Caltech | Center for Technology & Management Education

Post Graduate Program in Cloud Computing

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PG CC - Microsoft Azure Architect Design: AZ:304

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Design for High Availability

Learning Objectives

By the end of this lesson, you will be able to:

- Recommend a solution for application and workload redundancy
- Recommend a solution for autoscaling
- Identify storage types for high availability
- Design a solution for autoscaling

A Day in the Life of an Azure Architect

You are working as an Cloud Architect in an company that offers OTT platform. You need to design a solution which could help the company with the below use cases:

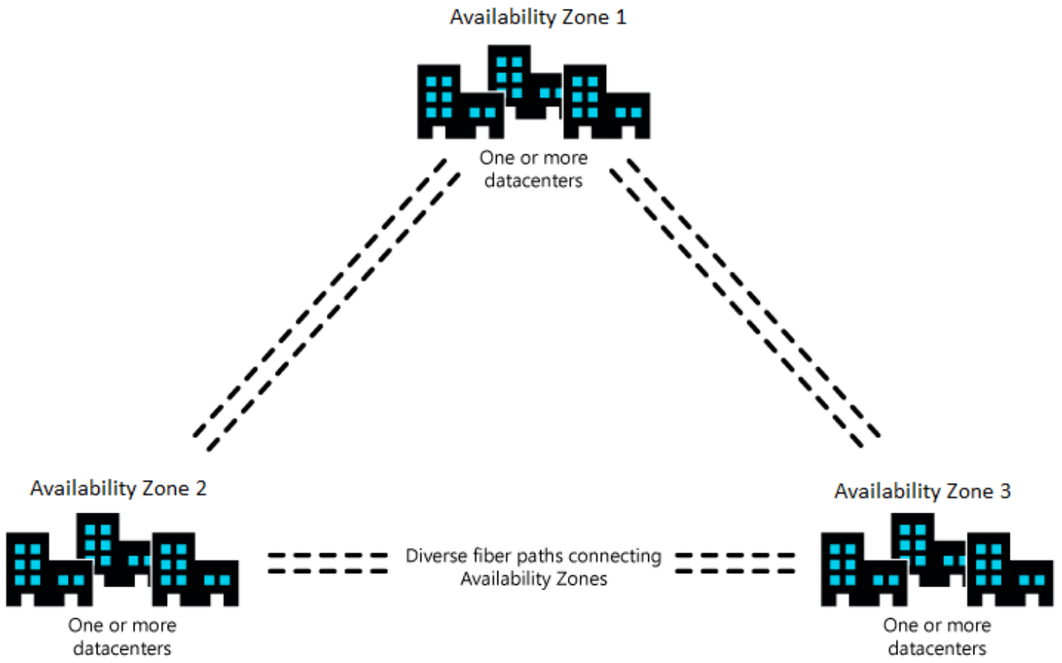
- Serve millions of customer at the same time across the globe.
- You need to have multiple deployments of an application in different regions.
- You need to ensure that customers get the content served depending on the location.
- Automatically scales your application when resource demand varies.

To achieve all of the above, along with some additional features, we would be learning a few concepts in this lesson that will help you find a solution for the above scenario.

Recommend a Solution for Application and Workload Redundancy

Building Solutions for High Availability Using Availability Zones

Availability Zones are physical locations inside an Azure region that are distinct from one another.



- A zone is made up of one or more data centers with independent power, cooling, and networking.
- The physical separation of availability zones within a region limits the impact on applications.

Zones are designed to support services, capacity, and availability from other zones in the region.

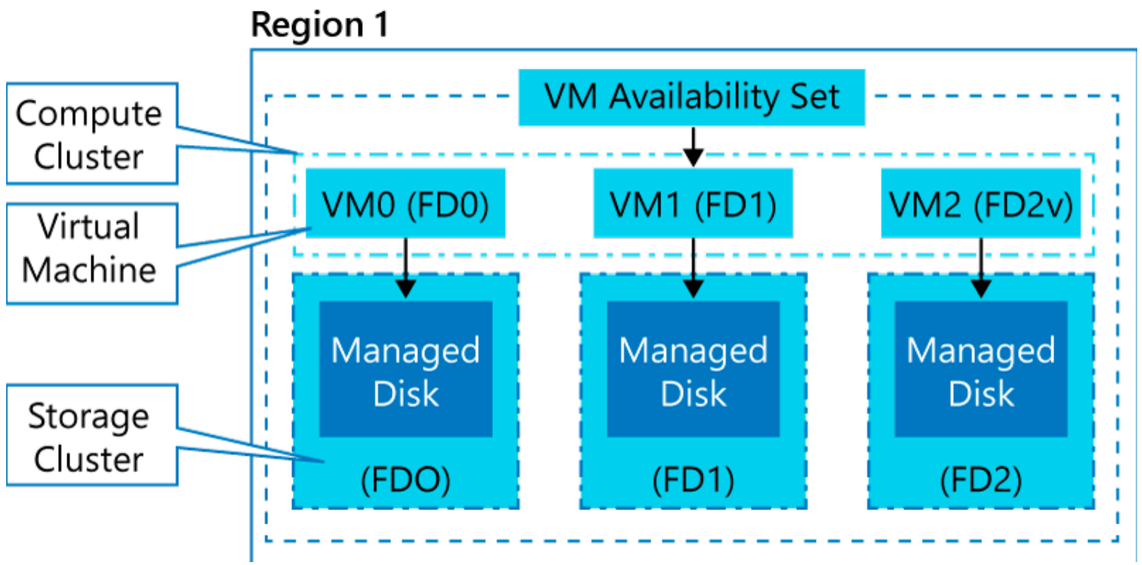
Delivering Reliability in Azure

Designing solutions that continue to function despite failure is key to improving reliability.

Resilient foundation	Foundation is the Microsoft investment in the platform, including availability zones
Resilient services	Services support high availability, such as zone-redundant storage (ZRS)
Resilient applications	Applications should be architected to support resiliency

Availability Sets

An availability set is a logical grouping of VMs within a data center.



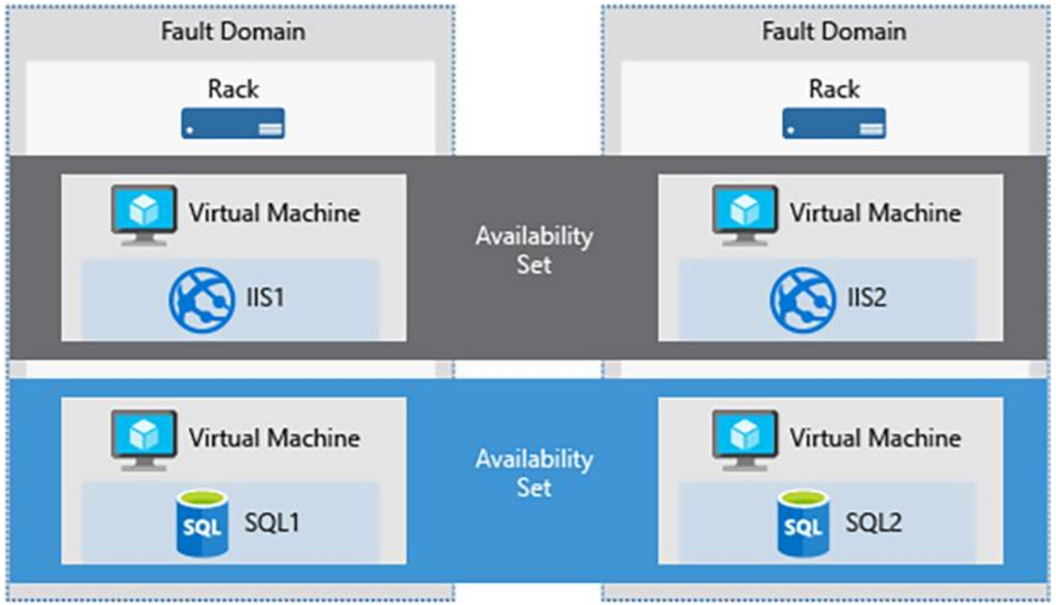
- On compute clusters, VMs are automatically distributed across fault and update domains.
- On storage clusters, it provides equal resiliency with managed disks.

It provides a service level agreement (SLA) of 99.95 % availability (for 2 or more VMs).

Update and Fault Domains

Update domains

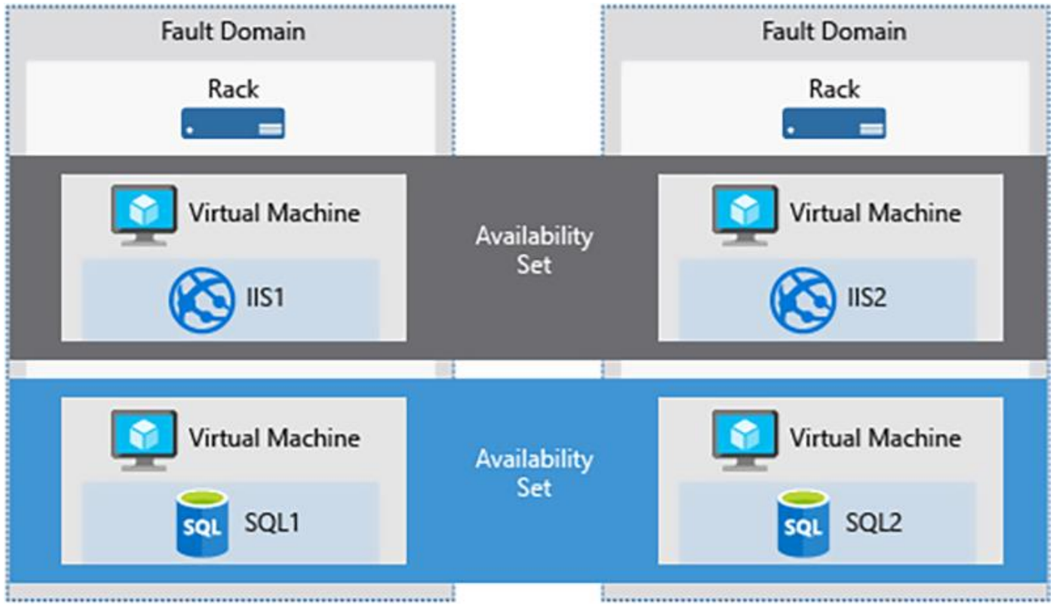
- Azure can make incremental or rolling updates across a deployment using update domains.
- Only one update domain is rebooted at a time during scheduled maintenance.
- There are five update domains by default, but you can add up to 20 more.



Update and Fault Domains

Fault domains

- These are a set of virtual machines that share a single point of failure and a similar set of hardware and switches.
- At least two fault domains are allocated to each VM in an availability set.
- Up to three fault domains can be configured.



Service Level Agreements

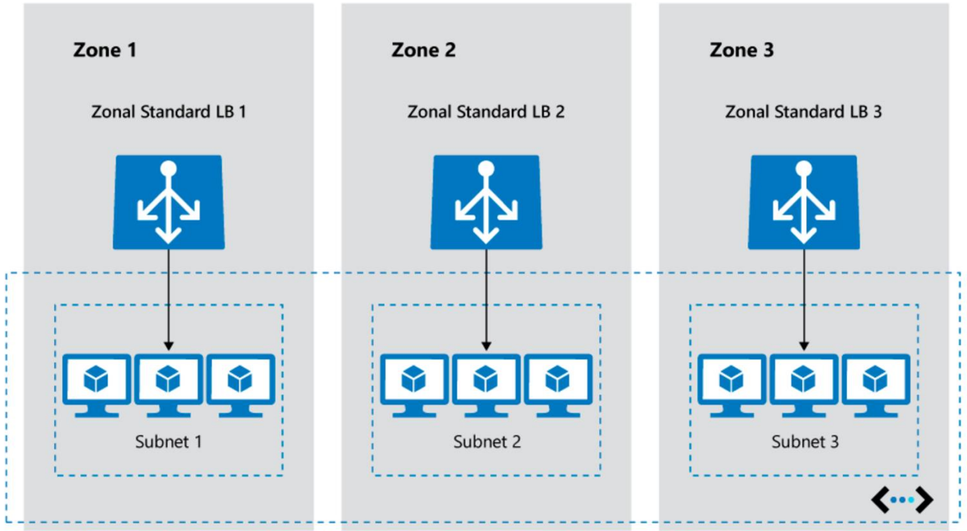
SLA 01	SLA 02	SLA 03
99.99% Uptime guarantee For all virtual machines with two or more instances deployed in two or more Availability Zones	**99.95%** Uptime guarantee For all virtual machines with two or more instances deployed in the same Availability Set	**99.90%** Uptime guarantee For any single instance virtual machine that uses premium storage for all operating system disks and data disks

Note

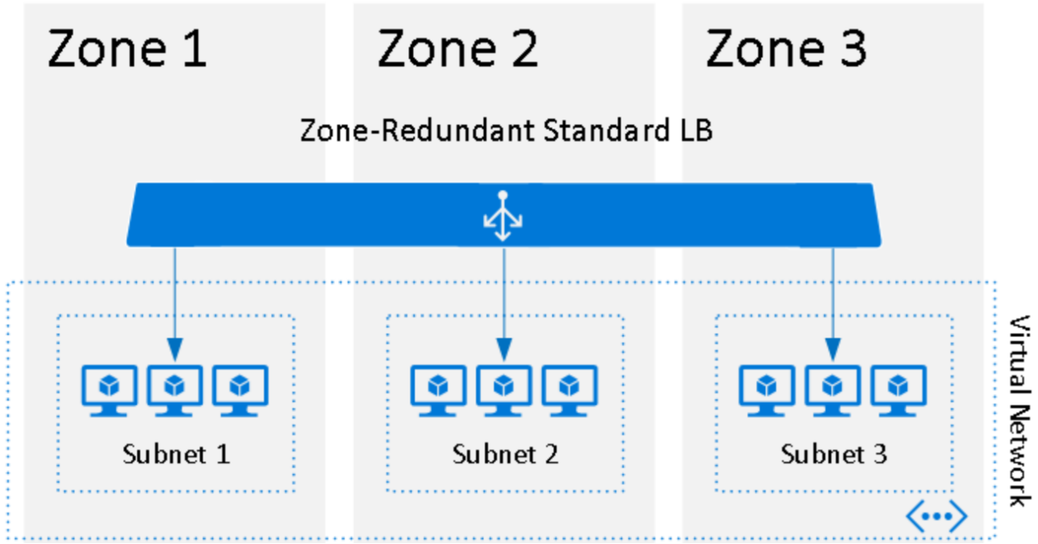
A VM can only be added to an availability set when it is created.

Zonal vs. Zone-Redundant Architecture

The comparison of zonal and zone-redundant architecture is shown below:



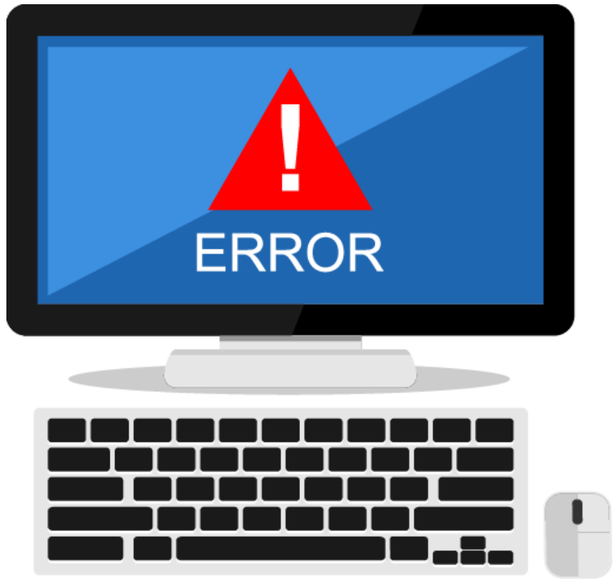
Individual load balancers deployed to specific zones



Zone-redundant load balancer

Storage Account Replication

Storage Account Replication stores multiple copies of user data to protect from planned and unplanned events such as:

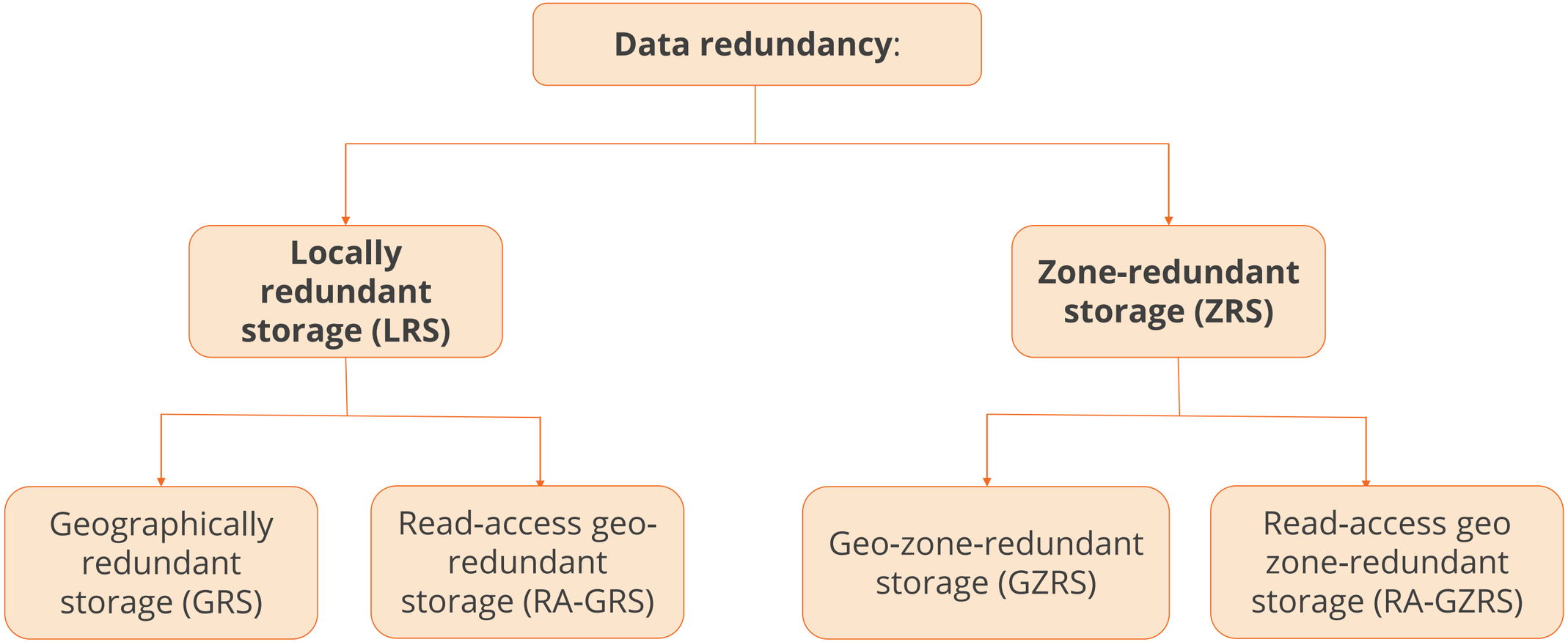


- Hardware failures
- Network or power outages
- Massive natural disasters

It ensures user storage accounts have their backup even in failure.

Storage Account Replication

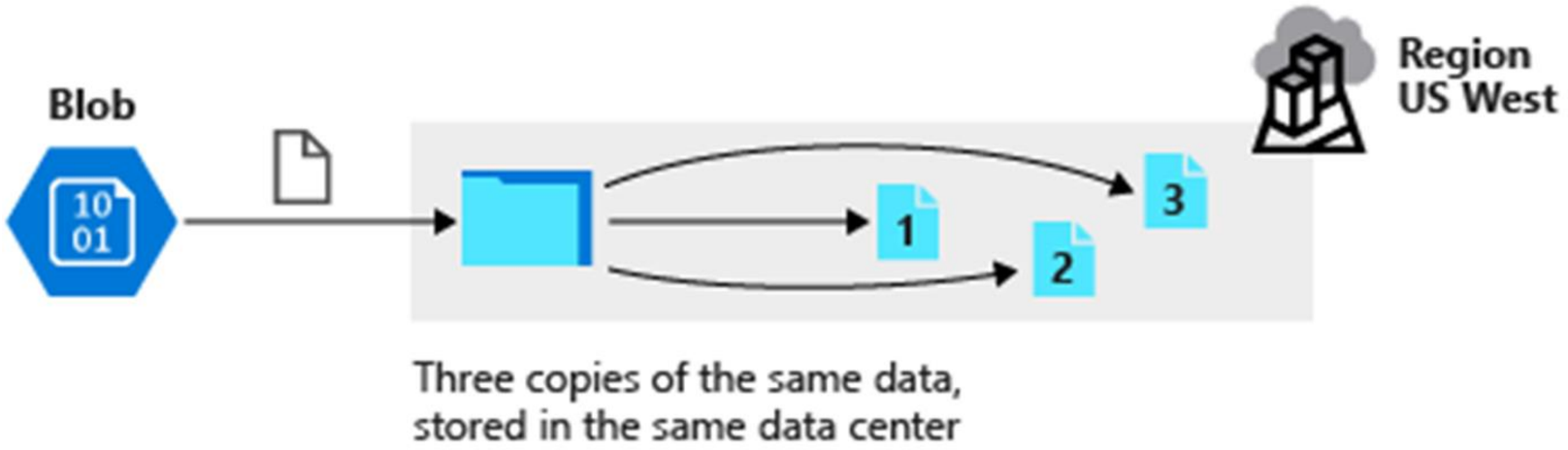
Below are the types of replication models:



Data in an Azure Storage account is always replicated three times in the primary region.

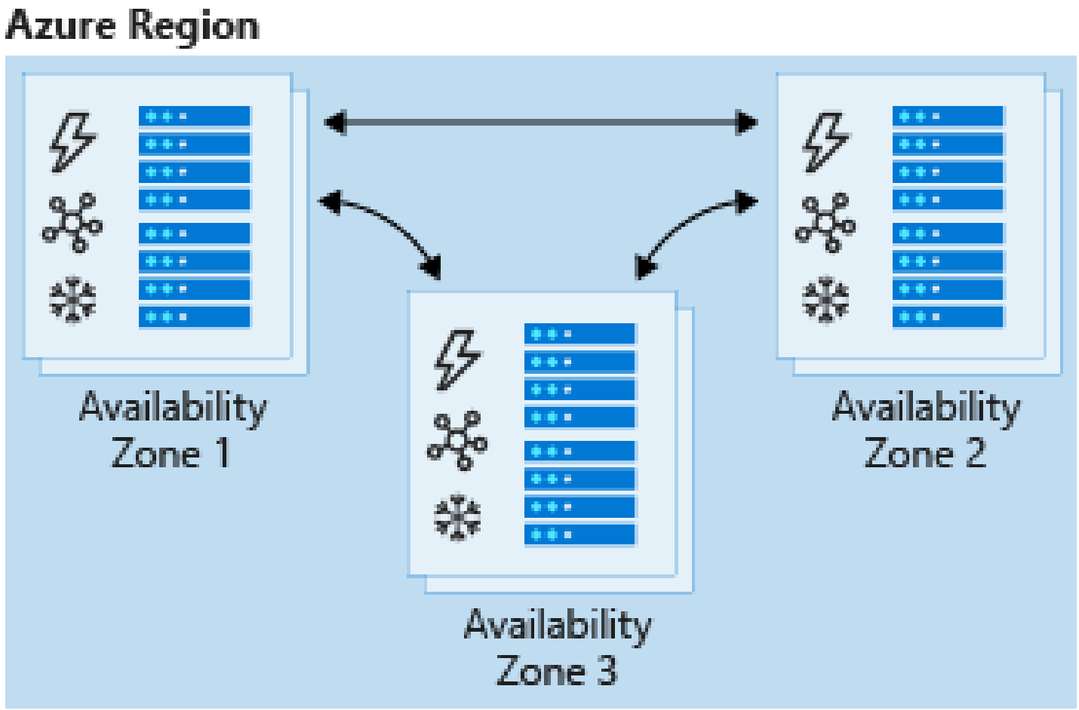
Locally Redundant Storage

Locally redundant storage copies data synchronously three times within a single physical location in the primary region.



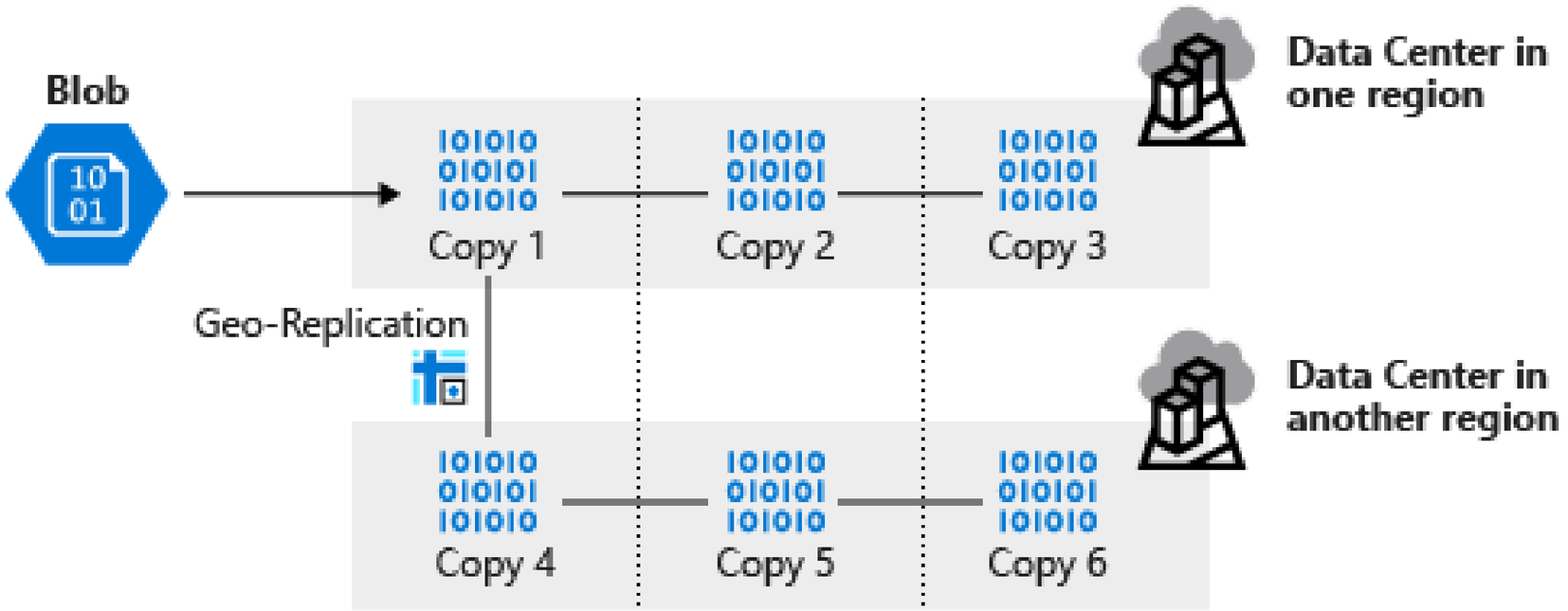
Zone Redundant Storage

Zone redundant storage copies data synchronously across three Azure availability zones in the primary region.



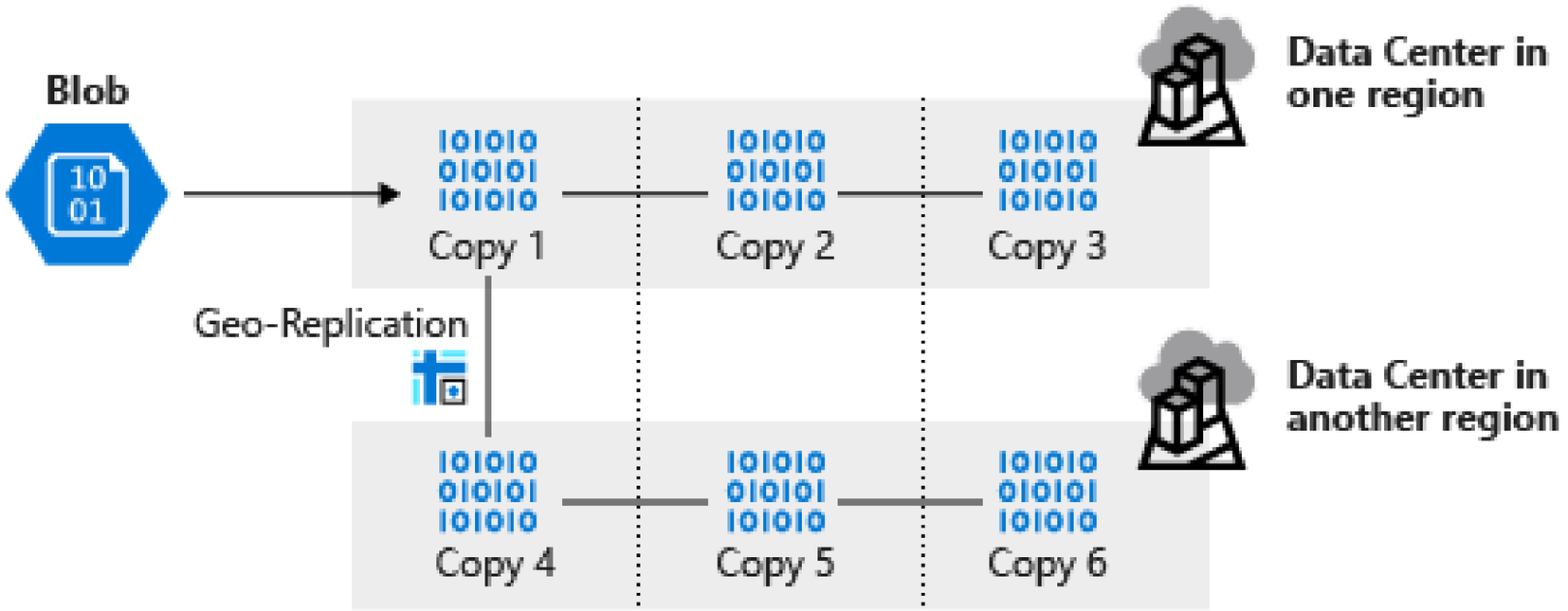
Geographically Redundant Storage

Geographically redundant storage copies data synchronously three times within a single physical location in the primary region using LRS.



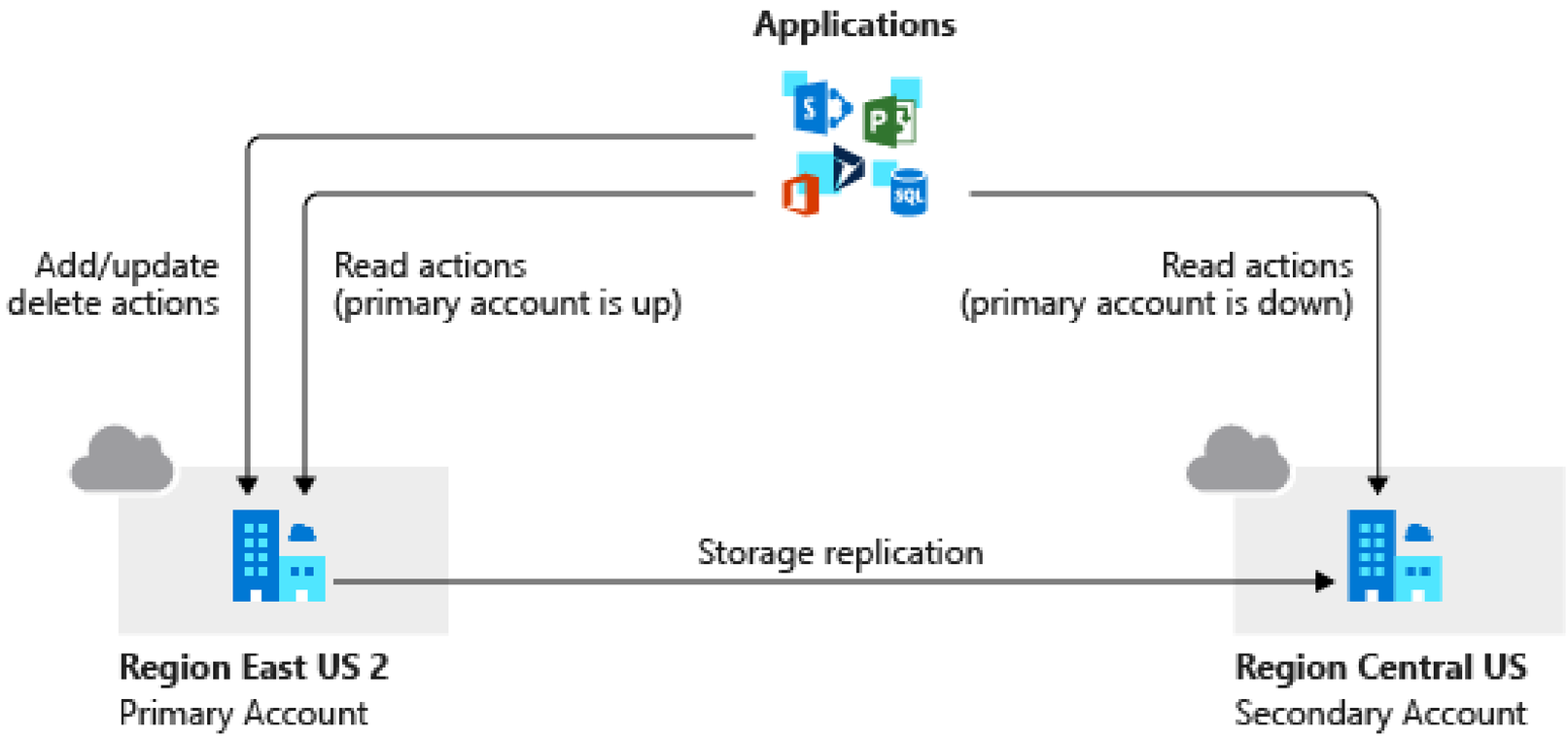
Geographically Redundant Storage

Geographically redundant storage copies your data asynchronously in a secondary region a hundred miles from the primary region to a single physical location.



Read-Access Geo-Redundant Storage

When the read access is enabled to the secondary region, data is available to be read, where the primary region becomes unavailable.



High Availability and Azure SQL Database

There are two types of high availability models used in Azure SQL database:

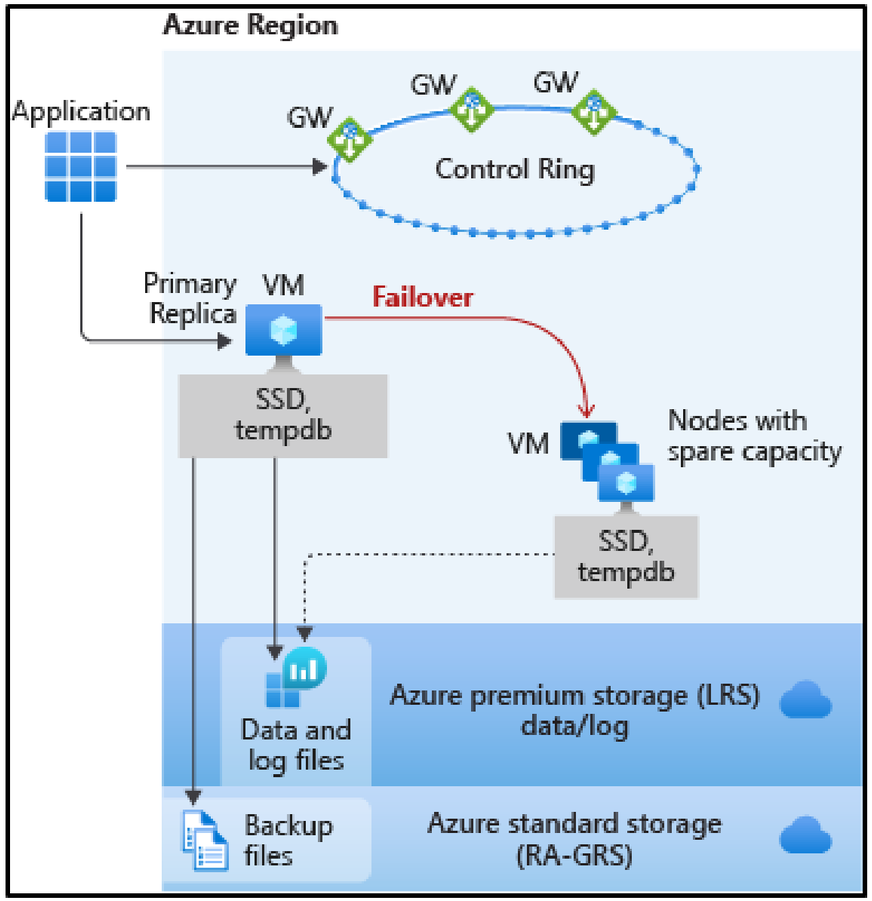
Standard Availability Model

Premium Availability Model

The standard availability model is based on a separation of compute and storage whereas the premium availability model is based on a cluster of database engine processes.

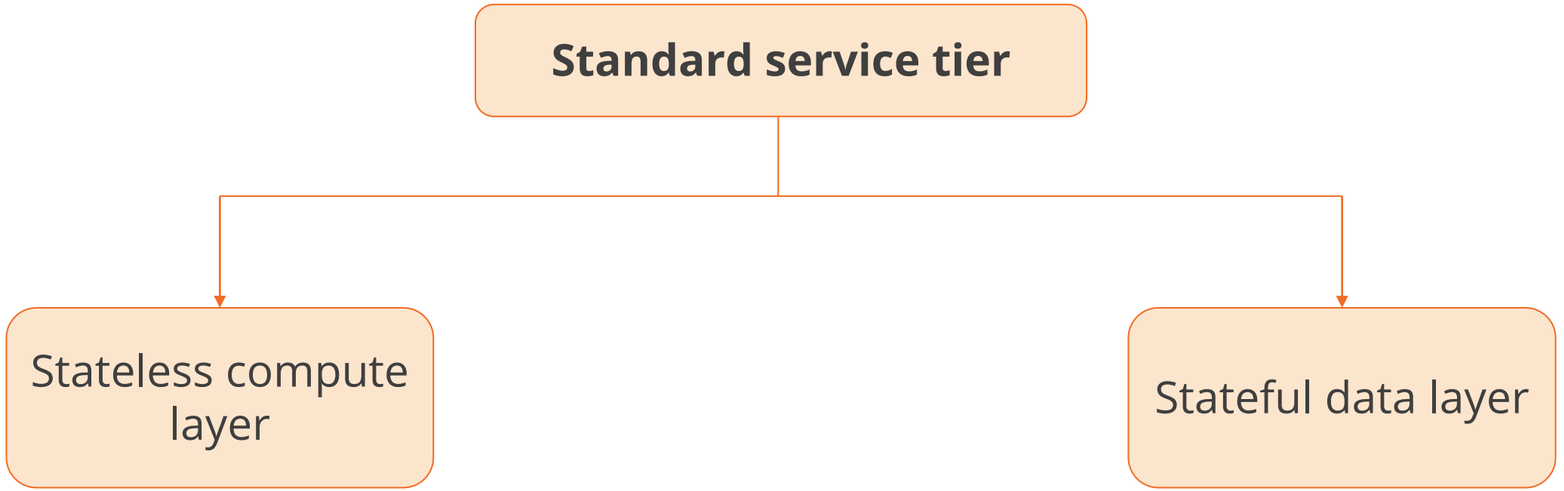
Standard Availability Model

The following figure shows four different nodes with separate compute and storage layers:



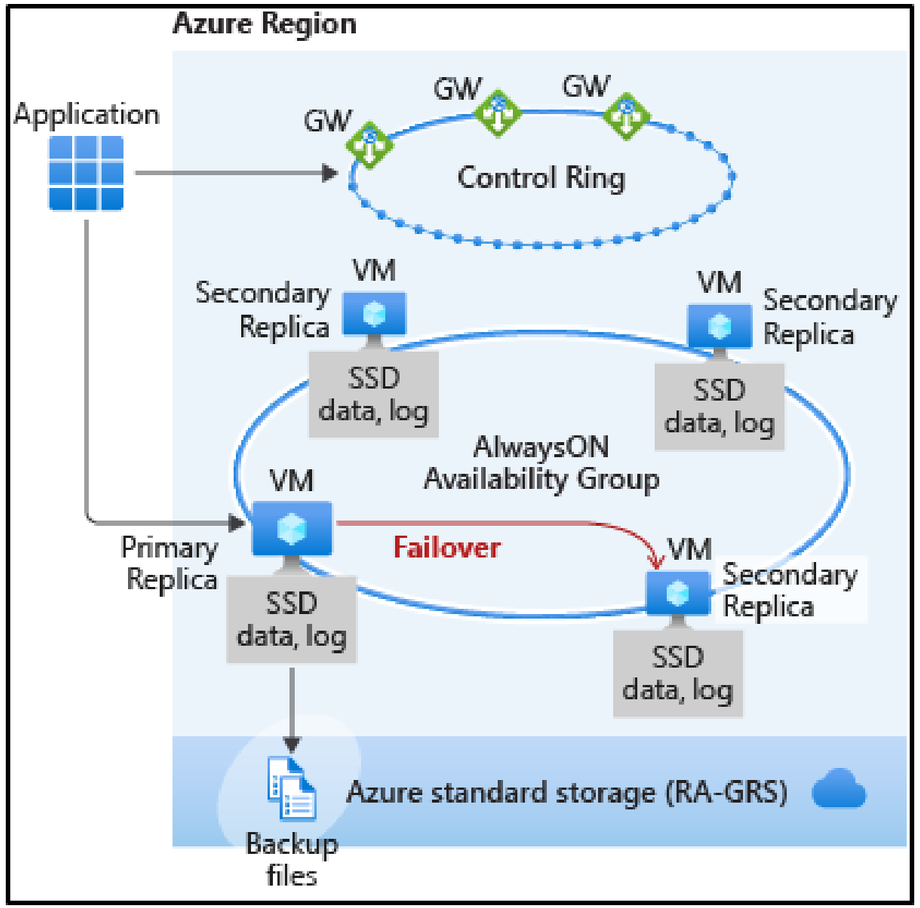
Standard Availability Model

The standard and general purpose service tier availability includes two layers:



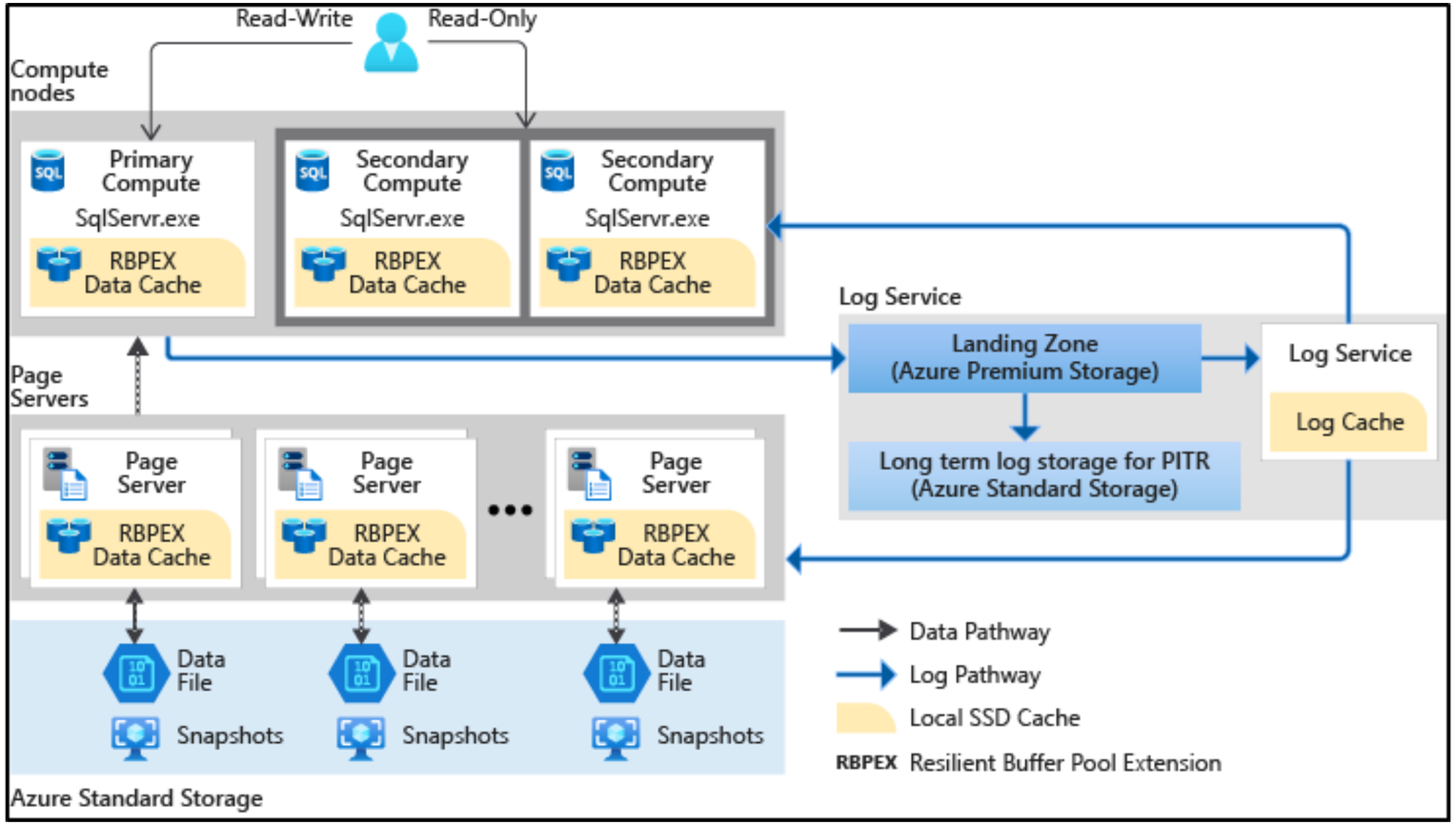
Premium and Business Critical Service Tier Availability

The premium model of high availability is shown below:



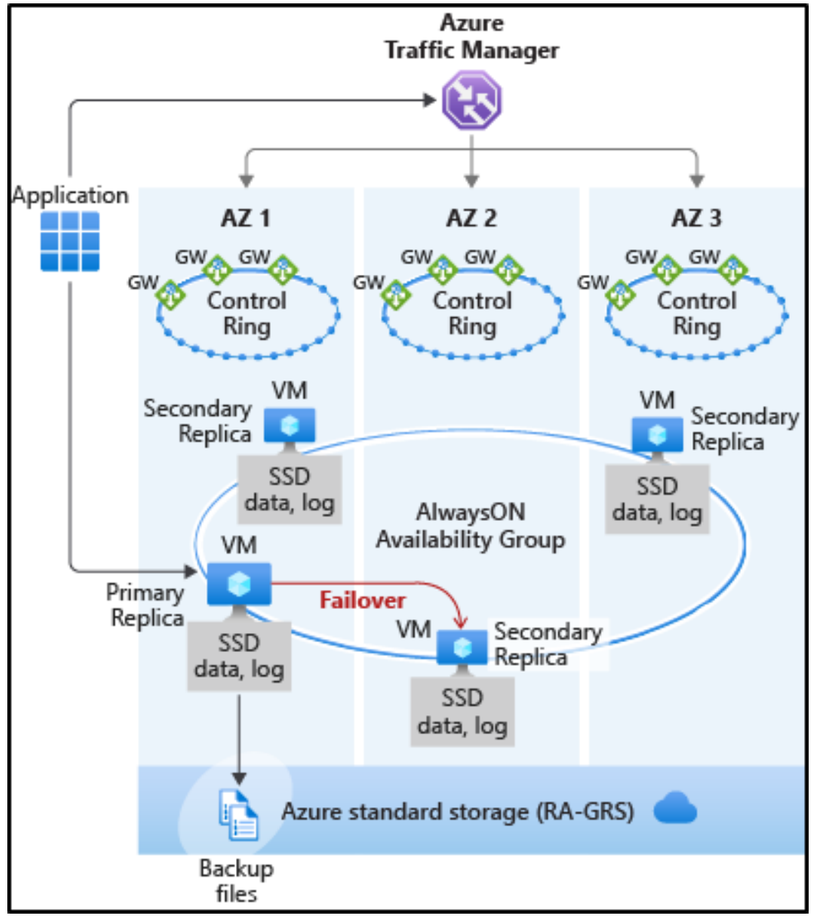
Hyperscale Service Tier Availability

The diagram given below will help you to understand the hyperscale service tier:



Zone Redundant Configuration

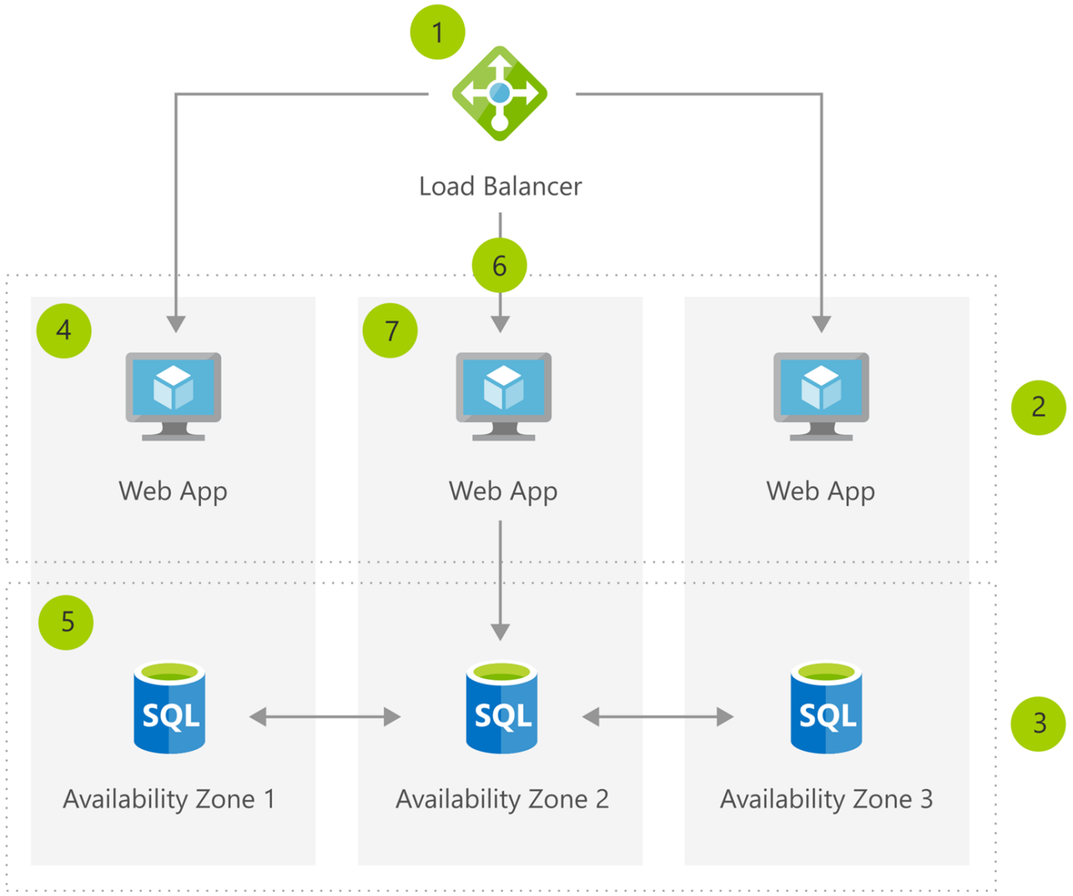
The following figure shows the zone redundant version of high availability:



High Availability for Business Continuity and Disaster Recovery

High availability for business continuity and disaster recovery can be achieved by:

- Creating a zone-redundant load balancer
- Creating front-end subnet
- Creating DB subnet
- Creating VMs in three availability zones
- Configuring zone-redundant SQL DB
- Adding VMs to the load balancer's backend pool
- Deploying your application on VMs for redundancy and high availability



Assisted Practice

Virtual Machine Availability set

Duration: 10 Min.

Problem Statement:

You've been requested to offer a method for achieving high availability for a virtual machine-hosted application. To do so, create an availability set, which is a logical grouping of VMs that helps Azure to understand how your application is designed to offer redundancy and availability.

Assisted Practice: Guidelines

Steps to create virtual machine availability set are:

1. Login to your Azure portal
2. Search for virtual machines
3. Configure availability set while creating a VM

Assisted Practice

Virtual Machine Availability Zone

Duration: 10 Min.

Problem Statement:

You have been asked to showcase the availability zone option available on your virtual machine as an Azure Architect to increase the level of control you have over the availability of the applications and data on your VMs.

Assisted Practice: Guidelines

Steps to create virtual machine availability zone are:

1. Login to your Azure portal
2. Search and select virtual machines
3. Select availability zone
4. Configure the availability zone while creating a VM

Assisted Practice

Azure SQL DB – Geo-Replication

Duration: 10 Min.

Problem Statement:

Demonstrate how you can use Azure SQL DB - Geo-Replication to construct readable secondary databases of individual databases on a server in the same or a different data center.

Assisted Practice: Guidelines

Steps to create a secondary SQL database in the Resource Group database in Azure using the geo-replication:

1. Create Azure SQL Database
2. Create a Secondary Database Using the Geo-Replication

Assisted Practice

Implement Azure Storage Replication
Duration: 10 Min.

Problem Statement:

As an Azure Architect, you've been asked to assist your organization with an Azure storage solution to safeguard your storage account data from both scheduled and unforeseen occurrences, such as temporary hardware failures, network or power outages, and catastrophic natural catastrophes. Even if your storage account fails, the solution should ensure that your availability and durability goals are met.

Assisted Practice: Guidelines

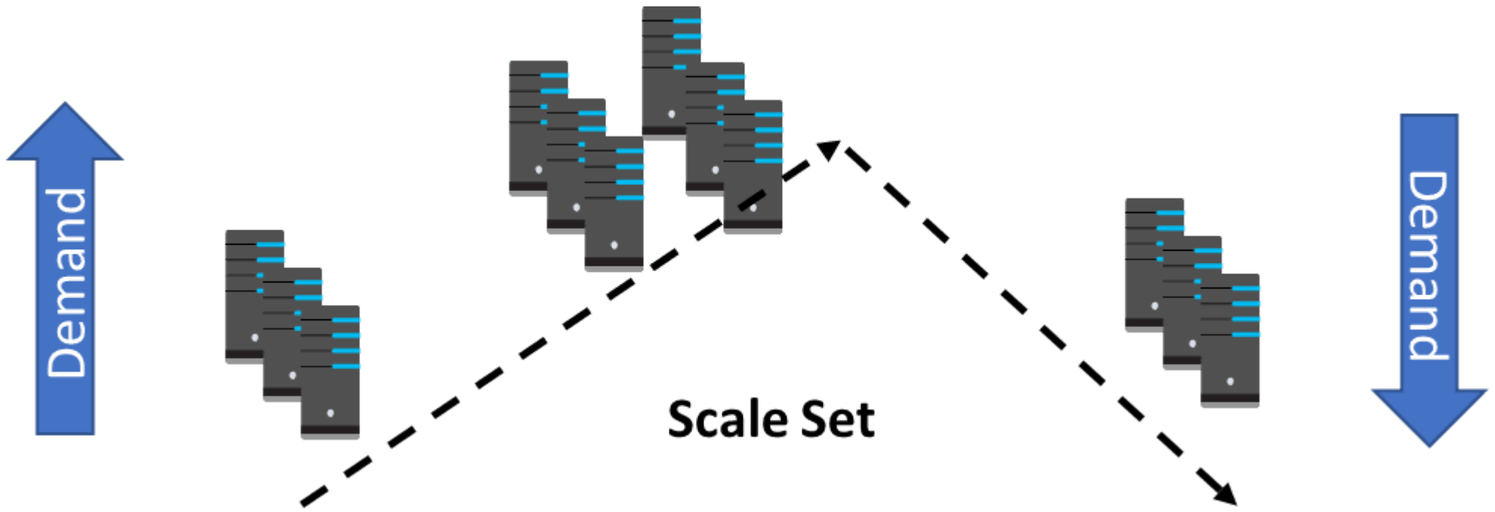
Steps to implement Azure storage replication:

1. Login to the Azure portal
2. Search for and select Storage Account
3. Select the configuration setting
4. Update the Replication setting

Recommend a Solution for Autoscaling

Scale Sets

Azure Virtual Machine Scale Sets enable the user to deploy a set of identical VMs.



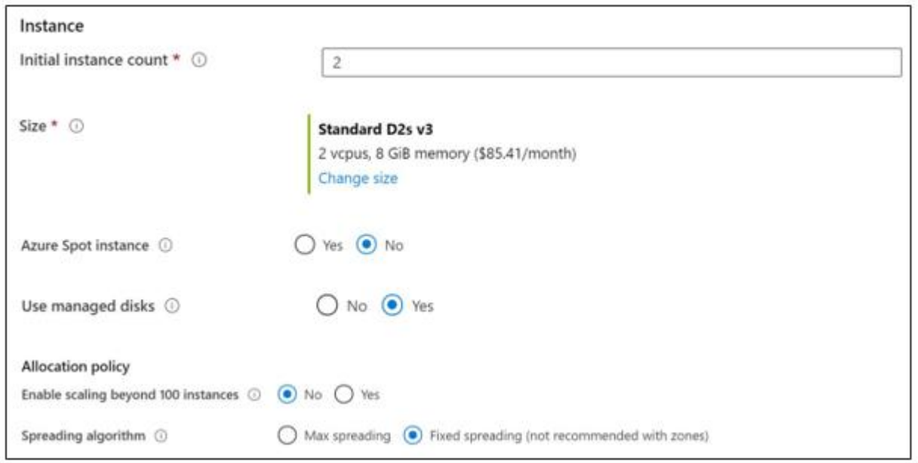
Scale Sets Benefits

These are the benefits of scale sets:

- All VM instances are created from the same base OS image and configuration.
- Scale sets are used to run multiple instances of the user's application.
- Scale sets can automatically increase or decrease the number of VM instances to accommodate changing client demand - called Autoscale.
- Scale sets are highly scalable and can contain up to 1,000 VM instances. (600 when using custom images)

Implementing Scale Sets

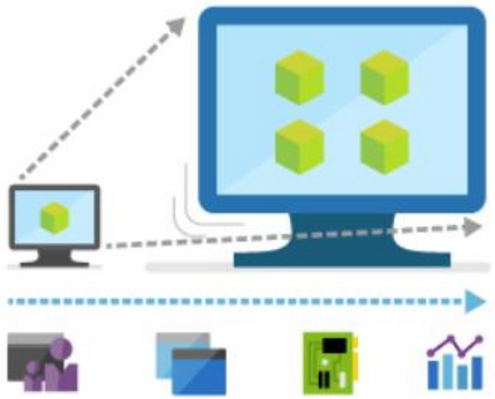
The following is the implementation of scale sets:

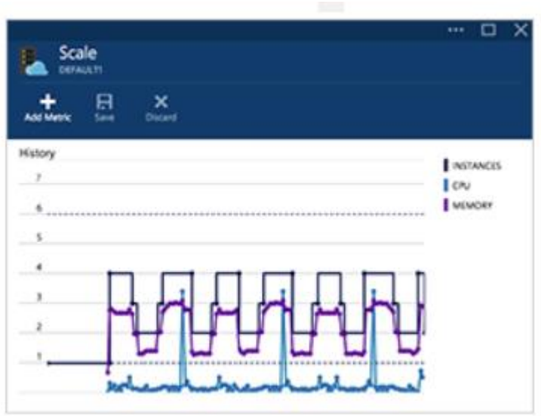


- Instance count: Number of VMs in the scale set (0 to 1000)
- Instance size: The size of each virtual machine in the scale set
- Azure spot instance: Can save up to 80%
- Use managed disks
- Enable scaling beyond 100 instances

Autoscale

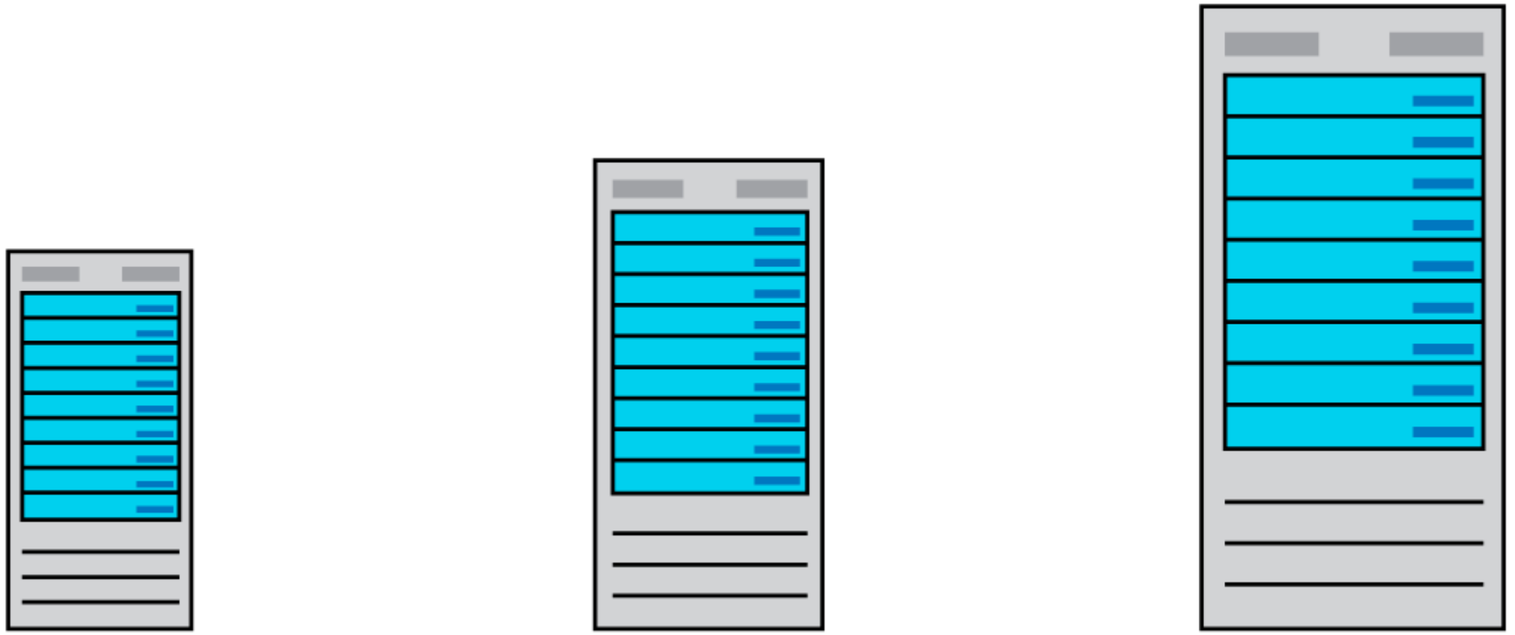
- Defines rules to adjust capacity automatically
- Schedule events to increase or decrease at a fixed time
- Reduces monitoring and optimizes performance





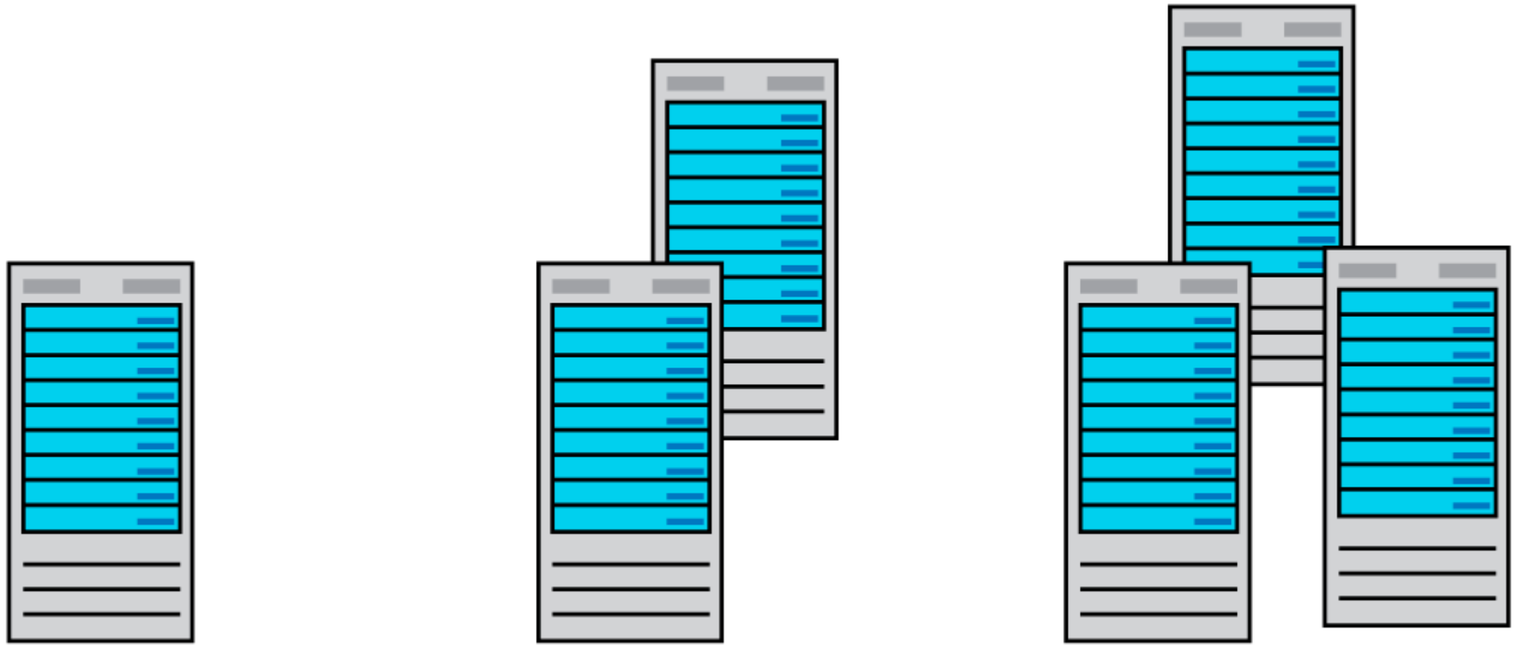
Vertical Scale

Vertical scaling is also known as scale up and scale down, which means increasing or decreasing virtual machine sizes in response to a workload.



Horizontal Scale

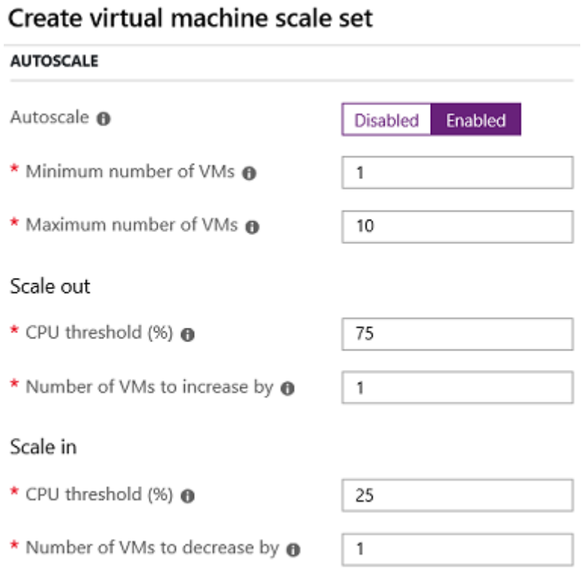
Scale-out (increase) the number of VMs in the set



Scale-in (reduce) the number of VMs in the set

Implementing Autoscale

It defines the minimum, maximum, and default number of VM instances.



It creates more advanced scale sets with scale-out and scale-in parameters.

Azure App Service High Availability

The Azure App Service is a Platform as a Service offering (PaaS) from Microsoft that enables a user to build, deploy, and scale web applications.

Azure App Service Plan

An App Service plan defines a set of compute resources for web apps.

The App Service plan determines the capabilities and resources available to its web apps.

Azure App Service Plan

Web apps can share the same App Service plan.

Isolate the app into a new App Service plan when:

- The app is resource-intensive
- A user wants to scale the app independently from other apps
- The app needs resources in a different geographical region

Scale In or Out

The autoscale feature allows the user to scale out and in the number of instances of their app service plan based on the schedules they set or the metrics they define.

In Basic Tier, users can scale up to 3 instances

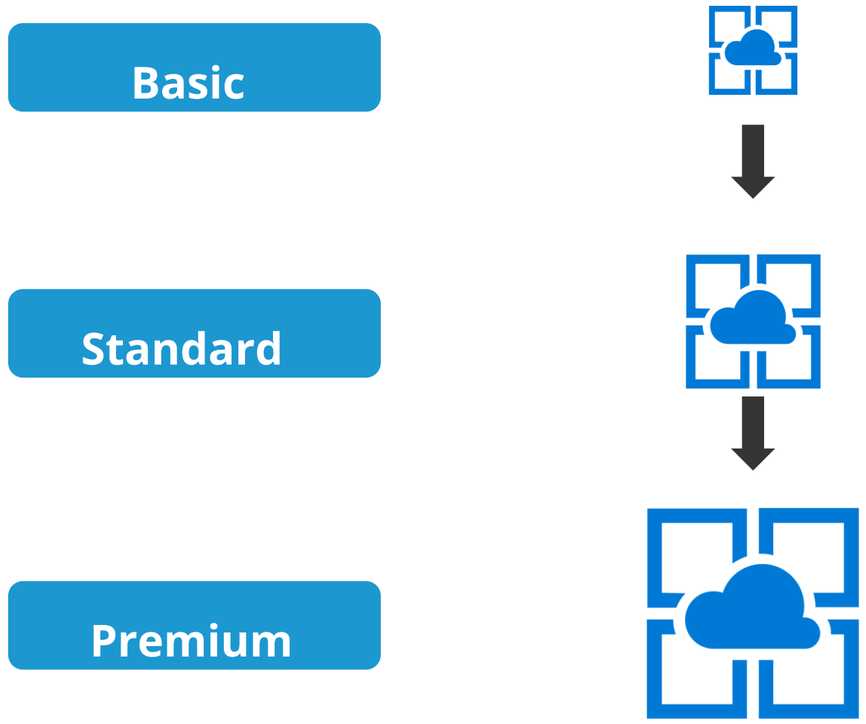
In Isolated (App Service Environment), it is 100

In Premium Tier, maximum is 20

In Standard Tier, users can scale up to 10 instances

Scale Up or Down

The following are the different types of tier for scaling up or down:



Assisted Practice

Virtual Machine Scale Set

Duration: 10 Min.

Problem Statement:

You've been asked to recommend a tool that will automatically scale your application as resource demand changes, ensuring high availability.

Assisted Practice: Guidelines

Steps to create a virtual machine scale set are:

1. Login to your Azure portal
2. Create a load balancer
3. Create a virtual machine scale set

Identify Storage Types for High Availability

Storage Account Failover

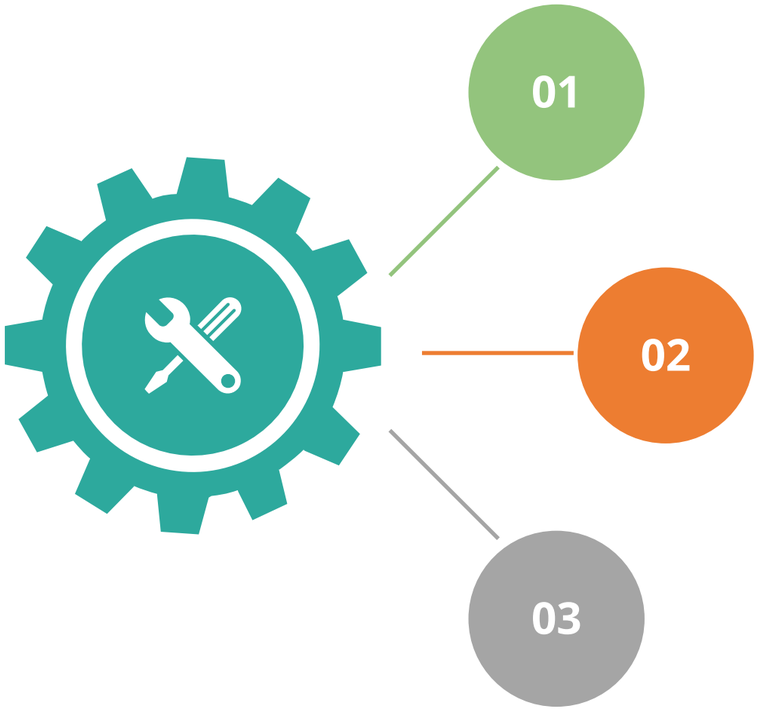
Storage Account Failover prevents the user against unplanned service outages.

- It is an integral part of the disaster recovery plan.
- It helps the user in the event of the primary endpoint becoming unavailable.

Storage Account Failover

Azure Storage supports account failover for geo-redundant storage accounts.

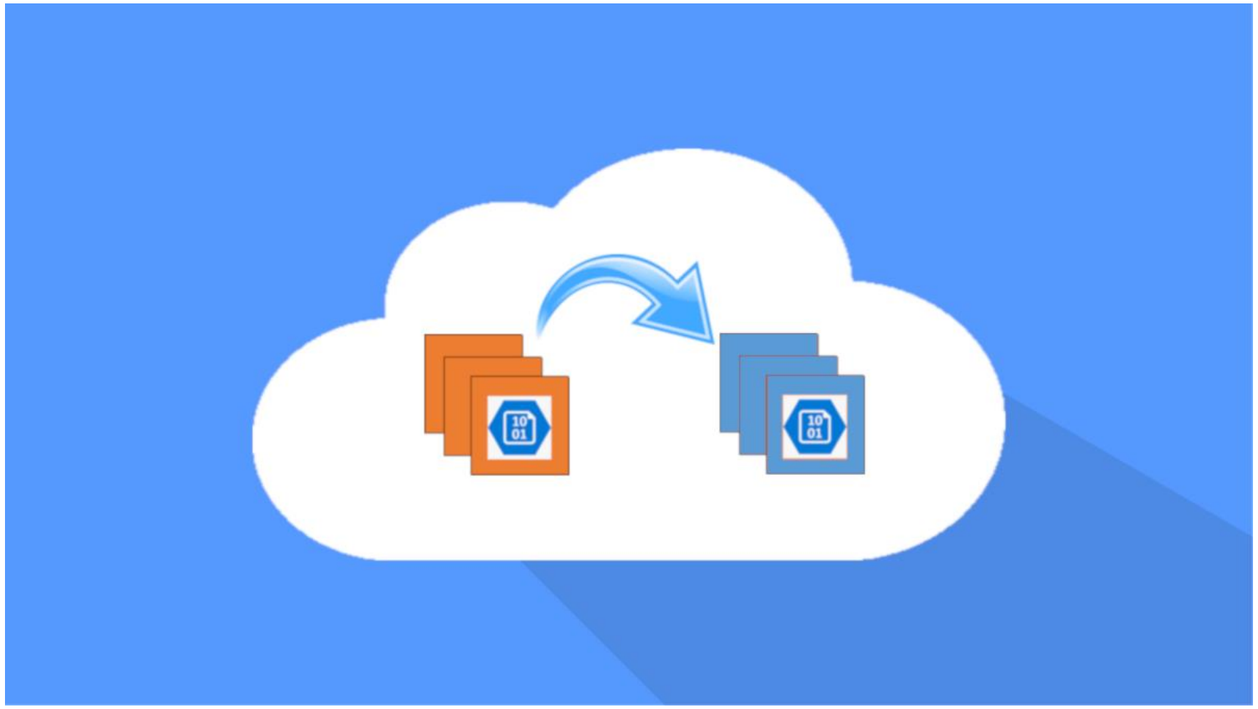
Storage Account Failover is available for the following account types:



- General-purpose V1
- General-purpose V2
- Blob Storage Account

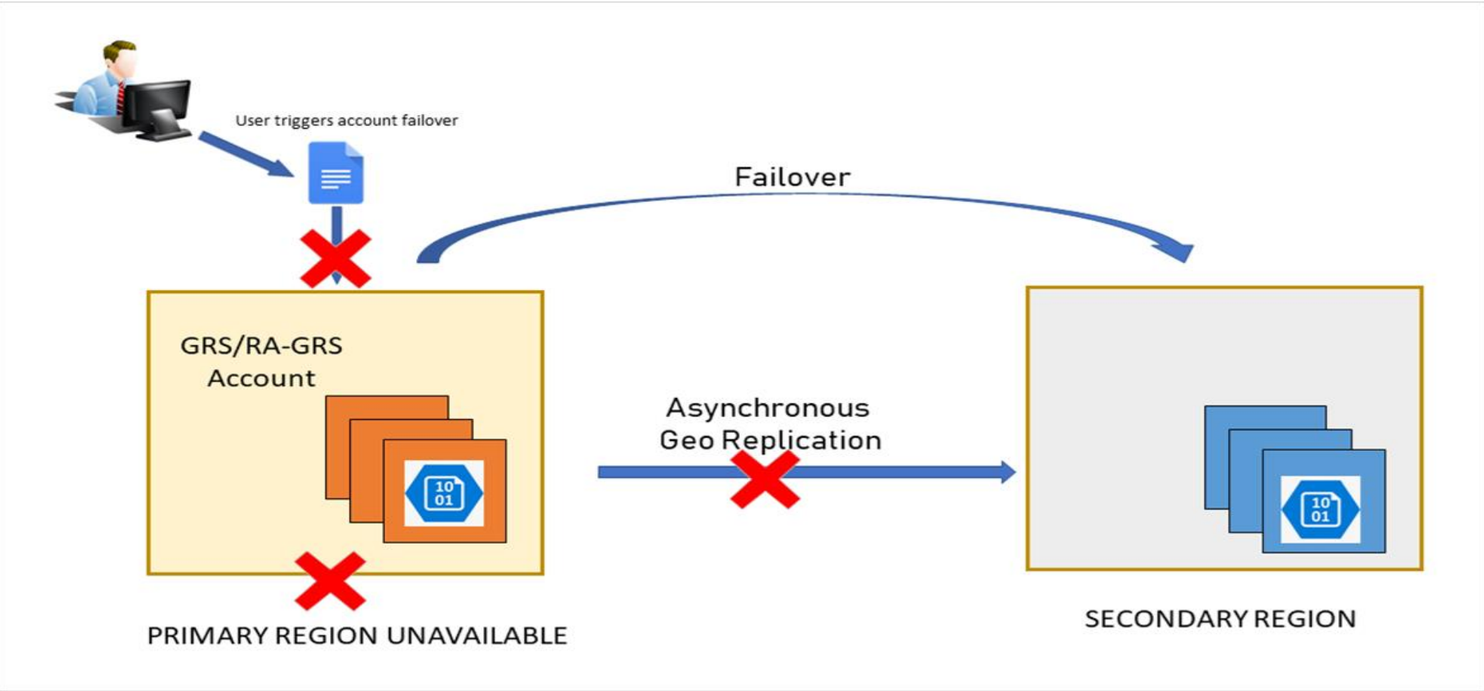
Storage Account Failover

If the primary endpoint becomes impossible to access, the user can start the storage account failover process.



How an Account Failover Works?

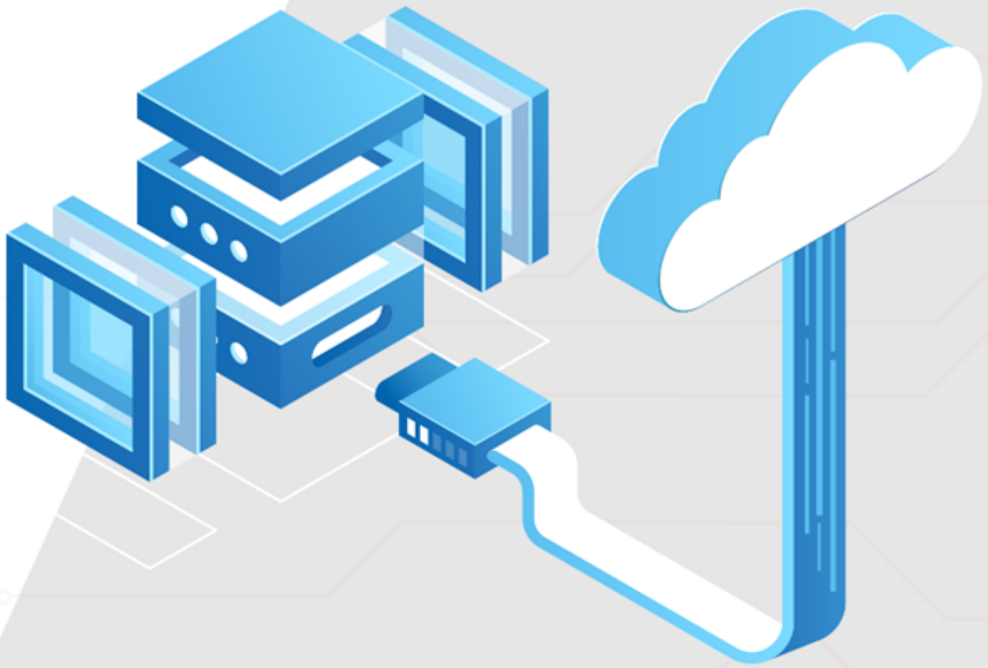
The failover updates the secondary endpoint to become the primary endpoint for your storage account.



Once the failover is complete, clients can begin writing to the new primary endpoint.

Key Takeaways

- Standard and Premium are the two types of high availability models.
- The user can construct and manage a group of load-balanced VMs using Azure virtual machine scale settings.
- Storage Account Failover prevents the users against unplanned service outages.
- Storage Account Replication ensures user storage accounts have their backup even in the case of failure.



Thank you