







Azure Virtual Machines Workloads

| | |
|---|--|
| Development & Test Quickly provision and un-provision entire environments | Running applications in the cloud Custom applications Customer Relationship Management (CRM) Content Management Server (CMS) Enterprise Resource Planning (ERP) Business Intelligence (BI) |
| Hybrid applications Applications that span your data center and the cloud | Disaster recovery IaaS-based disaster recovery solution |

What do I need to think about before creating a VM?

| Naming | Locations | VM size | Limits | OS disks & images | Extensions | Related resources |
|---|---|--------------------|---|---------------------------------------|---|---|
| The names of your application resources | The location where the resources are stored | The size of the VM | The maximum number of VMs that can be created | The operating system that the VM runs | The configuration of the VM after it starts | The related resources that the VM needs |

Tools to create and manage VMs

| | | | | | |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| Azure Portal | ARM Templates | Azure CLI | Azure PowerShell | Client SDK | REST API |

Azure Virtual Machine Benefits



Get more choice

Choose Linux or Windows.
Choose to be on-premises, in the cloud, or both.
Choose your own virtual machine image or an image in our marketplace.



Scale to what you need

Scale from one to thousands of virtual machine instances.
Scale globally so you're closer to where your customers are.



Pay only for what you use

Per-second billing based on VM size and OS.
You only pay for the compute time you use.



Enhance security and compliance

We'll help you:

- encrypt sensitive data,
- protect virtual machines from viruses and malware,
- secure network traffic,
- and meet regulatory and compliance requirements.

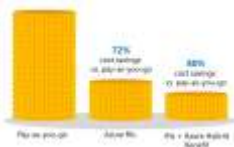
Azure Hybrid Use Benefit (HUB)

- Prerequisite
 - Windows Server or Windows Client licenses with Software Assurance
- Benefit
 - [Save up to 49%](#) with a license you already own
- How to use
 - With an [EA subscription](#): Enable this option during VM creation or afterwards
 - Without an [EA subscription](#): upload a custom VM and deploy using a Resource Manager template or Azure PowerShell



Azure Reserved Instances (RIs)

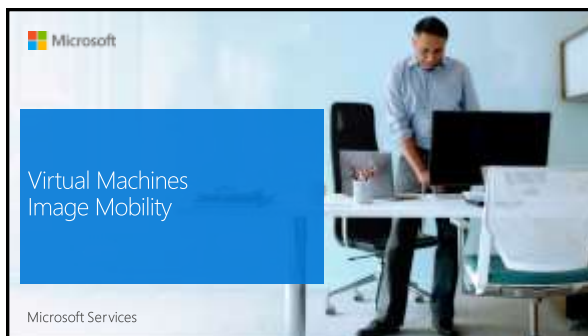
- One or three-year terms on Windows and Linux virtual machines
- Specify your Azure region, virtual machine type, and term
- Up to [72 percent discount](#) compared to pay-as-you-go prices



Azure Spot VMs

- Azure Spot VMs are created using unused compute capacity
- Significantly cheaper than Standard VMs
- Great for workloads that can handle interruptions like batch processing jobs, dev/test environments, large on-going compute workloads etc.
- Evicted at any point in time when Azure needs the capacity back, with 30 seconds notice
- The amount of available capacity can vary based on size, region, time of day, and more
- No SLA and no high availability guarantees
- Select VM sizes only





Introduction to Disks and Images

Generalized VM

VM Creation from Image

"I want to create several VMs based on this model"

- VHD to be provisioned
- Prepared with sysprep (removed computer name, SID, etc)
- Created by uploading or by capture

Specialized VM

VM Creation from Disk

"I want to create a VM based on this 'ready-to-use' disk"

- VHD already provisioned
- "Snapshot" to deploy a VM to a good known point in time
- Created by uploading or by taking a disk snapshot




Azure Marketplace Images

Microsoft

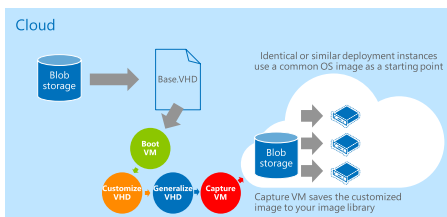
- Windows Server 2008 R2 / 2012 / 2016 / 2019
- SQL Server 2012 / 2014 / 2016 / 2019
- BizTalk Server 2013 / 2016
- SharePoint Server 2013 / 2016
- Visual Studio 2013 / 2015 / 2019

Open Source

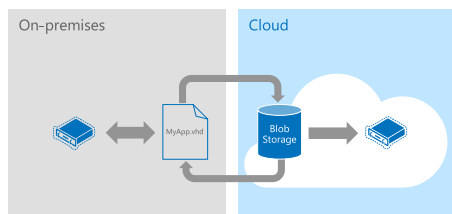
- OpenSUSE 42.3
- CentOS 7.5
- Ubuntu 19.04
- SUSE Linux Enterprise Server 15
- Red Hat Enterprise Linux 8

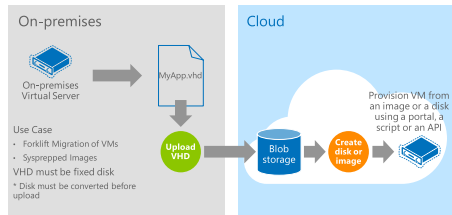
Azure Custom Images



Disks and Images Mobility



Bring Your Own Image or Disk



Tips on Bring Your Own (BYO) Generalized Images

- Sysprep and **Generalize** is expected
- Do not put **unattend.xml** on the disk
- Do not install virtual machine Integration Components
- Install the Azure VM Agent
- Enable RDP



Azure Shared Image Gallery

- Share your images to different users, service principals, or AD groups within your organization
- Helps you **build structure and organization around your managed images**:
 - Global replication
 - Versioning and grouping
 - High availability
 - Can be shared across subscriptions or Azure AD, using RBAC



Demo: Create a Virtual Machine in Azure Portal based on a Marketplace image



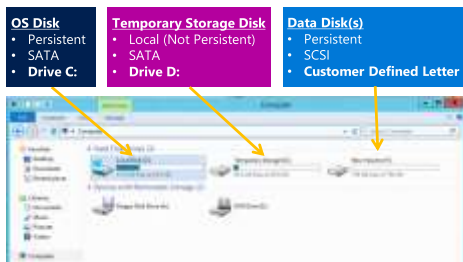
Microsoft

Virtual Machines Disks

Microsoft Services



VM disk layout – Windows OS



Persistent Disk Management – Windows OS

- C:\ = OS Disk
- D:\ = Non-Persistent Cache Disk
 - ↳ **Must not be used to store data that you are not willing to lose!**
- E:\, F:\, G:\ and all subsequent Data Disks – you will need to attach and format them

| Capability | OS Disk | Data Disk |
|--------------------|---------------------------------|--|
| Host Cache Default | ReadWrite | None |
| Max Capacity | 64 TB | 64 TB |
| Hot Update | Cache Setting requires a reboot | Change Cache without reboot, Add/Remove without reboot |

Disk Caching – Windows OS

Supported Cache Modes:

| Disk Type | Read Only | Read Write | None |
|----------------|--|------------|-----------|
| OS Disk | Supported | Default | Supported |
| Data Disks | Supported | Supported | Default |
| Temporary Disk | Not stored in Microsoft Azure Storage Blob Service | | |


Ephemeral OS disks

- Ephemeral OS disks are not persistent and are created on the virtual machine host storage instead of remote Azure Storage
- Work well for stateless workloads, where applications are tolerant of individual VM failures, but are more affected by VM deployment time or reimaging the individual VM instances
- Lower read/write latency to the OS disk and faster VM reimage
- Supported on DSv1, DSv2, DSv3, Esv3, Fs, Fsv2, GS, M VMs
- Free of charge

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Types of Disks and Performance

| Types | | Performance | | |
|--|--|---|--|---|
| Unmanaged disks (UMDs) | Managed disks (MDs) | Standard | Premium | Ultra (only MDs) |
| Create and specify storage account to store disks Manage scalability targets of the storage account | Azure creates and manages storage account and disks Specify disk size and performance tier Standard, Premium or Ultra | Backed by HDDs or SSDs Cost-effective storage Suitable for dev/test, non-critical, infrequent access Geo-replication options | Backed by SSDs only High-performance and low-latency disk support Suitable for mission critical production environment | Backed by SSDs only Sub-millisecond latency for the most demanding workloads Suitable for the most IO intensive workloads |

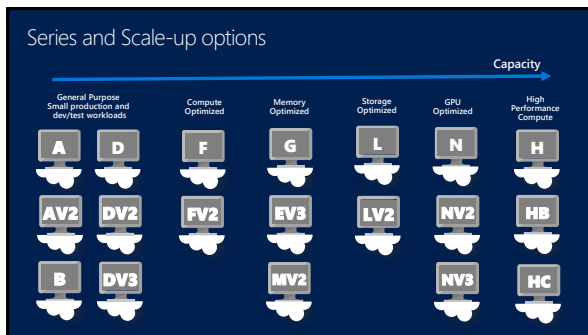


Virtual Machines Sizes

Microsoft Services



Series and Scale-up options



Specs example – VM Size Dv3

General Purpose

DV3

Processor: 2.4 GHz Intel Xeon ® E5-2673 or 2.3 GHz Intel XEON ® E5-2673 v4

| VM Size | vCPU | Memory (GiB) | Temp Disk (GiB) | Max Data Disk | Max IOPS/Read MBPS/Write MBPS | Max NICs / Network bandwidth |
|---------|------|--------------|-----------------|---------------|-------------------------------|------------------------------|
| D2_v3 | 2 | 8 | 50 | 4 | 3000/46/23 | 2 / 1000 |
| D4_v3 | 4 | 16 | 100 | 8 | 6000/93/46 | 2 / 2000 |
| D8_v3 | 8 | 32 | 200 | 16 | 12000/187/93 | 4 / 4000 |
| D16_v3 | 16 | 64 | 400 | 32 | 24000/375/187 | 8 / 8000 |
| D32_v3 | 32 | 128 | 800 | 32 | 48000/750/375 | 8 / 16000 |
| D48_v3 | 48 | 192 | 1200 | 32 | 96000/1000/500 | 8 / 24000 |
| D64_v3 | 64 | 256 | 1600 | 32 | 96000/1000/500 | 8 / 30000 |

Use Case: Enterprise-grade applications, relational databases, in-memory caching, and analytics

Specs example – VM Size Ev3

Memory Optimized

EV3

Processor: 2.3 GHz Intel XEON ® E5-2673 v4

| VM Size | vCPU | Memory (GiB) | Temp Disk (GiB) | Max Data Disk | Max IOPS/Read MBPS/Write MBPS | Max NICs / Network bandwidth |
|---------|------|--------------|-----------------|---------------|-------------------------------|------------------------------|
| E2_v3 | 2 | 16 | 50 | 4 | 3000/46/23 | 2 / 1000 |
| E4_v3 | 4 | 32 | 100 | 8 | 6000/93/46 | 2 / 2000 |
| E8_v3 | 8 | 64 | 200 | 16 | 12000/187/93 | 4 / 4000 |
| E16_v3 | 16 | 128 | 400 | 32 | 24000/375/187 | 8 / 8000 |
| E20_v3 | 20 | 160 | 500 | 32 | 30000/469/234 | 8 / 10000 |
| E32_v3 | 32 | 256 | 800 | 32 | 48000/750/375 | 8 / 16000 |
| E48_v3 | 48 | 384 | 1200 | 32 | 96000/1000/500 | 8 / 24000 |

Use Case: processor in a hyper-threaded configuration, providing a better value proposition for most general purpose workloads

Specs example – VM Size Nv3

GPU Optimized

NV3

Processor: 2.3 GHz Intel XEON ® E5-2673 v4

GPU: NVIDIA Tesla M60

| VM Size | vCPU | Memory (GiB) | Temp Disk (GiB) | GPU | GPU Memory (GiB) | Max Data Disk | Max IOPS/MBPS | Max NICs | Virtual WST | Virtual App |
|----------|------|--------------|-----------------|-----|------------------|---------------|---------------|----------|-------------|-------------|
| NV12s_v3 | 12 | 112 | 320 | 1 | 8 | 12 | 20000 / 200 | 4 | 1 | 25 |
| NV24s_v3 | 24 | 224 | 620 | 2 | 16 | 24 | 40000 / 400 | 8 | 2 | 50 |
| NV48s_v3 | 48 | 448 | 1280 | 4 | 32 | 32 | 80000 / 800 | 8 | 4 | 100 |

Use Case: Optimized and designed for remote visualization, streaming, gaming, encoding, and VDI scenario

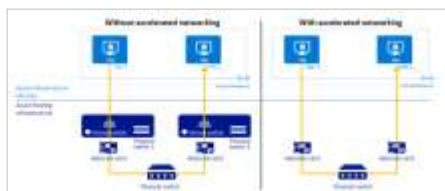


Accelerated Networking

- Accelerated networking enables a single physical NIC on an Azure host machine to appear as multiple NIC's to the host OS.
- Allows an Azure guest VM to think that it has its own physical NIC so that it can send and receive traffic directly to and from this NIC instead of going via its virtual switch.
- Can be enabled during VM creation time or on an existing VM.
- Supported on Dv2/DSv2, F/Fs, D/Dsv3, D/Dsv4, E/Esv3, Ea/Easv4, Fsv2, Lsv2, Ms/Mms, and Ms/Mmsv2 VMs.

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Virtual Machine with and without Accelerated Networking



Virtual Machine with Accelerated Networking Deployment

- Deploy a VM instance with 8 or more cores and enable accelerated networking during deployment.
- Install the accelerated networking [driver](#) and reboot.
- Confirm the presence of the **Mellanox ConnectX-3 Virtual Function Ethernet Adapter**



Multi-NIC Support

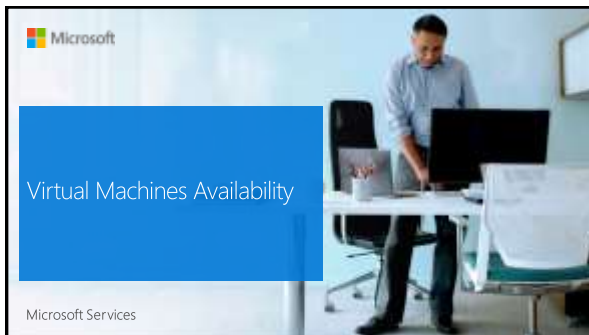
- Using multiple NICs on your VM allows you to manage network traffic better
- Isolate traffic between front-end NICs and backend NICs
- Different VM sizes support a varying number of NICs
- On-premises VM's with multiple NIC's can be migrated to Azure



Multiple IPs Per NIC

- Up to 256 private and public IP addresses can be assigned to each NIC
- Private IP addresses support Network Security Groups (NSGs) and User Defined Routes (UDRs)
- Through multiple IPs per NIC, load balancing can be configured across both primary and secondary NICs
- Allows NVAs to enforce different security policies based on the NICs and also provide bandwidth isolation among different traffic types
- Configured using the Azure portal, PowerShell, Azure CLI or ARM templates





Understand planned vs. unplanned maintenance

| Planned maintenance events | Unplanned maintenance events |
|--|--|
| <ul style="list-style-type: none"> Periodic updates made by Microsoft The majority are performed without any impact Some updates require a reboot of your virtual machine to apply the required updates | <ul style="list-style-type: none"> Faults on the hardware or physical infrastructure Azure platform will automatically migrate your virtual machine from the unhealthy physical machine hosting to a healthy physical machine Such events are rare, but may also cause your virtual machine to reboot |

VM Connectivity Service Level Agreements (SLA)

| Single VM | Availability Set | Availability Zone |
|------------------|-------------------|-------------------|
| <p>SLA 99.9%</p> | <p>SLA 99.95%</p> | <p>SLA 99.99%</p> |

More information about SLAs on <https://azure.microsoft.com/support/legal/sla>

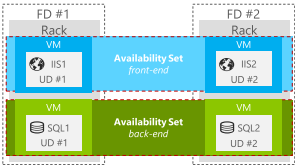
Best practices for high availability

- Configure multiple virtual machines in an **availability set/zone for redundancy**
- Configure each **application tier** into **separate availability sets/zones**
- Combine **Load Balancers** with **availability sets/zones**

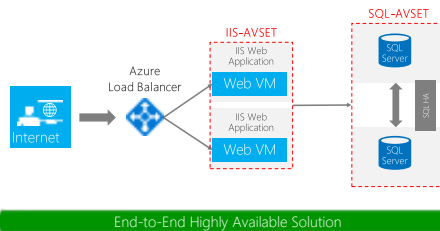
Fault and Update Domains

| Fault Domain (FD) | Update Domain (UD) |
|---|---|
| <ul style="list-style-type: none">Represent groups of resources anticipated to fail together, i.e. same rackFabric spreads instances across fault at least two fault domainsThe number of fault domains is controlled by the Azure FabricAnticipated to fail together: share power source and network switch2 or 3 fault domains by default | <ul style="list-style-type: none">Represents groups of resources that will be updated togetherHost OS updates honor service update domainsSpecified in service definitionUntil 20 update domains |

Application tiers into separate Availability Sets

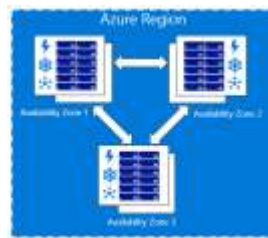


Combine a load balancer with availability sets



Availability Zones

- An Availability Zone is a physically separate datacenter in an Azure region
- Ensures high availability in the event of a datacenter outage
- Resources are deployed across 1 – 3 zones in the same region
- Each zone is equipped with independent power, cooling, and networking
- ~1.2 ms latency between zones



Supported Availability Zones Services

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> • Windows & Linux Virtual Machines • Virtual Machine Scale Sets • Azure App Services • Azure Kubernetes • Managed Disks • Zone-Redundant Storage • Load Balancer | <ul style="list-style-type: none"> • Public IP address • VPN & ExpressRoute Gateway • Application Gateway (v2) • Azure Firewall • SQL Database • Event Hubs • Service Bus | <ul style="list-style-type: none"> • Azure Data Explorer • SQL Database • Azure Cache for Redis • Azure Cosmos DB • Event Hubs • Service Bus • Event Grid • Azure AD Domain Services |
|--|--|--|

Demo: Create an
Availability Set in Azure
Portal



Microsoft

Virtual Machines
Agent and Extensions

Microsoft Services



Azure VM
Agent

Manages VM
interaction with the
Azure Fabric Controller

Enables and executes
Azure virtual machine
extensions

Installed by default on
Windows VMs deployed
from Azure Gallery

Can be manually
installed using a
[Windows installer
package](#)

Virtual Machine Extensions

- Small applications that provide post-deployment configuration and automation tasks on Azure virtual machines.
- Custom script extension allows any PowerShell script to be run on a VM

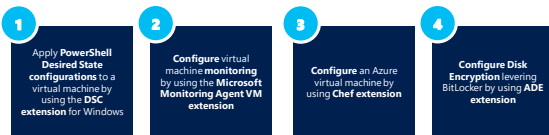
Prerequisites

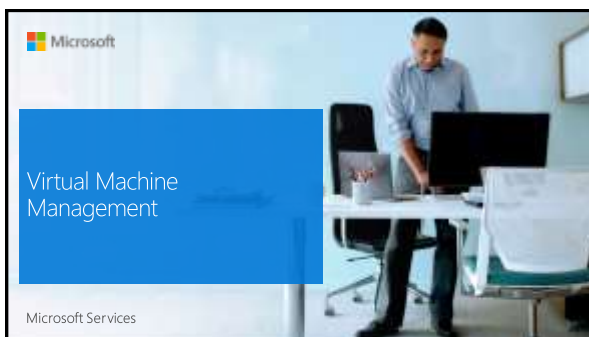
- Azure VM Agent
- Each VM Extension may have its own set of prerequisites



Virtual Machine Extensions

Use cases





Start/Stop a Virtual Machine

- Start and Stop are **1-click operations** in Azure Portal
- Stopping** a VM will **deallocate** compute resources
- Start and stop options can be automatically trigger through Azure Automation



Resize a Virtual Machine

- After creation, a VM can be **scaled up or down** by changing its size
- It requires a simple **reboot**
- If the new size is not available on the hardware cluster that is hosting the VM, it must be deallocated first



Connect to a Virtual Machine

- To connect to a running VM use a **Remote Desktop (RDP)** or **Secure Shell (SSH)** session for Windows or Linux, respectively
- From AzurePortal:
 - Use the **Connect** button to connect through Private or Public IP





Virtual Machine Scale Sets

- Azure virtual machine scale sets let you create and manage a group of identical, load balanced VMs
- VM instances can automatically increase or decrease in response to demand or a defined schedule
- Provide high availability to your applications, and allow you to centrally manage, configure, and update a large number of VMs
- Build large-scale services for areas such as compute, big data, and container workloads

The diagram illustrates the architecture of a Virtual Machine Scale Set. It shows a stack of blue rectangles representing 'Scaleable Virtual Machine' instances. These instances are connected to a central yellow circle labeled 'Base OS Image'. Below the stack, there are two yellow circles labeled 'OS Image Diff Disk'. The diagram shows how multiple VM instances share a common base OS image and use differential disks for their unique configurations.

Virtual Machine Scale Sets Benefits

| | |
|---|--|
| Easy to create and manage multiple VMs <p>All VM instances are created from the same base OS image and configuration allowing you to easily manage multiple VMs without additional configuration tasks or network management.</p> | Provides high availability and application resiliency <p>If one of the VM instances has a problem, customers continue to access your application through one of the other VM instances with minimal interruption.</p> |
| Allows your application to automatically scale as resource demand changes <p>Scale sets can automatically increase the number of VM instances as application demand increases, then reduce the number of VM instances as demand decreases.</p> | Works at large-scale <p>Supports up to 1000 VM instances</p> |

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Virtual Machine Scale Sets vs. Virtual Machines

| Scenario | Manual group of VMs | Virtual Machine Scale Set |
|----------------------------------|--|--|
| Adding additional VM instances | Manual process to create, configure, and ensure compliance | Automatically creates from central configuration |
| Traffic scaling and distribution | Manual process to create and configure load balancer or Application Gateway | Can automatically create and integrate with Azure load balancer or Application Gateway |
| High availability and redundancy | Manually create availability set or distribute VMs across Availability Zones | Automatic distribution of VM instances across Availability Zones or Availability Sets |
| Scaling of VMs | Manual monitoring and Azure Automation | Automatic based on fixed metrics or custom metrics, application insights, or schedule |

Demo: VM Scale Sets





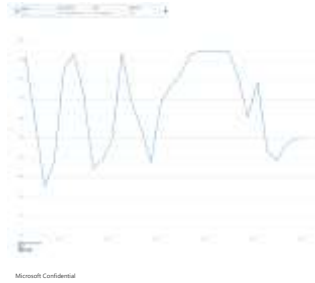
Azure Monitoring

Microsoft Services



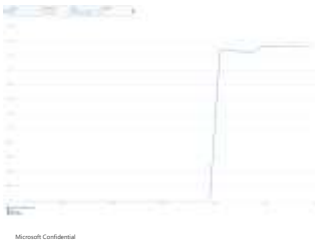
Azure Host Metrics

- Standard metrics are host computer metrics that are enable by default in all VMs
- Host metrics Examples:
 - Percentage CPU
 - Network In/Out
 - Disk Read/Write Operations
- For checking it, in Azure Portal click in **Metrics**



Azure Guest Metrics

- Guest metrics can also be configured to be directly seen in Azure Portal
- Guest metrics Examples:
 - \Memory\% Committed Bytes
 - \LogicalDisk_Total\% Free Space
 - \System\System Up Time
- For enabling it:
 - Azure Portal click in **Diagnostic Settings**
 - Enable **guestlevel monitoring**
 - Select what are the **PerfCounters** and **Rate**
- This will install Azure Diagnostics Extension and collect logs to a Storage Account



Azure VM Alerts

- Based on **host** or **guest** metrics, you can set up alerts that will trigger actions
- Possible actions examples:
 - Send a notification via SMS, Phone, Email, APP
 - Trigger an Automation Runbook (Resize VM, Start another VM, etc)
 - Trigger a Logic App or Azure Function
 - Trigger a Webhook



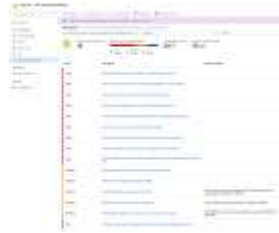
Azure Advisor

- Azure Advisor is a best practice analyzer for Azure deployments.
- Used to analyze your resource configuration and usage telemetry and recommend solutions to help improve the cost effectiveness, performance, high availability, and security of your Azure resources.
- Accessed via Azure portal or REST API, no PowerShell support yet.
- Is a free service.



Azure Advisor Recommendation Categories

- **High Availability:** To ensure and improve the continuity of your business-critical applications.
- **Security:** To detect threats and vulnerabilities that might lead to security breaches.
- **Performance:** To improve the speed of your applications.
- **Cost:** To optimize and reduce your overall Azure spend.



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Azure Advisor Operations & Management

- Provides recommendations for Virtual Machines, Availability Sets, Application Gateways, App Services, SQL servers, SQL databases, and Redis Cache.
- Advisor recommendations are updated hourly.
- Access Advisor recommendations as Owner, Contributor, or Reader for a subscription, a resource group, or a specific resource.
- Snooze or dismiss a recommendation.



Demo: Azure Monitoring and Azure Advisor





Lab: Introduction to Azure Virtual Machines



Microsoft Services



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