

1. Availability Sets

What are Availability Sets?

Availability Sets are an Azure feature designed to improve the availability of virtual machines by distributing them across **fault domains** and **update domains** within a single datacenter.

Key Concepts

Fault Domain (FD):

- A logical grouping of hardware that shares common power and networking.
- Distributes VMs across multiple racks to ensure hardware-level failure protection.

Update Domain (UD):

- A logical group of VMs that are updated together during Azure planned maintenance.
 - Ensures not all VMs in an application are taken offline simultaneously.
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Benefits of Availability Sets

1. **Fault Tolerance:** Protects against rack-level hardware failures.
 2. **High Availability:** Ensures that not all VMs are impacted by planned maintenance.
 3. **SLA:** Provides a 99.95% uptime SLA for VMs deployed in an availability set.
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When to Use Availability Sets

- For workloads requiring high availability, like multi-instance web servers or databases.
 - For applications deployed within a single region.
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Lab: Deploy an Availability Set

Objective:

Learn how to create an availability set and deploy VMs into it.

Steps:

1. **Create an Availability Set:**
 - Go to the **Azure Portal**.

- Click **Create a resource** > **Compute** > **Availability Set**.
- Enter details:
 - **Name:** (e.g., MyAvailabilitySet).
 - **Resource Group:** Select or create a resource group.
 - **Region:** Choose a region (e.g., East US).
 - **Fault Domains:** Set to 2 or 3.
 - **Update Domains:** Set to 5.
- Click **Review + Create** > **Create**.

2. Create VMs in the Availability Set:

- Navigate to **Create a resource** > **Compute** > **Virtual Machine**.
- On the **Basics** tab:
 - Select the **Resource Group** of the availability set.
 - Under **Availability Options**, choose **Availability Set**.
 - Select the previously created availability set.
- Complete the VM configuration and deploy.

3. Test Fault Tolerance:

- Stop a VM in one fault domain and observe how the others remain unaffected.

2. Availability Zones

What are Availability Zones?

Availability Zones are physically separate datacenters within a region, providing higher fault tolerance by distributing resources across isolated zones.

Key Features

- **Physical Isolation:** Zones are physically separated to prevent correlated failures.
- **High Availability SLA:** Offers 99.99% uptime SLA for zone-aware applications.
- **Redundancy:** Ensures zone-level fault protection.

Lab: Deploy a VM in Availability Zones

Steps:

1. **Create a Resource Group:**

- Go to **Resource Groups** and create one.
 - 2. **Deploy a VM in a Specific Zone:**
 - Navigate to **Create a resource > Compute > Virtual Machine**.
 - On the **Basics** tab:
 - Select **Availability Zone** under **Availability Options**.
 - Choose a specific zone (e.g., Zone 1).
 - Complete and deploy the VM.
 - 3. **Test Zone Redundancy:**
 - Deploy another VM in a different zone and test connectivity.
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3. Virtual Machine Scale Sets (VMSS)

What are VM Scale Sets?

VM Scale Sets are designed to deploy and manage a group of identical VMs, enabling automatic scaling and load balancing.

Features

- **Auto-Scaling:** Automatically increases or decreases VMs based on load.
 - **Fault Tolerance:** Distributes instances across fault/update domains.
 - **Integration:** Works seamlessly with load balancers and Availability Zones.
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Lab: Deploy a VM Scale Set

Steps:

1. **Create a Scale Set:**
 - Navigate to **Create a resource > Compute > Virtual Machine Scale Set**.
 - On the **Basics** tab:
 - Choose the region and select **Availability Zones** for zone-level redundancy.
 2. **Configure Scaling Rules:**
 - Under **Scaling**, define rules for auto-scaling based on CPU usage.
 3. **Deploy and Test:**
 - Simulate high CPU usage and observe auto-scaling behavior.
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Comparison Table

Feature	Availability Sets	Availability Zones	VM Scale Sets
Fault Tolerance	Rack-level failures	Datacenter-level failures	Automatic scaling and fault tolerance
Update Management	Update domains for planned maintenance	Redundancy across zones	Integrated auto-scaling
High Availability SLA	99.95%	99.99%	Depends on scaling rules

Azure High Availability Services: Pricing Models

1. Availability Sets

Pricing Model:

- Availability Sets are free of charge.
- You only pay for the virtual machines (VMs) deployed in the availability set and associated resources such as storage and networking.

Cost Considerations:

- **VM Costs:** Charged based on the size, type, and hours the VMs run.
- **Managed Disks:** Each VM in the set uses managed disks, billed separately based on disk size, type (Standard, Premium, or Ultra), and IOPS.
- **Network Costs:** Include data transfer between VMs and any additional services (e.g., load balancers).

Example Estimate:

- 2 VMs in a Standard_DS2_v2 size with Standard SSD disks may cost around \$150/month depending on the region.
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2. Availability Zones

Pricing Model:

- **Data Transfer Between Zones:** Traffic between VMs across availability zones incurs inter-zone data transfer costs.
 - Outbound data transfer across zones is typically charged at ~\$0.01/GB.
- **VM and Resource Costs:** You pay for VMs, disks, and other resources deployed in the zones.

Cost Considerations:

- If deploying VMs across zones, ensure efficient traffic management to reduce inter-zone data costs.

- Load balancers or application gateways with zone redundancy also add to the overall cost.

Example Estimate:

- Deploying 2 VMs in different zones with a Standard Load Balancer may cost approximately \$170/month (including inter-zone traffic).

3. Virtual Machine Scale Sets (VMSS)

Pricing Model:

- **Pay-As-You-Go:** VMs in the scale set are billed on a per-second basis, based on their size and configuration.
- **Auto-Scaling:** You only pay for the instances that are running. Scale-in reduces costs during periods of low demand.
- **Disk and Network Costs:** Each instance uses managed disks and networking, which are billed separately.

Additional Costs:

- **Load Balancer:** If integrated with a load balancer, its usage will add to the cost.
- **Scaling Rules:** Higher auto-scaling activity can result in increased costs for spinning up new VMs.

Example Estimate:

- A VMSS with 5 Standard_B2s VMs running 24/7 with auto-scaling could cost around \$500/month, depending on the scaling activity.

Comparison of Pricing Models

Feature	Availability Sets	Availability Zones	VM Scale Sets
Service Cost	Free	Free	Free
VM Costs	Standard VM costs	Standard VM costs	Pay-As-You-Go for VMs
Additional Costs	Managed disks, networking	Inter-zone data transfer, networking	Load balancer, scaling activity costs
Cost Efficiency	High	Medium (due to inter-zone charges)	High during scale-in periods

Tips for Cost Optimization

1. Availability Sets:

- Use the right VM size and type based on workload requirements.
- Opt for Azure Reserved Instances for long-term savings (up to 72%).

2. Availability Zones:

- Minimize inter-zone data transfer by deploying tightly coupled resources in the same zone.

- Leverage Azure Cost Management for monitoring and optimizing zone-specific expenses.

3. **VM Scale Sets:**

- Configure auto-scaling rules to scale in during off-peak hours.
- Use spot VMs for non-critical workloads to reduce costs significantly.

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