Microsoft

Azure SQL Database Business Continuity

Module 3

Learning Units covered in this Module

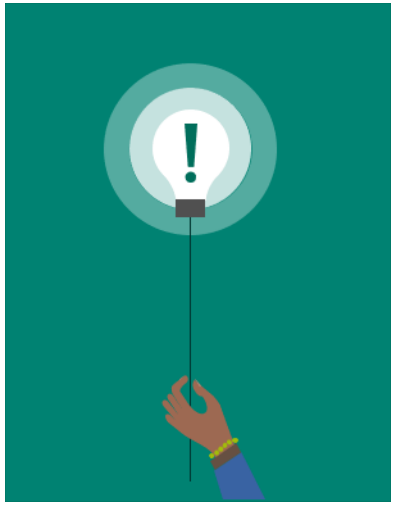
- Lesson 1: Business Continuity Features in Azure SQL Database
- Lesson 2: Disaster Recovery Features in Azure SQL Database
- Lesson 3: Backing up and Restoring Azure SQL Database

Lesson 1: Business Continuity Features in Azure SQL Database

Objectives

After completing this learning, you will be able to:

- Understand the various business continuity options within Azure SQL Database.
- Understand how to copy and export Azure SQL Databases.
- Understand how to perform a point-in-time restore.
- Understand how to perform a restore of a deleted database.



Business Continuity Problem

Enabling the application to continuously operate during unplanned and planned disruptive events.

Disruption scenarios in general:

- Local hardware or software failures
- Data corruption or deletion typically caused by an application bug or human error.
- Datacenter outage, possibly caused by a natural disaster.
- Upgrade or maintenance errors.

Business Continuity

Availability:

- Azure SQL DB includes resiliency and reliability that protects against software or hardware failures.
- Automated backups to protect data from corruption or accidental deletion.
- Provides SLA of 99.99%

High Availability :

- Achieved through Availability Zones.
- Provides Service Level Agreement (SLA) of 99.9995 %

Disaster Recovery:

- Active geo-replication
- Failover groups
- Geo-restore

Basic (DTU), Standard (DTU), General Purpose (vCore) High Availability

Behaves like Failover Cluster Instance

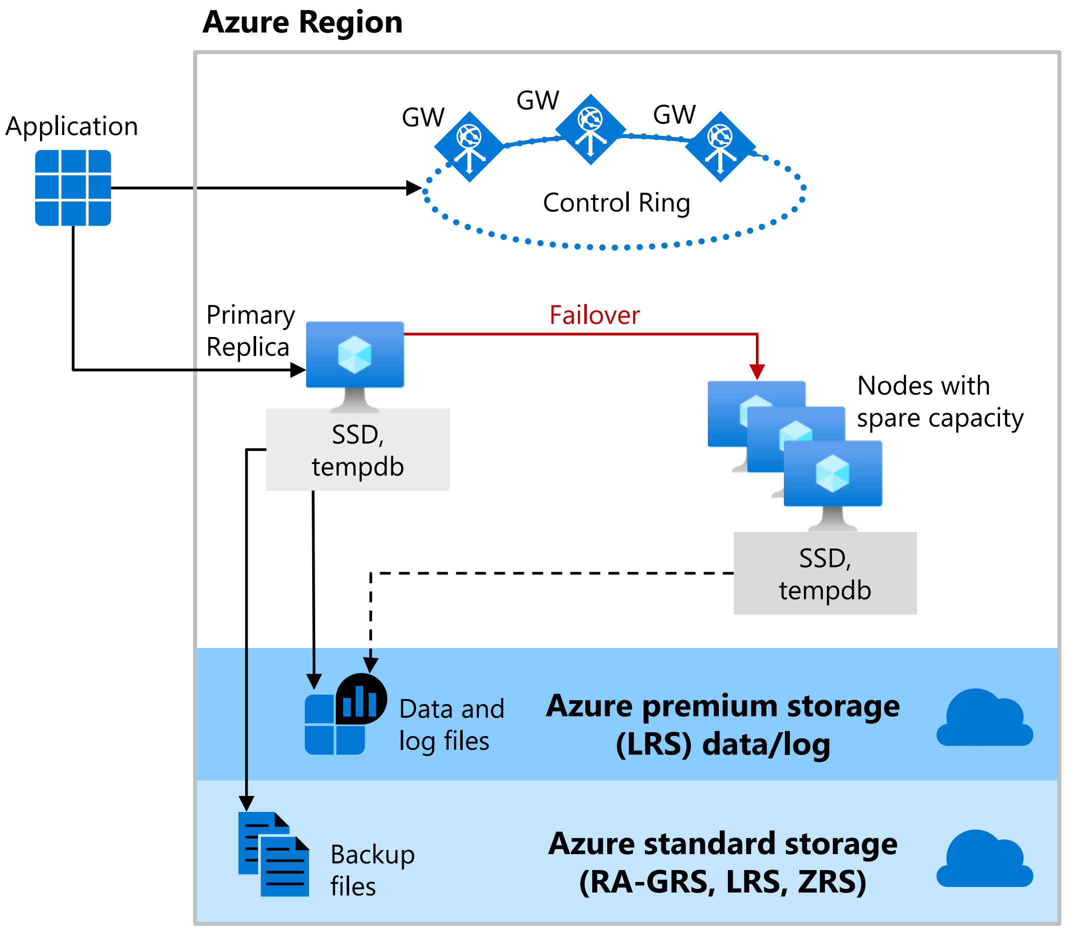
Remote storage provides data redundancy within a datacenter

Backup files are in a different location with geo-redundancy

Failover decisions based on SQL and Service Fabric

Recovery time depends on spare capacity

Connectivity redirection built-in



Premium (DTU) and Business Critical (vCore) High Availability

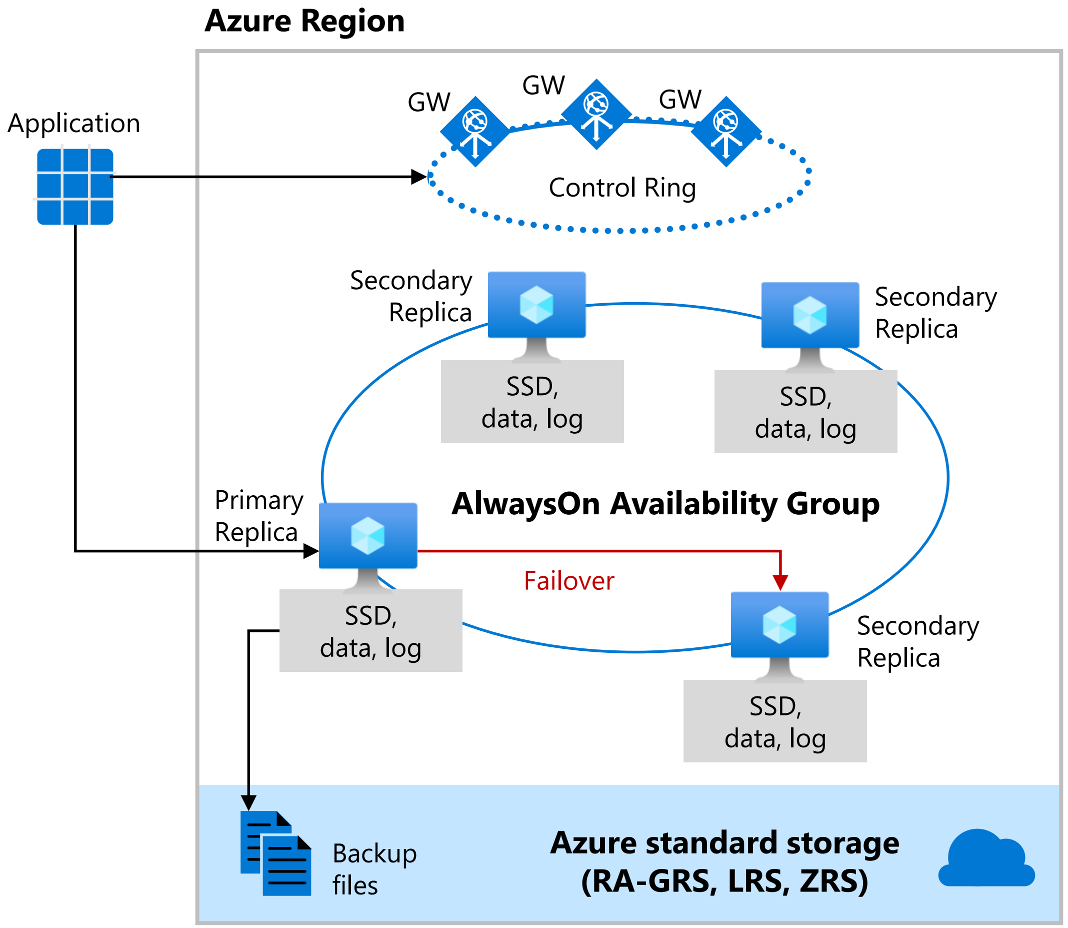
High availability is achieved by replicating both compute and storage to additional nodes.

High availability is implemented using a technology like SQL Server Always On Availability Groups.

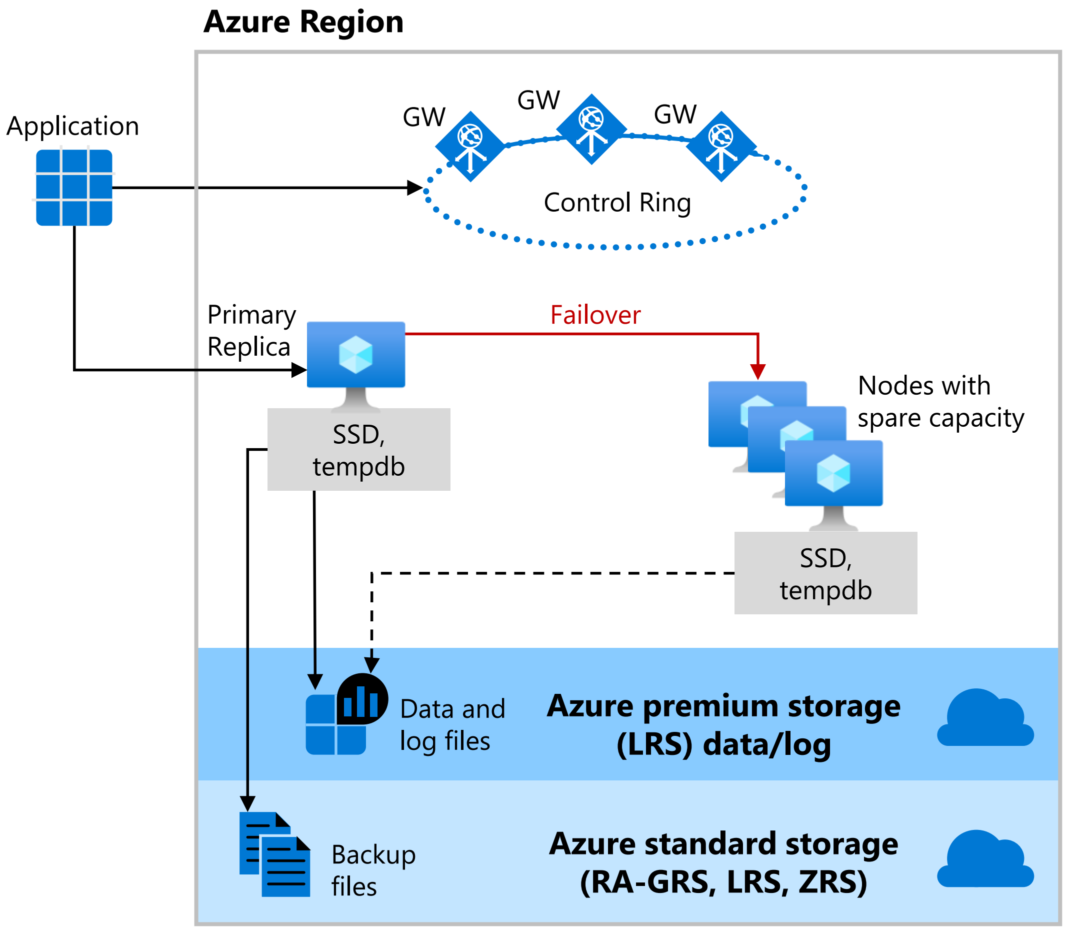
The cluster includes a single primary replica for read-write workloads, and up to three secondary replicas (compute and storage) containing copies of data.

The failover is initiated by the Azure Service Fabric.

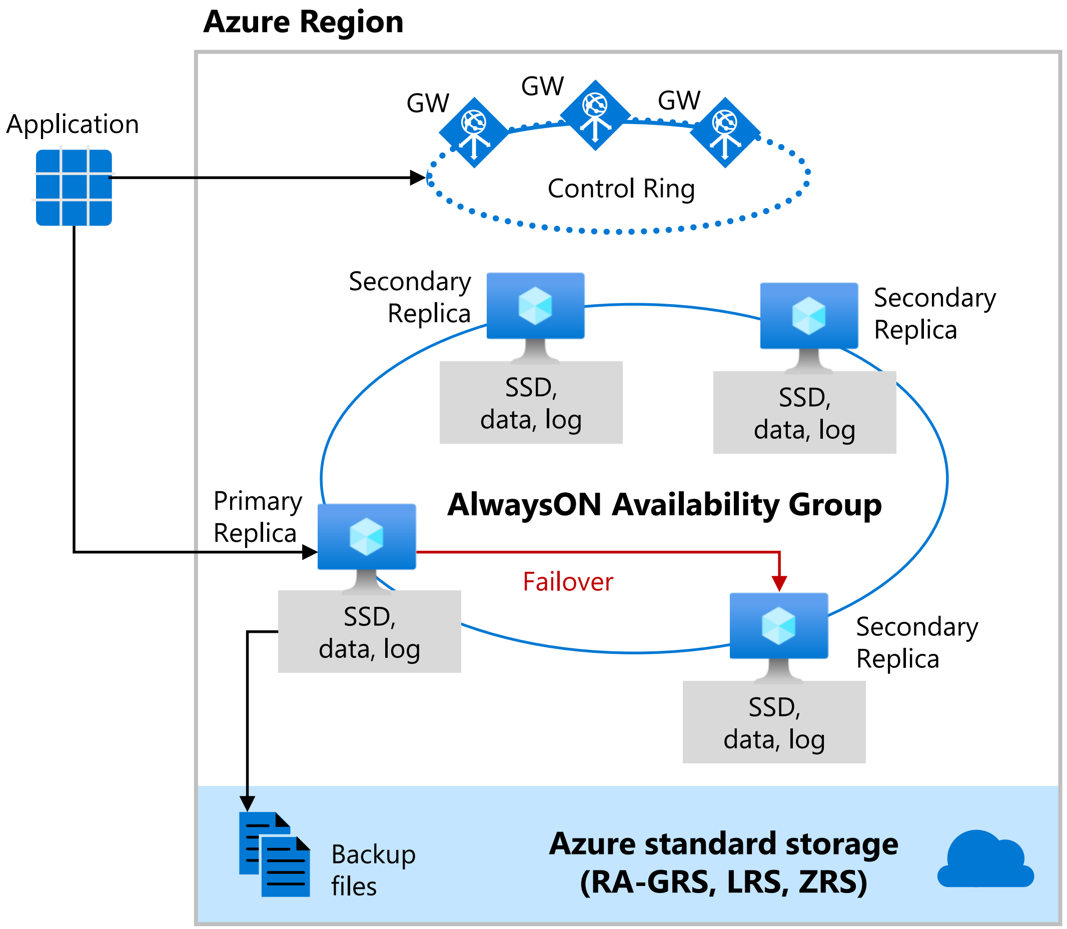
As an extra benefit, the premium availability model includes Read Scale-Out feature.



Side by Side comparison



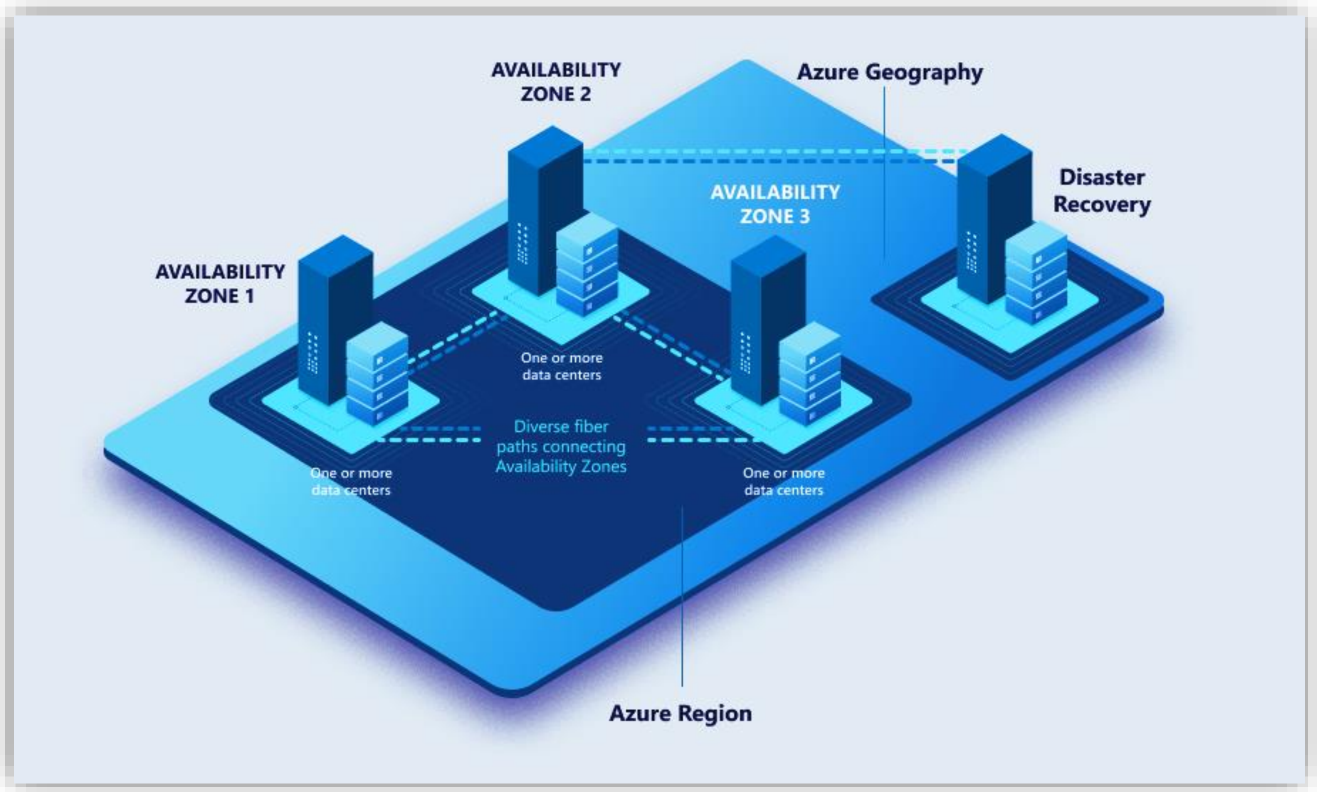
General Purpose (GP) service tier



Business Critical (BC) service

Backup storage redundancy

To enable high durability of backups several ways of replication are offered on instance creation.



The backups can be all located within

1. LRS: The same building (Local)
2. ZRS: Same region, different buildings (Zone)
3. GRS: Across paired regions (Geo)
4. GZRS: Different buildings AND paired regions (Geo-Zone)

Zone redundant configuration – General Purpose

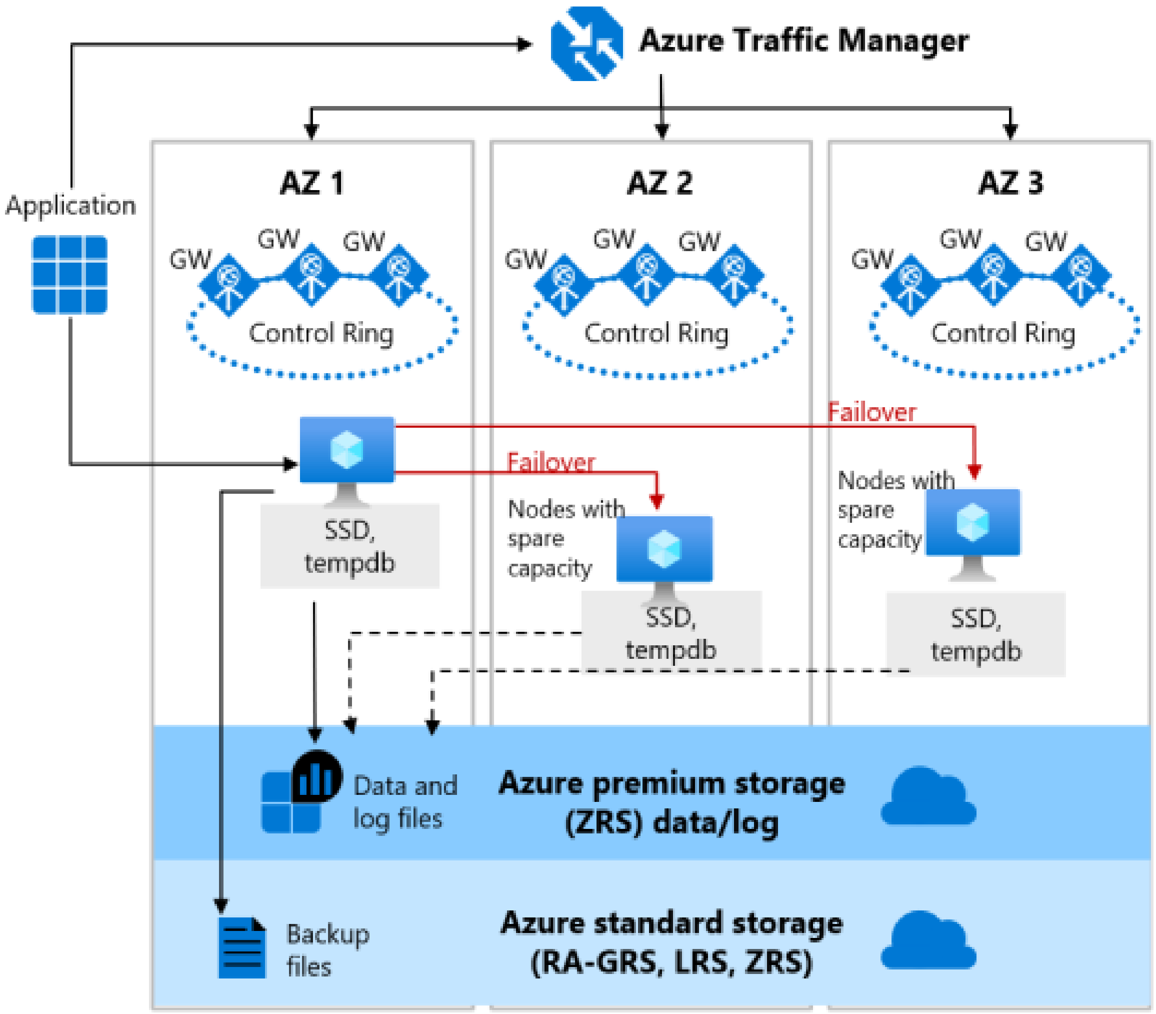
Zone redundant configurations are available in the General Purpose, Premium, and Business Critical service tiers

For General Purpose service tires, a stateful data layer with the database files (.mdf/.ldf) are stored in ZRS(zone-redundant storage).

Using ZRS the data and log files are synchronously copied across three physically isolated Azure availability zones.

For zone-redundant serverless and provisioned General Purpose databases, nodes with spare capacity are readily available in other Availability Zones for failover.

The routing is controlled by Azure Traffic Manager (ATM).

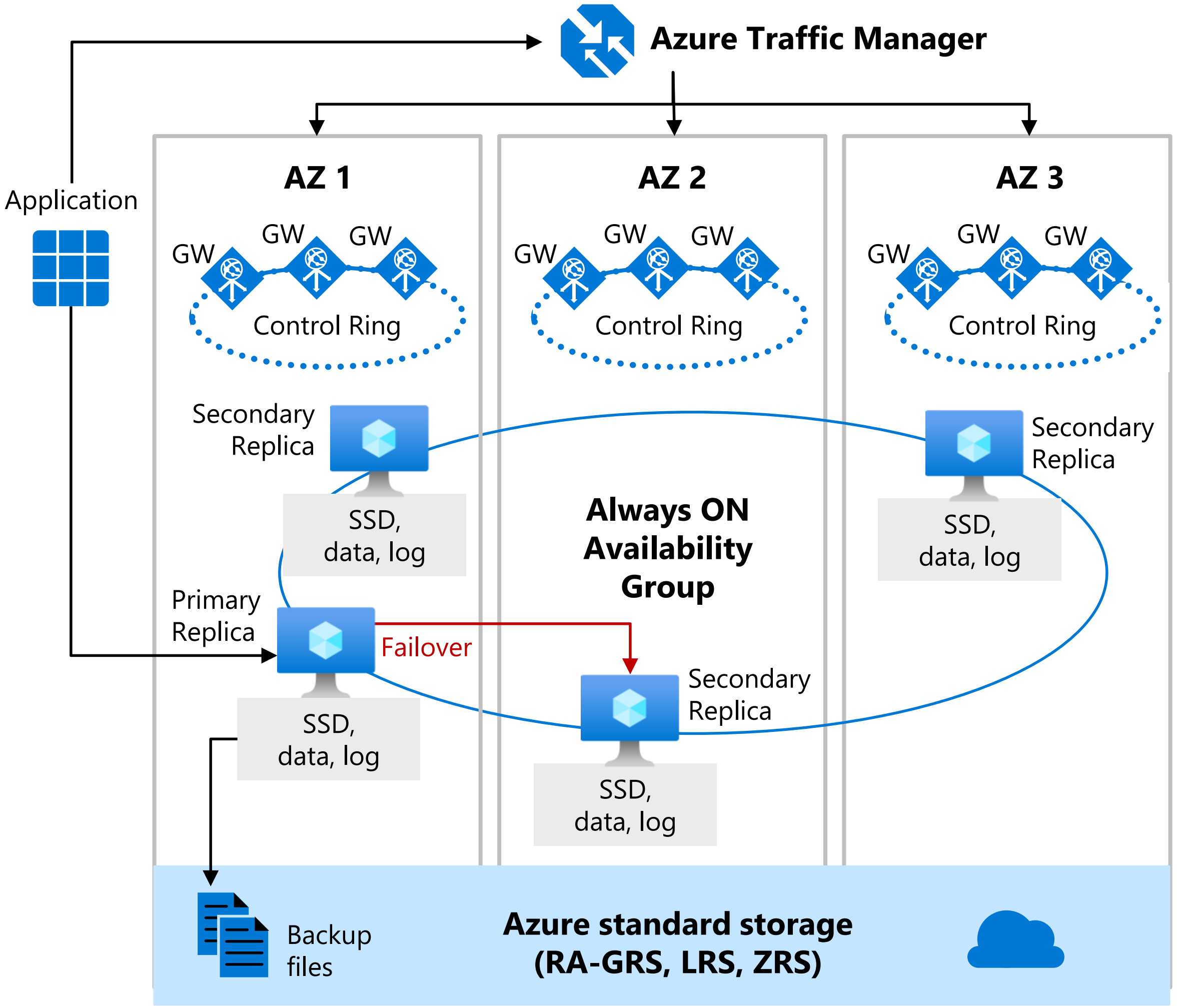


Zone redundant configuration – Premium and Business Critical

By default, the cluster of nodes for the premium availability model is created in the same datacenter.

SQL Database can place different replicas of the Business-Critical database to different availability zones in the same region.

The zone redundant databases have replicas in different datacenters with some distance between them, the increased network latency may impact the performance.



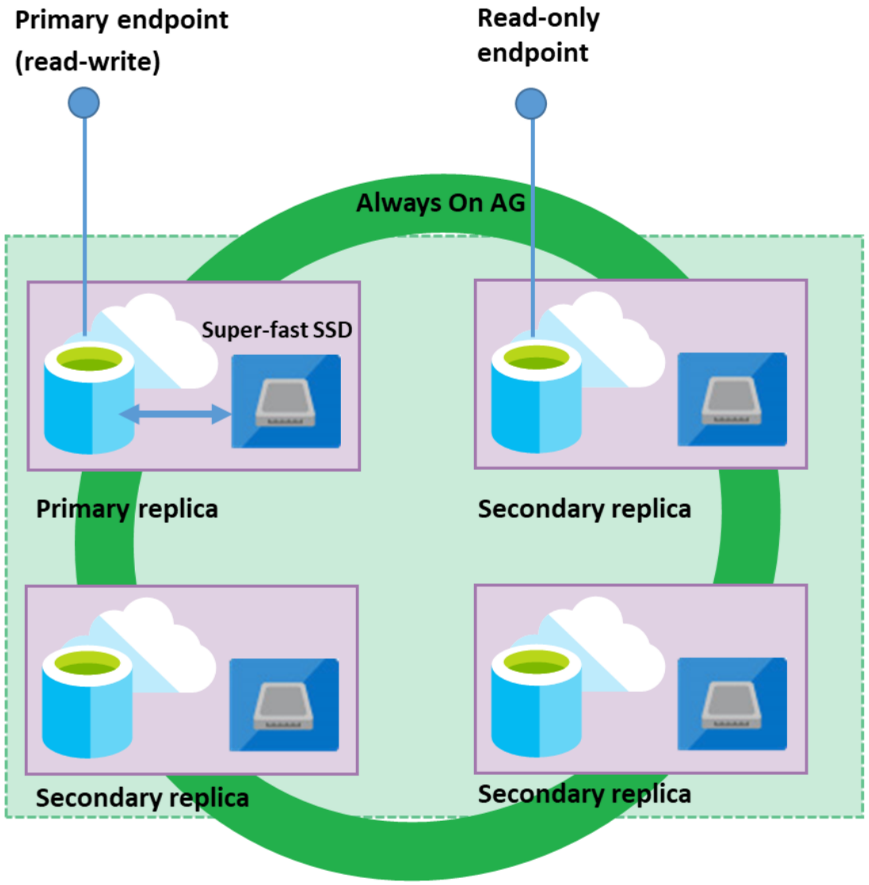
Read Scale-Out

Each database in the Premium and Business Critical service tiers is automatically provisioned with several AlwaysON replicas to support the availability SLA. These replicas are provisioned with the same compute size as the read-write.

Read Scale-Out redirects the read-only client connections to one of the ready-only replicas available instead of sharing the read-write replica.

Effectively isolate the read-only workload from the main read-write workload and doubles the compute capacity of the database or elastic pool at no additional charge.

This is ideal to scale-out for complex analytical workloads without affecting the primary OLTP workload.



How to use Read Scale-Out?

Default Configuration

- **Enabled** in **Managed Instance** Business Critical tier.
- **Disabled** in **database** placed on **SQL Database server** Premium and Business Critical tiers.

Setup Methods

- **Azure Portal**
  - Settings > Configure > Premium/Business Critical tier > Read scale-out.
- **PowerShell**
  - Set-AzSqlDatabase or
  - New-AzSqlDatabase cmdlets.
- **Azure Resource Manager REST API**
  - Create or
  - Update method

Connection

- Applications will be directed to either the read-write replica or to a read-only replica according to the **ApplicationIntent property** configured in the application's **connection string**.
- Use **ApplicationIntent=ReadOnly**; to connect to the read-only replica.

If your database is geo-replicated, be sure the read scale-out is enabled on both primary and geo-replicated secondary databases.

Demonstration

Enable and disable Read Scale-Out

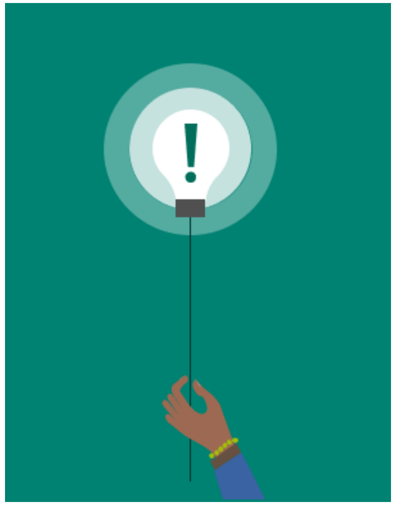
- Enabling a database with read scale-out.
- Connecting to a Read Scale-Out replica.
- Disabling read scale-out.

Lesson 2: Disaster Recovery Features in Azure SQL Database

Objectives

After completing this learning, you will be able to:

- Understand the various disaster recovery options within Azure SQL Database



Service Level Agreement (SLA)

Service tier	Single zone SLA	Multiple zones SLA
Basic, Standard, General Purpose	99.99%	N/A
Premium, Business critical	99.99%	99.995%

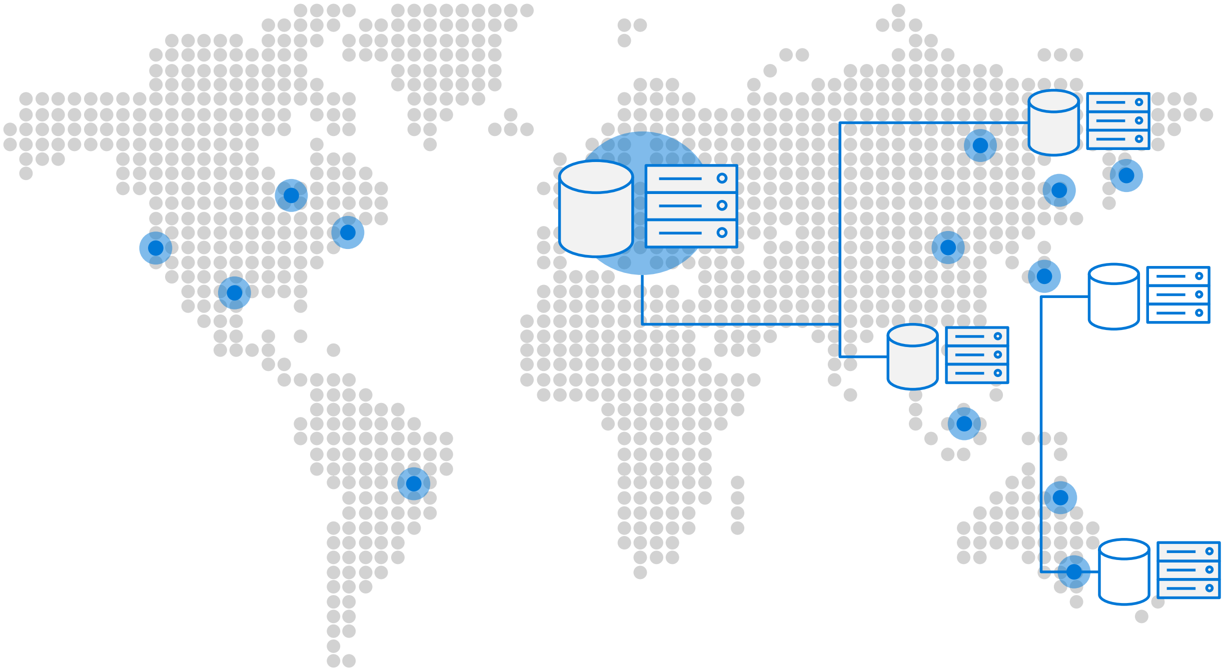
Business continuity	Service tier	SLA
Recovery point objective (RPO)	Business critical with Geo-DR	5 sec
Recovery Time Objective (RTO)	Business critical with Geo-DR	30 sec

SLA for Azure SQL Database

SLA for Azure SQL Managed Instance

Active Geo-replication

Service levels	Basic, standard, premium Self service
Readable secondaries	Up to 4
Regions available	Any Azure region
Replication	Automatic, asynchronous
Manageability tools	REST API, PowerShell, or Azure Portal
Recovery time objective (RTO)	<1 hour
Recovery point objective	<5 minutes
Failover	On demand



Up to 4 secondaries

Active geo-replication capabilities

Asynchronous Replication

Readable secondary databases

Multiple Readable Secondary Replicas

Configurable performance level of the secondary database

User-controlled failover and failback

Keeping credentials and firewall rules in sync

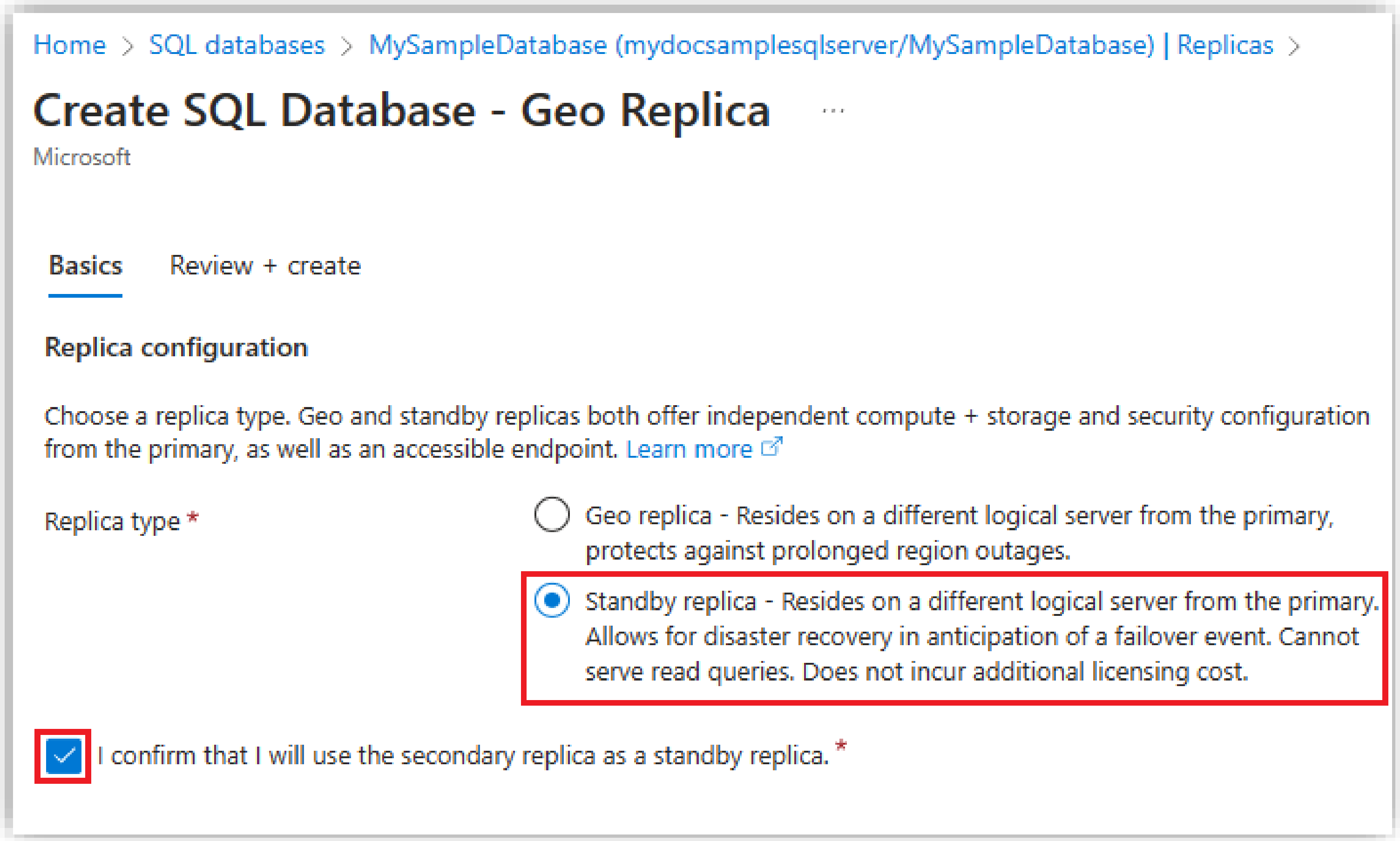
Stand-by Replicas

Available for General Purpose or Business Critical service tiers.

A secondary database replica that is used *only* for disaster recovery. Cannot have any workloads running on it, or applications connecting to it.

Provides you with the number of vCores licensed to the primary database at no extra charge under the failover rights benefit.

Save on licensing costs up to 40%. You're still billed for the compute and storage that the secondary database uses.



Home > SQL databases > MySampleDatabase (mydocsamplesqlserver/MySampleDatabase) | Replicas >

Create SQL Database - Geo Replica ...

Microsoft

Replica configuration

Choose a replica type. Geo and standby replicas both offer independent compute + storage and security configuration from the primary, as well as an accessible endpoint. Learn more

Replica type *

○ Geo replica - Resides on a different logical server from the primary, protects against prolonged region outages.

● Standby replica - Resides on a different logical server from the primary. Allows for disaster recovery in anticipation of a failover event. Cannot serve read queries. Does not incur additional licensing cost.

☑ I confirm that I will use the secondary replica as a standby replica. *

Failover groups extend geo-replication

Enable geo-replication for a group of databases within a server.

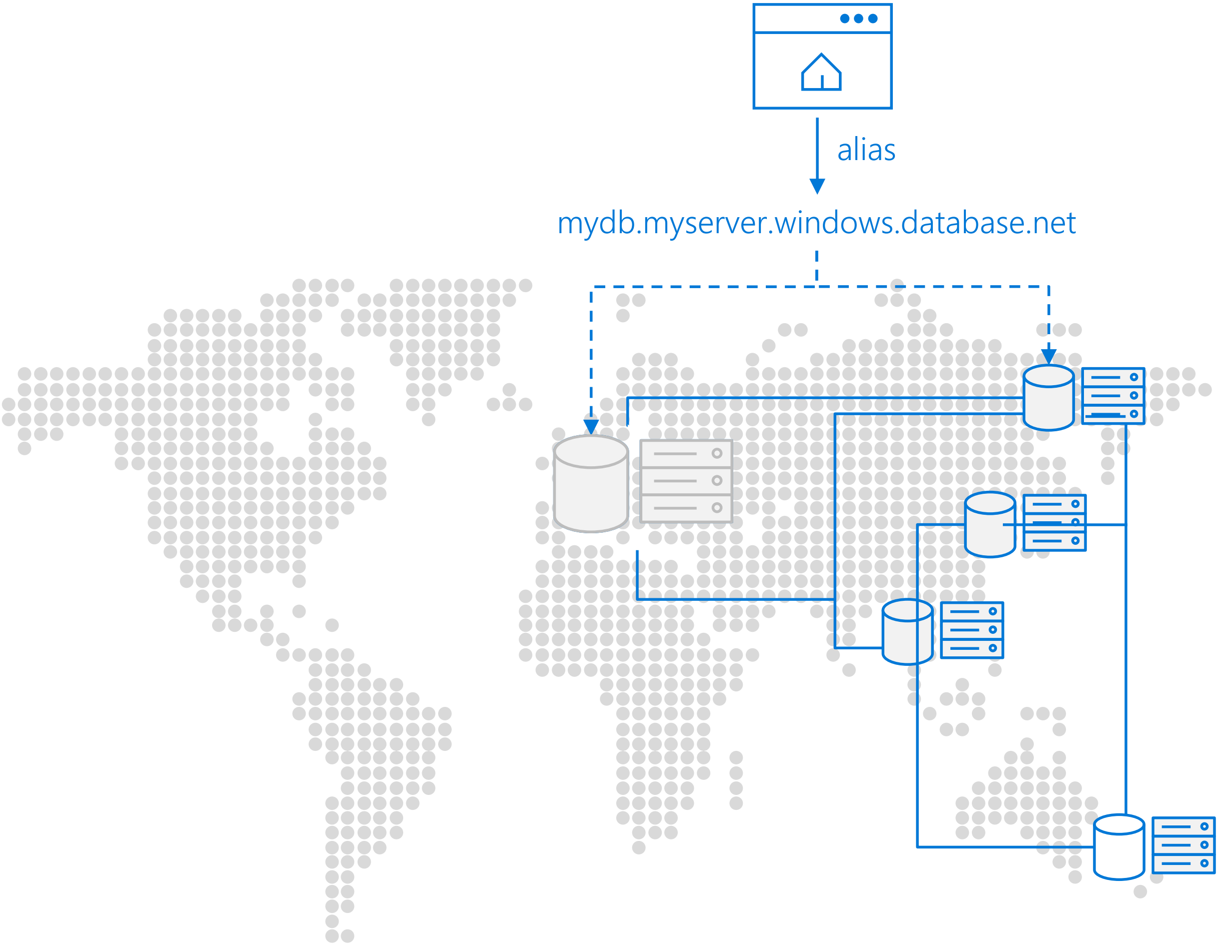
Automatically or manually failover a group of databases.

Available for all service tiers.

Configure the auto-failover policy that best meets your application needs.

Usage of and listener end-points.

DNS record is automatically updated.



*Currently in private preview - Microsoft Confidential – Shared Under NDA Only

Auto-failover group capabilities

Failover group

Failover group listener

Automatic Failover Policy

Grace Period with Data Loss

Active geo-replication vs auto-failover groups

	Geo-replication (Database)	Auto-failover groups (Server)
Automatic failover	No	Yes
Fail over multiple databases simultaneously	No	Yes
Update connection string after failover	Yes	No
Managed instance supported	No	Yes
Can be in same region as primary	Yes	No
Multiple replicas	Yes	No
Supports read-scale	Yes	Yes

Demonstration

Geo Replication

- Setup Geo Replication for an Azure SQL Database.

Configure Geo Replication for an Azure SQL Database

- **Exercise 1:** Create a Failover Group.
- **Exercise 2**: Verify the functionality of the secondary.
- **Exercise 3**: Perform a Failover.

Questions?

Knowledge Check

True or false: Can you configure both Synchronous and Asynchronous Replication for the replicas in Geo Replication?

True or false: Both primary and secondary databases are required to have the same service tier.

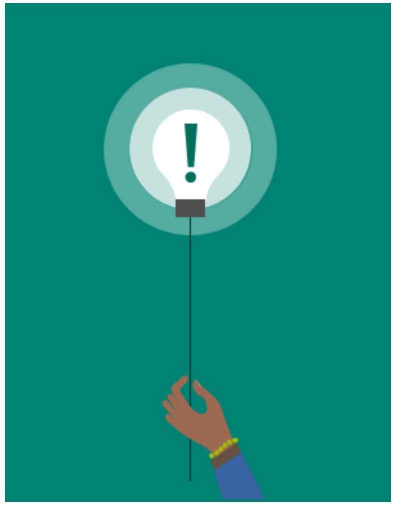
What is the Grace period with data loss on the Failover Group?

Lesson 3: Backing up and Restoring Azure SQL Database

Objectives

After completing this learning, you will be able to:

- Understand backing up and restoring Azure SQL Databases
- Setting Point-in-time-Retention (PITR) Backup Policies
- Setting Long-Term Retention (LTR) Backup Policies
- Performing Point-in-time Restore operations.

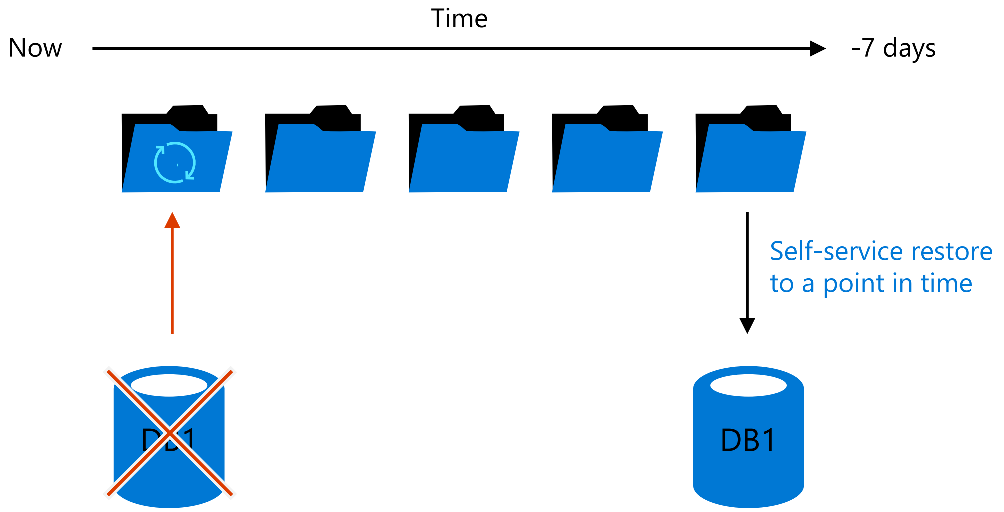


Backup and restore

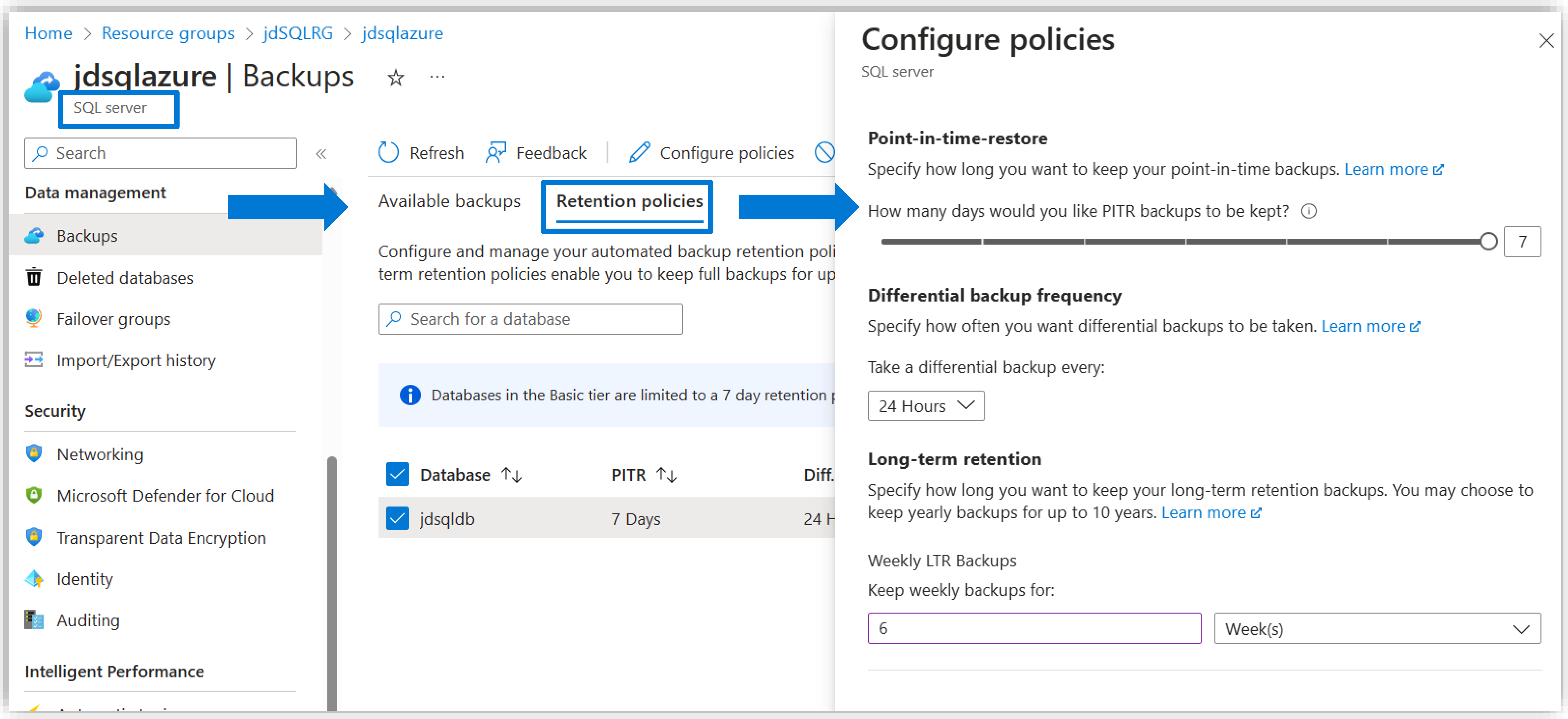
Auto backups and Point in Time Restore (PITR)

- Full Database backup once a week
- Differential Backups every 12-24 hours
- Log Backups every 5-10 minutes
- Backup files on Azure storage with RA-GRS replicated
  - Can optionally select LRS or ZRS
- Backup Integrity checks
- Restore to new database
- Long-term retention (up to 10 years) of backups
- Geo-restore of databases if primary region down
- Restore backups of deleted databases

Backups retained for 7/35 days



Setting Backup Policies



Home > Resource groups > jdSQLRG > jdsqlazure

jdsqlazure | Backups ☆ ...

SQL server

Search «

Data management

- Backups
- Deleted databases
- Failover groups
- Import/Export history

Security

- Networking
- Microsoft Defender for Cloud
- Transparent Data Encryption
- Identity
- Auditing

Intelligent Performance

Refresh | Feedback | Configure policies

Available backups | Retention policies

Configure and manage your automated backup retention poli
term retention policies enable you to keep full backups for up

Search for a database

Databases in the Basic tier are limited to a 7 day retention p

☑ Database ↑↓	PITR ↑↓	Diff.
☑ jdsqldb	7 Days	24 H

Configure policies

SQL server

Point-in-time-restore

Specify how long you want to keep your point-in-time backups. Learn more

How many days would you like PITR backups to be kept? ⓘ

7

Differential backup frequency

Specify how often you want differential backups to be taken. Learn more

Take a differential backup every:

24 Hours

Long-term retention

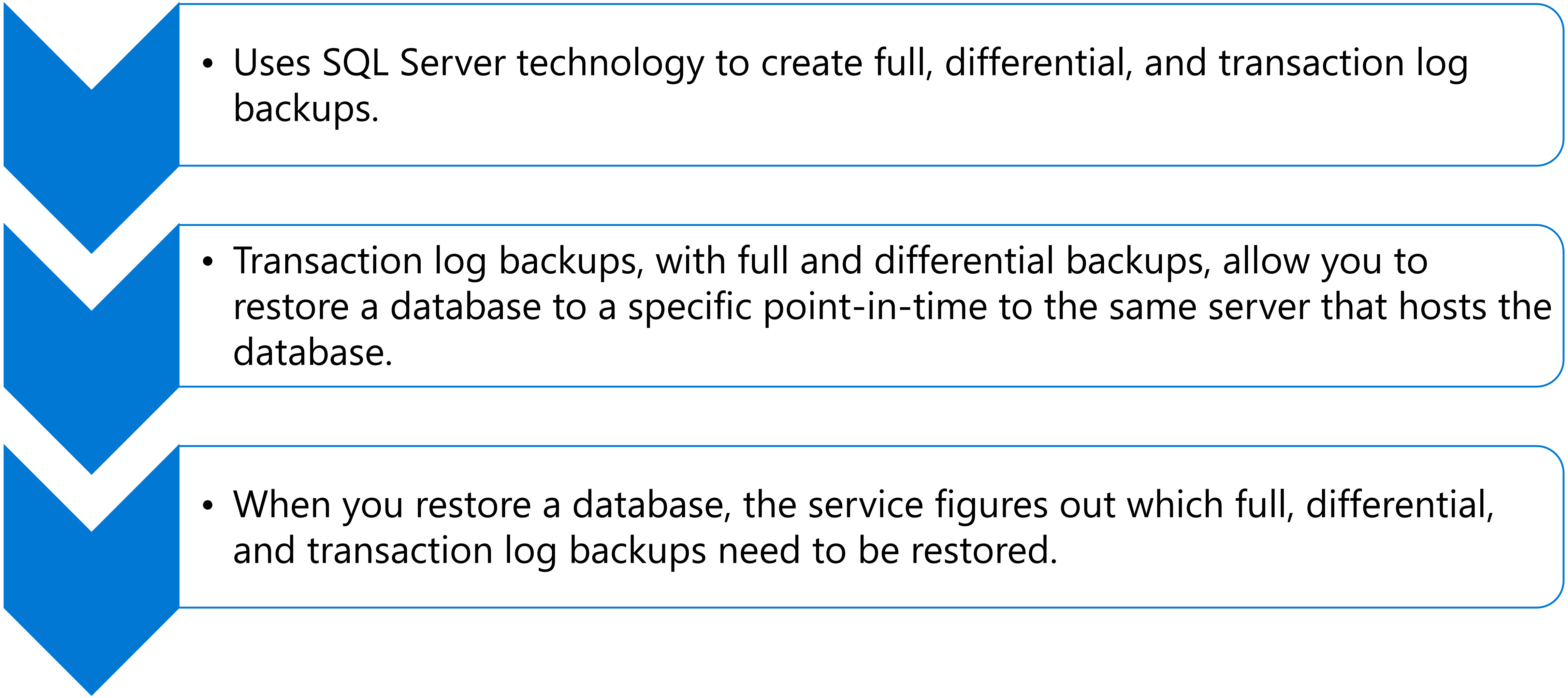
Specify how long you want to keep your long-term retention backups. You may choose to keep yearly backups for up to 10 years. Learn more

Weekly LTR Backups

Keep weekly backups for:

6 | Week(s)

Automatic Backups



- Uses SQL Server technology to create full, differential, and transaction log backups.
- Transaction log backups, with full and differential backups, allow you to restore a database to a specific point-in-time to the same server that hosts the database.
- When you restore a database, the service figures out which full, differential, and transaction log backups need to be restored.

Backup storage redundancy

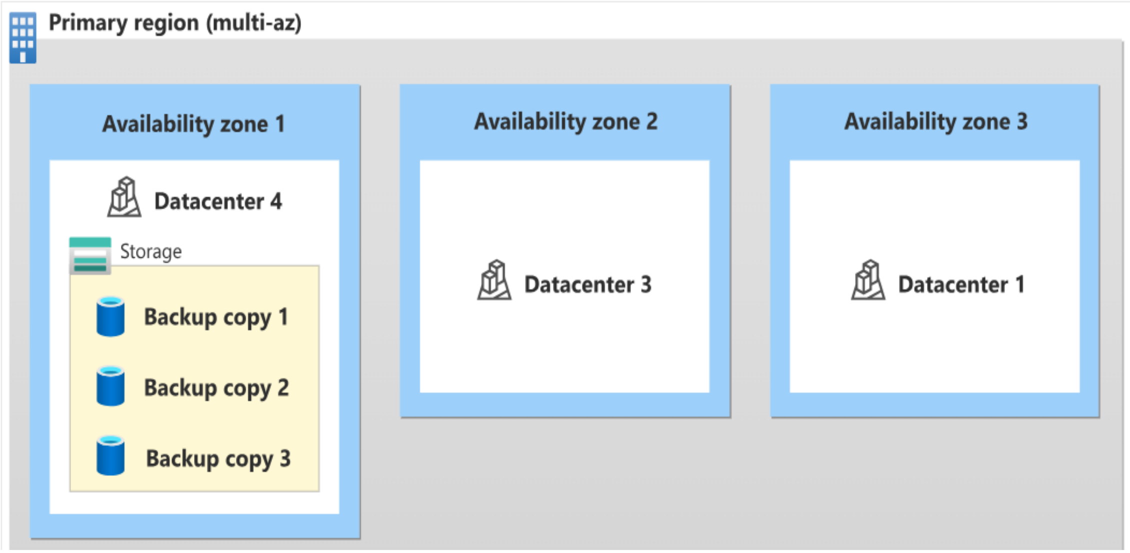
By default, new Azure SQL Databases store backups in geo-redundant storage blobs that are replicated to a paired region.

You can then recover a database using these backups using the Azure portal or PowerShell.

The Azure Portal provides a Workload environment option that helps to preset some configuration settings. These settings can be overridden.

Storage Redundancy for Backups

Locally redundant storage (LRS)



Primary region (multi-az)

Availability zone 1

Datacenter 4

Storage

Backup copy 1

Backup copy 2

Backup copy 3

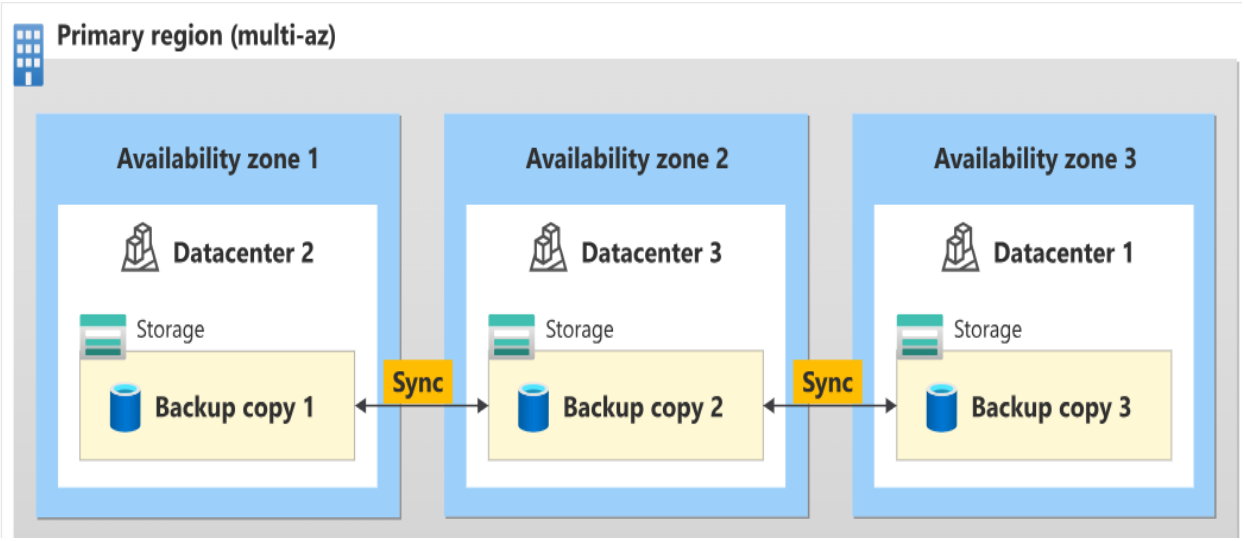
Availability zone 2

Datacenter 3

Availability zone 3

Datacenter 1

Zone-redundant storage (ZRS)



Primary region (multi-az)

Availability zone 1

Datacenter 2

Storage

Backup copy 1

Sync

Availability zone 2

Datacenter 3

Storage

Backup copy 2

Sync

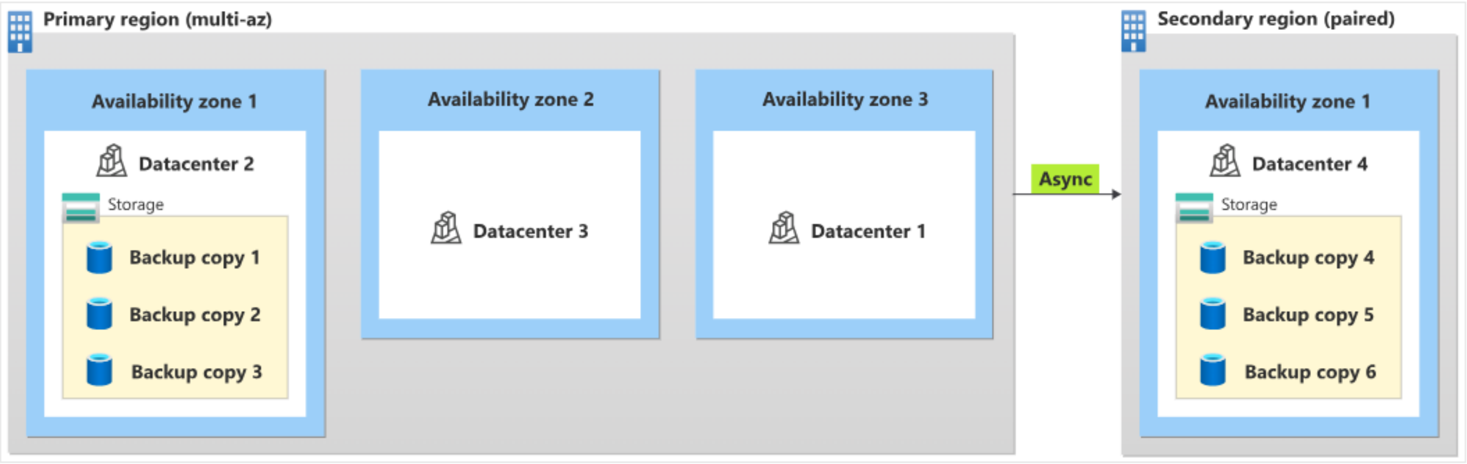
Availability zone 3

Datacenter 1

Storage

Backup copy 3

Geo-redundant storage (GRS)



Primary region (multi-az)

Availability zone 1

Datacenter 2

Storage

Backup copy 1

Backup copy 2

Backup copy 3

Availability zone 2

Datacenter 3

Availability zone 3

Datacenter 1

Async

Secondary region (paired)

Availability zone 1

Datacenter 4

Storage

Backup copy 4

Backup copy 5

Backup copy 6

Azure SQL Database Backup Retention Periods

All Azure SQL databases (single, pooled, and managed instance databases) have a default backup retention period of **seven** days.

You can change backup retention period up to 35 days.

If you delete a database, SQL Database will keep the backups in the same way it would for an online database.

If you need to keep the backups for longer than the maximum retention period, you can modify the backup properties to add one or more long-term retention periods to your database.

The point-in-time backups are geo-redundant and protected by Azure Storage cross-regional replication.
How long are backups kept.

How to change backup retention period

You can change the default PITR backup retention period using the Azure portal, PowerShell, or REST API.

The following examples illustrate how to change PITR retention to 28 days.

PowerShell

```
Set-AzSqlDatabaseBackupShortTermRetentionPolicy -ResourceGroupName resourceGroup -ServerName testserver -DatabaseName testDatabase -RetentionDays 28
```

REST

```
PUT https://management.azure.com/subscriptions/00000000-1111-2222-3333-444444444444/resourceGroups/resourceGroup/providers/Microsoft.Sql/servers/testserver/databases/testDatabase/backupShortTermRetentionPolicies/default?api-version=2017-10-01-preview
```

The supported values are: 7, 14, 21, 28 or 35 days.

Extending the Retention Period

You can configure a single or a pooled database with a long-term backup retention policy (LTR) to automatically retain the database backups in separate Azure Blob storage containers for up to 10 years.

You can then recover a database using these backups using the Azure portal or PowerShell.

Deleting LTR backup is non-reversible. To delete an LTR backup after the server has been deleted you must have Subscription scope permission.

How SQL Database long-term retention works

Long-term backup retention leverages the automatic SQL Database backups created to enable point-time restore (PITR).

Specify for each SQL database how frequently you need to copy the backups to the long-term storage.

- Weekly backup retention (W)
- Monthly backup retention (M)
- Yearly backup retention (Y)
- Week of year (WeekOfYear)

W=0, M=0, Y=5, WeekOfYear=3

The 3rd full backup of each year will be kept for 5 years.

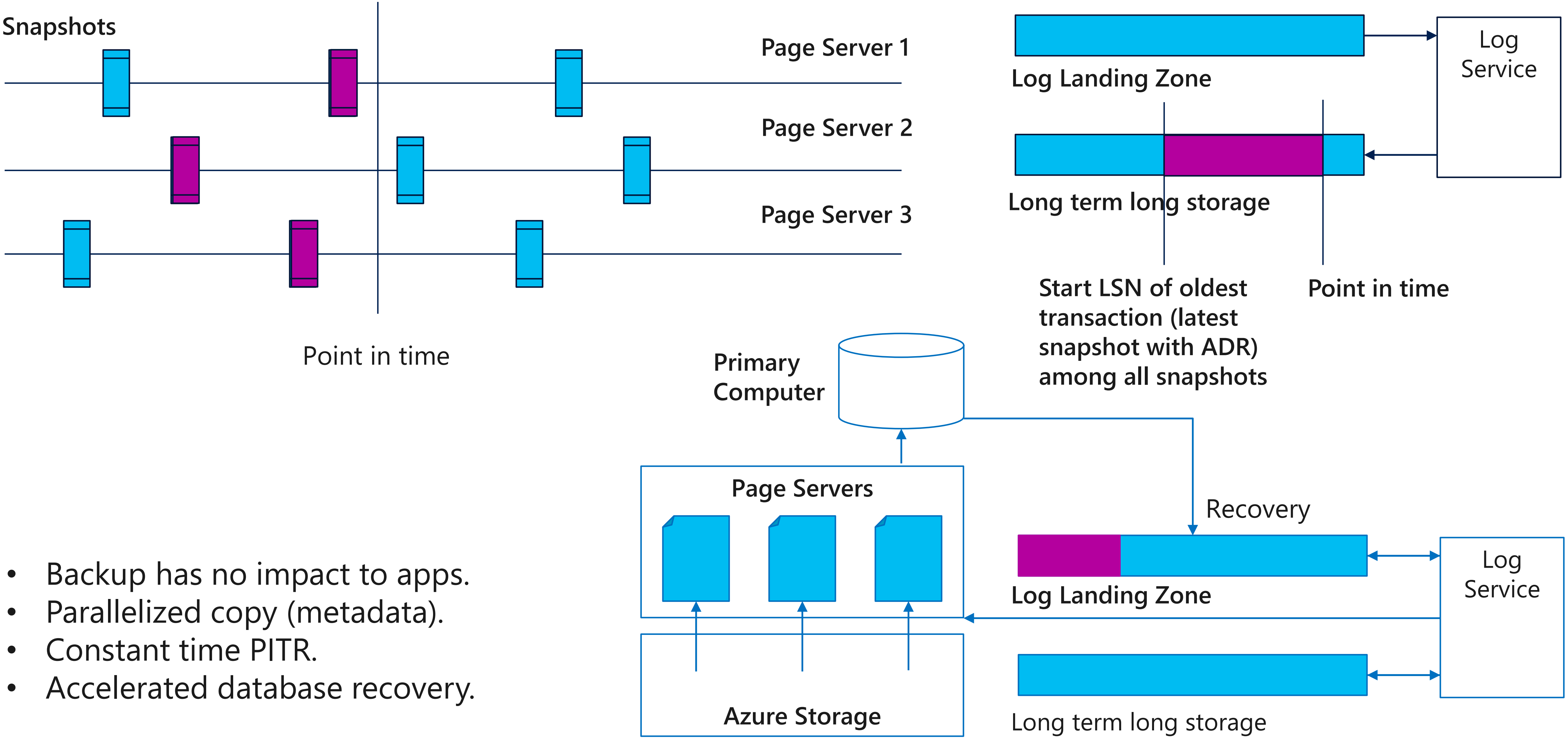
W=0, M=3, Y=0

The first full backup of each month will be kept for 3 months.

W=12, M=0, Y=0

Each weekly full backup will be kept for 12 weeks.

Hyperscale Backup & Restore



- Backup has no impact to apps.
- Parallelized copy (metadata).
- Constant time PITR.
- Accelerated database recovery.

Demonstration

Configure the long-term retention and view backups in long-term retention.

Copy & Export

Copy

- Copies an Azure SQL Database to another DB on same or different Server.
- Essentially Creates a snapshot.

Export

- Creates BACPAC.
- Use Portal, SSMS, PowerShell or SQLPackage Utility.

Neither of these were really designed for ongoing backup operations.

Point In Time Restore

The database can be restored to any service tier or performance level

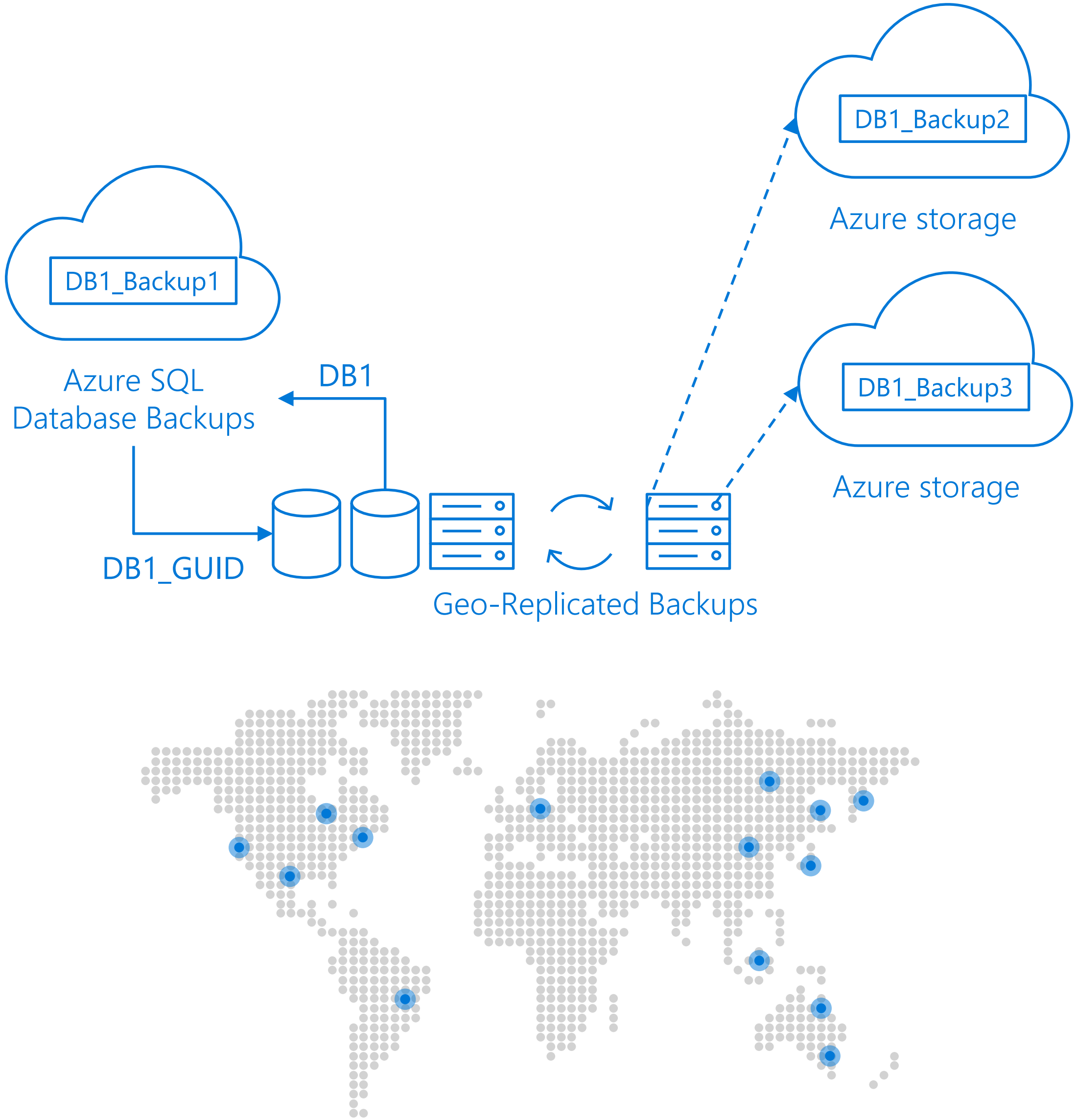
- Creates a new database in the same logical server.

Database Replacement

- Rename the original database and then give the restored database the original name using the ALTER DATABASE command in T-SQL.

Data Recovery

- Write and execute the necessary data recovery scripts to extract data from the restored database to the original database.



Geo-Restore

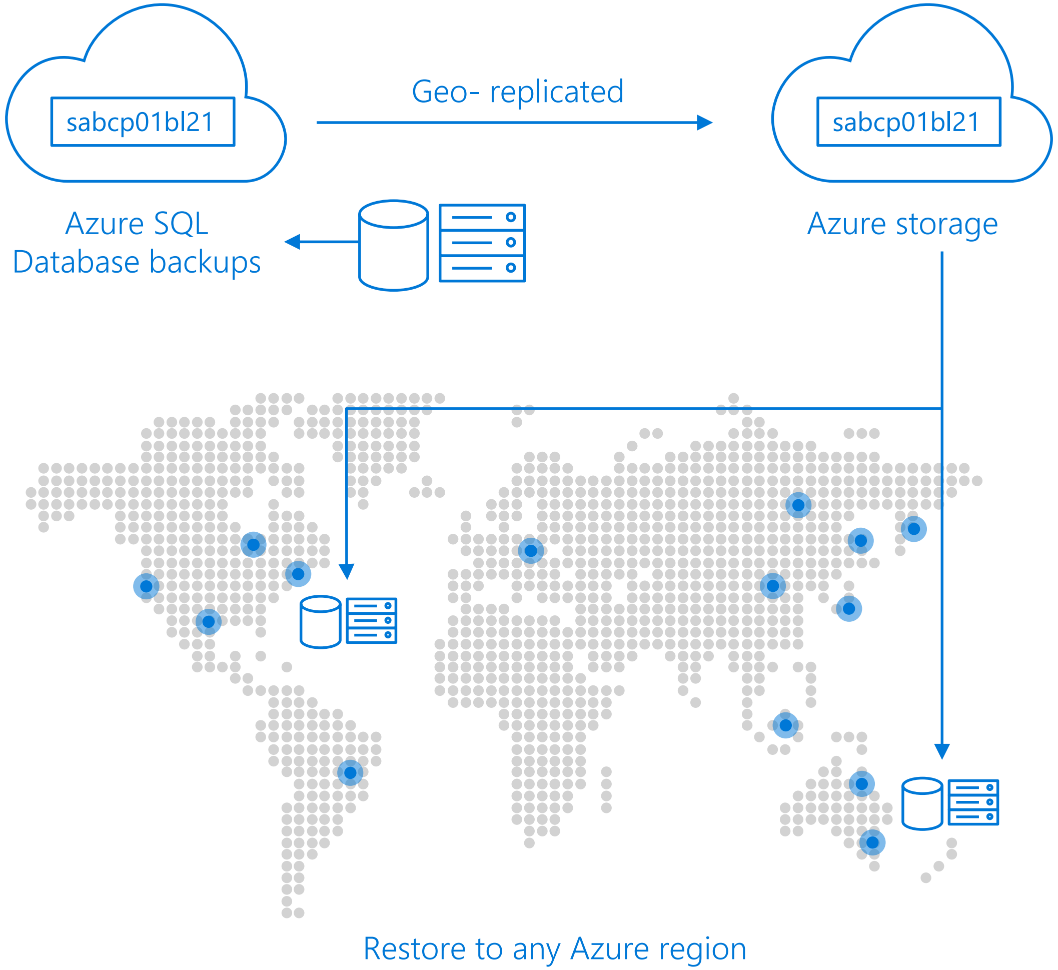
Restores last daily backup to any Azure region.

Built on geo-redundant Azure Storage.

RTO≥24h, RPO=24h

Database URL will change after restore.

Point-in-time restore on a geo-secondary is not currently supported.



Recover an Azure SQL database by using automated database backups

By default, Azure SQL Database backups are stored in **geo-replicated blob storage** (RA-GRS storage type).

The following options are available for database recovery by using automated database backups. You can:

- Create a **new database** on the **same SQL Database server**, recovered to a specified point in time within the retention period.
- Create a **database** on the **same SQL Database server**, recovered to the deletion time for a deleted database.
- Create a **new database** on any SQL Database server **in the same region**, recovered to the point of the most recent backups.
- Create a **new database** on any SQL Database server **in any other region**, recovered to the point of the most recent replicated backups.

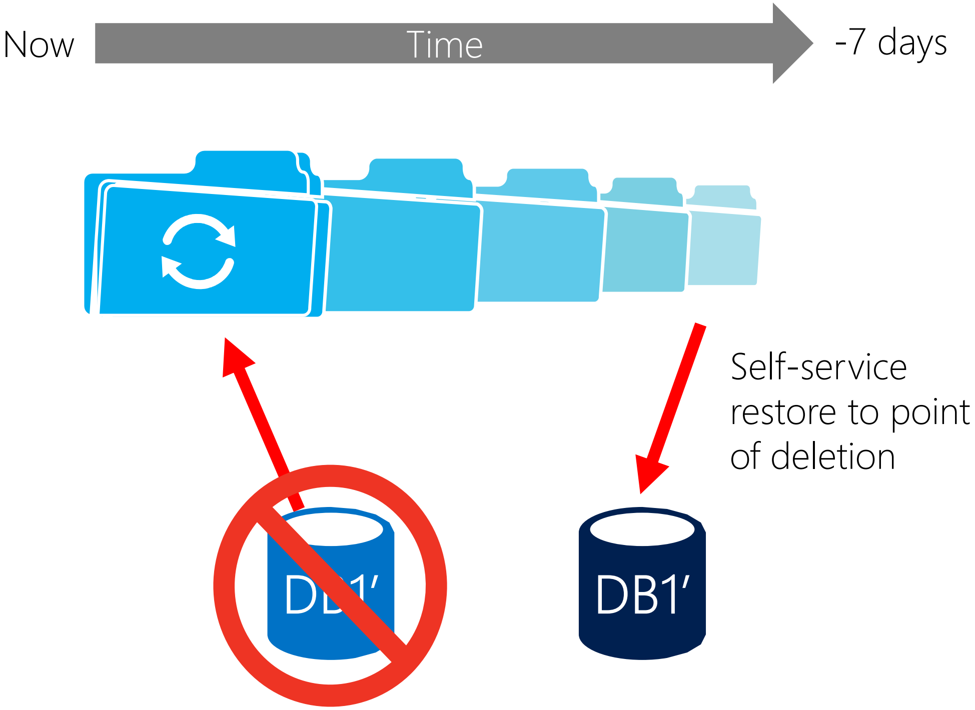
If you configured backup long-term retention, you could also create a new database from any long-term retention backup on any SQL Database server.

Restore Deleted Database

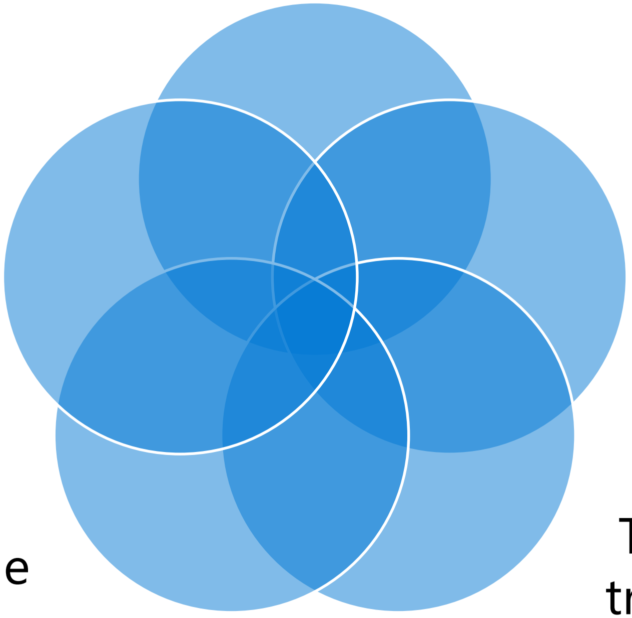
Recovery after accidental database deletion:

- Restores the database to the point of deletion. (earlier backups are deleted).
- Creates a new database on the server used by the original database.
- You can choose to failover to the restored database or use scripts to recover data.

Backups retained for 7/35/35 days



Factors Affecting Recovery Time



Size of the database.

Performance level of the database.

The number of transaction logs involved.

The network bandwidth if the restore is to a different region.

Number of concurrent restore requests.

Demonstration

Point in Time Restore

- Perform a point in time restore of a database.

Point in time restore of an Azure SQL Database

- **Exercise 1**: Perform a point in time restore over the original database.
- **Exercise 2**: Rename old and new databases.

LAB

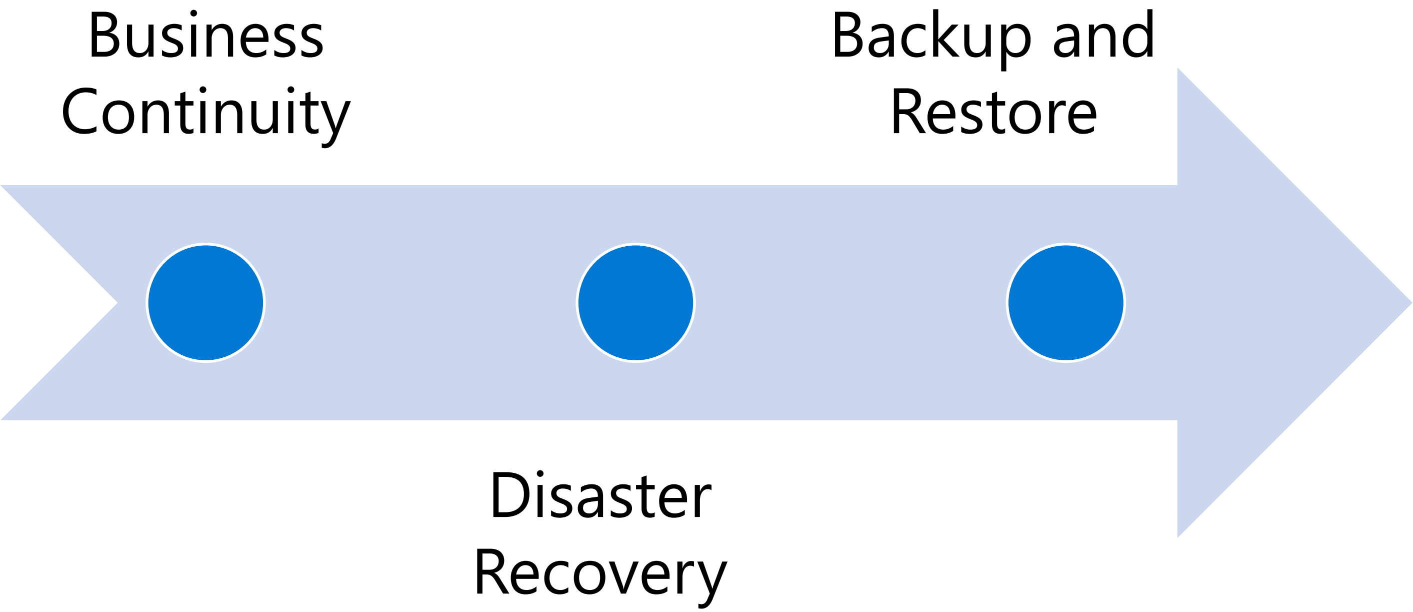
Questions?

Knowledge Check

True or false: Daily and weekly backups of Azure SQL databases are automatically uploaded to geo-redundant Azure Storage.

True or false: When performing a point-in-time restore, you can choose to overwrite the source database?

Module Summary



Business Continuity

Disaster Recovery

Backup and Restore

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