Microsoft

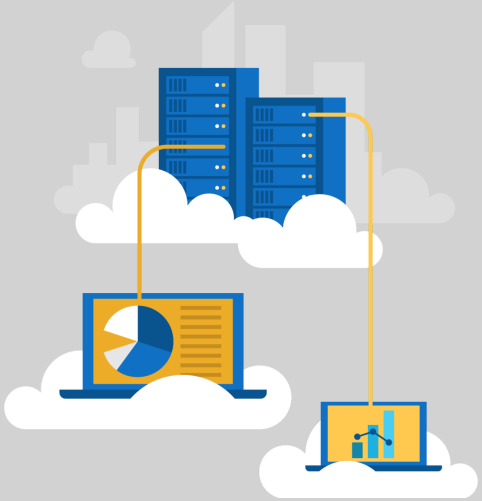
Module 05: Implement IaaS solutions

Microsoft

Topics

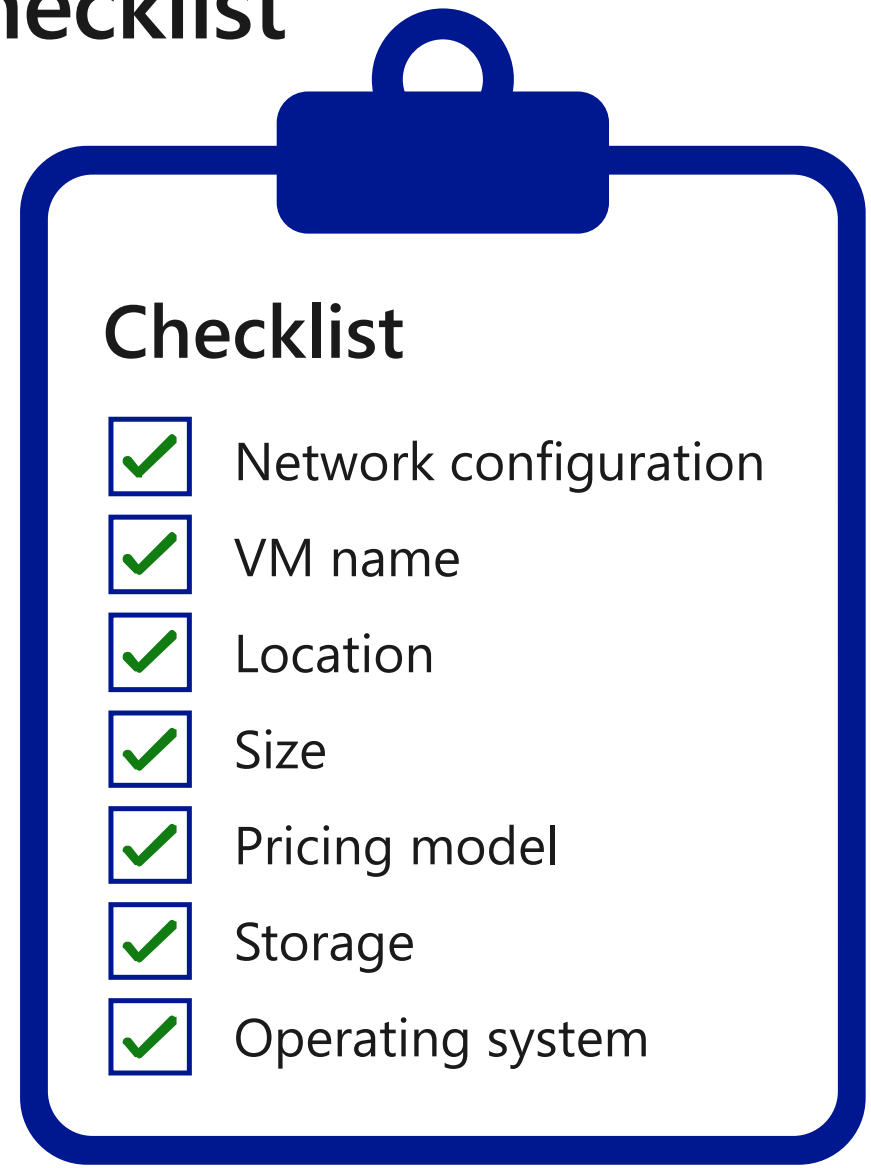
- Provisioning VMs in Azure
- Create and deploy Azure Resource Manager templates
- Create container images for solutions
- Publish a container image to Azure Container Registry
- Create and run container images in Azure Container Instances

Lesson 01: Provisioning VMs in Azure



Azure virtual machine creation checklist

- Before you create a VM, you should consider the following:



Naming a VM

- The VM name is used as the computer name, which is configured as part of the operating system
- Rules:
  - Up to 15 characters for a Windows VM
  - Up to 64 characters for a Linux VM

Naming a VM (continued)

Current best practices for VM name choices:

Element	Example	Notes
Environment	dev, prod, QA	Identifies the environment for the resource
Location	uw (US West), ue (US East)	Identifies the region into which the resource is deployed
Instance	01, 02	For resources that have more than one named instance (such as web servers)
Product or Service	service	Identifies the product, application, or service that the resource supports
Role	sql, web, messaging	Identifies the role of the associated resource

VM pricing models

- Two primary costs for every VM:
  - **Storage** – The cost of storing data in every virtual hard disk. This cost is independent of whether the VM is running
  - **Compute –** The usage-based price for compute capacity when the VM is currently allocated

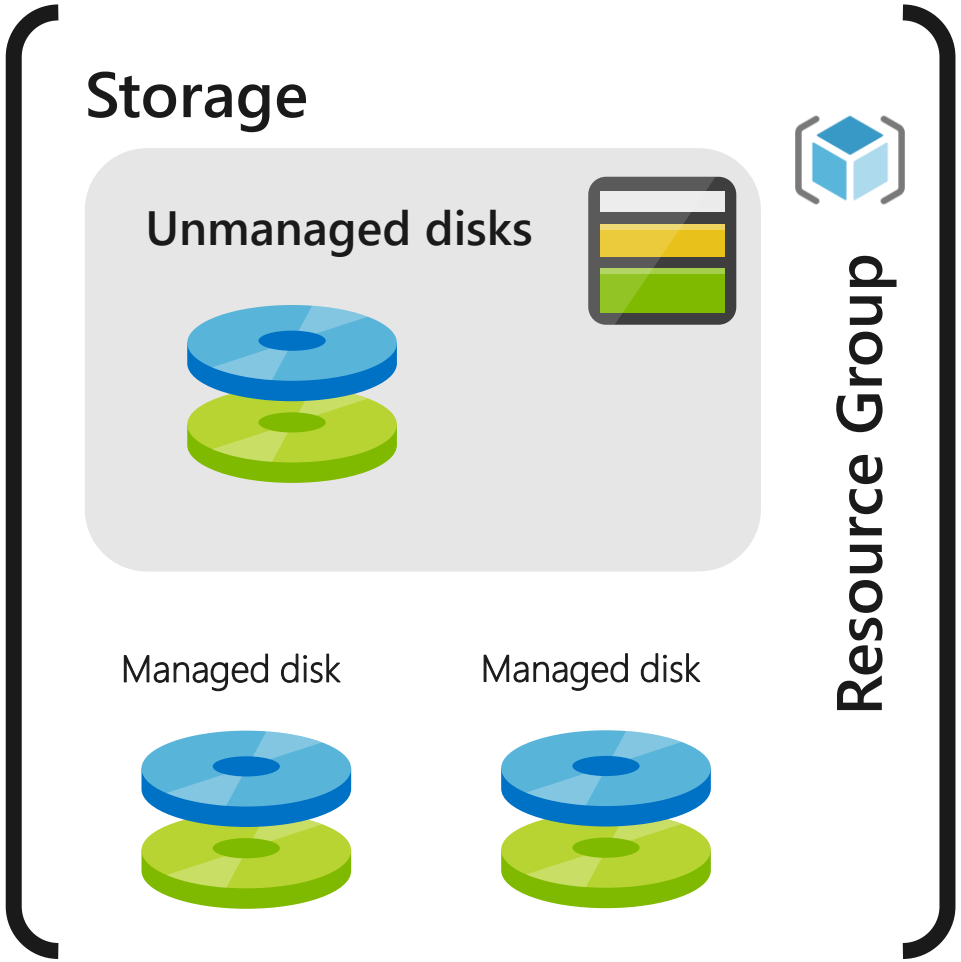
- There are two payment options for compute costs:
  - **Pay as you go** – Compute capacity is billed and paid as it is used without a long-term commitment
  - **Reserved instances –** Compute capacity can be pre-purchased at a reduced rate for anticipated usage

VM storage options

- Virtual disks can be backed by either Standard or Premium Storage accounts
  - Azure Premium Storage leverages solid-state drives (SSDs) to enable high performance and low latency for VMs running I/O-intensive workloads
- You can choose either unmanaged disks or managed disks

Managed and unmanaged disks

- Managed disks
  - The Azure platform manages the disk and the backing storage
  - You don't have to worry about storage account limits and thresholds
- Unmanaged disks
  - You manually create and manage virtual hard disks (VHDs) in your Storage account
  - You will need to consider account throughput and capacity limits when using this model



Azure virtual machine creation and management

- Azure portal
  - Browser-based user interface that allows you to create and manage all your Azure resources
- Azure Resource Manager
  - Allows you to create templates, which can be used to create and deploy specific configurations of multiple Azure resources
- Azure PowerShell
  - Optional package that adds Azure-specific commands to PowerShell
- Azure CLI
  - Cross-platform command-line tool for managing Azure resources
- Programmatic (APIs)

Create an Azure VM by using the Azure portal

Home > New > Create a virtual machine

Create a virtual machine

Basics | Disks | Networking | Management | Guest config | 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.
Looking for classic VMs? Create VM from Azure Marketplace

PROJECT DETAILS

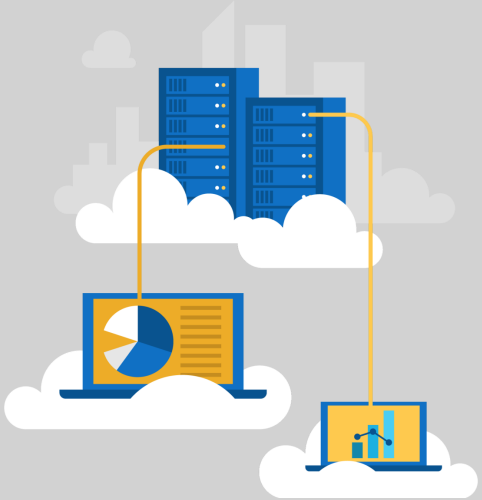
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

* Subscription: Pay-As-You-Go

* Resource group: (New) myResourceGroup

Create new

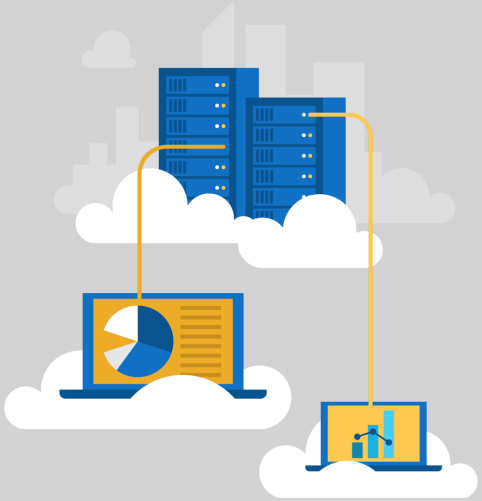
Demonstration: Creating an Azure VM by using the Azure portal



Create an Azure VM by using PowerShell

```
Connect-AzAccount

New-AzResourceGroup -Name "myResourceGroup" -Location EastUS

New-AzVM `
    -ResourceGroupName "myResourceGroup" `
    -Name "myVM" `
    -Location "East US" `
    -VirtualNetworkName "myVnet" `
    -SubnetName "mySubnet" `
    -SecurityGroupName "myNetworkSecurityGroup" `
    -PublicIpAddressName "myPublicIpAddress" `
    -OpenPorts 80,3389
```

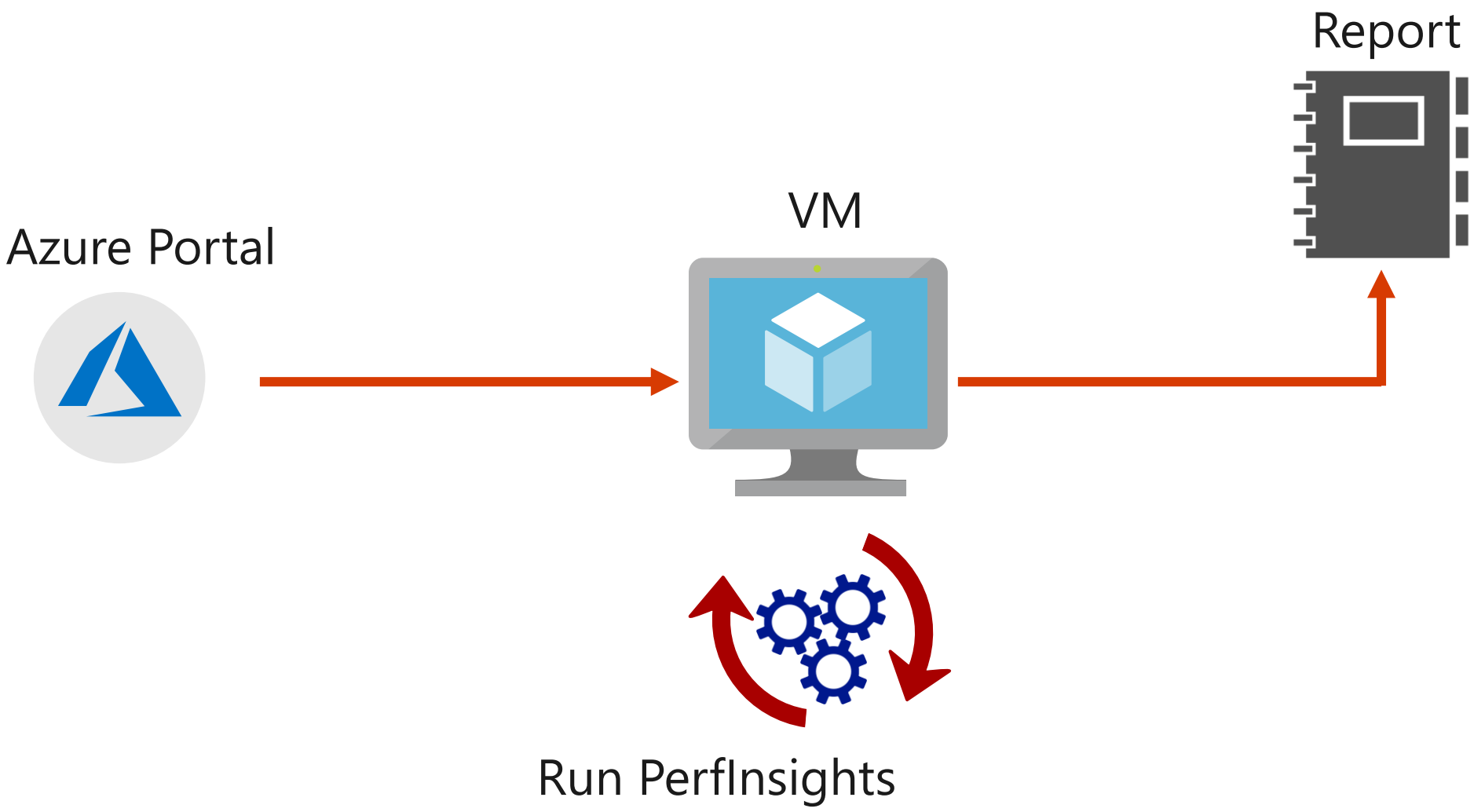
Demonstration: Creating an Azure VM by using PowerShell



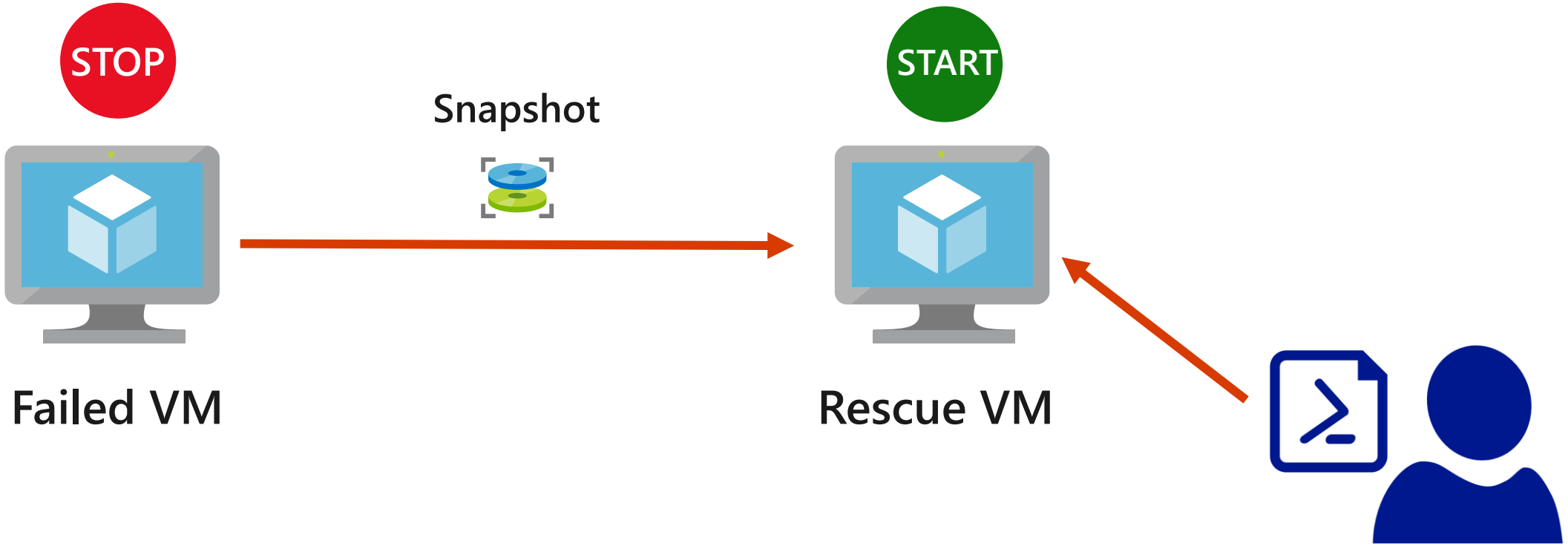
Accessing an Azure VM by using PowerShell

```
Get-AzPublicIpAddress -ResourceGroupName "myResourceGroup" `
 | Select "IpAddress"

mstsc /v:publicIpAddress

Install-WindowsFeature -name Web-Server –IncludeManagementTools
```

Capturing performance diagnostics for a VM



Recovering a failed VM by using a rescue VM



Sizing a VM

- Each VM size offers a variation of the following characteristics:
  - Processing power
  - Memory
  - Storage capacity
- Based on the workload, you're able to choose from a subset of available VM sizes

VM configuration options

Computational performance	1 virtual CPU (vCPU) - 128 vCPUs
Memory	1 gibibyte (GiB) - 4 tebibyte (TiB)
Disk storage	4GiB - 64TiB Up 160,000 IOPs
Networking	30 GB Ethernet 100 GB InfiniBand
Availability	Single VM service-lvel agreement (SLA) 99.9% Multi AZ SLA 99.99%

VM categories

Virtual machines

- Entry level
- Burstable
- General purpose
- Compute intensive
- Memory optimized
- GPU accelerated
- High performance computing
- Storage optimized

Purpose built

SAP®

CRAY

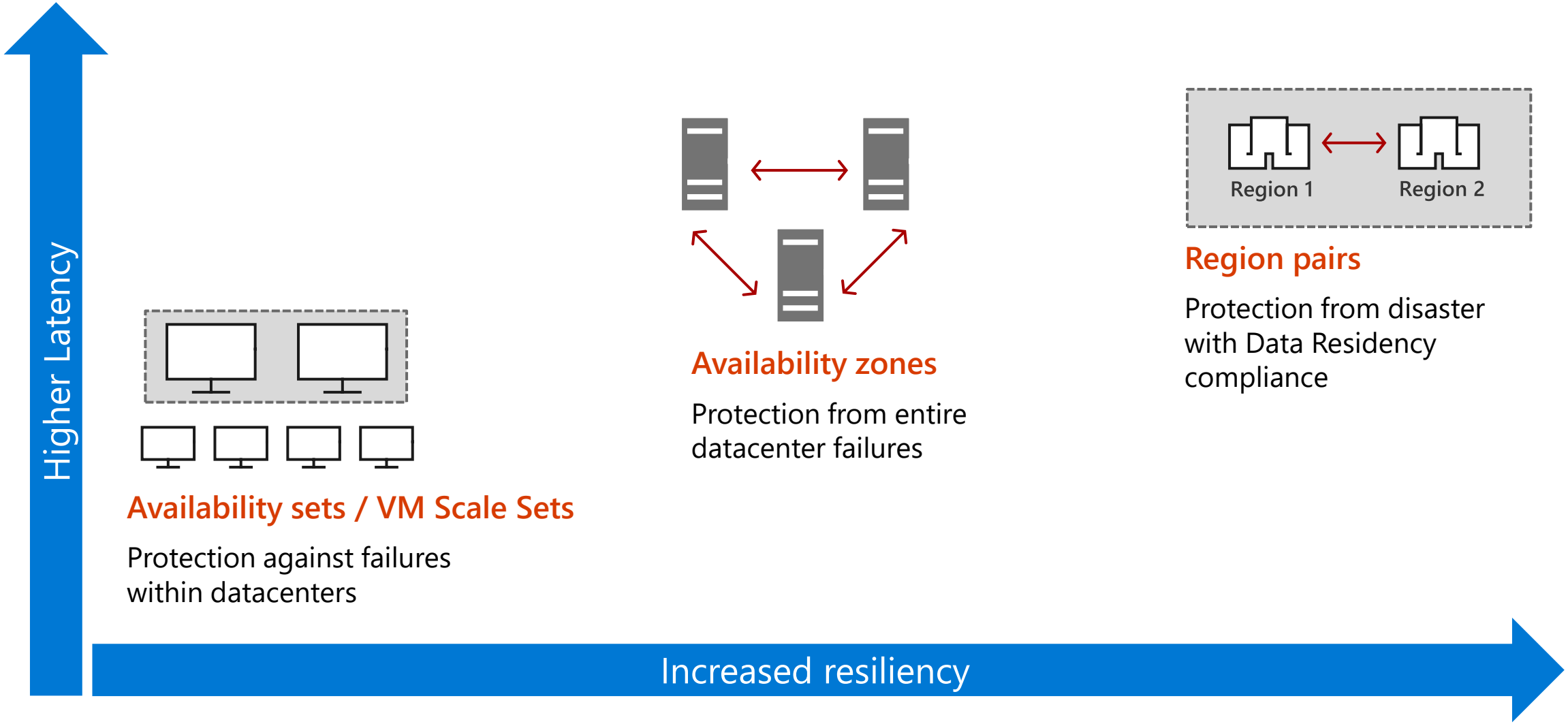
VM categories (cont.)

Option	Description
General purpose	General-purpose VMs are designed to have a balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute optimized	Compute optimized VMs are designed to have a high CPU-to-memory ratio. Suitable for medium traffic web servers, network appliances, batch processes, and application servers.
Memory optimized	Memory optimized VMs are designed to have a high memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage optimized	Storage-optimized VMs are designed to have high disk throughput and IO. Ideal for VMs running databases.
GPU	GPU VMs are specialized virtual machines targeted for heavy graphics rendering and video editing. These VMs are ideal options for model training and inferencing with deep learning.
High performance compute	High-performance compute is the fastest and most powerful CPU virtual machine with optional high-throughput network interfaces.

Manage the availability of your Azure VMs

- **Availability** is the percentage of time a service is available for use
- In the event of a physical failure within the Azure datacenter:
  - Azure will move the VM to a healthy host server automatically
  - “Self-healing” migration could take several minutes
  - If your VM is isolated to a single instance, the application(s) hosted on that VM will not be available
- VMs could also be affected by periodic updates initiated by Azure itself

High availability and disaster recovery

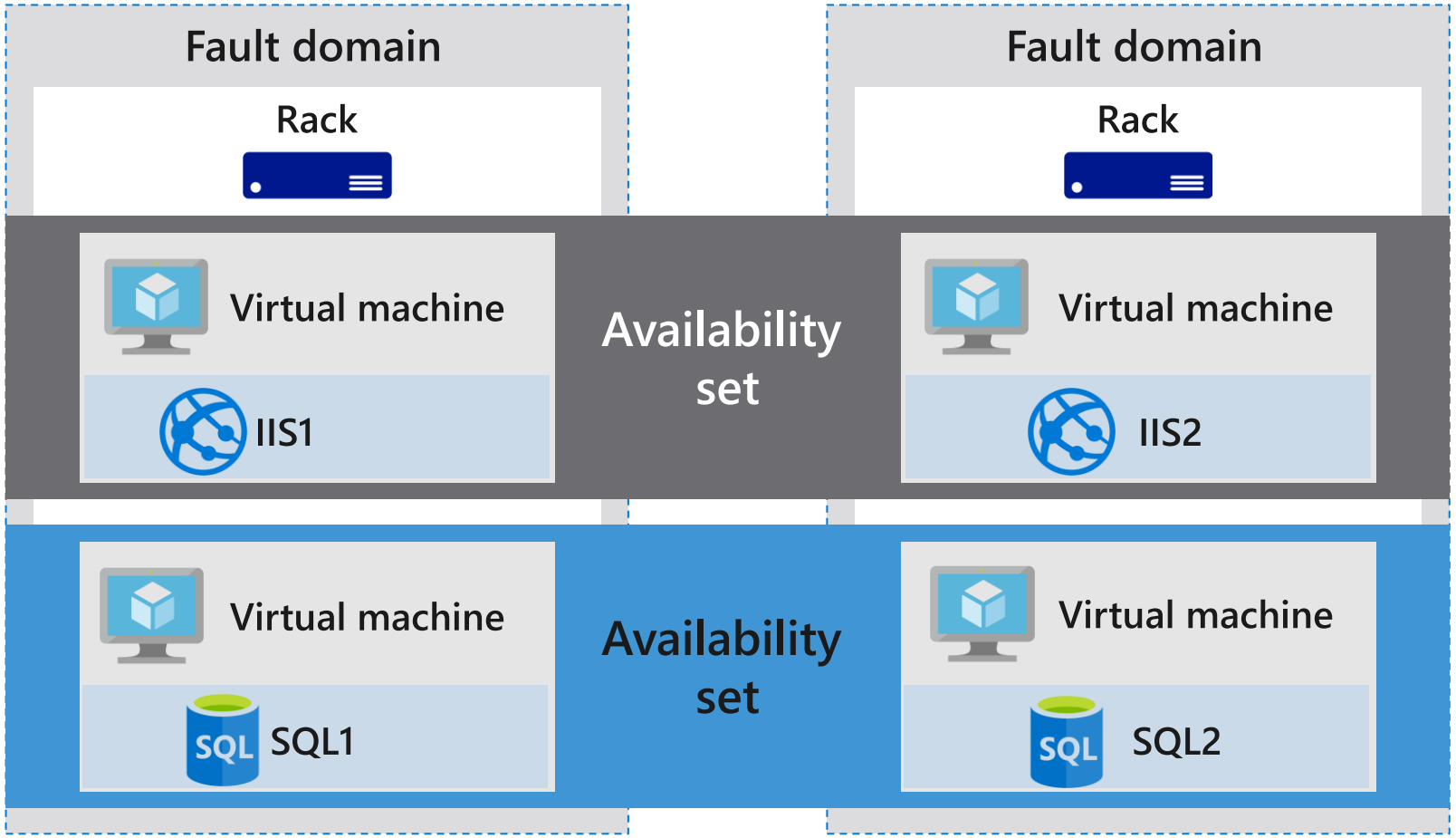


Availability sets

- **Availability set** – logical feature used to ensure that a group of related VMs are deployed so that:
  - They are not all subject to a single physical point of failure
  - They are not all upgraded at the same time
- **Update domain** – logical group of hardware that can undergo a maintenance update at the same time

Fault domains

Fault domain – a logical group of hardware in Azure that shares a common power source and network switch



Update domains

- Update domains enable targeting specific sets of hardware for maintenance or rebooting.

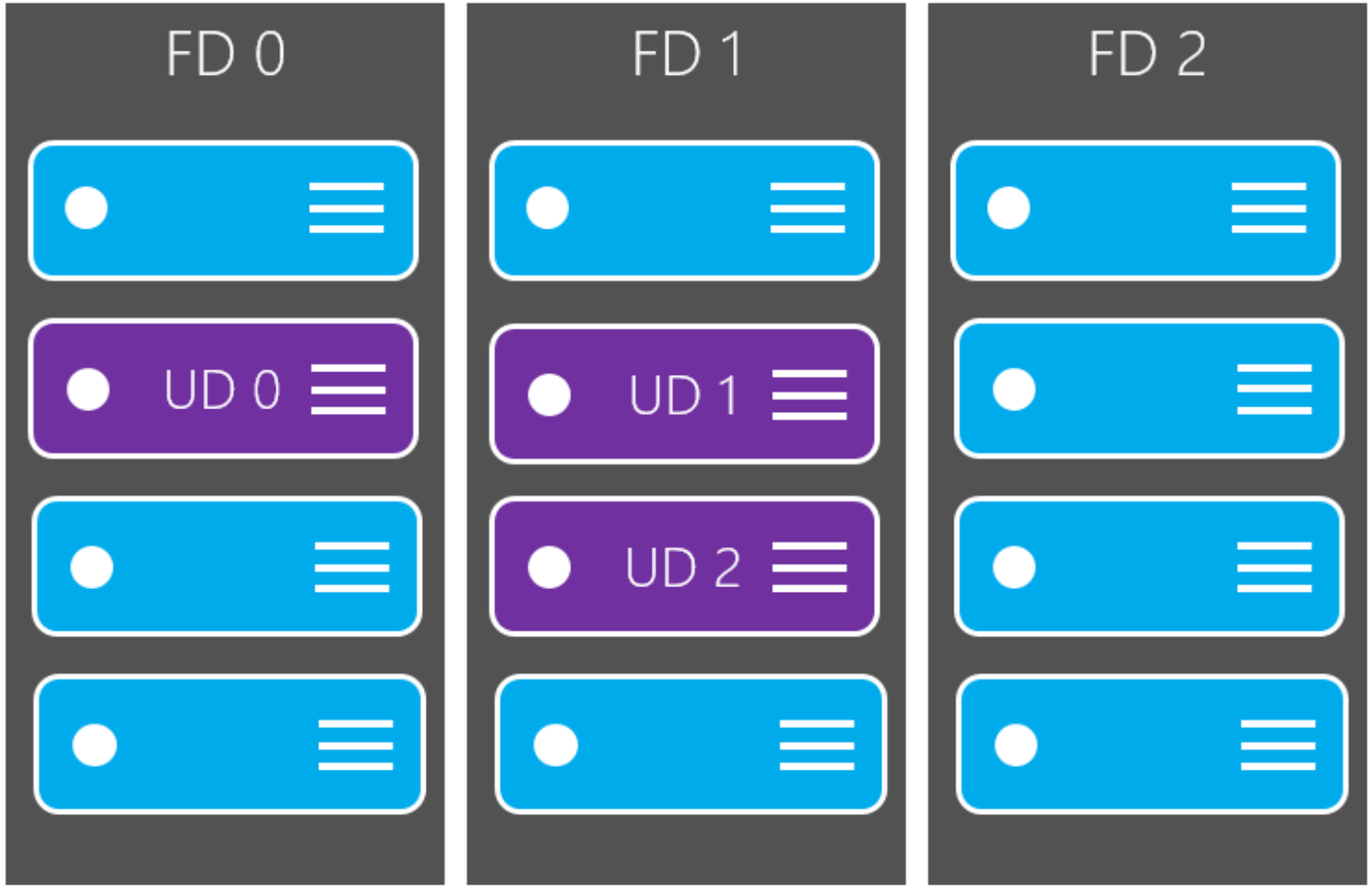


Image in Azure Marketplace

- Images in Azure Marketplace are grouped into the following categories:
  - Publisher
    - Organization that creates an image
  - Offer
    - Group of related images
  - SKU
    - Instance of an offer, typically a release
  - Version
    - A specific release version number

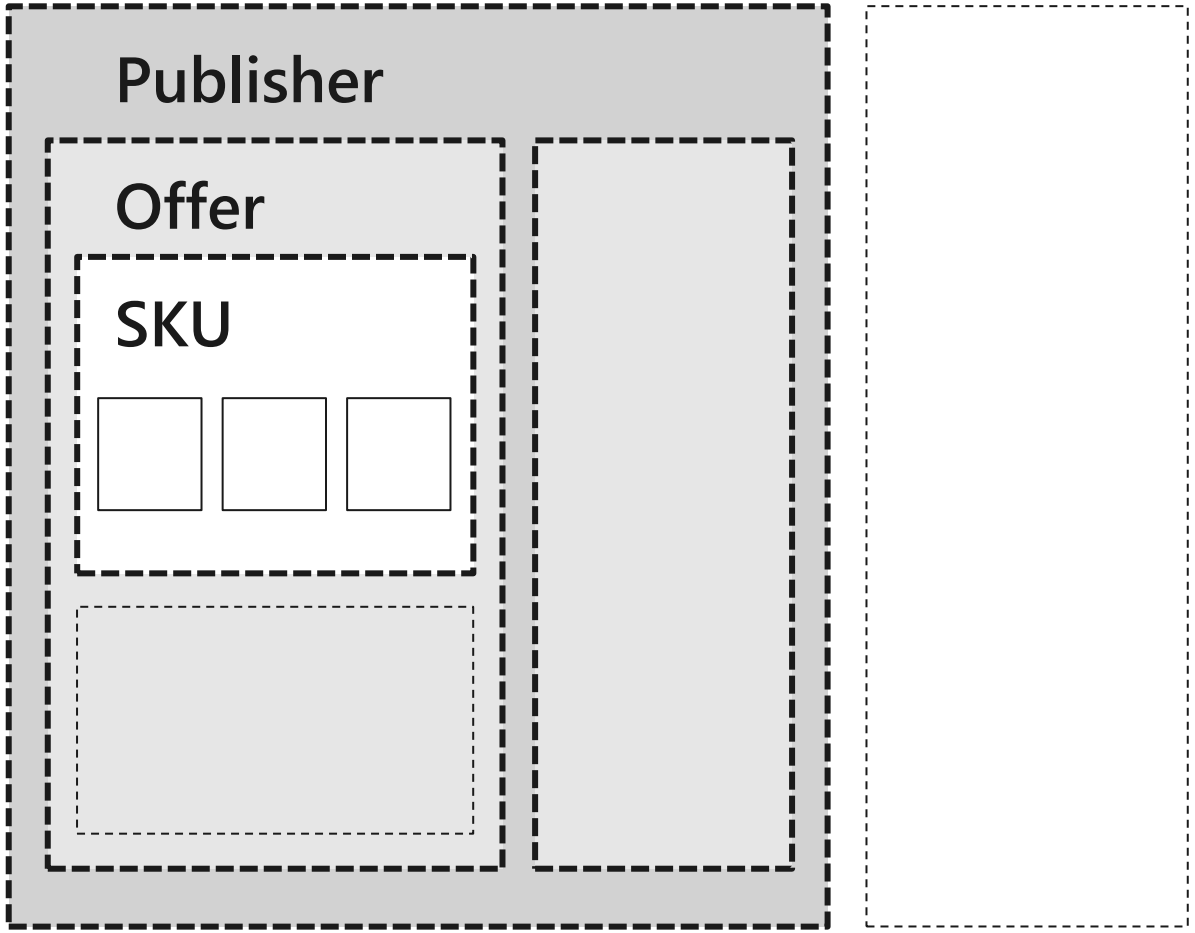


Image Sources - Windows Server example

- Microsoft Windows Server PUBLISHER
  - Windows Server Semi-Annual OFFER
  - Windows Server OFFER
    - 2012 Datacenter SKU
    - 2012-R2-Datacenter SKU
    - 2016-Datacenter SKU
    - 2016-Datacenter-Core SKU
    - 2016-Datacenter-with-Containers SKU
    - 2019-Datacenter SKU
    - 2019-Datacenter-Core SKU
    - 2019-Datacenter-with-Containers SKU

2019.0.20181107 IMAGE
2019.0.20181122 IMAGE
2019.0.20181218 IMAGE
2019.0.20190115 IMAGE
2019.0.20190214 IMAGE
2019.0.20190314 IMAGE
2019.0.20190410 IMAGE
2019.0.20190603 IMAGE
2019.0.20190620 IMAGE

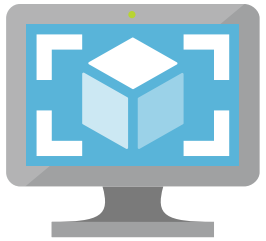


Image Sources - Ubuntu example

- Canonical PUBLISHER
  - Ubuntu Core OFFER
  - Ubuntu Snappy OFFER
  - Ubuntu Server OFFER
    - 12.04 SKU
    - 14.04 SKU
    - 16.04 SKU
    - 18.04-LTS SKU
    - 18.10 SKU
    - 19.04 SKU
    - 19.10-DAILY SKU

19.10.201905250 IMAGE
19.10.201905290 IMAGE
19.10.201905300 IMAGE
19.10.201905310 IMAGE
19.10.201906040 IMAGE
19.10.201906050 IMAGE
19.10.201906120 IMAGE
19.10.201906140 IMAGE
19.10.201906220 IMAGE
19.10.201906230 IMAGE

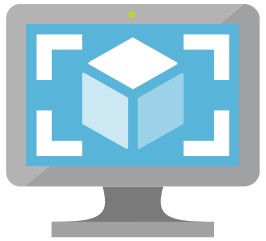
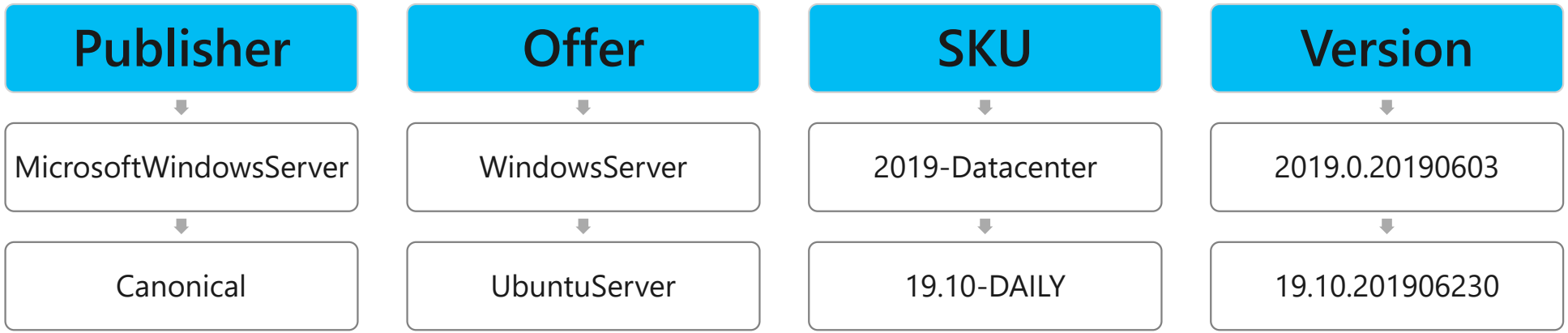


Image Uniform Resource Name (URN)

Short-hand string to quickly access a known VM image Format

PUBLISHER:OFFER:SKU:VERSION



Finding image sources by using the Azure CLI

```
# Get a list of all publishers available in the East US region
az vm image list-publishers --location eastus

# Get a list of all offers for the MicrosoftWindowsServer publisher
az vm image list-offers --location eastus --publisher MicrosoftWindowsServer

# Get a list of SKUs for the WindowsServer offer
az vm image list-skus --location eastus --publisher MicrosoftWindowsServer --
offer WindowsServer

# Get a list of all images available for the 2019-Datacenter SKU
az vm image list --all --location eastus --publisher MicrosoftWindowsServer --
offer WindowsServer --sku 2019-Datacenter
```

Finding image sources by using the Azure CLI (cont.)

```
# Get the 2019.0.20190603 version of the VM image
az vm image show --location eastus --publisher MicrosoftWindowsServer --offer
WindowsServer --sku 2019-Datacenter --version 2019.0.20190603

# Alternatively, use an URN to get the specified version of the VM image
az vm image show --location eastus --urn
MicrosoftWindowsServer:WindowsServer:2019-Datacenter:2019.0.20190603
```

Finding image sources by using Azure PowerShell

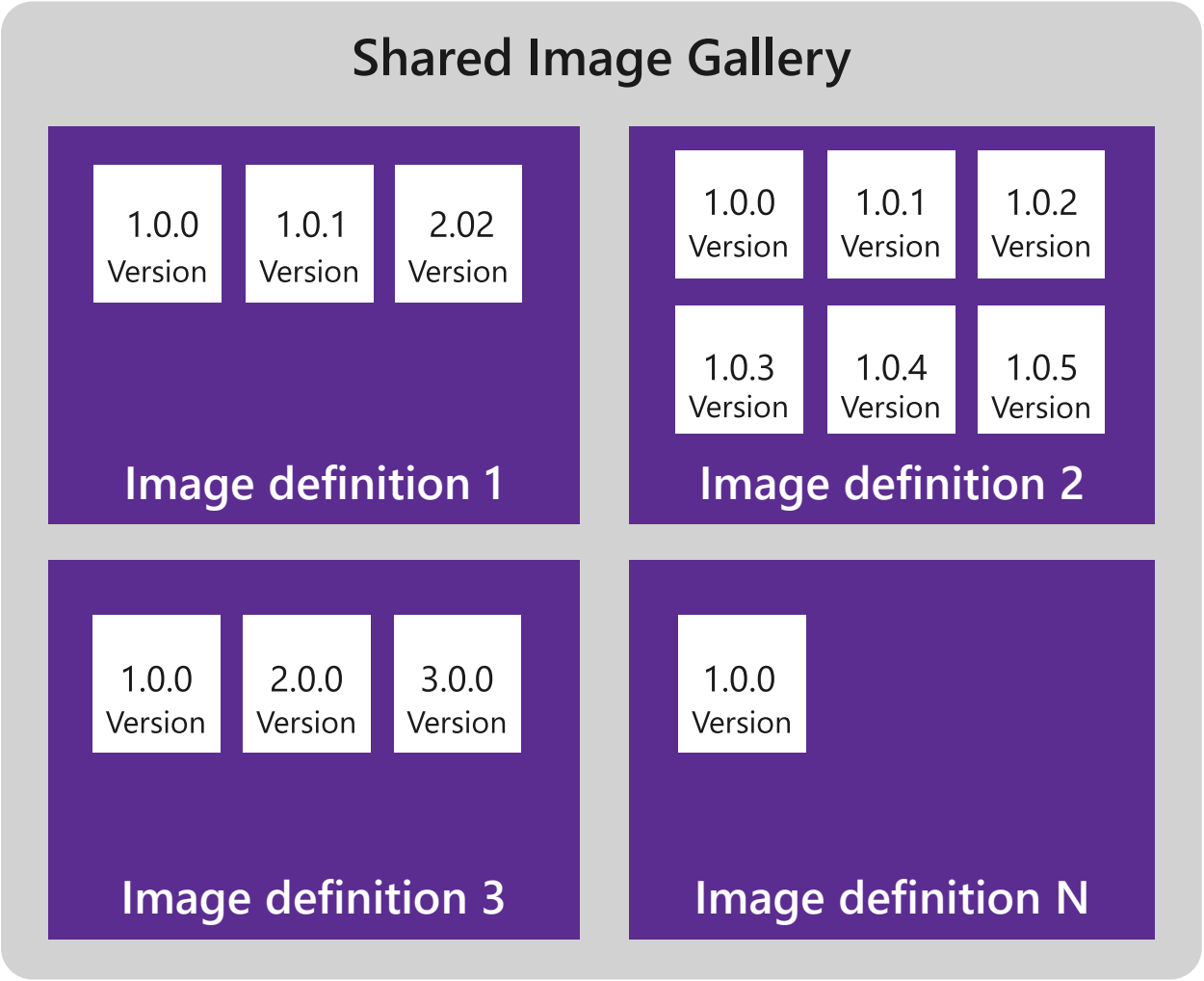
```
# Get a list of all publishers available in the East US region
Get-AzVMImagePublisher -Location eastus

# Get a list of all offers for the Canonical publisher
Get-AzVMImageOffer -Location eastus -PublisherName Canonical

# Get a list of SKUs for the UbuntuServer offer
Get-AzVMImageSku -Location eastus -PublisherName Canonical -Offer UbuntuServer

# Get a list of all images available for the 19.10-DAILY SKU
Get-AzVMImage -Location eastus -PublisherName Canonical -Offer UbuntuServer -
Sku 19.10-DAILY
```

Finding Image Sources using Azure PowerShell (cont.)

```
# Get the 19.10.201906230 version of the VM image
Get-AzVMImage -Location eastus -PublisherName Canonical -Offer UbuntuServer -
Sku 19.10-DAILY -Version 19.10.201906230
```

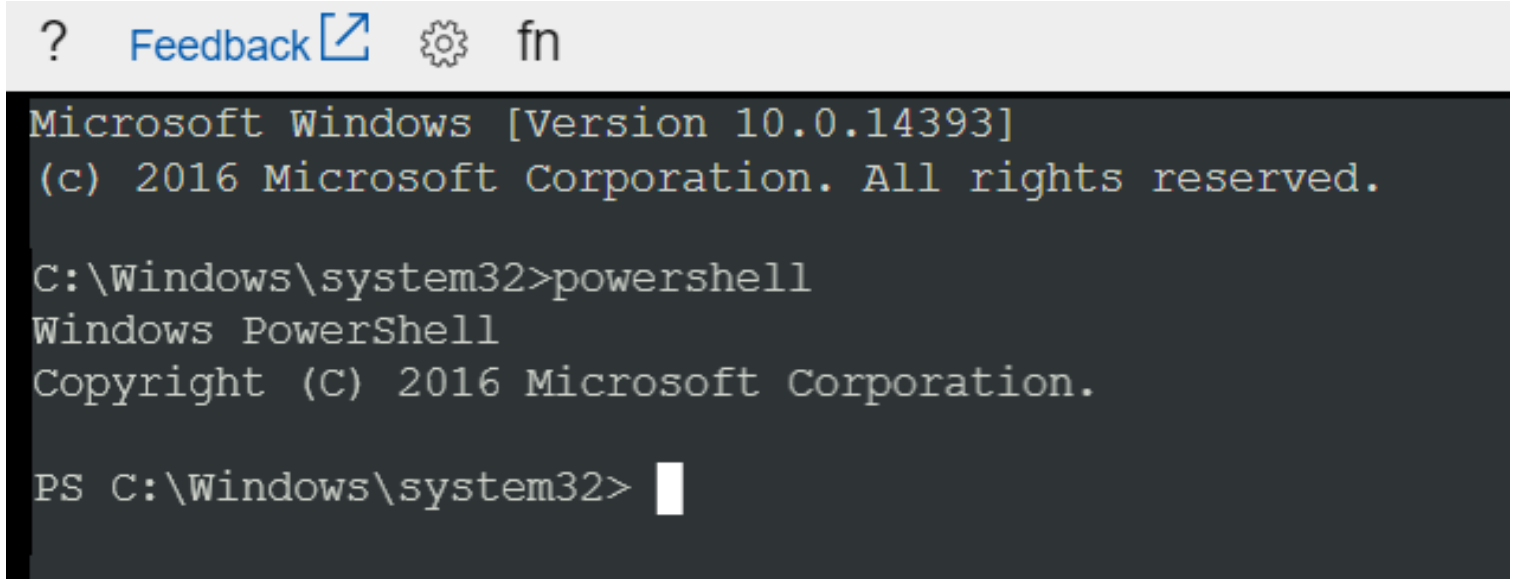
Azure Shared Image Gallery

- Service to manage your images
- Provides
  - Global replication
  - Versioning
  - Grouping
  - High availability
  - Image sharing across subscriptions
  - Image replicas

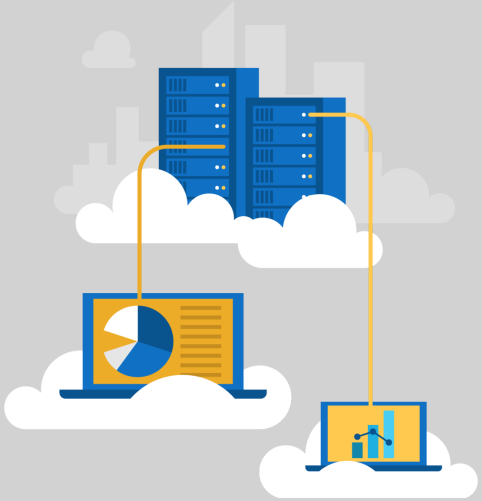


VM Serial Console

- Console access to a VM independent of network or OS state
- Available in Linux or Windows
  - Bash, CMD, PowerShell, NMI, SysRq, vi, GRUB, etc…

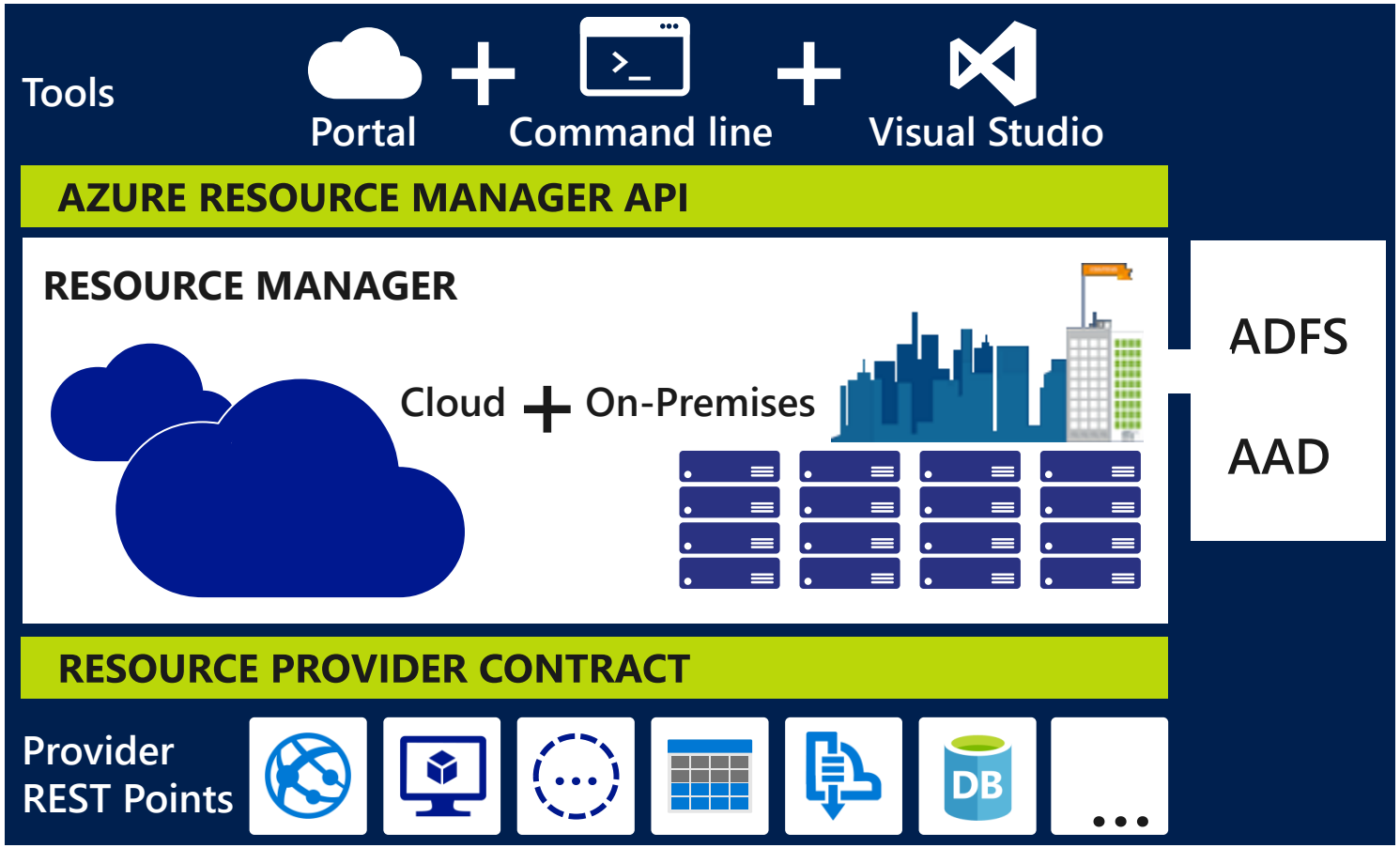


Lesson 02: Create and deploy Azure Resource Manager templates



Azure Resource Manager overview

- Resource Manager provides a consistent management layer to perform tasks
  - Azure PowerShell
  - Azure CLI
  - Azure portal
  - REST API
  - Client SDKs



Terminology

- Resource
  - Single manageable item available through Azure
- Resource group
  - Container holding related resources
- Resource provider
  - Service that supplies resource instances in accordance with a predefined contract
- Resource Manager template
  - JSON file that defines one or more resources, specifying their resource providers, to be deployed to a resource group
- Declarative syntax
  - The act of describing your resources by using a template instead of manually creating the resources

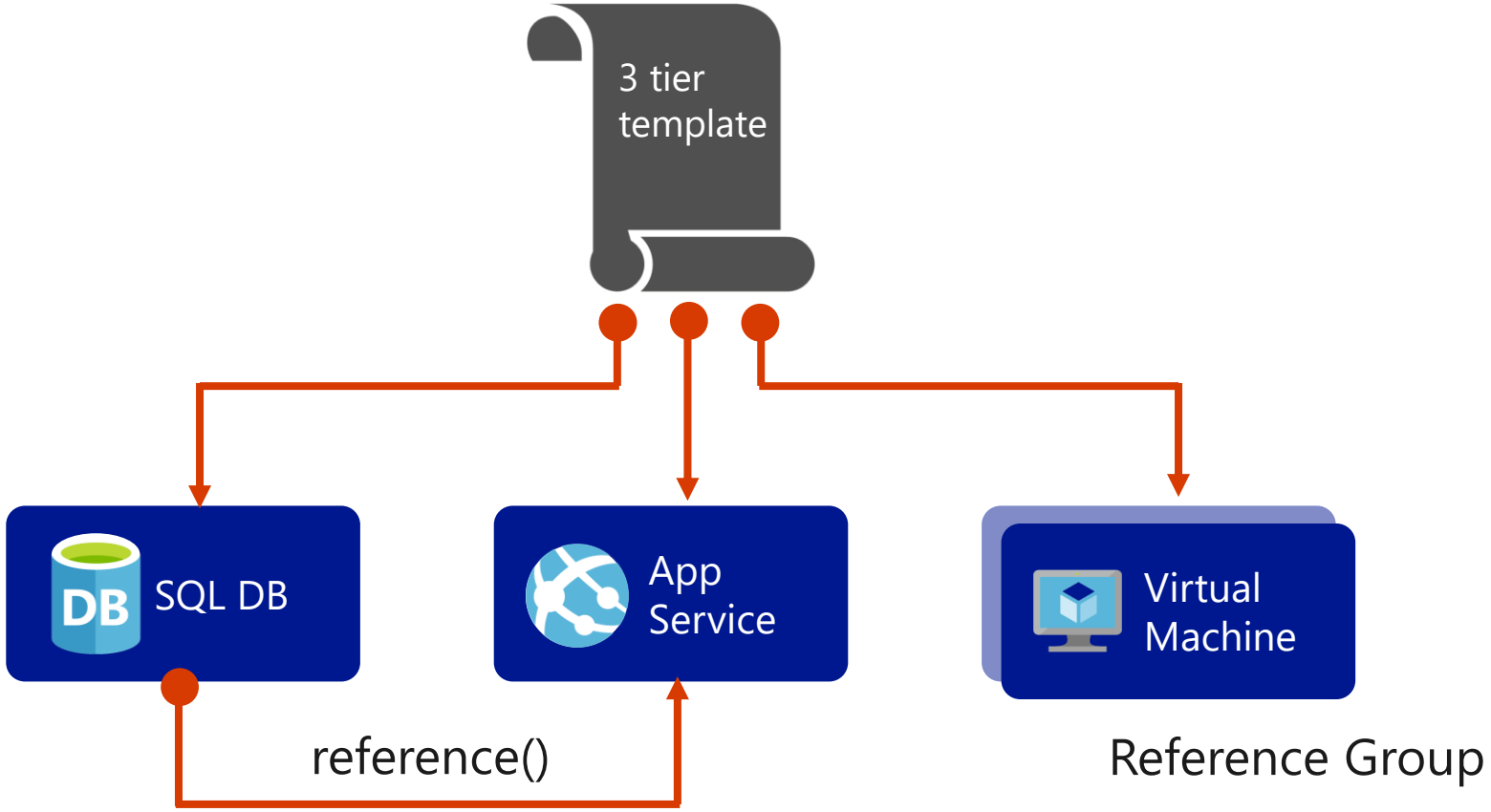
Resource Manager template deployment

```
"resources": [
    {
        "apiVersion": "2016-01-01",
        "type":
"Microsoft.Storage/storageAccounts",
        "name": "mystorageaccount",
        "location": "westus",
        "sku": {
            "name": "Standard_LRS"
        },
        "kind": "Storage",
        "properties": {}
    }
]
```

```
PUT
https://management.azure.com/subscri
ptions/{subscriptionId}/resourceGrou
ps/{resourceGroupName}/providers/Mic
rosoft.Storage/storageAccounts/mysto
rageaccount?api-version=2016-01-01
REQUEST BODY
{
    "location": "westus",
    "properties": {},
    "sku": {
        "name": "Standard_LRS"
    },
    "kind": "Storage"
}
```

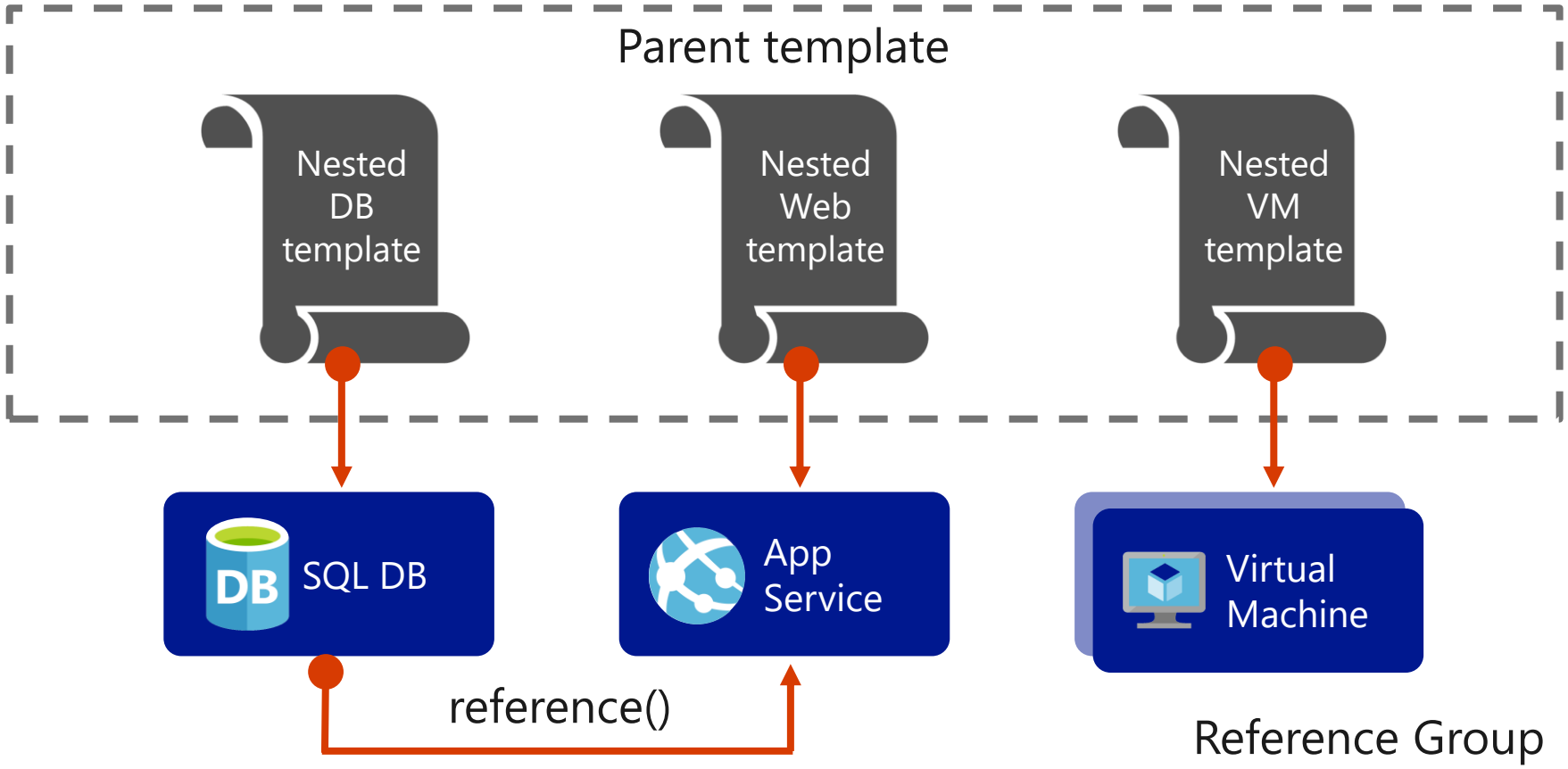
Three-tier Azure Resource Manager template

Three-tier application through a single Resource Manager template

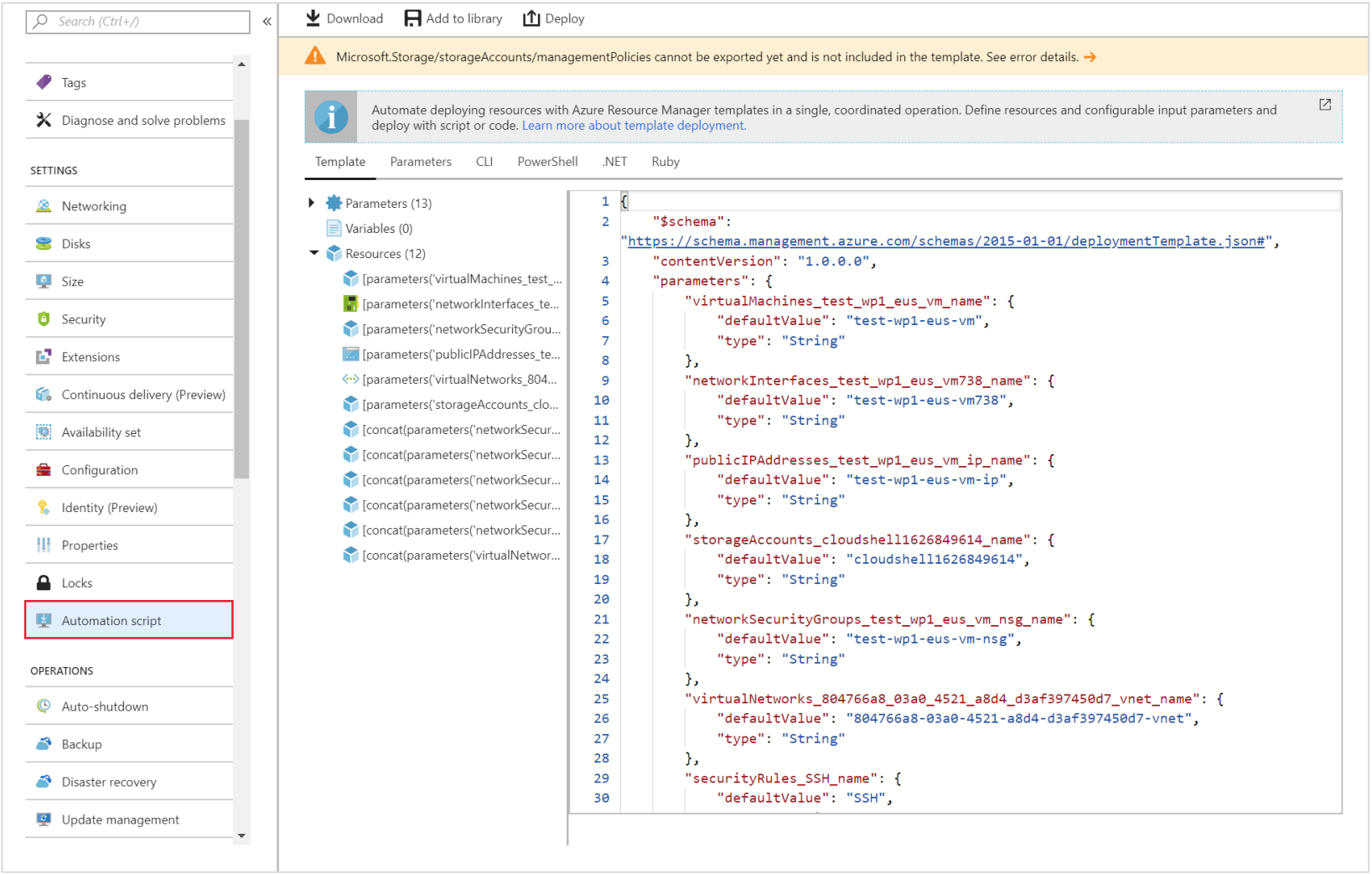


Nested Resource Manager template

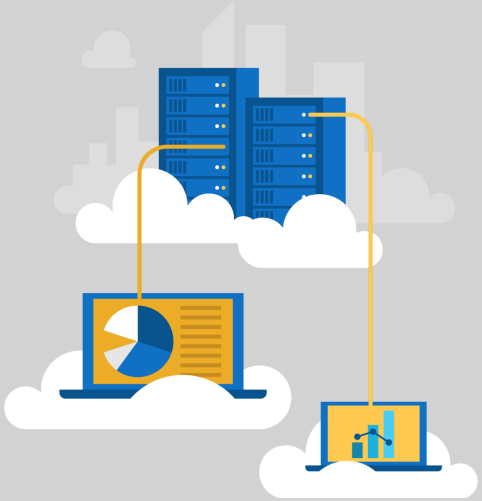
Nested templates deploying a similar three-tier application



Create Resource Manager templates by using the Azure portal



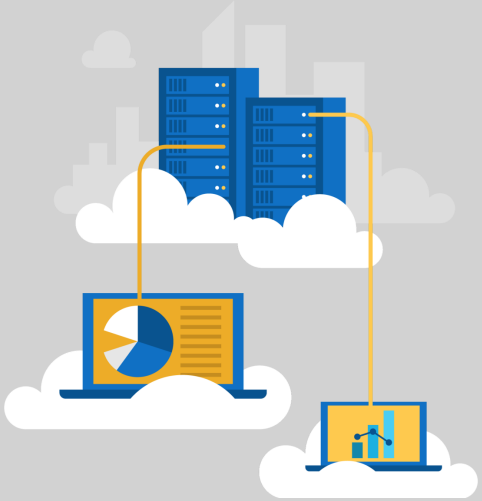
Demonstration: Creating Azure Resource Manager templates by using the Azure portal



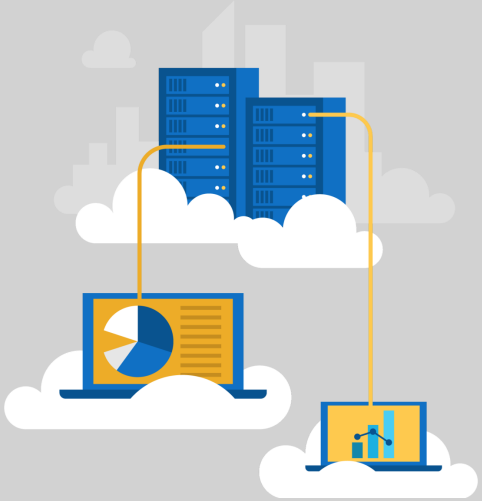
Deploying Azure Resource Manager templates by using Azure CLI

```
az group create --name $resourceGroupName --location $location

az group deployment create --name $deploymentName --resource-group
$resourceGroupName --template-file "azuredeploy.json"

az storage account show --resource-group $resourceGroupName --name
$storageAccountName
```

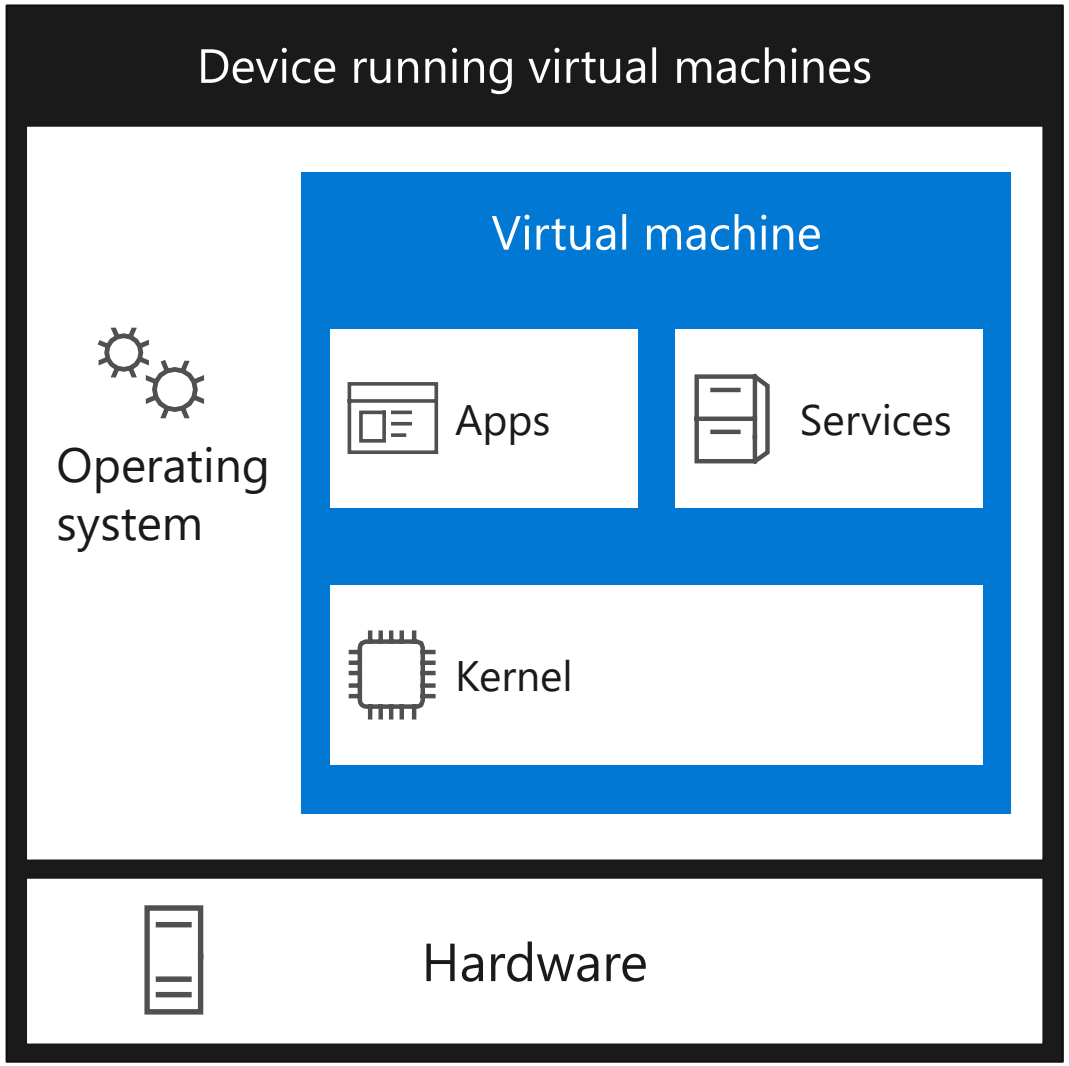
Demonstration: Creating Azure Resource Manager templates by using Visual Studio Code

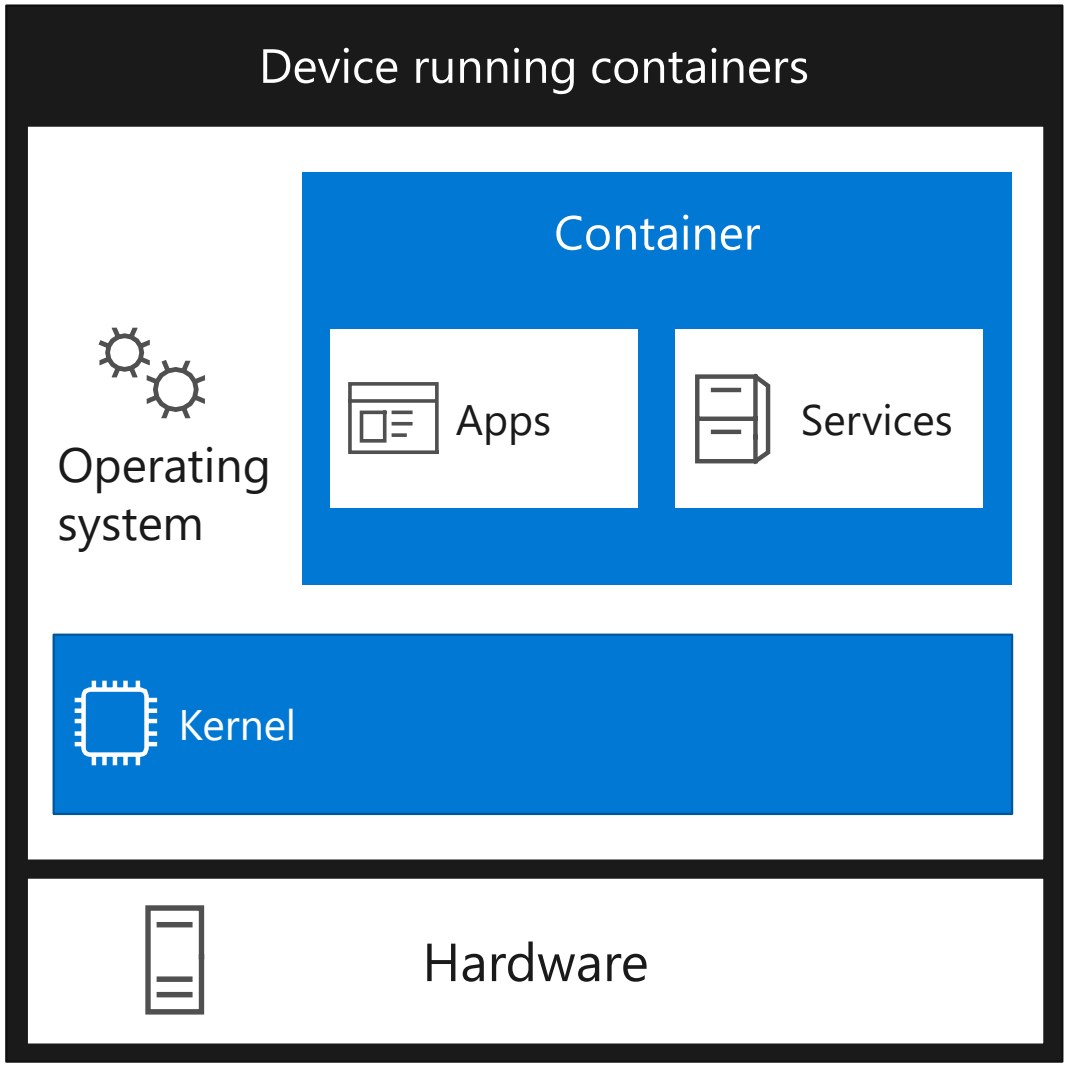


Lesson 03: Create container images for solutions



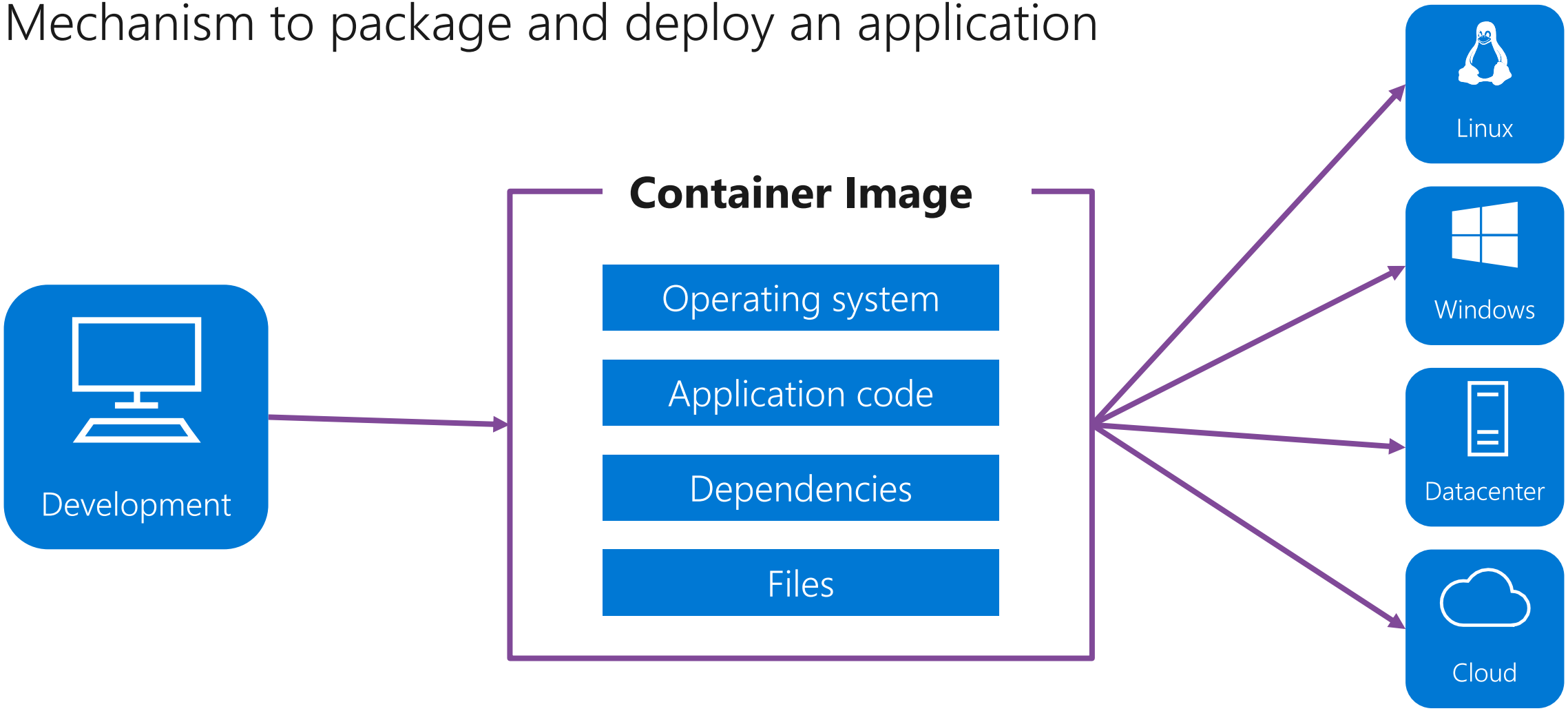
Virtualization and containers





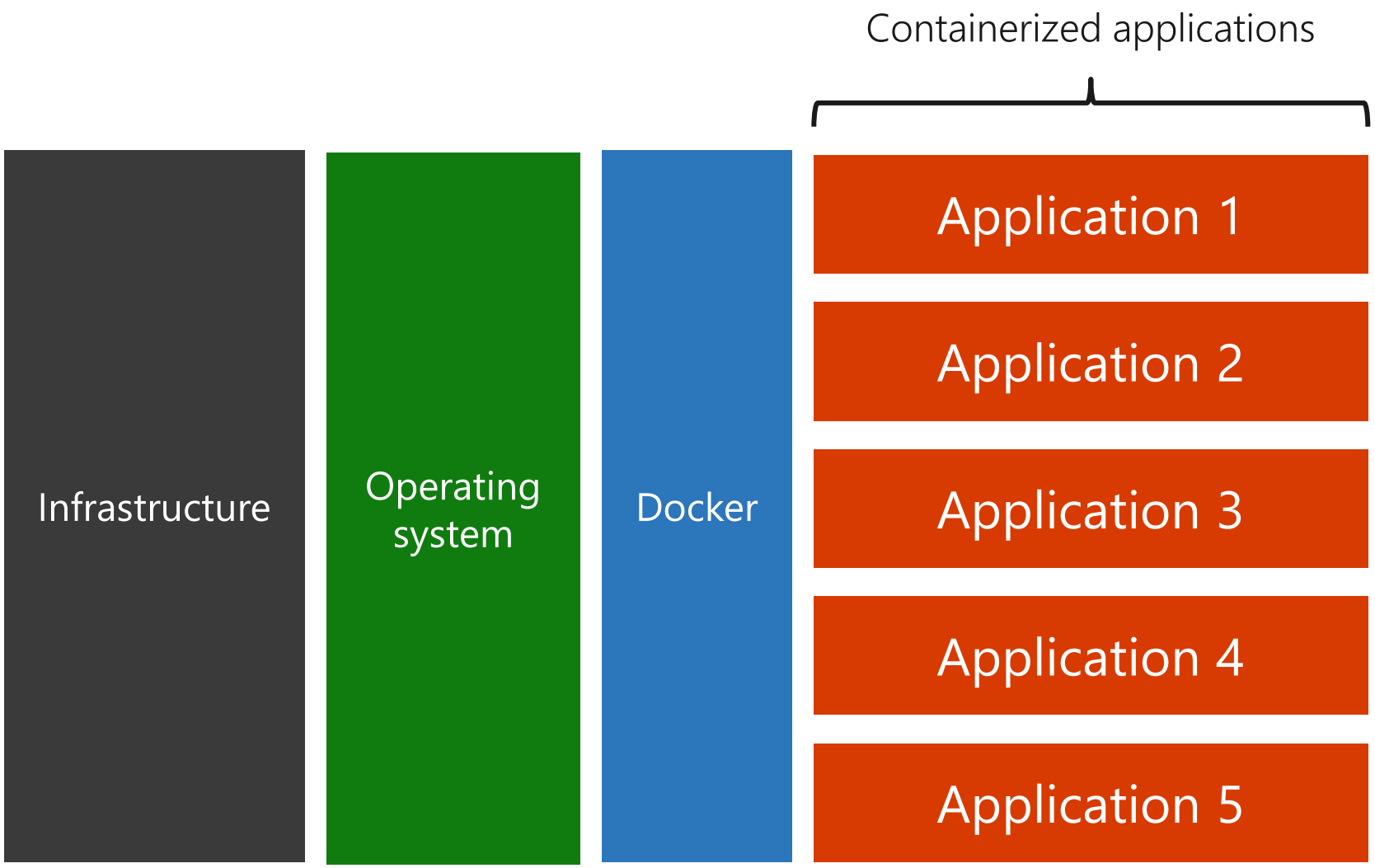
Container Images

Mechanism to package and deploy an application



Docker

- Containerization platform
- Runs "on top of" an operating system
  - Doesn't require a hypervisor
- Runs anywhere
  - Your desktop/laptop
  - Server environment
  - DevOps tools
  - Cloud services



Docker terminology

- **Container**
  - An instance of a Docker image
- **Container Image**
  - A standardized "unit of software" that contains everything required for an application to run
- **Build**
  - The process of creating a container image using a set of instructions
- **Pull**
  - The process of downloading a container image from a container registry
- **Push**
  - The process of uploading a container image to a container registry
- **Dockerfile**
  - A text file that contains instructions required to build a Docker image.
- **Registry**
  - A service that stores container images

Retrieving a new container image from Docker Hub

```
# Get Ubuntu container image
docker pull ubuntu
```

Container image name

```
# Get version 5.7 of MySQL container image
docker pull mysql:5.7
```

Container image tag

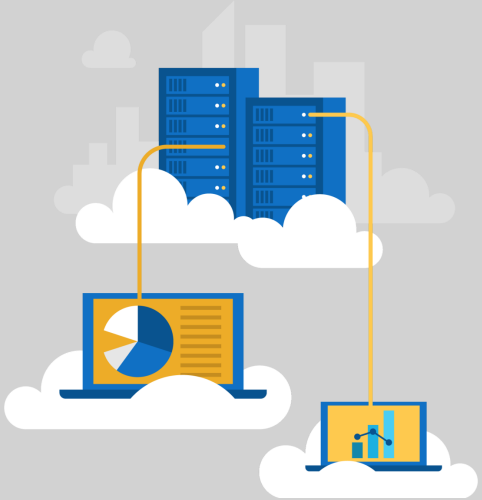
```
# Get the latest version of the nginx container image
docker pull nginx:latest
```

Running the retrieved container image

```
# Get the .NET application sample container image
docker pull mcr.microsoft.com/dotnet/core/samples:dotnetapp


# Run your container locally
docker run mcr.microsoft.com/dotnet/core/samples:dotnetapp


# View running containers
docker container ls -a
```

Image name and tag

Demonstration: Retrieving and deploying an existing Docker image locally



Creating a container image specification with a Dockerfile

```
FROM node:8.9.3-alpine
RUN mkdir -p /usr/src/app
COPY ./app/ /usr/src/app/
WORKDIR /usr/src/app
RUN npm install
CMD node /usr/src/app/index.js
```

Start with this container image

Run this command

Copy these files from the host

Change the working directory

Start the container with this command

Building the container image

```
# Build your container
docker build ./application -t tutorial-app
```

Path to build

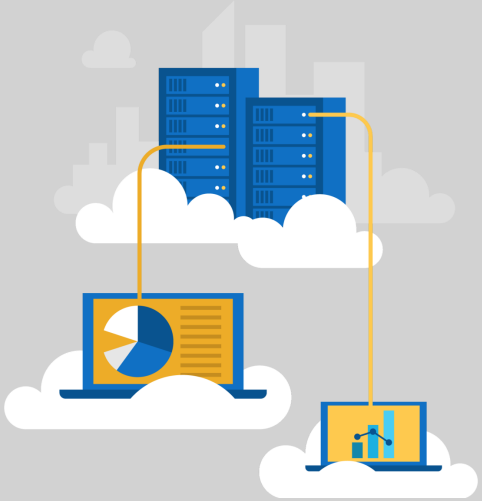
Docker tag

```
# After building, use the following command to view your new container image
docker images
```

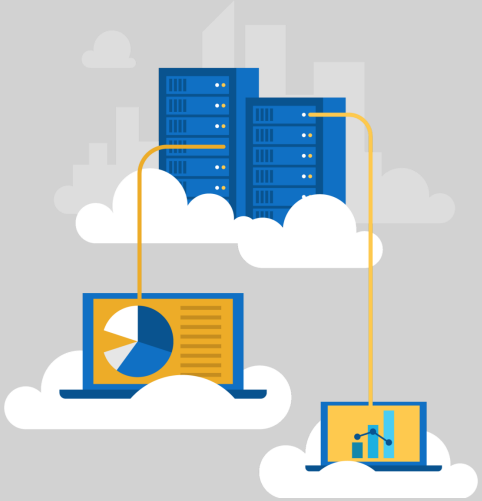
Running the custom container image as a container

```
# Run your container locally
docker run -d -p 8080:80 tutorial-app

# View running containers
docker container ls -a
```

Demonstration: Creating a container image by using Docker



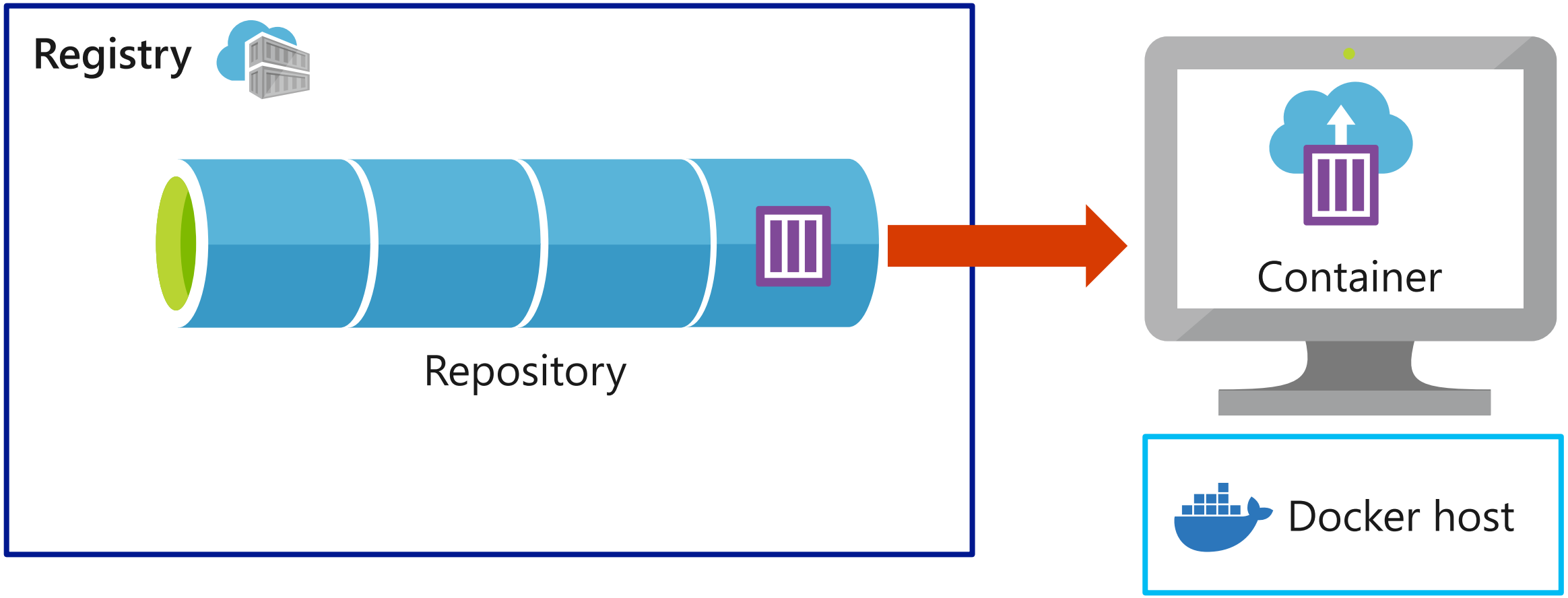
Lesson 04: Publish a container image to Azure Container Registry



Azure Container Registry (ACR)

- Managed Docker registry service
  - Based on the open-source Docker Registry 2.0
- Stores and manages private Docker container images
- Tight integration with multiple Azure services that support these Docker containers:
  - Azure App Service
  - Azure Batch
  - Azure Service Fabric
  - Azure Kubernetes Service

Docker containers and registries



Container Registry SKUs

SKU	Description
Basic	• Ideal for developers learning about Container Registry • Same programmatic capabilities as Standard and Premium, however, there are size and usage constraints
Standard	• Same capabilities as Basic, but with increased storage limits and image throughput. • Should satisfy the needs of most production scenarios.
Premium	• Higher limits on constraints, such as storage and concurrent operations, including enhanced storage capabilities to support high-volume scenarios. • Adds features like geo-replication for managing a single registry across multiple regions

Create a container registry by using Azure CLI

```
# Create a Container Registry instance
az acr create --resource-group <group> --name <acr-name> --sku Basic

# Login to Container Registry
az acr login --name <acrName>
```

Build a Docker image for Container Registry

```
# Pull existing Docker image
docker pull microsoft/aci-helloworld

# Obtain the full login server name of the Container Registry instance
az acr list --resource-group <group> --query "[].{acrLoginServer:loginServer}" --output table

# Tag image with full login server name prefix
docker tag microsoft/aci-helloworld <acrLoginServer>/aci-helloworld:v1

# Push image to Container Registry
docker push <acrLoginServer>/aci-helloworld:v1
```

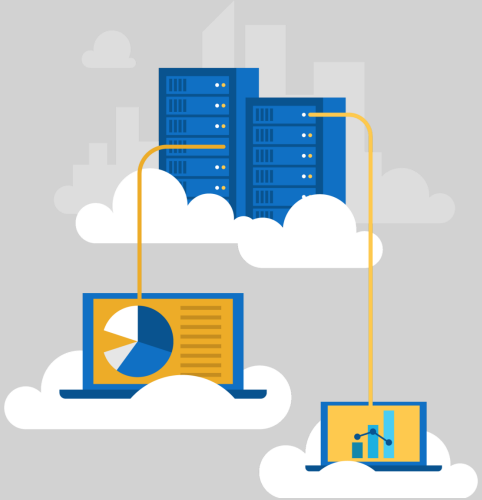
View a deployed image in Container Registry by using Azure CLI

```
# List container images
az acr repository list --name <acrName> --output table

# List the tags on the aci-helloworld repository
az acr repository show-tags --name <acrName> --repository aci-helloworld --output table
```

Deploy an image to Container Registry by using Azure CLI

```
# Enable admin user
az acr update --name <acrName> --admin-enabled true

# Query for the password
az acr credential show --name <acrName> --query "passwords[0].value"

# Deploy container image
az container create --resource-group <group> --name acr-quickstart --image
<acrLoginServer>/aci-helloworld:v1 --cpu 1 --memory 1 --registry-username <acrName> --
registry-password <acrPassword> --dns-name-label <fqdn> --ports 80

# View container FQDN
az container show --resource-group myResourceGroup --name acr-quickstart `
    --query instanceView.state
```

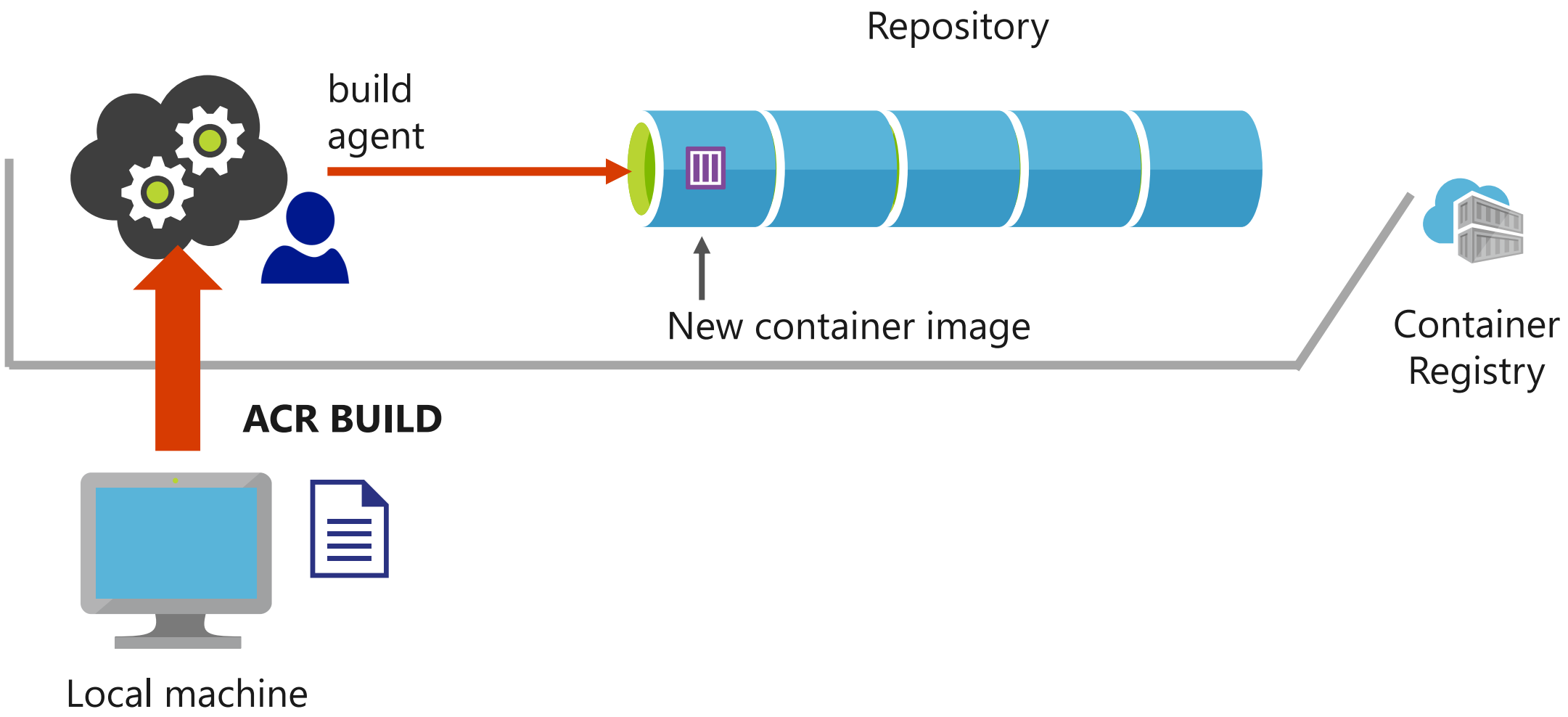
Demonstration: Deploying an image to ACR by using Azure CLI



Azure Container Registry Build (ACR Build)

- Suite of features within Container Registry that provides streamlined and efficient Docker container image builds in Azure
  - Offloads **docker build** operations to Azure
  - Replaces manual build by using Docker tools on your local machine
  - Build on demand
- Fully automate builds with source code commit and base image update build triggers

Building images in Container Registry



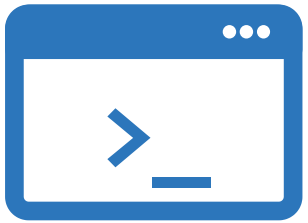
Trigger ACR Build by using Azure CLI

```
# Trigger build in Azure
az acr build --image <server>/<tag> --registry <registry> ./app
```

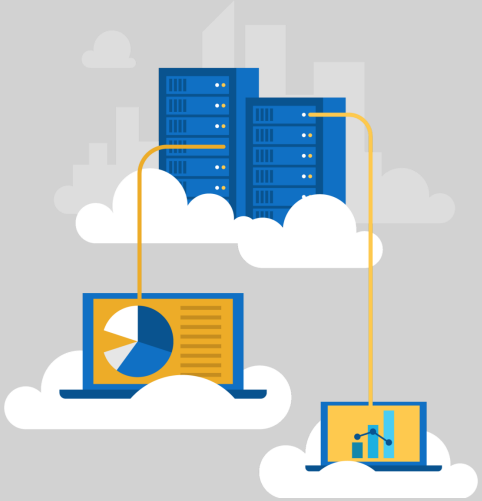
Registry server

Docker "tag"

Path to build



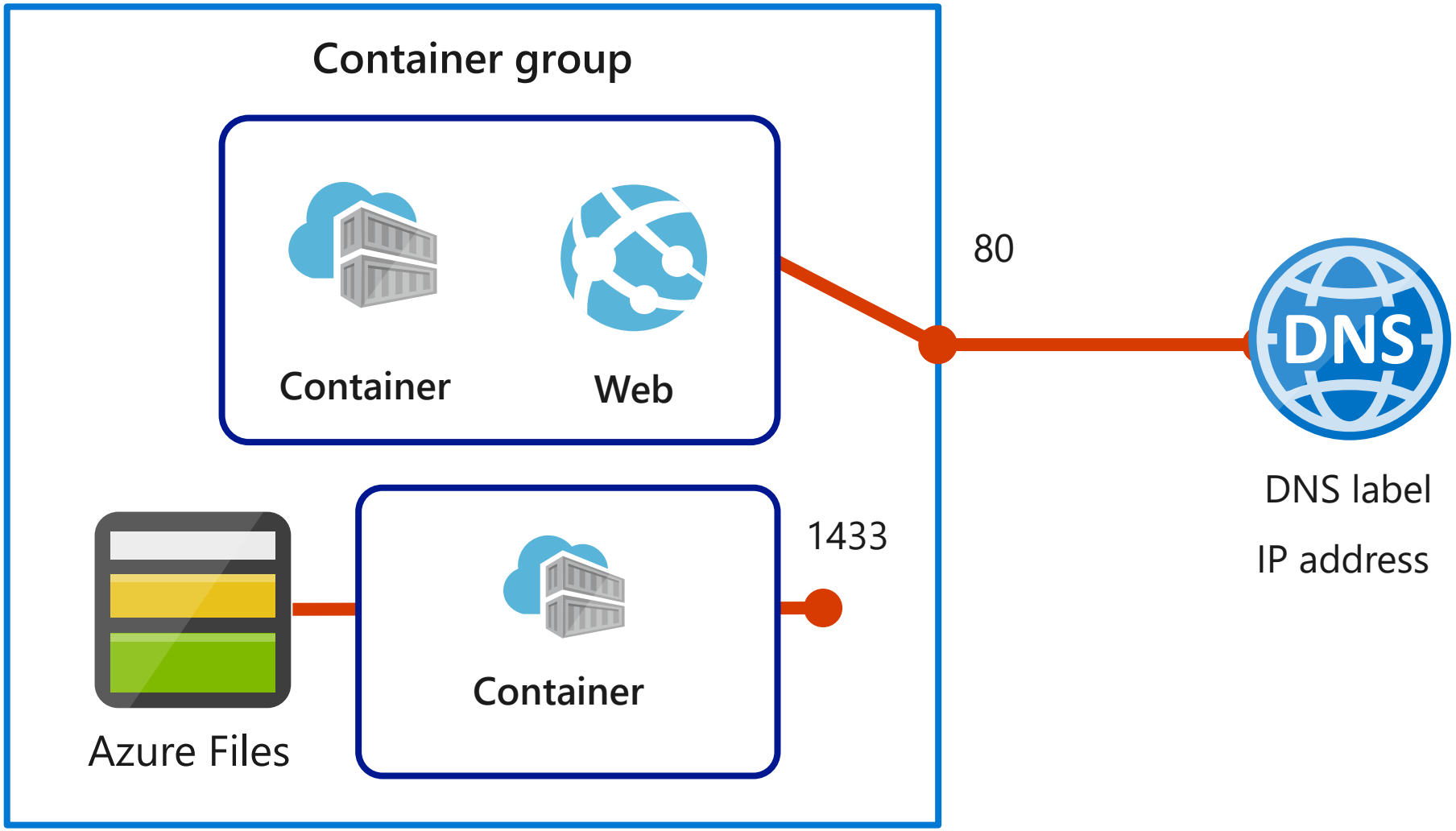
Lesson 05: Create and run container images in Azure Container Instances



Azure Container Instances (ACI)

- Simplest way to run a container in Azure:
  - Doesn’t require IaaS provisioning
  - Doesn’t require the adoption of a higher-level service
- Ideal for one-off, isolated container instances:
  - Simple applications
  - Task automation
  - Build jobs
- Supports Linux and Windows containers
- Supports direct mounting of Azure Files shares
- Container can be provisioned with public IP address and DNS name

Container groups



Container Instances features

Feature	Description
Fast startup times	Containers can start in seconds without the need to provision and manage VMs
Public IP connectivity and DNS name	Containers can be directly exposed to the internet with an IP address and a fully qualified domain name (FQDN)
Hypervisor-level security	Container applications are as isolated in a container as they would be in a VM
Custom sizes	Container nodes can be scaled dynamically to match actual resource demands for an application
Persistent storage	Containers support direct mounting of Azure Files shares
Linux and Windows containers	The same API is used to schedule both Linux and Windows containers
Co-scheduled groups	Container Instances supports scheduling of multicontainer groups that share host machine resources
Virtual network deployment	Container Instances can be deployed into an Azure virtual network

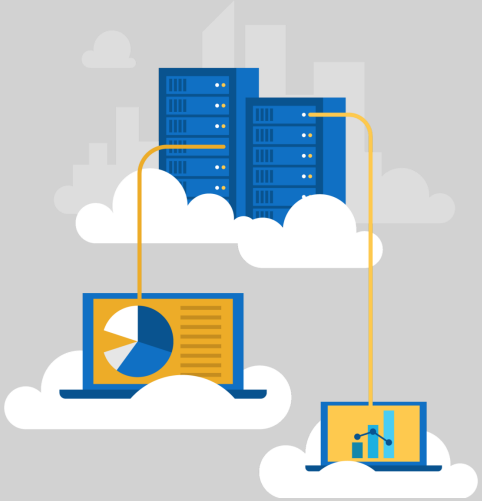
Deploy a container to Container Instances

```
# Get name of container registry login server
az acr show --name <acrName> --query loginServer

# Get container registry password
az acr credential show --name <acrName> --query "passwords[0].value"

# Deploy container
az container create --resource-group myResourceGroup --name aci-tutorial-app --image
<acrLoginServer>/aci-tutorial-app:v1 --cpu 1 --memory 1 --registry-login-server
<acrLoginServer> --registry-username <acrName> --registry-password <acrPassword> --dns-
name-label <aciDnsLabel> --ports 80
```

Verify a deployed container in Container Instances

```
# Verify deployment progress
az container show --resource-group myResourceGroup --name aci-tutorial-app --query
provisioningState

# View application URL
az container show --resource-group myResourceGroup --name aci-tutorial-app --query
ipAddress.fqdn

# View container logs
az container logs --resource-group myResourceGroup --name aci-tutorial-app
```

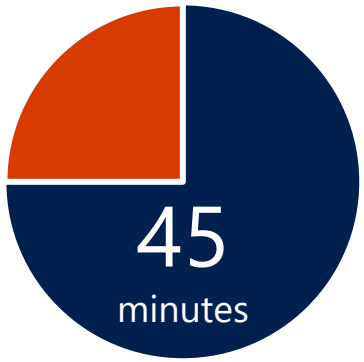
Demonstration: Running Azure Container Instances by using Cloud Shell



Lab: Deploying compute workloads by using images and containers

Lab: Deploying compute workloads by using images and containers

Duration



Lab sign-in information

Microsoft