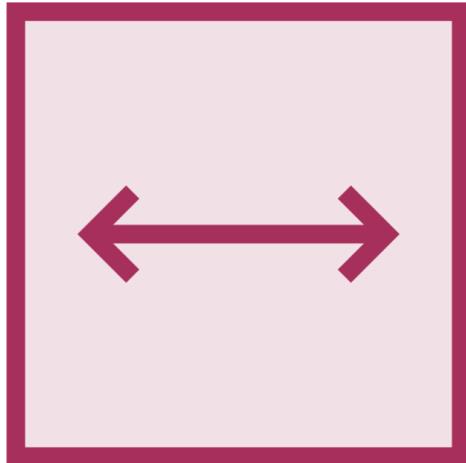
## Scalable



# Components



**Platform notification  
service (PNS)**  
Vendor-specific



**Notification hub**  
Communicates to PNS



**Namespace**  
Regional collection  
of hubs



# Demo



## Create an Azure Notification Hub

- Portal
- Namespace
- Notification Hub

## Explore Notification Hub



# Notification Hubs and Namespaces

Namespace is a collection of Notification Hubs

One namespace per application

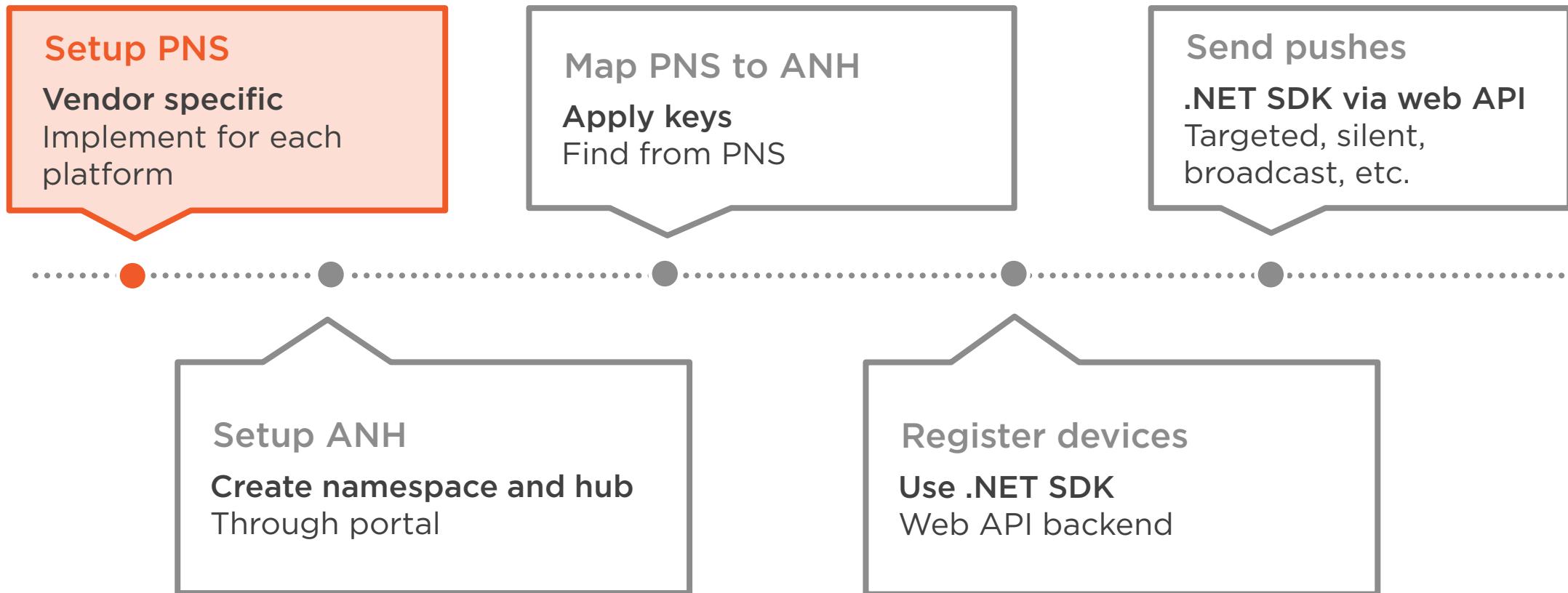
One hub per application environment

Credentials at namespace level

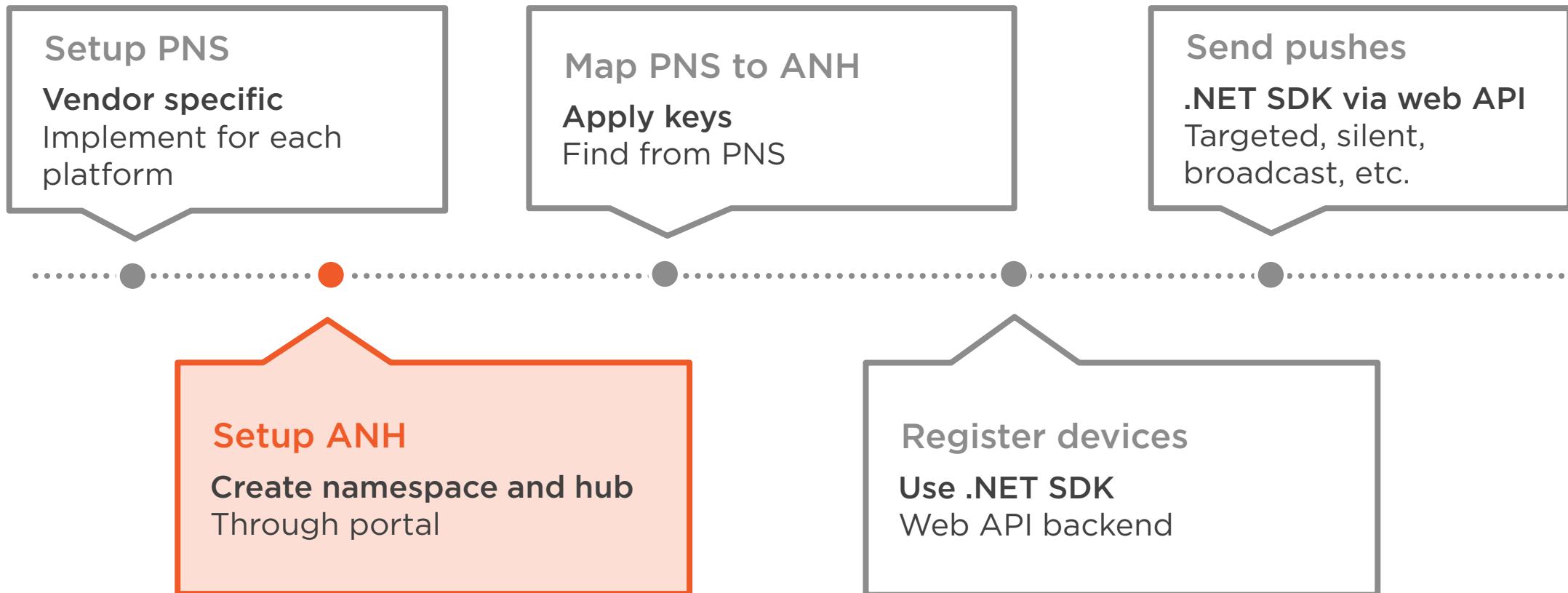
Billing at namespace level



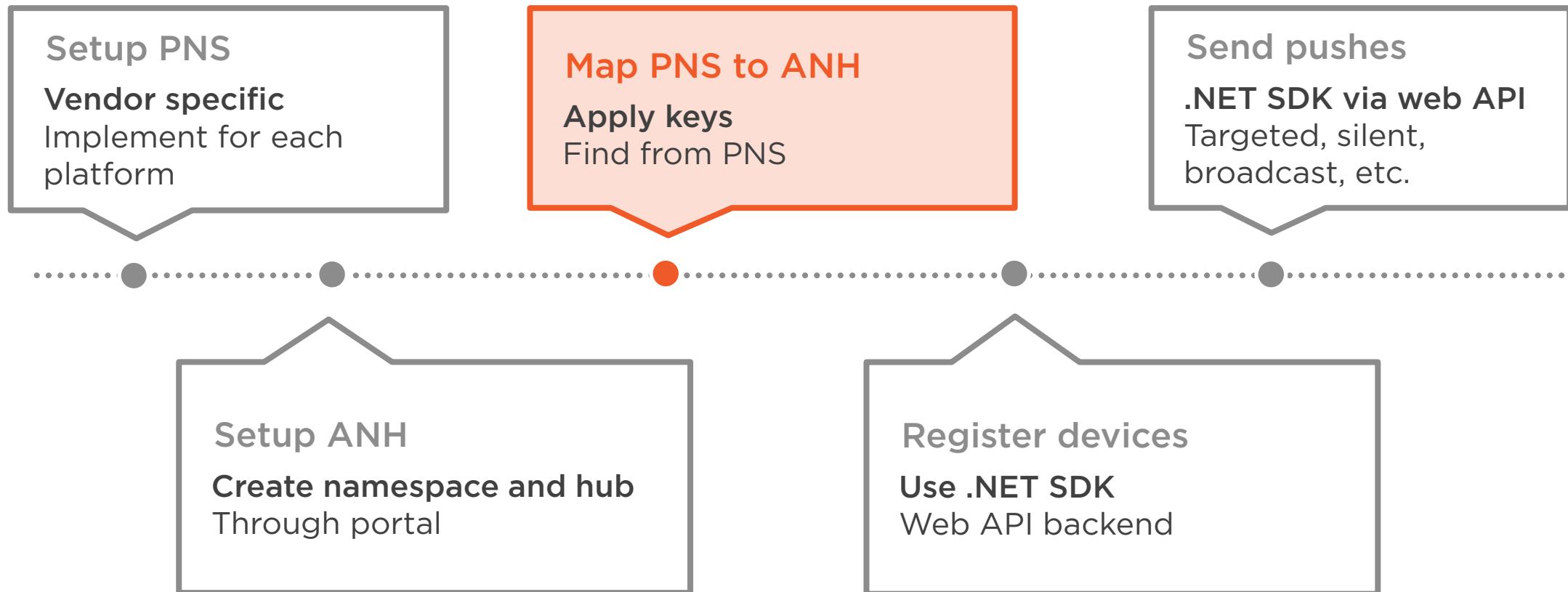
# Sending Notifications Workflow



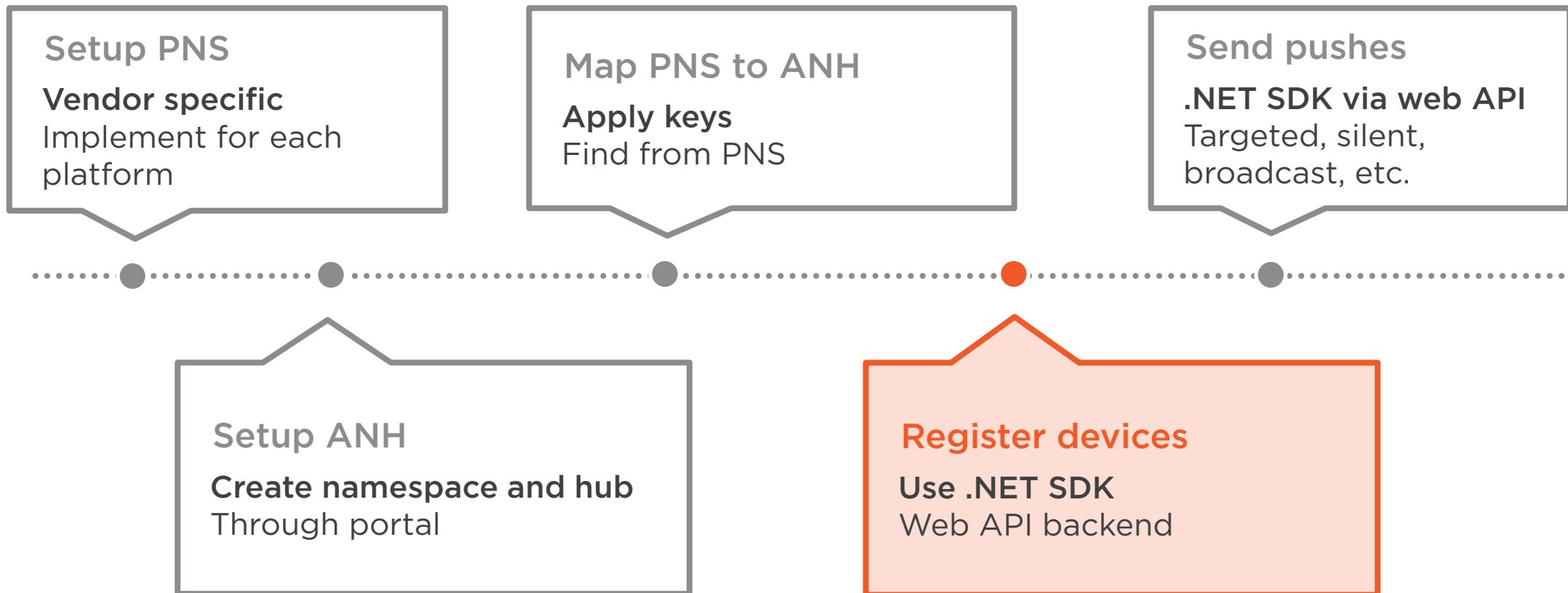
# Sending Notifications Workflow



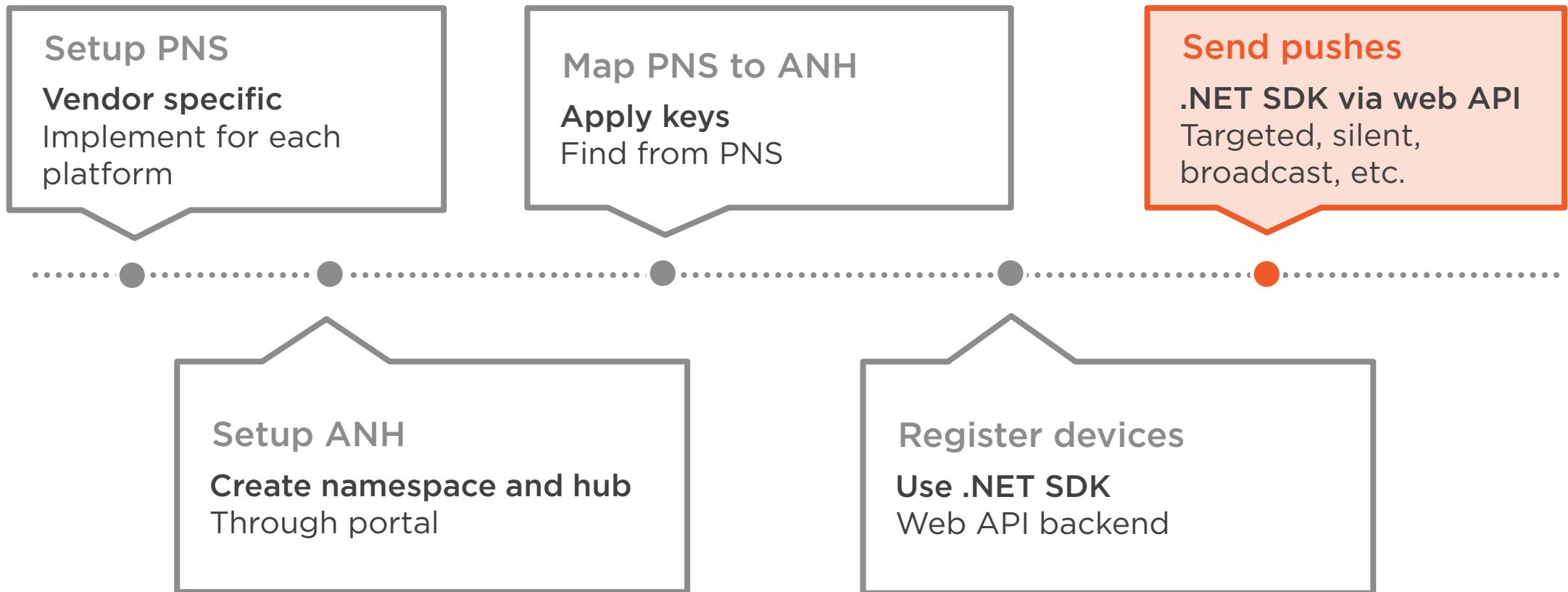
# Sending Notifications Workflow



# Sending Notifications Workflow



# Sending Notifications Workflow



```
NotificationHubClient hubClient = new NotificationHubClient(conxString, name);  
var installation = new Installation { InstallationId = "", PushChannel = "" };  
installation.Platform = NotificationPlatform.Apns; // could be others  
await hubClient.CreateOrUpdateInstallationAsync(installation);
```

## Register devices

**Microsoft.Azure.NotificationHubs NuGet package**

**ASP.NET Core web API**



```
var templateDictionary = new Dictionary<string, string>();  
templateDictionary.Add("message", "hello world");  
await hubClient.SendTemplateNotificationAsync(templateDictionary);
```

Send push notification

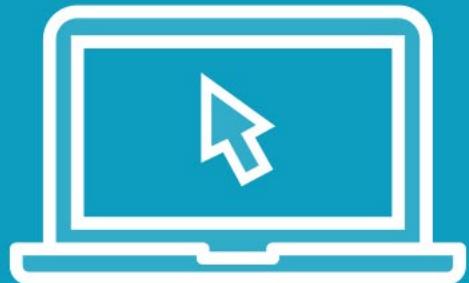
**Send to all devices**

**Dictionary keys mapped to placeholders**

**Templates can be registered with devices**



Demo



**Register devices**  
**Send push notifications**



# Summary



**Push notifications are app to user messages**

**Many different platform notification services**

**Azure Notification Hubs  
abstracts complexities**

- Multiple delivery patterns
- Telemetry
- Scalable

**Namespaces organize hubs**

- Map one per application

**.NET SDK to send pushes**



# Course Summary



## Pub/sub pattern

**Events contain smallest feasible payload**

### Azure Event Grid

- Discrete event messages

### Azure Event Hubs

- Big data series events

### Azure Notification Hubs

- App to user messages



# Microsoft Azure Developer: Develop Message-based Solutions

---

## AZURE QUEUE STORAGE



**David Tucker**

TECHNICAL ARCHITECT & CTO CONSULTANT

@\_davidtucker\_ [davidtucker.net](http://davidtucker.net)

# Objectives

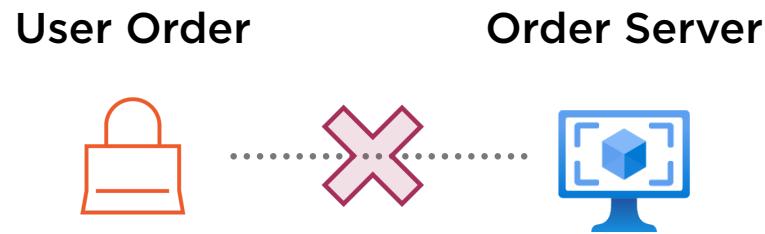
**Implement solutions that use Azure Queue Storage queues**

**Implement solutions that use Azure Service Bus**

## Purpose of Application Messaging

---

# Traditional Architecture



# Utilizing a Message-based Architecture



## Messaging Benefits

**Encourages application logic modularity**  
**Enables fault tolerance between modules**

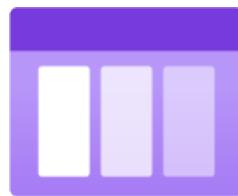
# Azure Queue Storage Capabilities

---

## Azure Queue Storage

**Fully-managed service that is a part of the Azure Storage suite that enables you to create durable and configurable message queues to enable application modularity and fault tolerance.**

## Azure Queue Storage



**Requires an Azure Storage account**  
(general-purpose v2)

**Queues are created within a single storage account**

**Supports messages up to 64 KiB in size**

**Messages exist within a single queue**

**Number of messages limited only by size of the storage account\***

**Supports a configurable time-to-live per message** (with the default at 7 days)

# Data Redundancy

**Locally Redundant  
Storage (LRS)**

**Zone-redundant  
Storage (ZRS)**

**Geo-redundant  
storage (GRS)**

**Geo-zone-redundant  
Storage (GZRS)**

**Read-access  
Geo-redundant  
Storage (RA-GRS)**

**Read-access  
Geo-zone-redundant  
Storage (RA-GZRS)**

# Queue URL Structure

**`https://pluralsight.queue.core.windows.net/pluralsight-queue`**

**storage account** **queue name**

# Queue Security

- Data in queues is encrypted by default**
- Azure Storage stored access policies can work with queues**
- Interactions with queue data are done via HTTP or HTTPS**
- Supports the following authorization approaches:**
  - Shared key
  - Shared access signature (SAS)
  - Azure AD

## Visibility Timeout

Messages are delivered to consumers, but are not immediately deleted from the queue. However, messages will not be visible in the queue again until a period of time has passed from the initial delivery. This period of time is the visibility timeout, and it enables fault tolerance for your applications.

## Scalability Limits for Queues

- A single queue cannot exceed 500 TiB**
- A single message cannot exceed 64 KiB**
- A queue supports no more than 5 stored access policies**
- A storage account can support 20,000 messages per second** (1 KiB message)
- A single queue can support 2,000 messages per second** (1 KiB message)

# Creating an Azure Queue Storage Queue

---

```
# create a queue
az storage queue create --name mysamplequeue

# delete a queue
az storage queue delete --name mysamplequeue

# view messages in a queue (without affecting visibility)
az storage message peek --queue-name mysamplequeue

# delete all messages in a queue
az storage message clear --queue-name mysamplequeue
```

## Interacting with Queues using the CLI

Azure CLI

# Demo

**Creating a storage account for use with  
Azure Queue Storage**

**Utilizing the portal to create a queue**

**Leveraging the portal to send a message  
to a queue**

# Utilizing Azure Queue Storage with the SDK

---

# Demo

**Utilizing the Azure SDK to interact with a queue in a JavaScript app**

**Sending messages to a queue via the SDK**

**Receiving messages from a queue via the SDK**

# Azure Service Bus

---



**David Tucker**

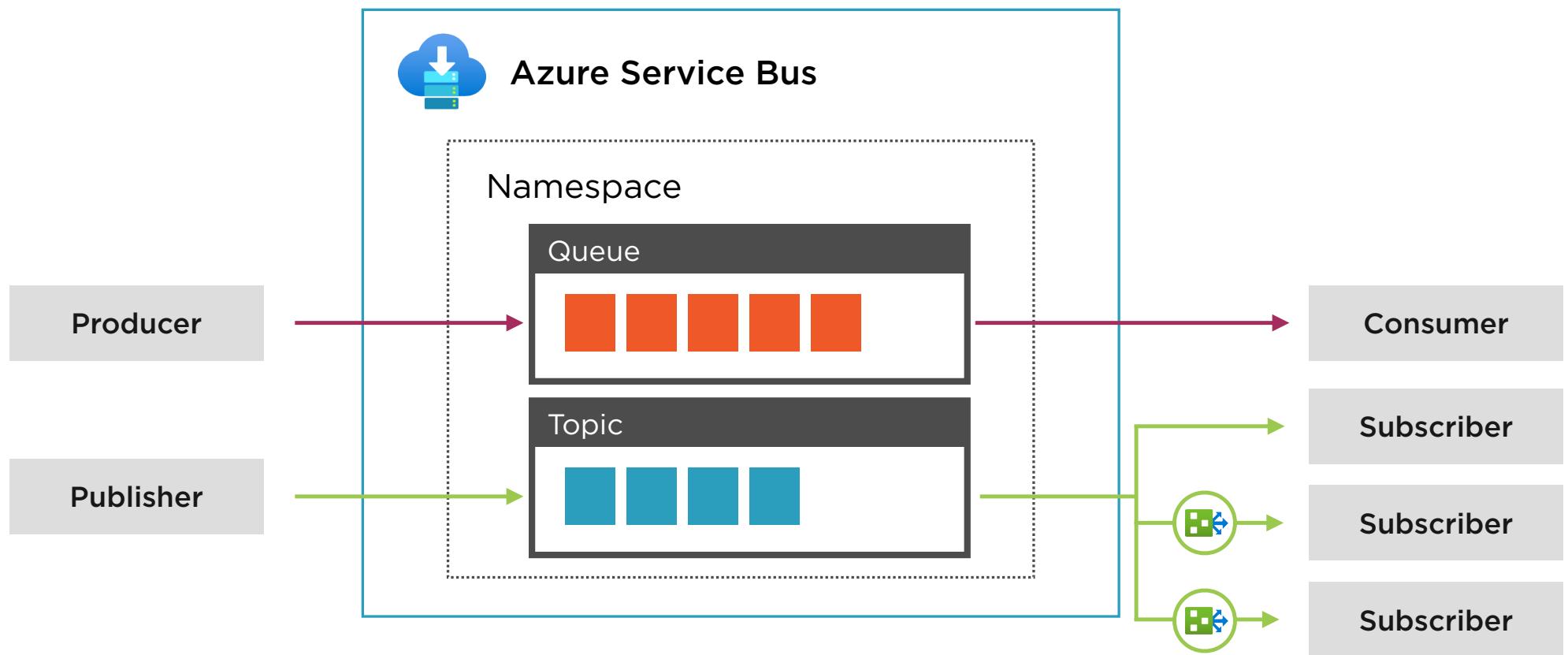
TECHNICAL ARCHITECT & CTO CONSULTANT

@\_davidtucker\_ [davidtucker.net](http://davidtucker.net)

## Azure Service Bus

**Fully-managed enterprise message broker service  
that enables multiple modes of messaging with  
integrations for common messaging systems  
including Java Message Service (JMS).**

# Organization of Azure Service Bus



## Azure Service Bus



- Supports both HTTP/HTTPS and AMQP protocols**
- Includes messaging for both queues and topics**
- Supports three different performance tiers: basic, standard, and premium**
- Supports advanced configurability:**
  - Ordering
  - Batching
  - DLQ
  - Duplicate detection

## Basic Tier

The **basic tier** of Azure Service Bus only supports queues (and not topics). To fully utilize the functionality of this service, it is recommended to use the **Standard** or **Premium** tier.

# Comparing Service Tiers

## Standard Tier

- Pricing is “pay as you go”
- Throughput is variable and has variable latency
- Utilizes shared resources
- Provides automatic scaling
- Supports messages up to 256 KB
- Does not support geo-disaster recovery or availability zones

## Premium Tier

- Pricing is fixed based on messaging units
- Throughput is fixed based on messaging units
- Utilizes dedicated resources
- Requires configuration of scaling rules
- Supports messages up to 1 MB
- Supports geo-disaster recovery and availability zones

# Service Bus URL Structure

**https://pluralsight.servicebus.windows.net/testqueue**



## Message Ordering

Azure Service Bus supports message FIFO (first in first out) ordering by leveraging sessions. This is supported in queues and topics, but must be enabled on the queue or topic.

# Scaling Azure Service Bus

- Standard tier namespaces support partitioning of queues and topics**
- Partitioning is not supported for premium tier namespaces**
- Partitioning enables separate messaging stores and brokers for a single entity**
- Partitioned queues and topics can use a partition key to determine the partition**
- Without a partition key, a round-robin algorithm is leveraged by Azure**
- Transactions on a partitioned entity must use a partition key**

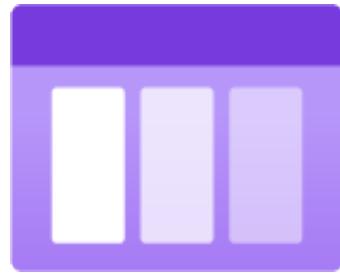
## Dead-letter Queue (DLQ)

Azure Service Bus supports a DLQ for a queue or topic. This enables you to capture messages that were not processed during their lifetime, and act accordingly with those messages.

## Selecting a Messaging Solution

---

# Azure Queue Solutions



**Azure Queue Storage**



**Azure Service Bus Queue**

# Azure Queue Storage Use Cases

- Total storage for queue needs to be over 80 GB**
- Logs needed for all transactions executed against queue**
- Need to track progress of message processing**

# Azure Service Bus Use Cases

**Need support for receiving messages without polling** (with AMQP 1.0)

**There is a need to guarantee message processing order** (FIFO)

**There is a need to detect duplicate messages**

**You need to support messages up to 256 KB**

**You may need to support topic based notifications** (one to many)

**You need to support publishing and consuming in batches**

# Creating an Azure Service Bus Queue

---

```
# create a queue
az servicebus queue create --namespace-name pluralsight
--name testqueue --resource-group pluralsight

# delete a queue
az servicebus queue delete --namespace-name pluralsight
--name testqueue
```

Interacting with Service Bus Queues using the CLI

Azure CLI

# Demo

- Creating an Azure Service Bus namespace**
- Utilizing the portal to create a queue**
- Leveraging the portal to send a message to a queue**

# Using a Service Bus Queue with the SDK

---

# Demo

**Creating a shared access policy for an Azure Service Bus namespace**

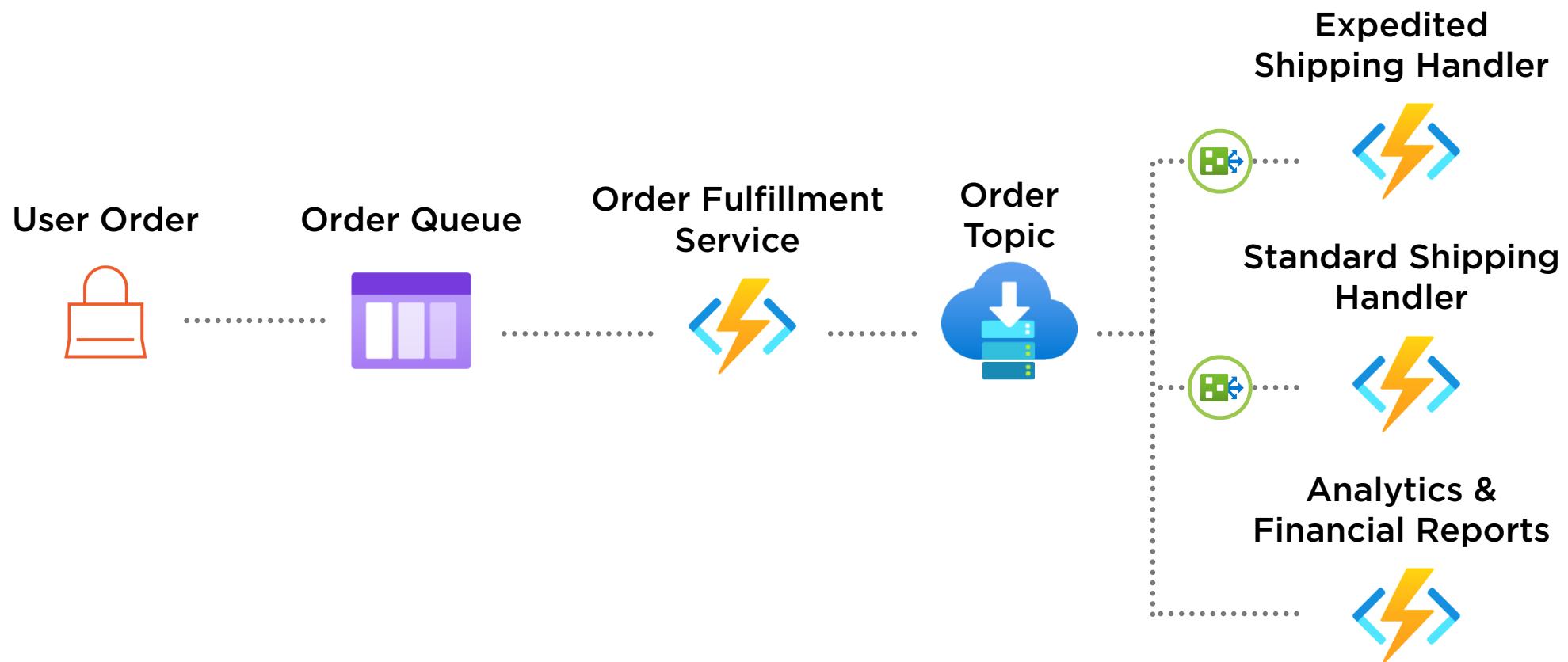
**Utilizing the SDK to produce messages for a queue**

**Receiving messages from a queue using the SDK**

# Utilizing Azure Service Bus Topics

---

# Utilizing a Message-based Architecture



## Azure Service Bus Topics



**Enables a one-to-many relationship between messages and consumers**

**A consumer creates a subscription to a topic**

**Subscriptions act as dedicated queues for a subscriber with configuration options**

**Topic filters can be specified as:**

- Boolean filters
- SQL filters
- Correlation filters

# Creating an Azure Service Bus Topic

---

```
# create a topic
az servicebus topic create --namespace-name pluralsight
--name testtopic --resource-group pluralsight

# delete a topic
az servicebus topic delete --namespace-name pluralsight
--name testtopic

# create a subscription
az servicebus topic subscription create --namespace-name pluralsight
--name testsub --topic-name testtopic
```

Interacting with Service Bus Topics using the CLI

Azure CLI

# Demo

**Creating an Azure Service Bus topic**

**Creating an Azure Service Bus topic subscription**

**Sending and receiving messages for a topic in the portal**

# Using a Service Bus Topic with the SDK

---

# Demo

**Publishing messages to a Service Bus topic using the SDK**

**Receiving messages from a topic using the SDK**

**Configuring filters for a Service Bus topic**

# Microsoft Azure Developer: Implement API Management

---

## INTRODUCTION TO AZURE API MANAGEMENT



**Daniel Krzyczkowski**

MICROSOFT MVP & SOFTWARE DEVELOPER

@DKrzyczkowski [www.techmindfactory.com](http://www.techmindfactory.com)



# Course Overview



**Learn how to architect API integration in Azure**

**Understand the components of the Azure API Management**

**Create Azure API Management instance**

**Discover how to protect your APIs from unauthorized use**

**How to implement policies**

**Summary**



# Module Overview



**Understand Azure API Management components**

**Configure Azure API Management in the Azure Portal**

**Integrate existing API application with API Management**

**Setup access for developers**



# Azure API Management Structure

---



# Azure API Management

Azure service to create consistent and modern API gateways  
for existing back-end services.

It provides secure, scalable API access for your applications.



# Azure API Management Components

## API gateway

Accepts API calls and routes them to your backends

## Azure portal

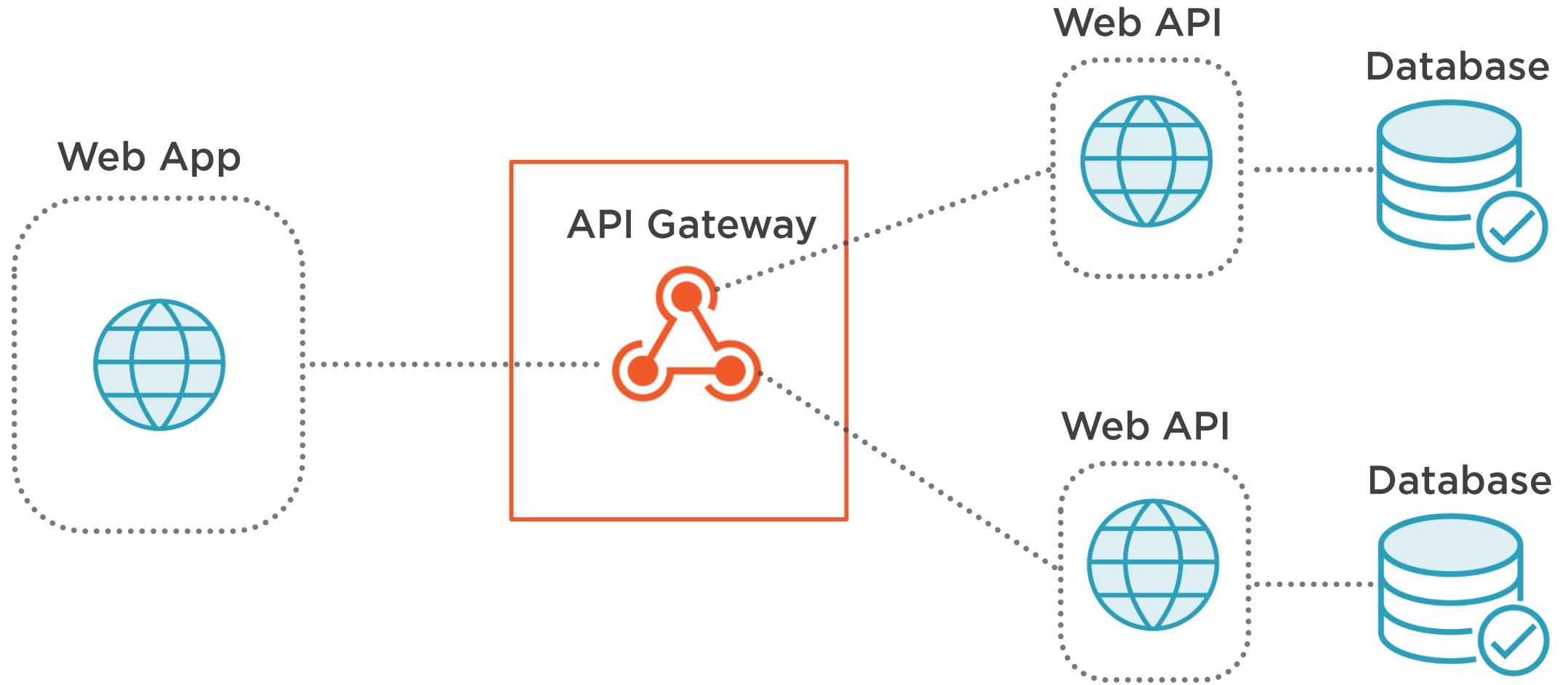
The administrative interface where you set up your API program

## Developer portal

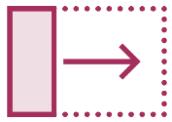
Web user interface for developers where they can read API documentation



# API Gateway



# API Gateway Capabilities



Accepts API calls and routes them to your backends



Verifies API keys, JWT tokens, certificates, and other credentials



Enforces usage quotas and rate limits



Caches backend responses



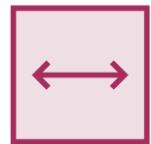
# Azure Portal Capabilities



**Define or import API schema**



**Set up policies like quotas or transformations on the APIs**



**Package APIs into products**



**Manage users**



# Developer Portal Capabilities



**Read API documentation**



**Create an account and subscribe to get API keys**



**Try out an API via the interactive console**



**Access analytics**



**Versions  
and  
Revisions**



# Versions

Versions allow to present groups of related APIs to the developers.

You can use versions to handle breaking changes in your API safely.

<https://apis.cars-island.com/car/all/v1>

<https://apis.cars-island.com/car/all/v2>



# Revisions

Revisions allow you to make changes to the APIs in a controlled and safe way, without disturbing your API consumers.

<https://apis.cars-island.com/car/all;rev=3>



Each version can have multiple revisions, just like a non-versioned API. You can use revisions without using versions, or the other way around



Typically versions are used to separate API versions with breaking changes, while revisions can be used for minor and non-breaking changes to an API



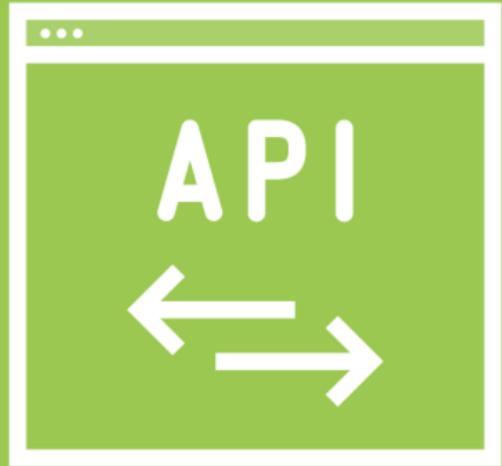
# Managing APIs with Products and Groups

---



APIs are the foundation of  
an Azure API Management  
service





## APIs and their operations

Each API in the Azure API Management contains a reference to the back-end service that implements the API and its operations



# Products and Groups

## Products

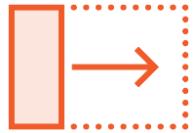
Products are how APIs are surfaced to developers, and have one or more APIs, title, description, and terms of use

## Groups

Groups are used to manage the visibility of products to developers



# Products Overview



**Products can be Open or Protected. Protected products must be subscribed to before they can be used**



**When a product is ready for use by developers, it can be published for developers to use it**



**Subscription approval is configured at the product level. Developers need this subscription to access products**



# Azure API Management Groups

## Administrators

Manage API Management service instances, creating the APIs, operations, and products

## Developers

Developers are granted access to the developer portal and build applications that call the operations of an API

## Guests

Unauthenticated developer portal users with certain read-only access, such as the ability to view APIs but not call them



Administrators can also  
create custom groups or  
leverage external groups in  
associated Azure Active  
Directory tenants



# Developers



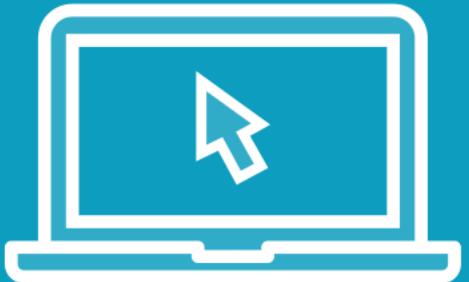
Developers can be created or invited to join by administrators, or they can sign up from the Developer portal



Each developer is a member of one or more groups, and can subscribe to the products that grant visibility to those groups



# Demo

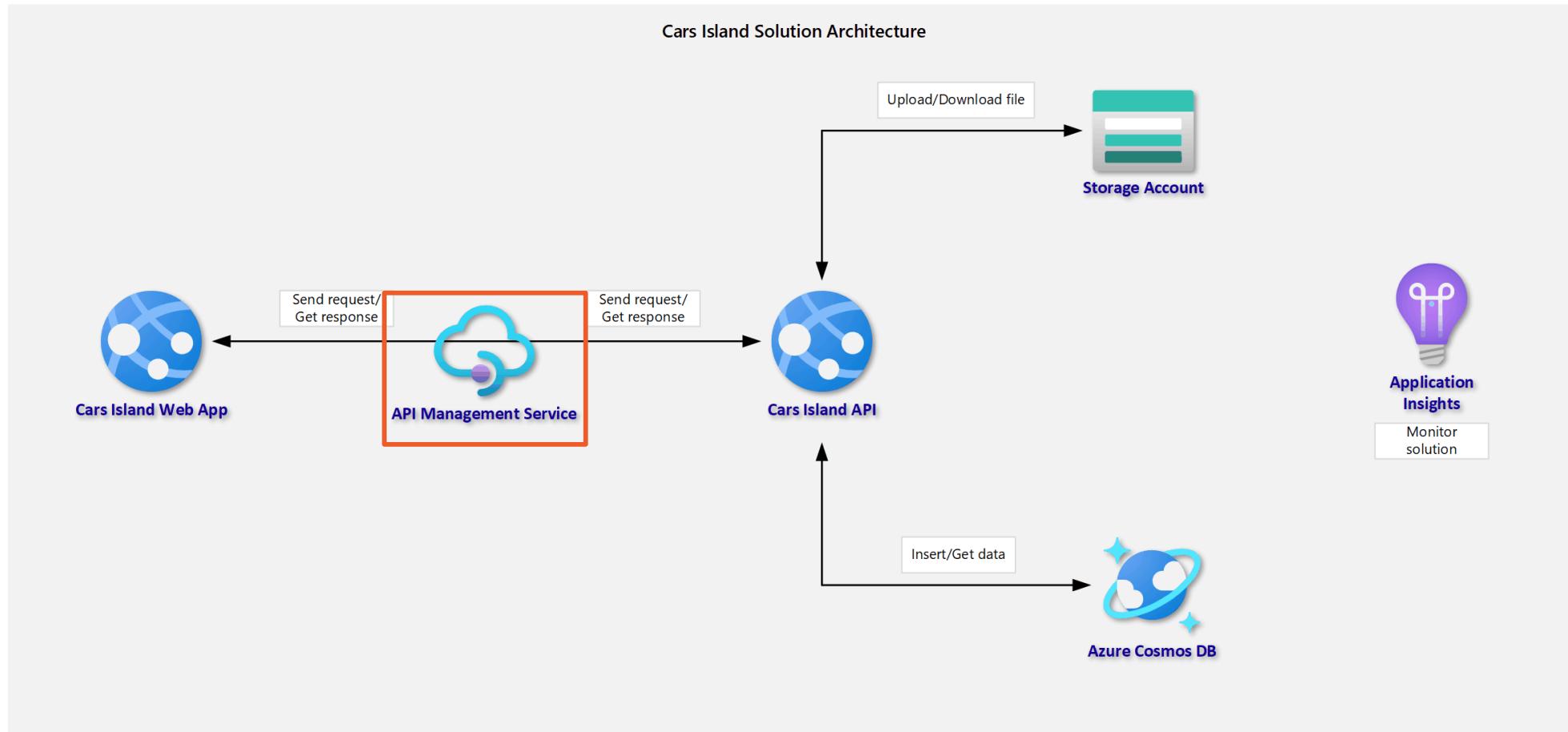


## Setup Azure API Management service

- Create an API Management in the Azure portal
- Integrate existing API application with API Management
- Setup access for developers



# Solution Architecture



# Before We Begin



Source code link: [github.com/Daniel-Krzyczkowski/Pluralsight](https://github.com/Daniel-Krzyczkowski/Pluralsight)



We will use Visual Studio 2019 (16.5.x)



Solution requires the .NET Core 3.1



# Summary



**Azure API Management structure and its capabilities**

**Control APIs access with groups and products**

**Create API Management instance and integrate it with existing API**

**Access APIs using Developer portal**



# Protect APIs and Improve Their Performance with API Management

---



**Daniel Krzyczkowski**

MICROSOFT MVP & SOFTWARE DEVELOPER

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# Module Overview



**Protect APIs from unauthorized with API keys and client certificate**

**Use policies to change the behavior of the API through configuration**

**Implement throttling to prevent resource exhaustion**

**Improve performance using caching policy**



# Concepts of Azure API Management Security and Policies

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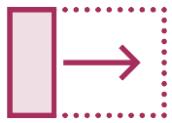
# Policies

Policies are a powerful capability of Azure API Management that allow changing the behavior of the API through configuration.

Policies are a collection of statements that are executed sequentially on the request or response of an API.



# Azure API Management Policies



**Format conversion from XML to JSON**



**Restrict the amount of incoming calls**



**Enforces existence and/or value of a HTTP Header**



**Caches response according to the specified cache control configuration**



# Access Restriction Policies

## Limit call rate by key

Prevents API usage by limiting call rate, on a per key basis

## Validate JWT tokens

Enforces existence and validity of a JWT token in header or query parameter

## Set usage quota by key

Enforces a renewable or lifetime call volume and/or bandwidth quota

## Check HTTP header presence

Enforces existence and/or value of a HTTP Header

## Limit call rate by subscription

Prevents API usage by limiting call rate, on a per subscription basis



# Advanced Policies

## Mock response

Returns a mocked response directly to the caller

## Forward request

Forwards the request to the backend service

## Retry

Retries execution of a request at the specified time intervals

## Set request method

Allows changing the HTTP method for a request

## Trace

Adds custom traces into the API Inspector output or Application Insights



# Transformation Policies

## Convert XML to JSON

Converts request or response body from XML to JSON

## Convert JSON to XML

Converts request or response body from JSON to XML

## Find and replace string in body

Finds a request or response substring and replaces it with a different substring

## Set backend service

Changes the backend service for an incoming request

## Set query string parameter

Adds, replaces value of, or deletes request query string parameter



# Caching Policies

## Store to cache

Caches response according to the specified cache control configuration

## Get from cache

Perform cache look up and return a valid cached response when available

## Remove value from cache

Remove an item in the cache by key



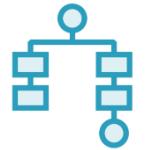
There are many more policies available in the Azure API Management



# Policy Scope



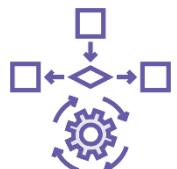
**Global scope - affects all APIs within the instance of API Management**



**Product scope - manages access to the product as a single entity**



**API scope - affects only a single API**



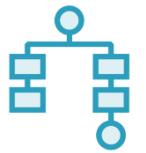
**Operation scope - affects only one operation within the API**



# When Do Policies Execute?



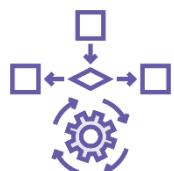
**Inbound policies execute when a request is received from a client**



**Backend policies execute before a request is forwarded to a managed API**



**Outbound policies execute before a response is sent to a client**



**On-Error policies execute when an exception is raised**



# Policy Structure Example

```
<policies>
  <inbound>
    <rate-limit calls="5" renewal-period="10" />
    <cache-lookup vary-by-developer="false" vary-by-developer-groups="false" must-revalidate="true" downstream-caching-type="none" caching-type="internal" />
    <base />
  </inbound>
  <backend>
    <base />
  </backend>
  <outbound>
    <cache-store duration="60" />
    <base />
  </outbound>
  <on-error>
    <base />
  </on-error>
</policies>
```



# Demo

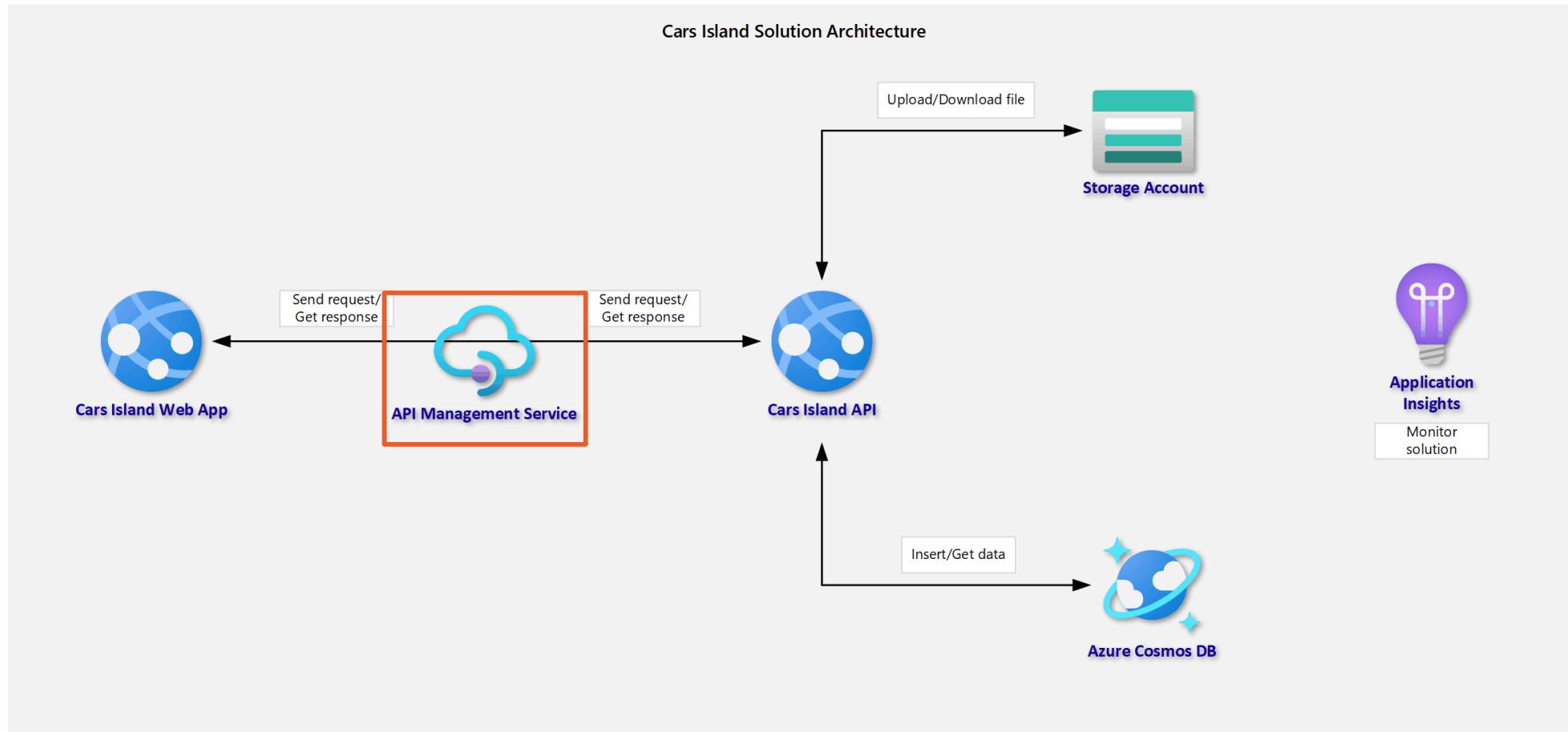


## Protect APIs from unauthorized access

- Access API with API key and client certificate



# Solution Architecture



# Before We Begin

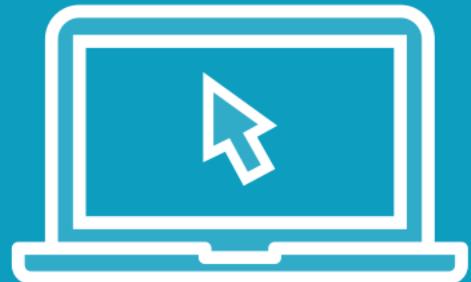


POSTMAN

Download from: [Postman.com](https://Postman.com)



# Demo

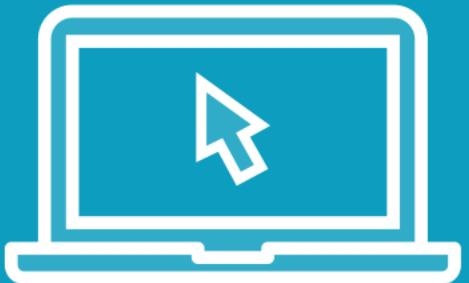


## Implement throttling to prevent resource exhaustion

- Implement throttling in the Azure API Management



# Demo



## Improve API performance

- Implement caching policy in the Azure API Management



# Summary



**Access restriction, transformation, caching and advances policies in the Azure API Management**

**Prevent unauthorized access by using API keys and client certificates**

**Using throttling to limit access to API endpoints by putting limits on the number of times an API can be called**

**Improve performance using caching policy**



# Thank you!

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# Exam Alert: Connect To and Consume Azure Services and Third-Party Services

---

## PREPARING FOR THE EXAM



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TECHNICAL ARCHITECT & CTO CONSULTANT  
 @\_daviddtucker\_ [daviddtucker.net](http://daviddtucker.net)

# Up Next: Objectives for the Exam

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# Objectives for the Exam

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# Consume Azure and Third-Party Services

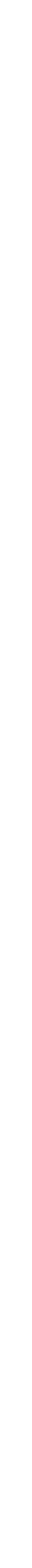
15-20%

**Implement API  
Management**

**Develop Event-  
based Solutions**

**Develop Message-  
based Solutions**

# Implement API Management



- Create an APIM instance**
- Configure authentication for APIs**
- Define policies for APIs**

# Develop Event-based Solutions

**Implement solutions that use Azure Event Grid**

**Implement solutions that use Azure Event Hub**

# Develop Message-based Solutions

**Implement solutions that use Azure Service Bus**

**Implement solutions that use Azure Queue Storage queues**

# Review API Management Implementation

---

# Areas of Focus

**Service  
Tiers**

**Caching**

**Access Restriction and  
Authentication**

**Policy  
Definition**

# API Management Pricing Tiers

**Consumption**

**Developer**

**Basic**

**Standard**

**Premium**

**Isolated\***

# API Management Cache Types

## Internal

Cache provided within the API Management service

## External

Redis compatible cache outside of API Management, such as Azure Cache for Redis

# API Management Caching

**Internal cache is limited in size based on the API Management tier**

**Internal cache is not available on the consumption tier for API Management**

**Both types of caching are configured in the API Management policies**

# Controlling Access to API's

## Access Restriction

Limiting access to an API based on specific settings

## Authentication

Verify credentials for a caller of an API

# Access Restrictions

- Checking an HTTP header for existence and value**
- Limit call rate by subscription and key**
- Restrict by IP address**
- Usage quotas per key**
- Validate JWT**

# Authentication Policies

**Basic Auth**

**Client Certificate  
Auth**

**Managed Identity  
Auth**

```
<policies>
  <inbound>
    <base />
    <cache-lookup vary-by-developer="false"
      vary-by-developer-groups="false" caching-type="internal">
      <vary-by-query-parameter>v</vary-by-query-parameter>
    </cache-lookup>
  </inbound>
  <outbound>
    <cache-store duration="60" />
    <base />
  </outbound>
</policies>
```

# Review Policy Structure



- Authentication and JWT handling**
- Cache configuration**
- Access restrictions**

# Review Event-based App Development

---

# Areas of Focus

**Understanding Messages  
and Events**

**Selecting an Event-based  
Service**

# Comparing Events and Messages

| Events  | Messages   |
|---|--|
| <b>Lightweight notification of a state change</b>                   | <b>Application data from a source system to be consumed elsewhere</b>        |
| <b>Publisher does not know (or care) how the message is handled</b> | <b>There is an expectation that a message will be handled by a receiver</b>  |
| <b>Follows a publisher/subscriber model</b>                         | <b>Can follow either a publisher/subscriber or a producer/consumer model</b> |

# Event Types

## **Discrete Events**

Report state change from a system and enable subscribers to take action

## **Series Events**

Report a condition and enable subscribers to analyze a condition over time

# Selecting an Event-based Service

- 1** Does your solution have an expectation of how data is handled or does it contain app data? If so, select a Messaging service.
- 2** Do you need a solution to send events to mobile devices as push notifications? [Select Azure Notification Hub](#).
- 3** Does your solution produce discrete events, that report state changes that a system can act on? [Select Azure Event Grid](#).
- 4** Does your solution report state over time for analysis by another system, such as in a data pipeline? [Select Azure Event Hub](#).

# Review Message-based App Development

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# Areas of Focus

**Services  
Overview**

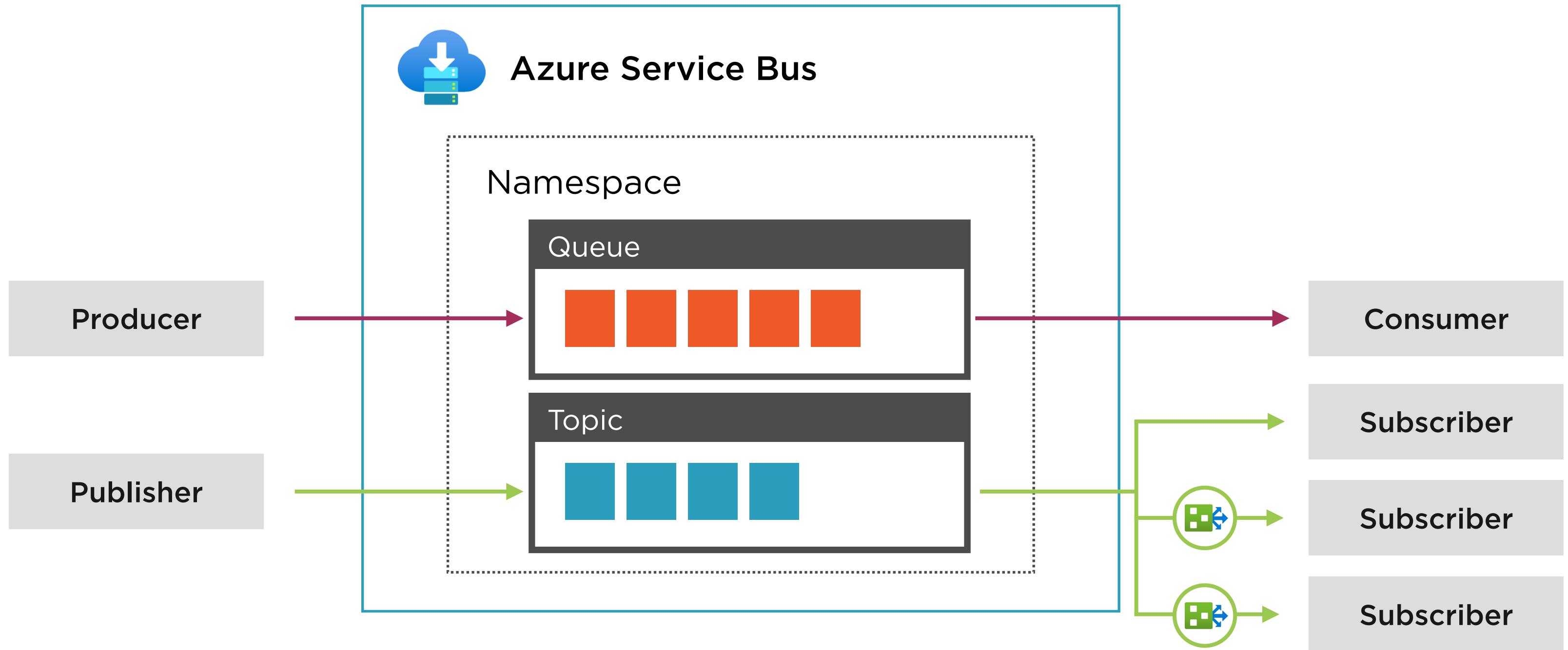
**Interacting with  
Services using the  
CLI**

**Selecting a  
Messaging Service**

# Sample Queue Storage Architecture



# Organization of Azure Service Bus



# Azure Service Bus Topic Filters



## **Topic filters can be specified as:**

- Boolean filters: specifies that all or none of the messages are selected
- SQL filters: a SQL-like expression to evaluate against message properties
- Correlation filters: matched against properties in the message

```
# create a queue
az storage queue create --name mysamplequeue

# delete a queue
az storage queue delete --name mysamplequeue

# view messages in a queue (without affecting visibility)
az storage message peek --queue-name mysamplequeue

# delete all messages in a queue
az storage message clear --queue-name mysamplequeue
```

## Interacting with Queue Storage using the CLI

Azure CLI

```
# create a topic
az servicebus topic create --namespace-name pluralsight
--name testtopic --resource-group pluralsight

# delete a topic
az servicebus topic delete --namespace-name pluralsight
--name testtopic

# create a subscription
az servicebus topic subscription create --namespace-name pluralsight
--name testsub --topic-name testtopic
```

# Interacting with Service Bus Topics using the CLI

Azure CLI

# Azure Queue Storage Use Cases

**Total storage for queue needs to be over 80 GB**

**Logs needed for all transactions executed against queue**

**Need to track progress of message processing**

# Azure Service Bus Use Cases

**Need support for receiving messages without polling** (with AMQP 1.0)

**There is a need to guarantee message processing order** (FIFO)

**There is a need to detect duplicate messages**

**You need to support messages up to 256 KB**

**You may need to support topic based notifications** (one to many)

**You need to support publishing and consuming in batches**

## Example Scenarios

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# Scenario 1



**Sylvia is implementing an API on API Management with the Standard tier**

**She is configuring the built-in cache so calls are cached per unique user**

**Unique users are identified based on a JWT token in the Authorization header**

**How should she configure the caching?**

# API Management Policy

```
<policies>
    <[1]>
        <base />
        <cache-lookup vary-by-developer="false"
                      vary-by-developer-groups="false" caching-type="[[3]]">
            <vary-by-header>[4]</vary-by-header>
        </cache-lookup>
    </[1]>
    <[2]>
        <cache-store duration="300" />
        <base />
    </[2]>
</policies>
```

## Scenario 2



**Edward's company is creating a new SaaS application on Azure**

**The solution analyzes IoT temperature sensors in food storage facilities**

**The data is ingested and then made available in a data pipeline**

**What approach would he take to build this solution?**

## Scenario 3



**Cindy is developing an architecture for an order processing application**

**She is creating the application in a modular manner**

**She is planning to leverage Azure Functions to process the orders**

**She will be using Azure Event Grid to handle the orders as discrete events**

**Does Cindy's architecture fit the use case?**

## Scenario 4



**Oscar's is creating a new single-page application using React**

**He needs to validate users for the application's API**

**He wants to use Azure AD with OAuth 2 authorization**

**He also needs to verify that the JWT is a token for his specific application**

**How should Oscar configure the policy in API Management?**

# API Management Policy

```
<policies>
  <inbound>
    <1 header-name="Authorization"
        failed-validation-error-message="Unauthorized">
      <2 url="https://login.microsoftonline.com/{aad-
tenant}/.well-known/openid-configuration" />
      <3 >
        <claim name="aud">
          <value>{Application ID of backend-app}</value>
        </claim>
      </3 >
    </1 >
  </inbound>
  ...
</policies>
```

## Scenario 5



**James's company has created a fantasy football platform**

**On draft day, all player acquisitions are handled in a queue**

**All acquisitions must be handled in order**

**Given the volume, it is estimated that the queue could grow to 10 GB**

**What service should James leverage for processing these acquisitions?**

# Scenario Answers

---

# Scenario 1



**Sylvia is implementing an API on API Management with the Standard tier**

**She is configuring the built-in cache so calls are cached per unique user**

**Unique users are identified based on a JWT token in the Authorization header**

**How should she configure the caching?**

# API Management Policy

```
<policies>
  <inbound>
    <base />
    <cache-lookup vary-by-developer="false"
      vary-by-developer-groups="false" caching-type="internal">
      <vary-by-header> Authorization </vary-by-header>
    </cache-lookup>
  </inbound>

  <outbound>
    <cache-store duration="300" />
    <base />
  </outbound>
</policies>
```

## Scenario 2



**Edward's company is creating a new SaaS application on Azure**

The solution analyzes IoT temperature sensors in food storage facilities

The data is ingested and then made available in a data pipeline

**What approach would he take to build this solution?**

**Solution:** Utilize Azure Event Hub to analyze the Series Events from the sensors



## Scenario 3

**Cindy is developing an architecture for an order processing application**

**She is creating the application in a modular manner**

**She is planning to leverage Azure Functions to process the orders**

**She will be using Azure Event Grid to handle the orders as discrete events**

**Does Cindy's architecture fit the use case?**

**Solution: No. She is using an event service for a message-based use case.**

## Scenario 4



**Oscar's is creating a new single-page application using React**

**He needs to validate users for the application's API**

**He wants to use Azure AD with OAuth 2 authorization**

**He also needs to verify that the JWT is a token for his specific application**

**How should Oscar configure the policy in API Management?**

# API Management Policy

```
<policies>
  <inbound>
    < validate-jwt header-name="Authorization"
      failed-validation-error-message="Unauthorized">
      < openid-config url="https://login.microsoftonline.com/{aad-
tenant}/.well-known/openid-configuration" />
      < required-claims >
        <claim name="aud">
          <value>{Application ID of backend-app}</value>
        </claim>
      </ required-claims >
    </ validate-jwt >
  </inbound>
  ...
</policies>
```

## Scenario 5



**James's company has created a fantasy football platform**

**On draft day, all player acquisitions are handled in a queue**

**All acquisitions must be handled in order**

**Given the volume, it is estimated that the queue could grow to 10 GB**

**What service should James leverage for processing these acquisitions?**

**Solution: Azure Service Bus**

# Next Steps

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Next Video Course:  
Preparing to Take the AZ-204 Exam

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# Microsoft Azure Developer: Preparing To Take the AZ-204 Exam

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## TAKING YOUR FIRST STEPS



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# What Is the AZ-204 Exam and Why Should I Care?



**Build Cloud Applications and Services**

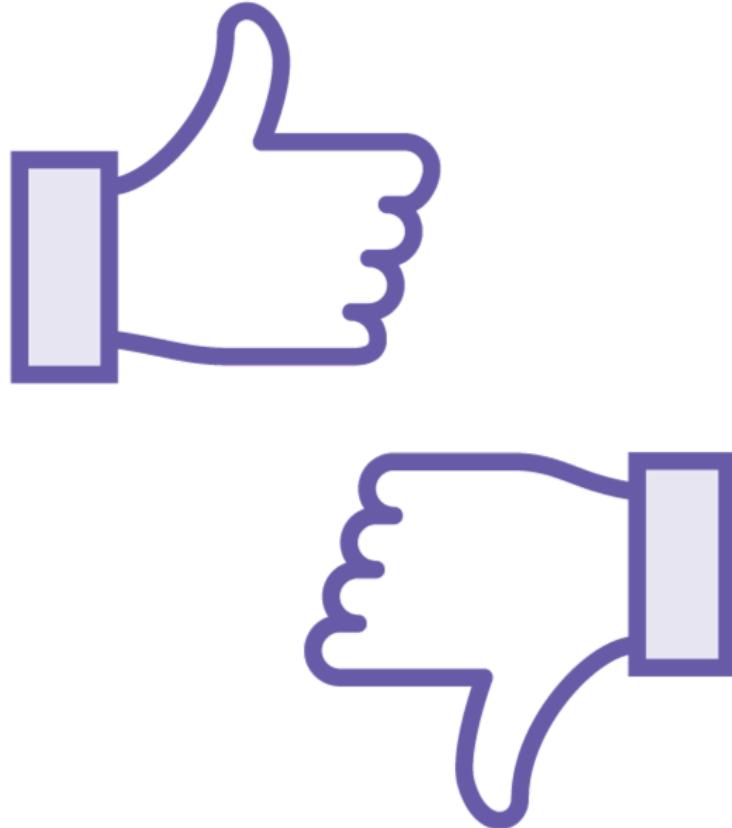
**Why take Microsoft exams?**

- Test your knowledge
- Certification

**Azure Developer Associate**



# What Is the AZ-204 Exam and Why Should I Care?



**Level of experience**

**Type of experience**

**Drive to succeed**



<https://docs.microsoft.com/en-us/learn/certifications/exams/az-204>

The screenshot shows the Microsoft Learn website for the AZ-204 exam. At the top, there's a navigation bar with links for Microsoft Docs, Documentation, Learn, Q&A, and Code Samples. Below that is another navigation bar with Learn, Products, Roles, Learn TV, Certifications, and FAQ & Help. On the right side of the top bar, there's a search bar, a user profile icon, and a progress bar labeled 'LEVEL 9' with a green bar and the text '4175/34199 XP'. A blue circular icon with a white dot and the word 'Saved' is also present.

The main content area features a large blue shield icon with 'EXAM' written on it. The title 'Exam AZ-204: Developing Solutions for Microsoft Azure' is displayed prominently. Below the title, a message states: 'The content of this exam was updated on March 26, 2021. Please download the skills measured document below to see what changed.' Another message indicates: 'Candidates for this exam should have subject matter expertise designing, building, testing, and maintaining cloud applications and services on Microsoft Azure.'

Further down, it says: 'A candidate for this certification should have 1-2 years professional development experience and experience with Microsoft Azure. In addition, the candidate for this role should have the ability to program in a language supported by Azure and proficiency in Azure SDKs, Azure PowerShell, Azure CLI, data storage options, data connections, APIs, app authentication and authorization, compute and container deployment, debugging, performance tuning, and monitoring.'

Information about ACE college credit is provided: 'You may be eligible for ACE college credit if you pass this certification exam. See [ACE college credit for certification exams](#) for details.'

Other details include: 'Part of the requirements for: [Microsoft Certified: Azure Developer Associate](#)', 'Related exams: none', 'Important: [See details](#)', and 'Go to Certification Dashboard'.

A section titled 'Schedule exam' is shown with a button to 'Schedule with Pearson VUE'. It also mentions 'For job seekers impacted by COVID-19' and 'Learn about our commitment to support people impacted by COVID-19'.

On the right side of the main content area, there's a sidebar with a dropdown menu set to 'United States' and a price of '\$165 USD\*'. A note says: 'Price based on the country in which the exam is proctored.'



# How Should I Take The Test?

## In person at a local test center

### Benefits

- Controlled environment
- Controlled equipment
- Testing center location

Find a local testing center

<https://bit.ly/3eHv8jF>

## Online from a home or office

### Benefits

- Familiar environment
- Time flexibility



# Getting Registered!

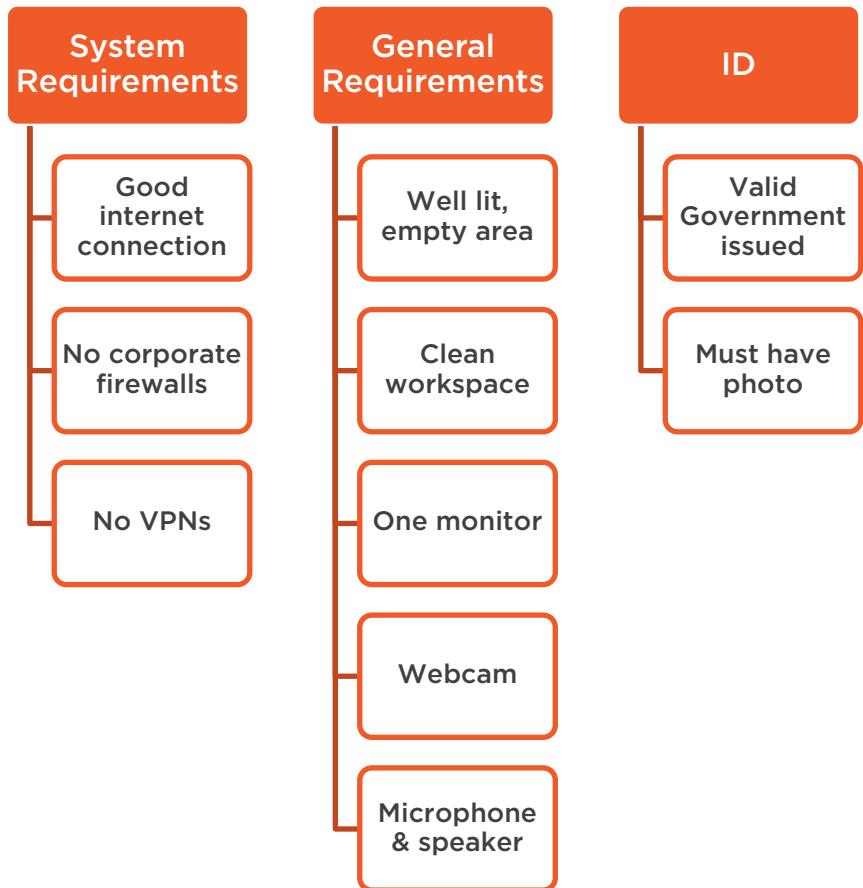


**Choose your date**  
**Receive the confirmation email**



# Exam Day – What You Need to Know

## Online Prep



## Check In

- Up to 30 minutes before
- Download Pearson Vue software
- Run system check
- Take picture of ID
- Take 4 pictures of workspace
- Wait for Proctor



# Exam Day – What You Need to Know

## In Person Prep



## Check In

- Show up early
- Check in
  - ID, photo, signature
- Place your items in a locker
- Proctor will thoroughly check you for items when entering the testing room
- Issued small whiteboard



# The Aftermath

## If You Pass

- What are the perks?
- <https://www.microsoft.com/en-us/learning/dashboard.aspx>

## If You Don't Pass

- Second time - 24 Hours
- Third/Forth/Fifth times - 14 Days
- Can't take more than 5 times in one year



# Test Structure and Strategies

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# Question Format Types

Multiple  
Choice

Build List

Case Studies

Drag and  
Drop

Hot Area

Best Answer

Repeated  
Answer



# Multiple Choice



## Question 2 (of 9)

Time remaining 01:45:32

- Review later
- Comment later

You are an administrator for fabrikam.com.

You need to prove domain ownership for your domain for Office 365.

Which two DNS record types can you create? Each correct answer presents a complete solution.

- A. Host record (A)
- B. Text record (TXT)
- C. Service record (SRV)
- D. Alias record (CNAME)
- E. Mail Exchanger record (MX)



Help



Calculator



Color scheme



Reset



Previous



Next



# Best Answer



## Question 3 (of 9)

- Review later
- Comment later

Time remaining 01:42:48

You are designing a Windows desktop application for your company by using Microsoft .NET Framework 4 and Microsoft SQL Server 2008.

The middle tier of the application uses several **DataAdapter** objects that query a SQL Server database. The user interface (UI) tier of the application uses controls that are bound to typed **DataSet** objects.

The database schema frequently changes.

You need to ensure that changes in the database schema do not impact the UI tier.

What should you do? More than one answer choice may achieve the goal. Select the **BEST** answer.

- A. Encapsulate the **DataAdapter** objects in a custom Data Transfer Object (DTO) class.
- B. Replace the **DataSet** objects with Language Integrated Natural Query (LINQ) objects.
- C. Encapsulate the **DataSet** objects in a custom Data Transfer Object (DTO) class.
- D. Replace the **DataAdapter** objects with **DataReader** objects.



Help



Calculator



Color scheme



Reset



Previous

Next

## Things to Consider

- Azure - always consider cost
- Security - less is more



# Build List



## Question 6 (of 9)

Time remaining 01:36:27

- Review later
- Comment later

You are an administrator at Woodgrove Bank. You need to implement a new policy to prevent employees from sending credit card numbers through email to external users. Employees who attempt to send the credit card numbers this way should receive the message "Internal audit policy failure."

You need to enforce the new policy.

Which four actions should you perform in sequence? To answer, move the appropriate actions from the list of actions to the answer area and arrange them in the correct order.

### Actions

Add an action to reject the message and include an explanation.

Choose the PCI Data Security Standard (PCI DSS) 15.0.3.0 template.

Create a new Transport Rule.

Add an action to reject the message and send enhanced status code.

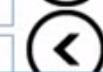


### Answer Area

1 Choose the U.S. Personally Identifiable Information (PII) Data template.

2 Create a new rule that applies to senders located outside the organization. Add a condition to detect the message for sensitive information: "Credit Card Numbers".

3 Create a new DLP policy from a template.



Create a new rule that applies to recipients located outside the organization. Add a condition to detect the message for sensitive information: "Credit Card Numbers".



Help



Calculator



Color scheme



Reset



Previous



Next



# Drag and Drop



## Question 5 (of 9)

- Review later
- Comment later

Time remaining 01:38:36

You have a Microsoft SharePoint 2013 Service Pack 1 (SP1) server farm.

You need to recommend which tools should be used to recover deleted SharePoint site groups, deleted document libraries, and deleted SharePoint Designer 2010 workflows. The solution must use the minimum amount of administrative effort.

Which tool should you recommend for each type of content? To answer, drag the appropriate tool to the correct recovery task. Each tool may be used once, more than once, or not at all. You may need to drag the split bar between panes or scroll to view content.

The interface shows a list of tools on the left and recovery tasks on the right. A vertical split bar is visible between the two panes.

| Tool                         | Recovery Task                 |
|------------------------------|-------------------------------|
| Microsoft SQL Server backups | Microsoft SQL Server backups  |
| Recycle Bin                  | Document libraries            |
| Windows Server Backups       | SharePoint Site groups        |
|                              | SharePoint Designer workflows |

Resources are represented by dashed boxes on the right side of the interface.



Help



Calculator



Color scheme



Reset



Previous



Next



# Hot Area



## Question 7 (of 9)

Time remaining 01:52:26

- Review later
- Comment later

You need to block spam email from senders whose email messages did not originate from the server they have explicitly designated in their DNS domain.

Which option should you select? To answer, select the appropriate option in the answer area.



### Answer Area

#### Mark as Spam

Specify whether to mark messages that include these properties as spam.

#### Empty messages:

Off ▾

#### JavaScript or VBScript in HTML:

Off ▾

#### Frame or IFrame tags in HTML:

Off ▾

#### Object tags in HTML:

Off ▾

#### Embed tags in HTML:

Off ▾

#### Form tags in HTML:

Off ▾



Help



Calculator



Color scheme



Reset



Previous



Next



# Case Studies

## Case Study

Time remaining 01:56:22

### Question

Background

Existing Environment

Business Requirements

Technical Requirements

Problem Statements

Exhibits



This exam includes at least one case study. **Case studies are not timed separately. You can use as much exam time as you would like to complete each case.** However, there may be additional case studies and sections on this exam. You must manage your time to ensure that you are able to complete all questions included on this exam in the time provided.

To answer the questions included in a case study, you will need to reference information that is provided in the case study. Case studies might contain exhibits and other resources that provide more information about the scenario that is described in the case study. Each question is independent of the other questions in this case study.

At the end of this case study, a review screen will appear. This screen allows you to review your answers and to make changes before you move to the next section of the exam. After you begin a new section, you cannot return to this section.

#### To start the case study

To display the first question in this case study, click the **Next** button. Use the buttons in the left pane to explore the content of the case study before you answer the questions. Clicking these buttons displays information such as business requirements, existing environment, and problem statements. If the case study has an **All Information** tab, note that the information displayed is identical to the information displayed on the subsequent tabs. When you are ready to answer a question, click the **Question** button to return to the question.



Help



Calculator



Color scheme



Reset



Next

## Tips

- **Timebox your reading**
- **Write down the facts**



# Repeated Answer Choices

## Question 4 (of 9)

Time remaining 01:40:21

- Review later
- Comment later

**Note: This question is part of a series of questions that use the same or similar answer choices. An answer choice may be correct for more than one question in the series. Each question is independent of the other questions in this series. Information and details provided in a question apply only to that question.**

An application is currently making use of an Azure storage account. Soft delete is enabled on the storage account.

The application uploads a blob named img1.jpg. Snapshot 1 is then created out of the blob. And then Snapshot 2 is created out of the blob. Snapshot 1 is then deleted.

A system error has caused the application to now go ahead and delete the blob and all of its snapshots. Would you be able to restore the blob img1.jpg?

- No
- Yes



Help



Calculator



Color scheme



Reset



Previous



Next



# Final Thoughts



**Not passing != failure**  
**You can do this!**

