Becoming an Azure SQL DBA

PASS24
Data Community Summit

Learning pathway session

① High Availability and BCDR

November 6 | 11:15 AM–12:15 PM | 345–346

Microsoft Azure Data

Bob Ward

Principal Architect
Microsoft

Bob Ward is a Principal Architect for the Microsoft Azure Data team, which owns the development for Microsoft SQL Edge to Cloud. Bob has worked for Microsoft for 30+ years on every version of SQL Server shipped from OS/2 1.1 to SQL Server 2022 including Azure SQL.

@bobwardms

https://aka.ms/azuresql4beginners

www.linkedin.com/in/bobwardms

Dr. Dani Ljepava

Product Manager
Microsoft

Dani is a Senior Product Manager at Microsoft working on building Azure SQL platform features.

Experience in SQL team includes hybrid environments, data mobility, high availability, backup and restore, monitoring, intelligent performance features, and development of data mobility features for SQL Server 2016-2022. Involved with building Azure SQL Managed Instance since the service launch in 2018.

@danimir

aka.ms/sqlmi-videos

https://www.linkedin.com/in/danimir

Pam Lahoud

Principal PM Manager
Microsoft

Pam Lahoud is a Principal PM Manager in Azure Data, based in Redmond, WA, USA. She has been with Microsoft since 2006 and currently leads the Databases in Fabric CAT team. She is passionate about SQL Server performance and has focused on performance tuning and optimization, particularly from the developer perspective, throughout her career. She is a SQL 2008 MCM with over 25 years of experience working with SQL Server, and co-author of the book “Learn T-SQL Querying”.

@SQLGoddess

https://aka.ms/LearnTSQLQuerying

https://www.linkedin.com/in/pam-lahoud

Niko Neugebauer

Product Manager
Microsoft

Niko is a Product Manager at Microsoft, who is working on building Azure SQL platform features.

In his previous roles for over 20 years he helped customers successfully build, migrate and optimize Microsoft Data solutions in OLTP & OLAP markets.

@nikoneugebauer

aka.ms/sqlmi-videos

www.linkedin.com/in/nikoneugebauer/

Erin Stellato

Product Manager
Microsoft

Erin Stellato is a Principal Program Manager on the SQL Experiences team, helping advance tools that customers use daily with Azure SQL. She is passionate about data and chocolate, but not always in that order. She previously worked as a consultant and was a Data Platform MVP and has been an active member of the SQL Server community as both a volunteer and speaker.

@erinstellato

https://www.sqlskills.com/about/erin-stellato/

www.linkedin.com/in/erinstellato

Learning Pathway: Becoming an Azure SQL DBA
Advancing the Role of the On-Premises SQL Server DBA

Wednesday Nov 6th

① **High Availability and BCDR**

11:15am – 12:15pm

Room 345-346

② **Security, Compliance, Threats, Connectivity**

2:00pm – 3:00pm

Room 345-346

Thursday Nov. 7th

③ **Performance Monitoring, Tuning and Alerting**

11:30am – 12:30pm

Room 345-346

④ **New Opportunities from Basics to Microsoft Copilot**

2:00pm – 3:00pm

Room 345-346

Agenda

- Introduction to Azure SQL
- Azure SQL High Availability and Disaster Recovery
  - Shared responsibilities Microsoft and DBA
- Automated backups in Azure SQL
  - Shared responsibilities Microsoft and DBA
- Learning resources

Introduction to Azure SQL

Overview of services

Azure SQL – family of SQL cloud databases

Customer manages

IaaS - Infrastructure as a Service

SQL Server on Azure Virtual Machines

Best for: *Migrating ("**lift and shift**") 3rd party apps* to customer-managed Azure virtual machines.

Microsoft manages

PaaS - Platform as a Service

Azure SQL Managed Instance

Best for: *Migrating custom **apps at-scale*** to a Microsoft-managed, SQL Server-compatible instance.

Azure SQL Database

Best for: ***Developing*** *highly-scalable, AI-ready applications* with SQL's reliability and security at commercial open-source database costs.

Migration

Innovation

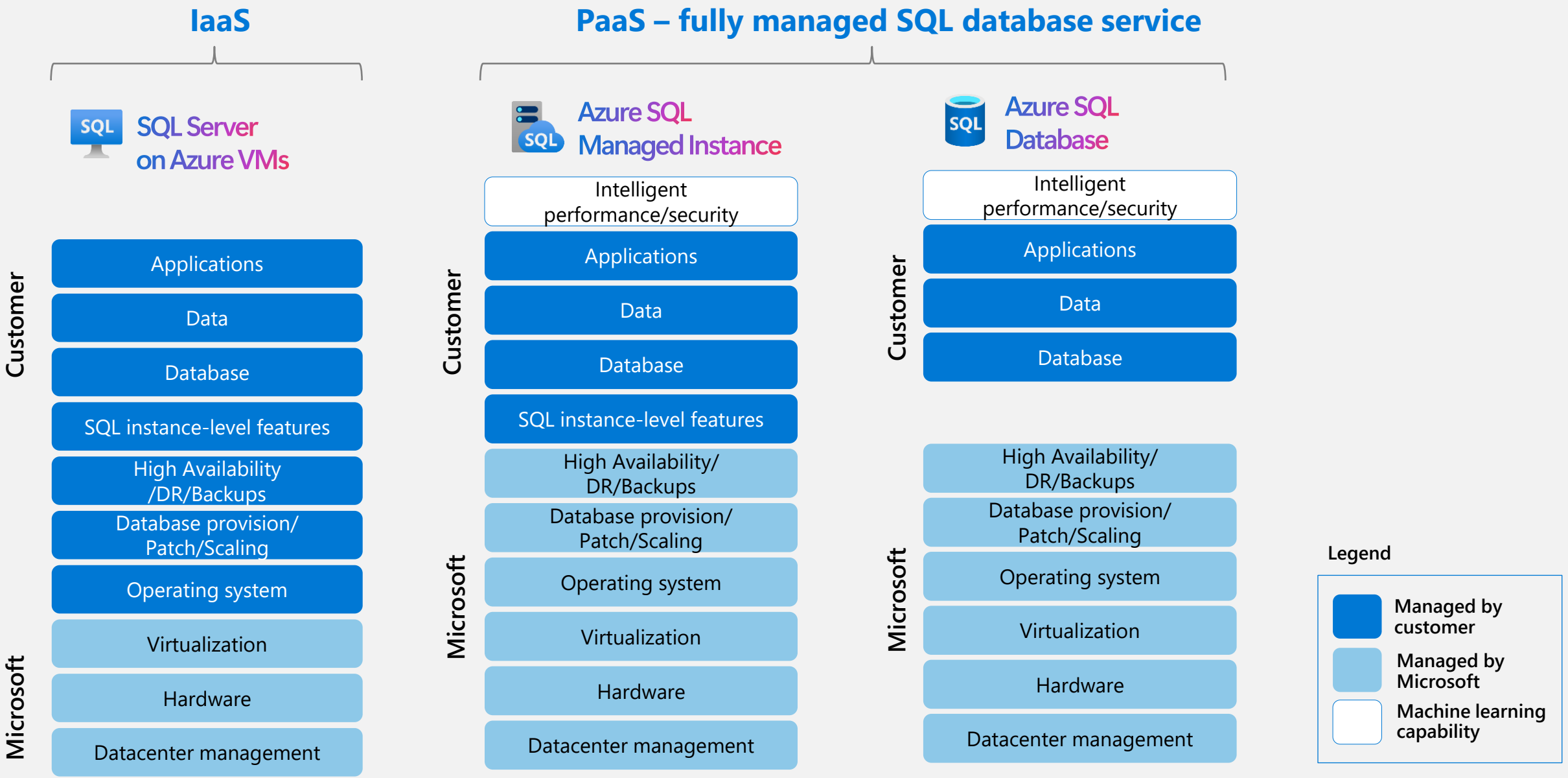
Azure SQL enabled by Azure Arc

Run Azure SQL on premises and in multi-cloud environments

Your first step on the journey to Azure.

Azure is the cloud that knows SQL Server best

Shared responsibility



Which Azure SQL offering is right for you?

Control — **Migration**

Customer managed

Do you need

- OS level access?
- Capabilities at the VM level?
- SQL Server versions 2008 - 2019?
- SSRS/SSAS?

Yes → SQL Server on Azure VMs*

No ↓

App Modernization

Microsoft managed

Do you need

- An instance model?
- On-premises SQL Server compatibility?
- Native vNet support?
- Native restore and log shipping
- Cross-DB queries and Linked Server
- Service Broker and Event Notifications
- SQL Agent and Transactional Replication
- .NET CLR integration
- Near real-time data replication from on-premises to the cloud?
- Up to 32TB of database storage

Yes → Azure SQL Managed Instance

No ↓

Cloud-Born App Development

Do you need

- A database model?
- Resource pooling for multi-tenant SaaS?
- More than 32TB of database storage?
- Serverless - workload based automatic pause\resume?

Yes → Azure SQL Database

Benefits of IaaS

- Maintain OS-level control
- Easy lift-and-shift eliminates app refactoring
- Faster path to the cloud

Benefits of PaaS

- Lower administrative burden
- No End of Support hassles
- Fully managed and always up to date
- Dynamic resource scaling
- Built-in high availability and automatic backups
- Multi-model capabilities

* Use Azure Arc to enable the same services in your datacenter or on the cloud of your choice, when a hybrid or multi-cloud approach is required

Optimize your Azure SQL Costs

Key offers lower your total cost of ownership

Azure Hybrid Benefit

- Transfer existing SQL Server licenses to get discounts (up to 55% savings)

Reserved Capacity

- Prepay for 1 or 3 years (up to 33% savings)
- Combine with Azure Hybrid Benefit (up to 80% savings)

Dev/Test Pricing

- Use dev/test subscription – no cost for SQL licenses
- Eligible with active Visual Studio subscriptions

License-Free Standby Replica

- Free SQL license if used as a passive replica

Azure SQL
High Availability
and Disaster Recovery

Overview of capabilities

Important Definitions

What is High Availability (HA)?

- Maintaining availability of the service/application with minimum downtime, this is typical place where four 9s (99.99%) come into picture.
- Any outage, for maintenance, upgrade, or failure, planned or unplanned, detracts from the HA goal.

Provided by the service

What is Disaster Recovery (DR)?

- Data Center is lost because of a natural calamity or some unforeseen power issue.
- Getting online is priority with an understanding of losing some data.

Opt-in capability

High Availability

Customer manages

IaaS - Infrastructure as a Service

SQL Server on Azure Virtual Machines

Microsoft manages

PaaS - Platform as a Service

Azure SQL Managed Instance

Azure SQL Database

SQL Server on Azure
Virtual Machines

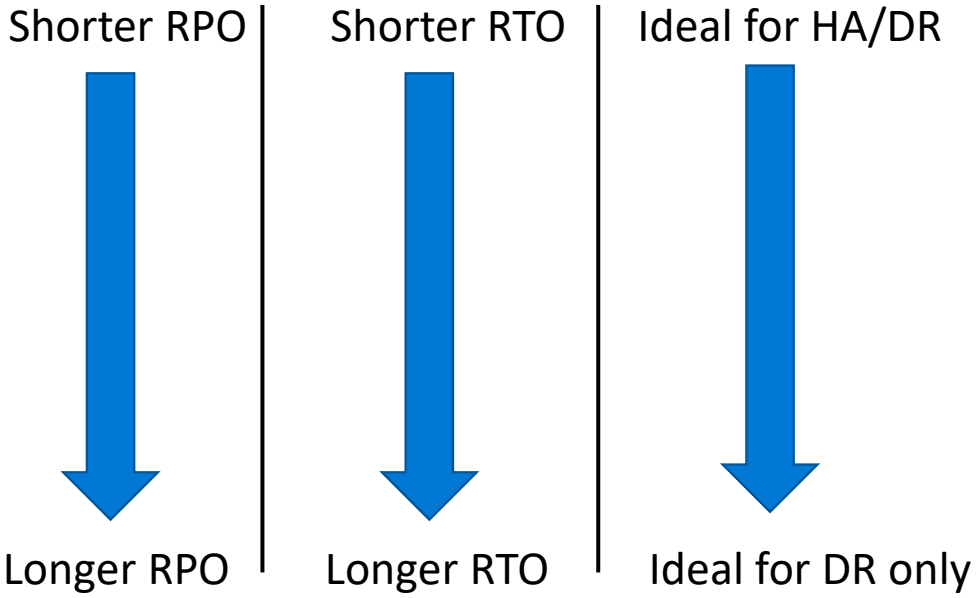
HA & DR for Azure IaaS services

SQL Server in Azure Virtual Machine HA

It's no different than on-premises

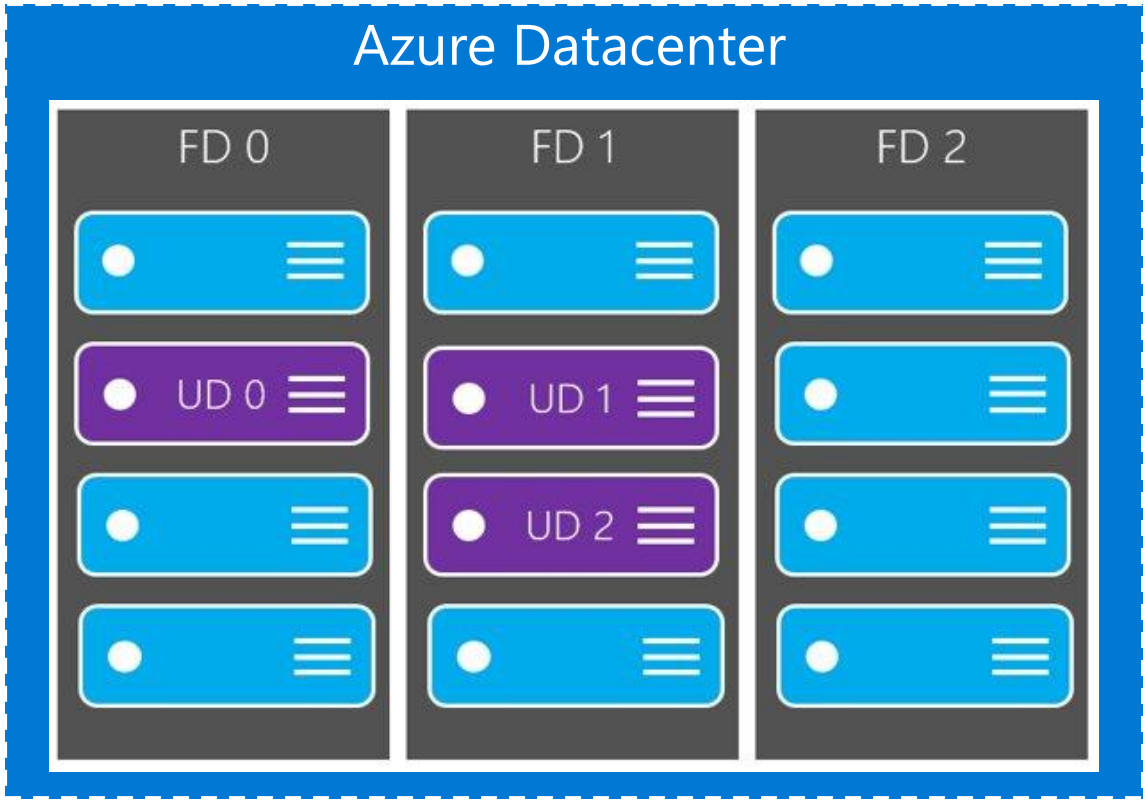
You manage:

- Always On Availability Group (AG)
- Always On Failover Cluster Instance (FCI)
- Log Shipping
- Backup and Restore



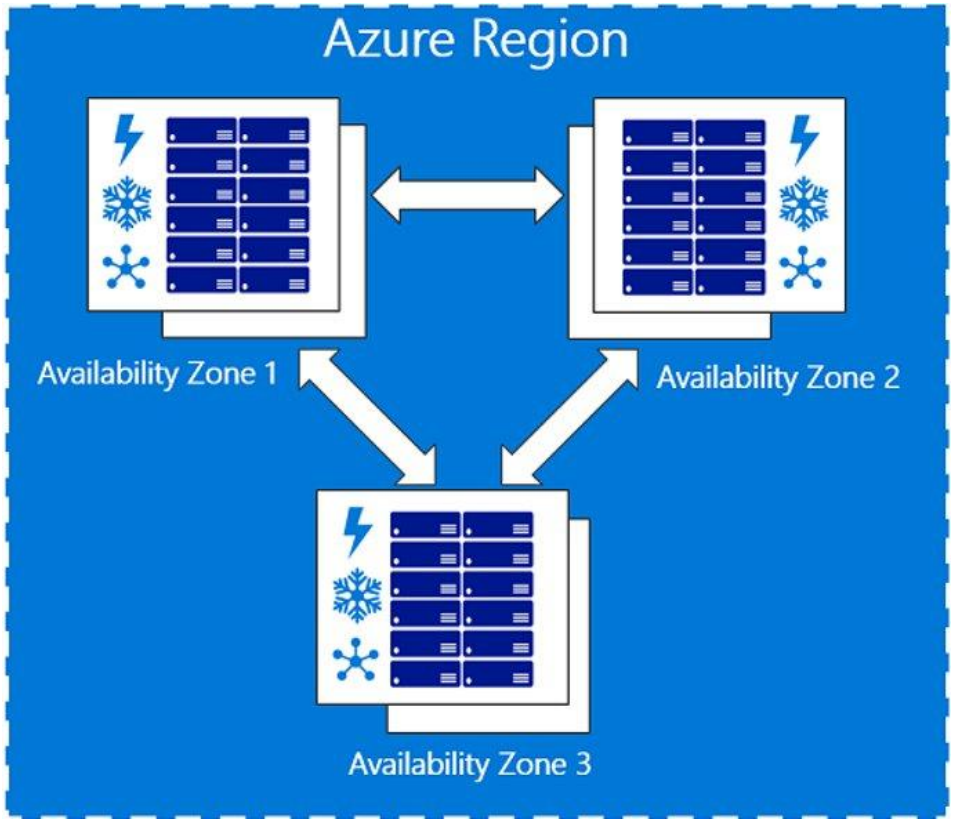
Redundancy options for Azure SQL VMs

Availability Sets (99.95% HA)



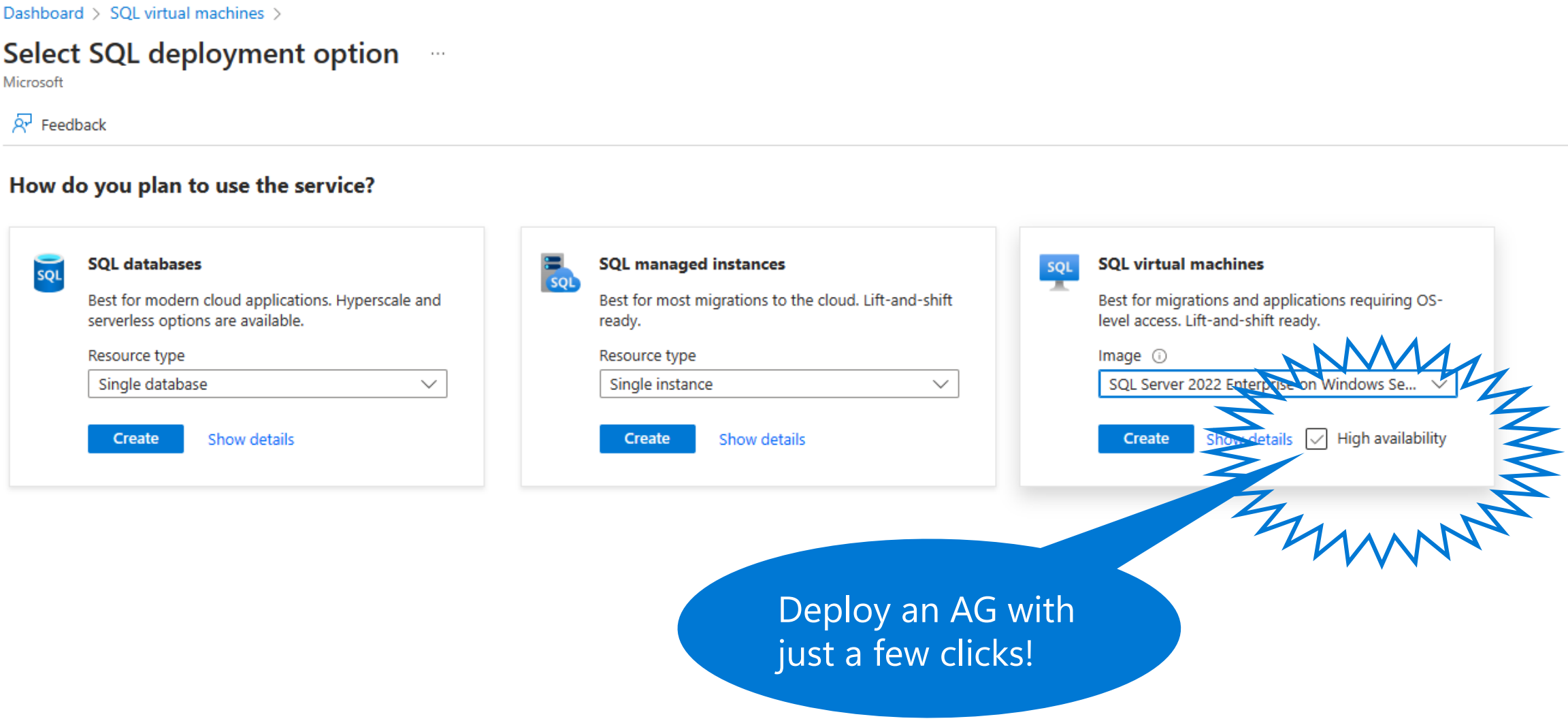
Separate Fault Domain and Update Domains

Availability Zones (99.99% HA)



Separate Availability Zones

Azure SQL VM HA/DR made easy!



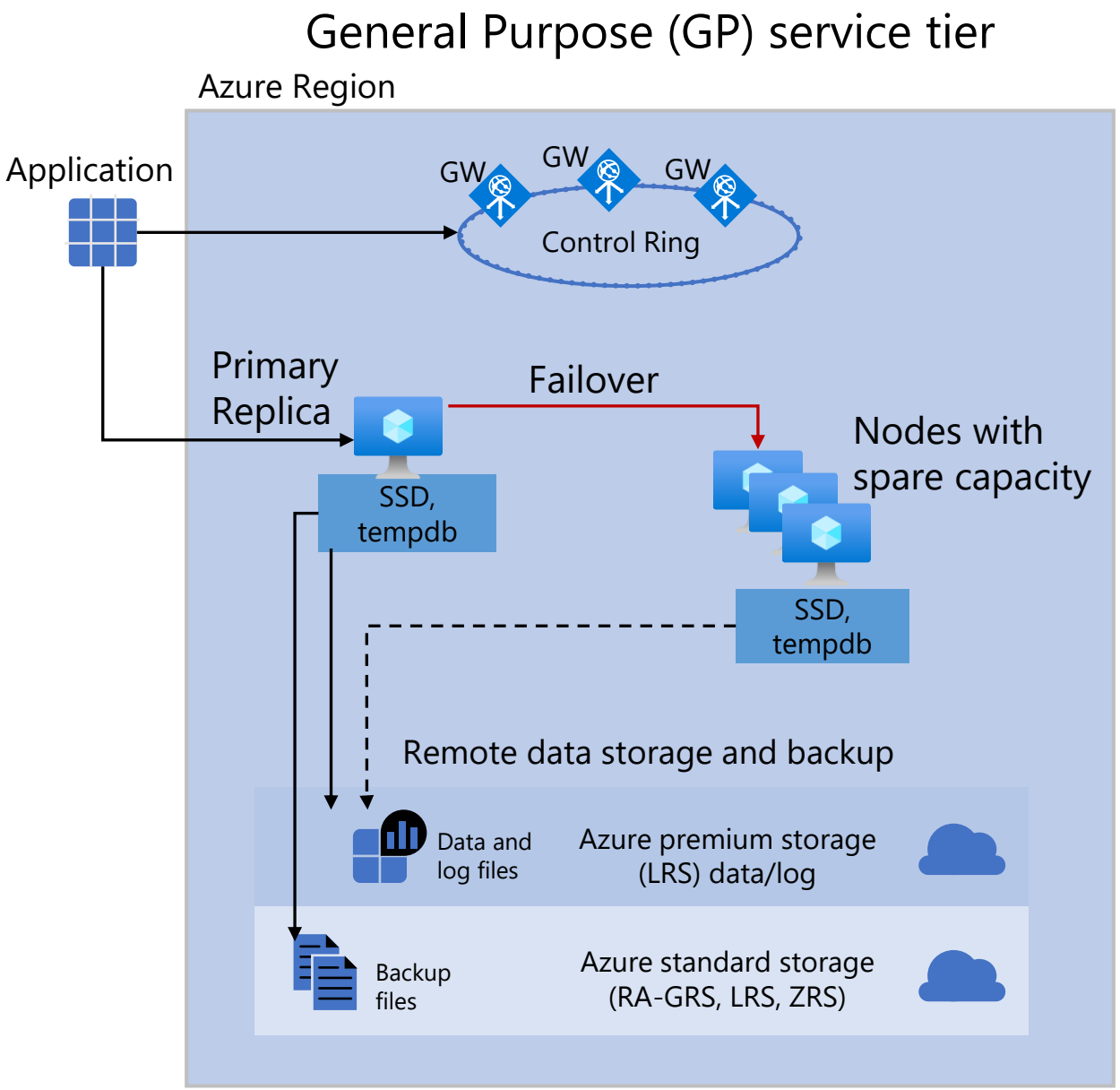
Azure SQL
Managed Instance

Azure SQL Database

HA for Azure PaaS services

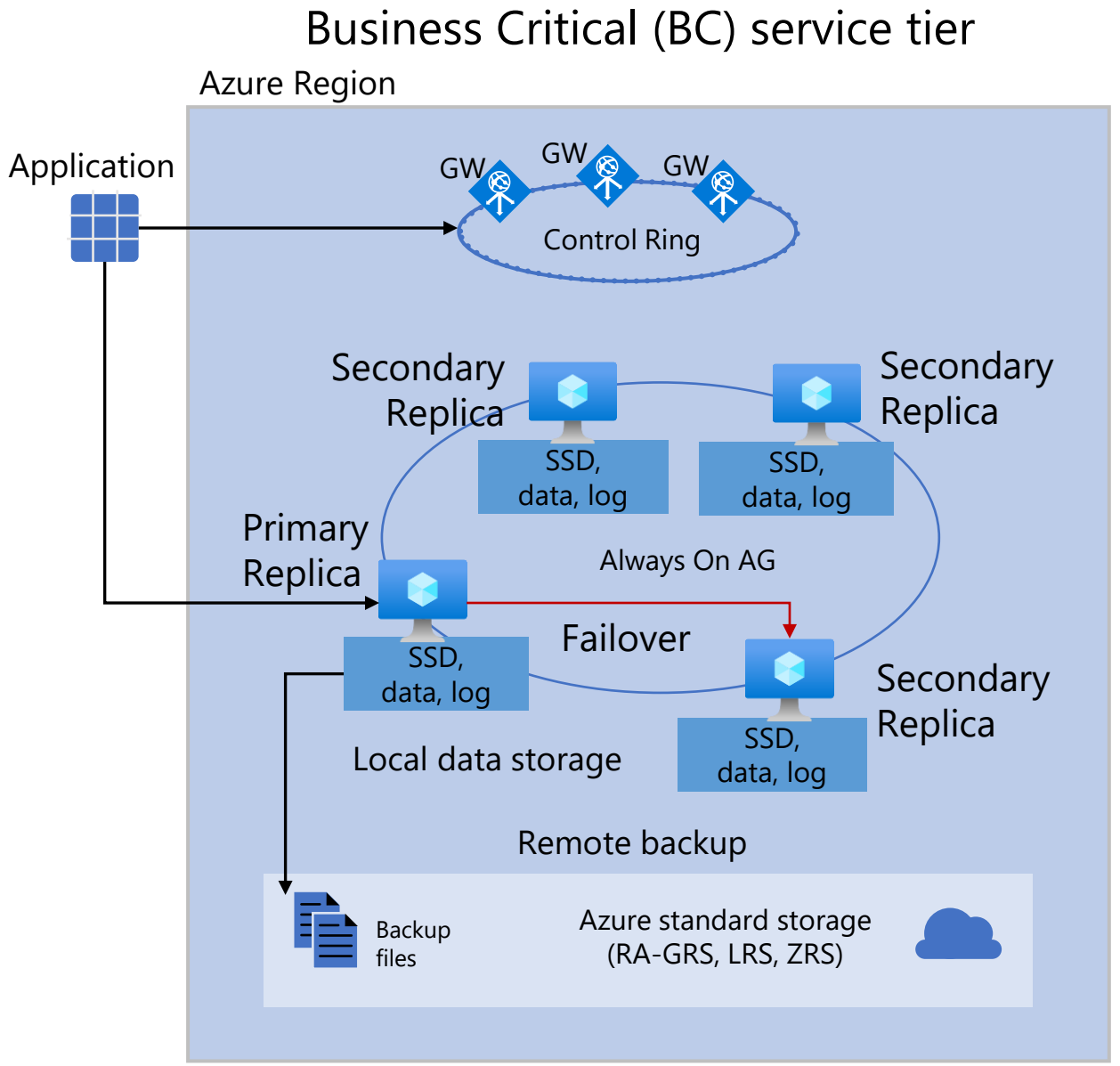
General Purpose (GP) High Availability (HA)

- Behaves like **Failover Cluster Instance (FCI)**
- 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

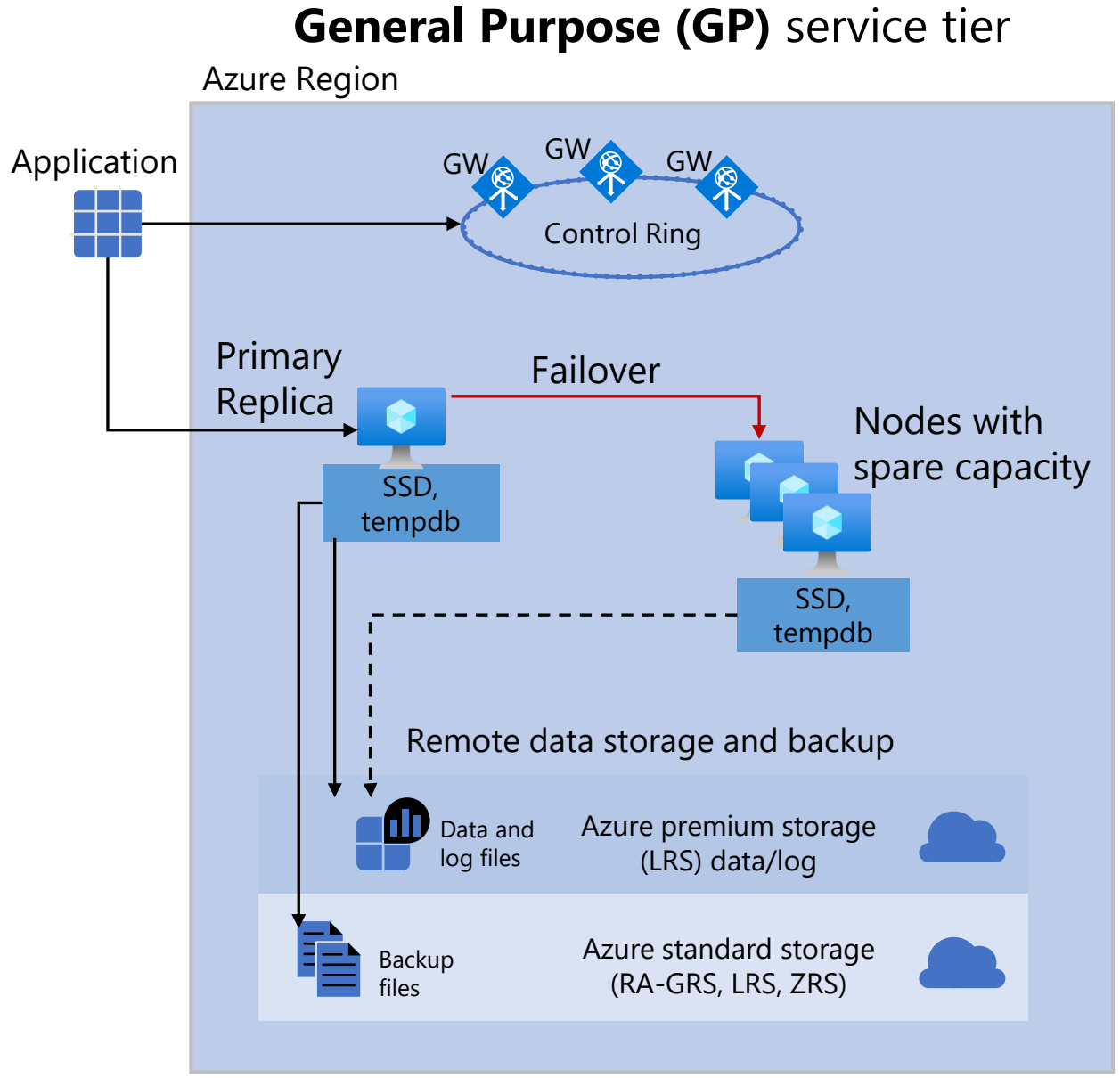


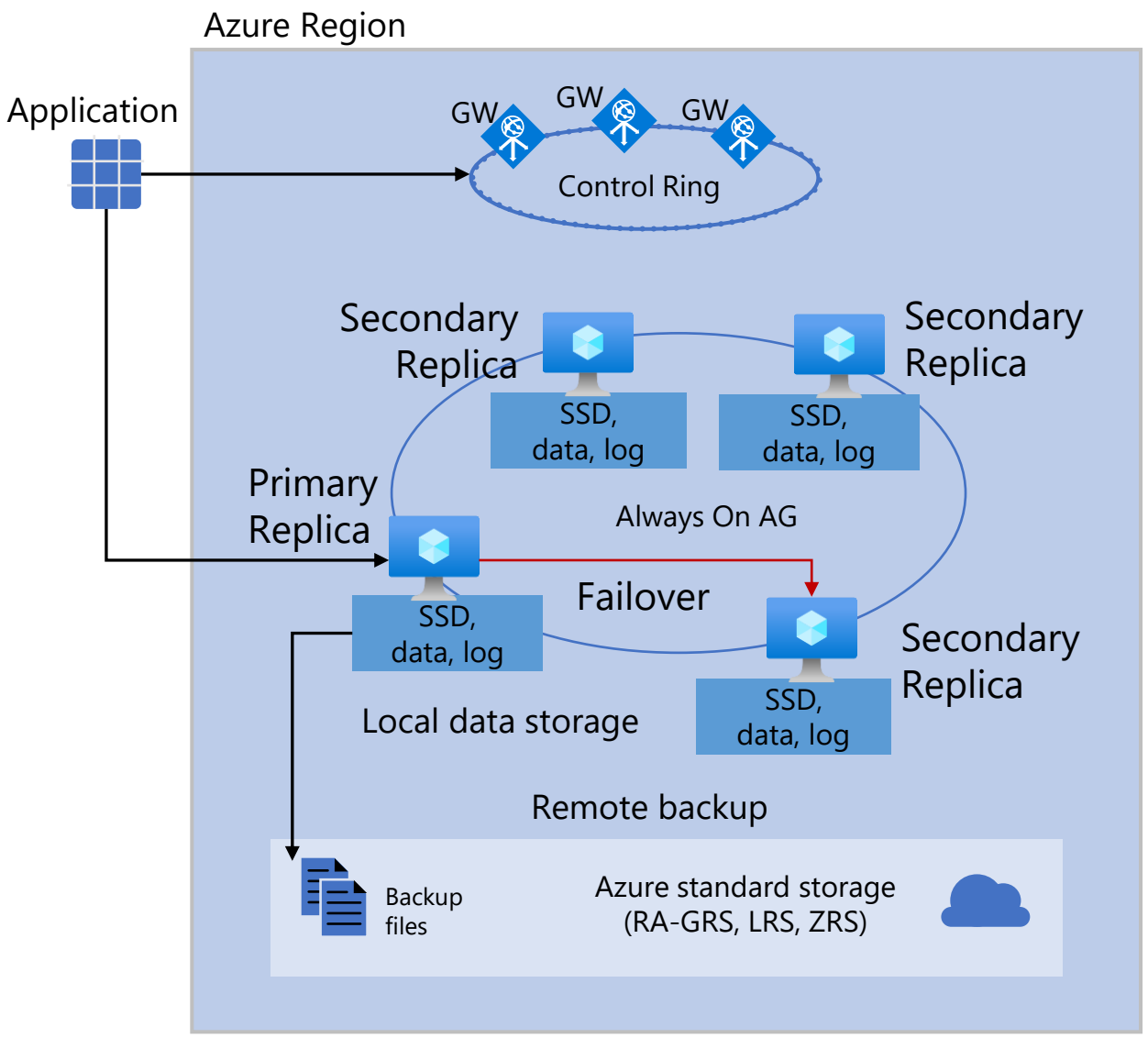
Business Critical (BC) High Availability (HA)

- Based on **Always On Availability Groups**
- 3 secondary replicas automatically created
- Four replicas kept available
- Backup files in a different location with geo-redundancy
- At least one secondary must sync for commits
- Automatic failover based on SQL and Service Fabric
- Recovery time extremely fast
- Connectivity redirection built-in
- Read Scale-Out from one of the replicas



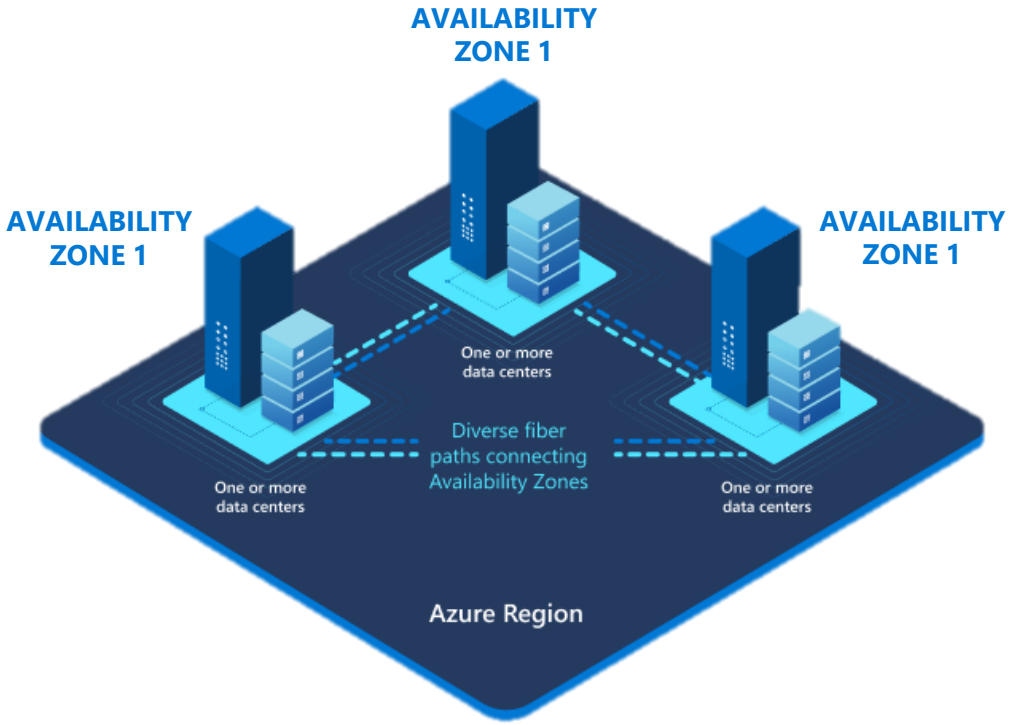
Side by side comparison BC and GP





Zone redundancy

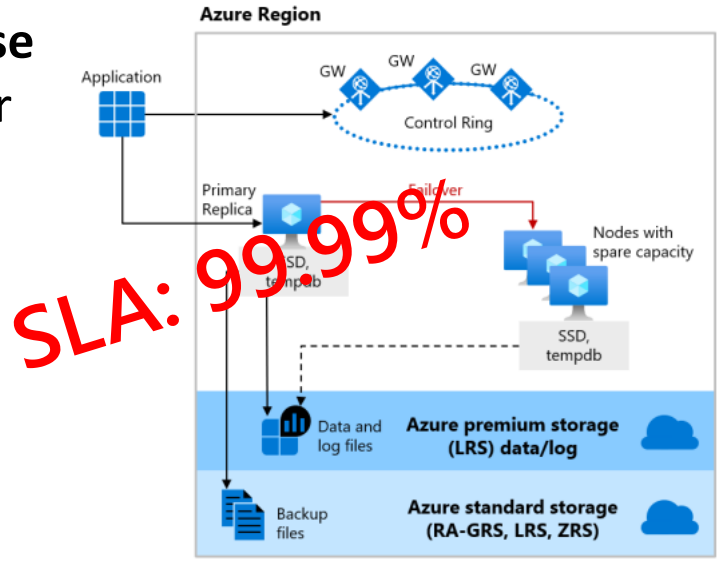
- Built on top of Azure Availability Zones
- Instances are replicated across multiple physical locations within an Azure region.
- Instances resilient to a much larger set of failures, including catastrophic datacenter outages, without any changes of the application logic.



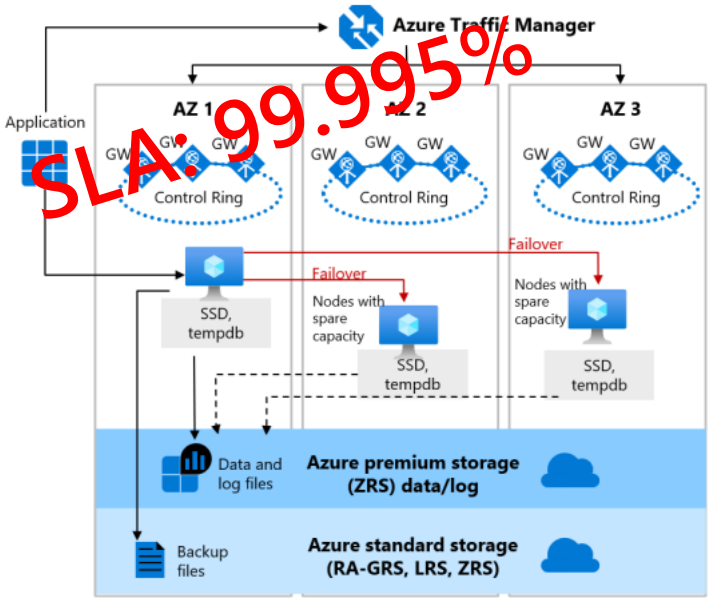
Zone redundant GP and BC

General Purpose (GP) service tier

Locally redundant

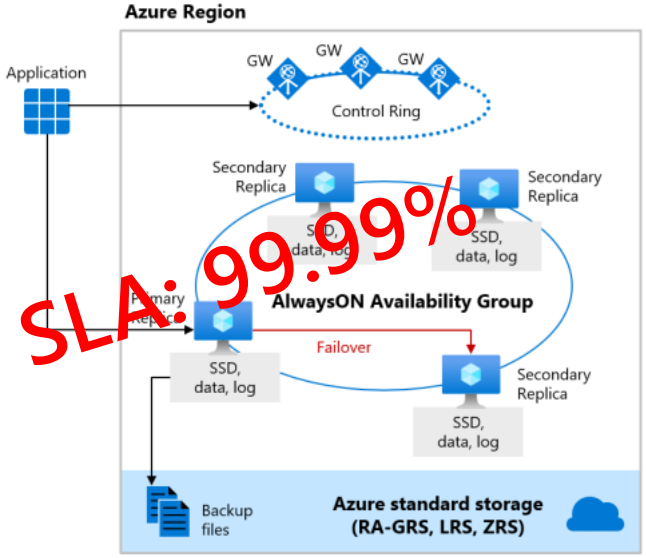


Zone-redundant

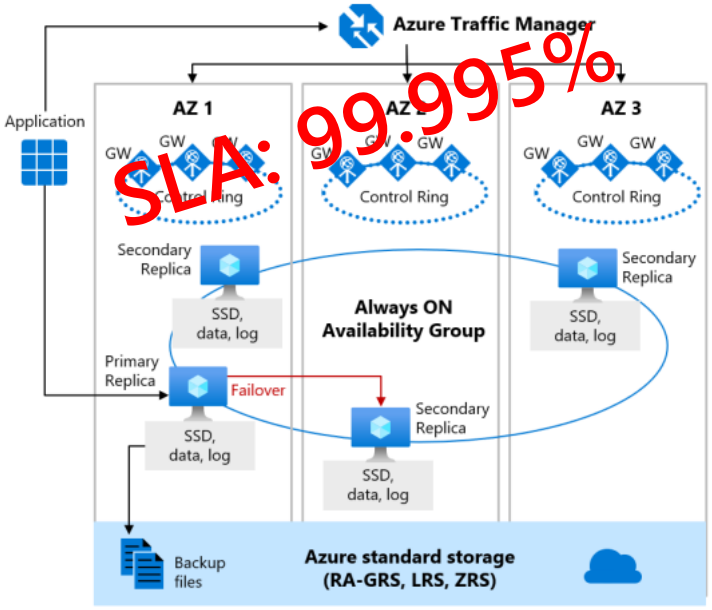


Business Critical (BC) service tier

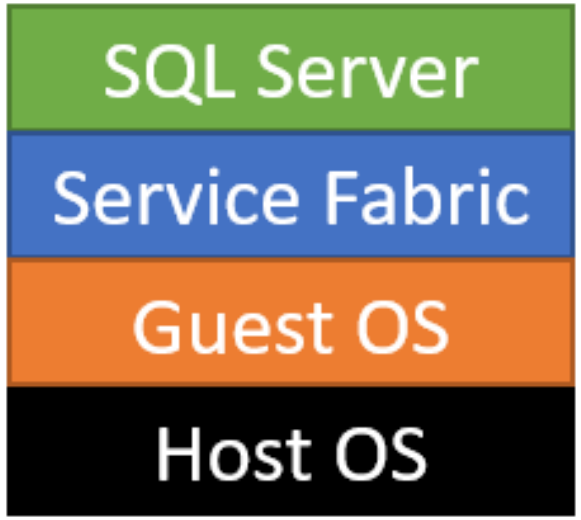
Locally redundant



Zone-redundant



Azure SQL Maintenance



Azure SQL's technology stack is layered.

Batching upgrades as much as possible for a **single consolidated planned maintenance event**

For compliance reasons occurs at least every ~35 days.

Instance failover types in Azure SQL

Automated	Manual

• **Planned failovers**
  • Service updates and patches
• **Unplanned failovers**
  • Faulty node
	• **User initiated**
	  • Testing app failover resiliency
	  • Query performance degradation or failed logins
	  • Limited to once each 15 min

Increase app resiliency

- **Retry logic**
  - Makes your workloads resilient to database maintenance
  - Helps with transactional workloads
  - Long running jobs are still impacted
- **Use the latest drivers**

Maintenance window (planned updates)

Default maintenance policy

- Every day during region's **off-peak hours** (5PM – 8AM)
- For Dev/Test environments and resilient workloads

Maintenance windows

Predefined time slots with 8 hours duration a day

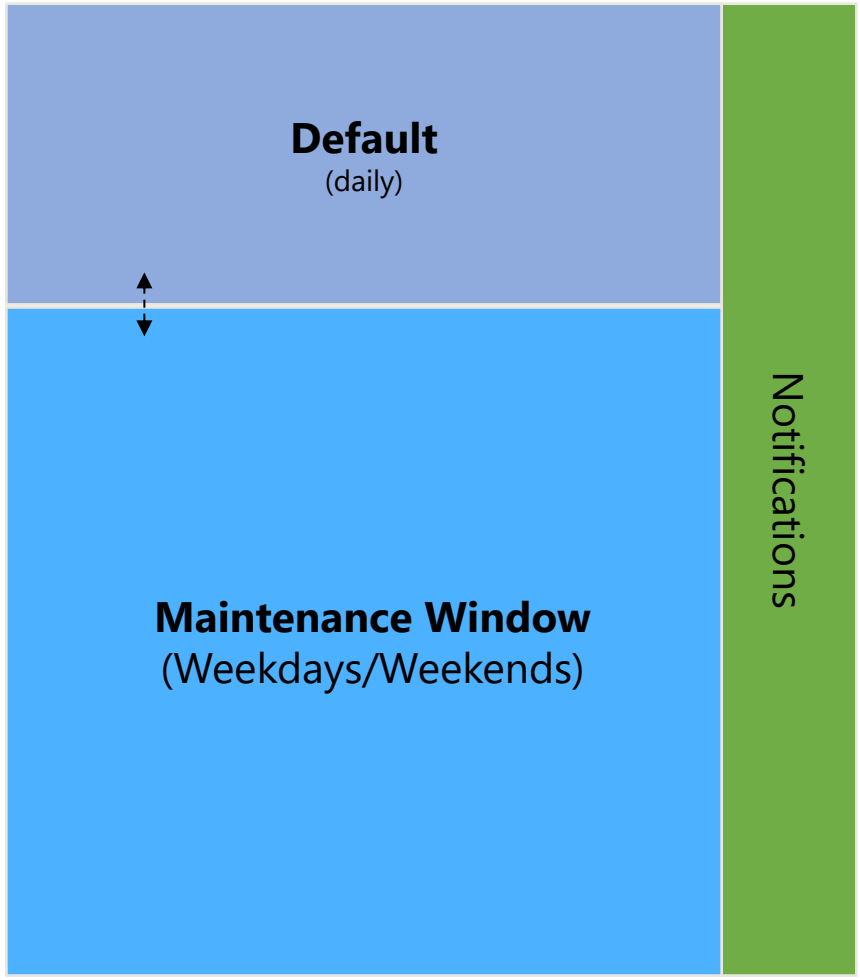
- **Weekdays**: Mon-Thu 10PM-6AM local times daily
- **Weekends**: Fri-Sun 10PM-6AM local times daily

Opt-in. required, free of charge.

Dev/test subscription types not eligible

Notifications

Anyone can subscribe via **Service Health** alerts



Shared Responsibility: High Availability (PaaS)

Azure responsibility

- Meeting **availability SLA of 99.99%** and **99.995 for ZR** through automated processes
- For **General Purpose** service tier Maintain healthy **spare compute nodes** within the virtual cluster
- For **Business Critical** service tier Maintain health of the internal **Always On** Availability Group

DBA responsibility

- Provide access to the TDE key protector in AKV (Azure Key Vault) for BYOK (Bring Your Own Key) scenario only
- Responsible use of logon triggers

Shared Responsibility: High Availability (PaaS)

Azure responsibility

- Perform fast local failovers in case of failures
- For ZR configurations - perform fast cross-zone failovers in case of zone outages

DBA responsibility

- Responsible use of manual instance failovers (once every 15 min)

Shared Responsibility: High Availability (PaaS)

Azure responsibility

- Monitor health 24x7 and perform preemptive mitigations (automated systems and by on-call engineers)
- Perform rolling upgrades with minimal number of failovers during configured maintenance window

DBA responsibility

- Monitoring applications and performance
- Monitor Transaction Log Full rate – ensure that features like CDC, transactional replication, or MI link don’t fill it up
- Subscribe to Service Health alerts

Azure SQL
Managed Instance

Azure SQL Database

DR for Azure PaaS services

Business Continuity: Disaster Recovery

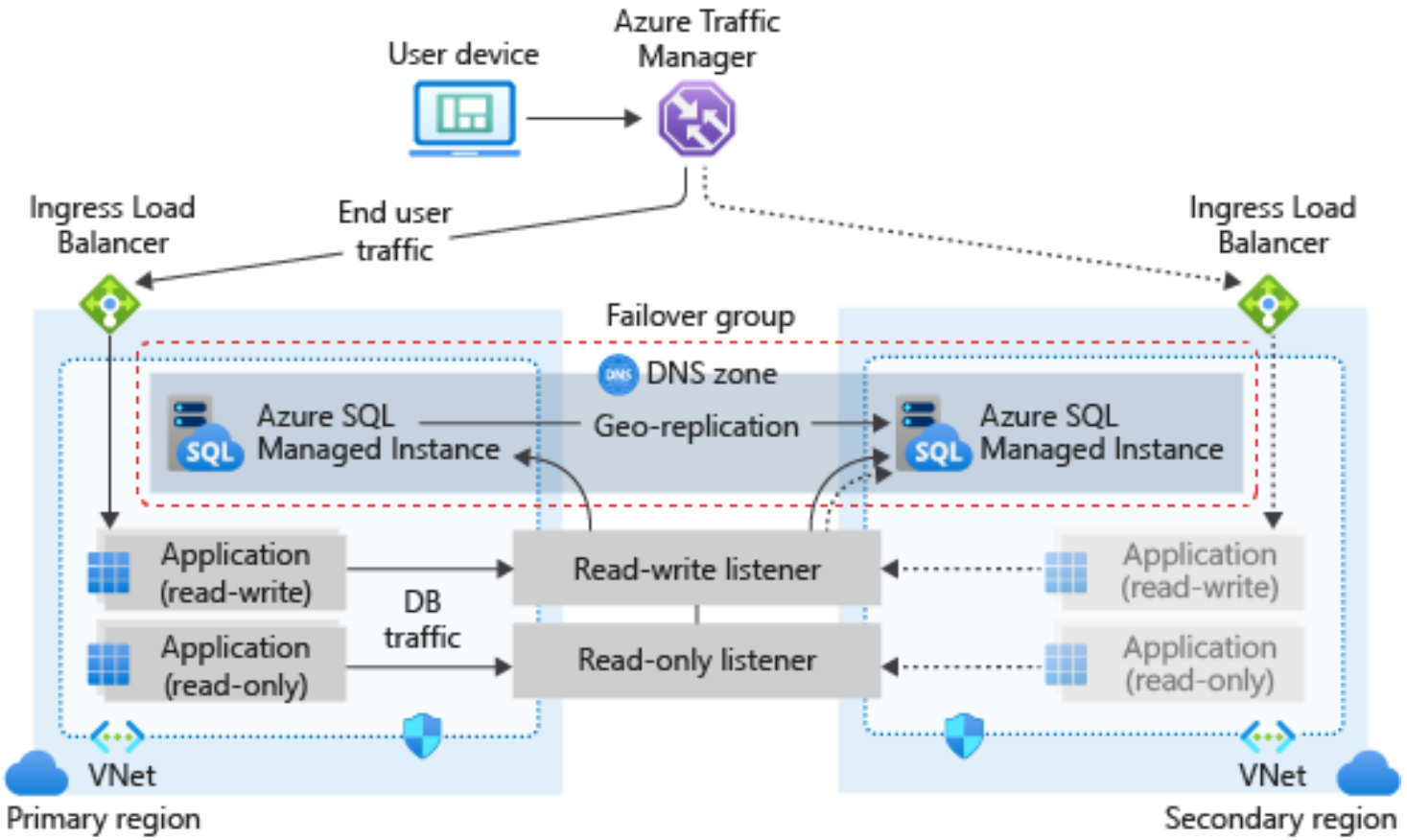
Cover outages that cannot be automatically mitigated with the built-in HA (high availability) infrastructure (e.g. natural disasters)

Failover groups provide **instance level** DR capability.

Initiated **manually**, or **automatically** in case of a catastrophic failure or partial loss

Requires **one-time setup**.

Failover policies supported: **Customer managed**, and **MSFT managed**.



Failover group connectivity

- Connectivity between the virtual network subnets hosting primary and secondary instance must be established and maintained for uninterrupted geo-replication traffic flow.

- Some ways to provide connectivity:

Recommended

Global virtual network peering

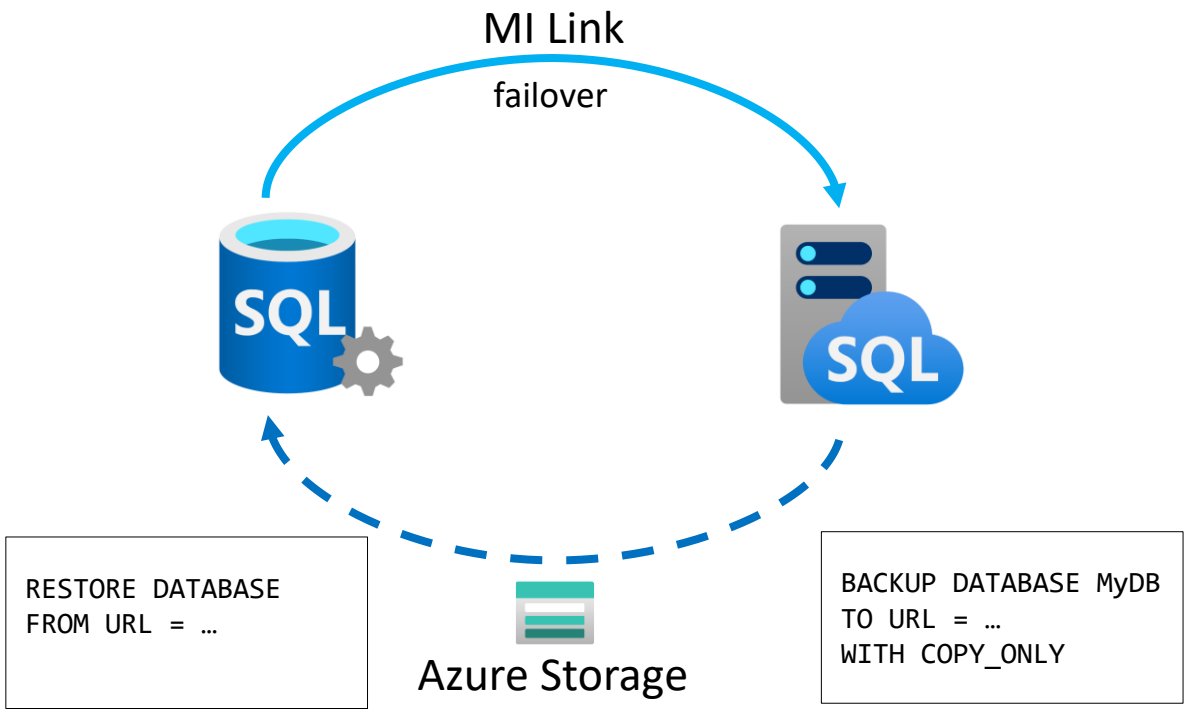
VPN gateways

Azure ExpressRoute

DR between SQL Server 2022 and SQL Managed Instance

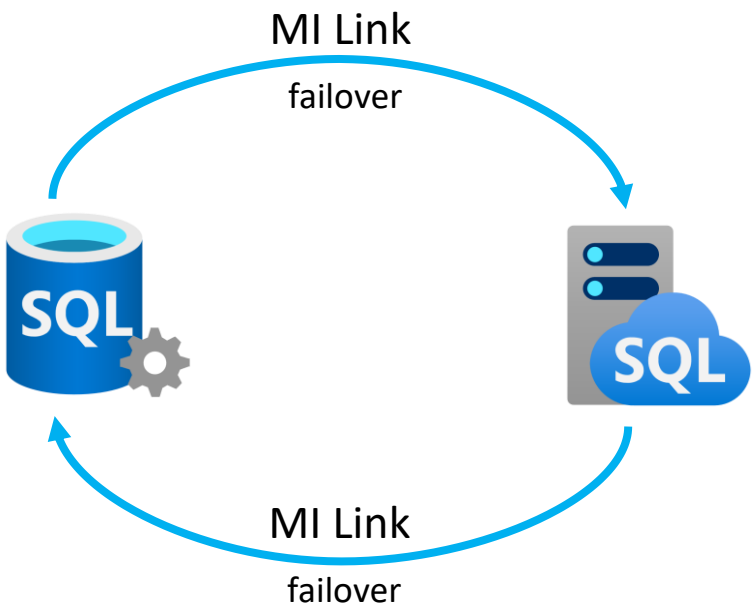
DR = failover **+ failback**

Offline failback



Available with SQL Server 2022

Online failback



Available with SQL Server 2022

Geo-restore from backups (GRS\GZRS)

Time objectives in case of a regional disaster

Geo-restore a backup from paired Azure region to any Azure region, in case you have been using GRS or GZRS backup storage

- The restore operation is size of data
- **RTO (Recovery Time Objective**) depends on the database size, expected up to 12hrs max
- **RPO (Recovery Point Objective)** – minimum expected backup restore time point 1hr in the past from the event of failure.

Recovery method	**RTO**	**RPO**
Geo-restore from geo-replicated backups	12 h	1 h

Shared Responsibility: DR (PaaS)

Azure responsibility

- Maintain health of the underlying Always On replication
- Provide reliable connection routing for failover group listener connections
- Orchestrate geo-failover for both customer-managed and Microsoft-managed failover policy

DBA responsibility

- Provide connectivity between VNets and subnets of the primary and secondary instances with the shortest network path (global VNet peering recommended)
- Provide access to the same TDE key protectors in AKV on primary and secondary instance (BYOK scenario only)

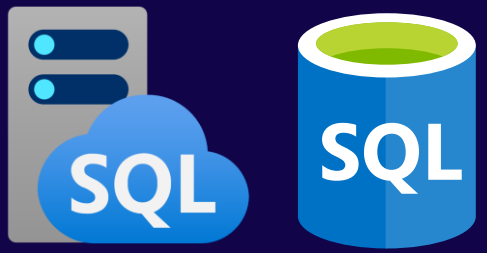
Do I still need to worry about High Availability?

Short answer:

- For IaaS services: Yes
  - You still need to manage your SQL Server in Virtual Machines

IaaS services
SQL Server in Azure Virtual Machine

- For PaaS services: No
  - High Availability is provided as a service with 99.99% SLA
  - With Zone Redundancy 99.995% for Azure SQL Database
  - You will have some minor management tasks if using BYOK encryption, and will need to exercise responsible use



PaaS services
Azure SQL Database and Managed Instance

Do I still need to worry about Disaster Recovery?

Short answer:

- For IaaS services: Yes
  - You still need to manage your DR options for SQL Server in Virtual Machines

IaaS services
SQL Server in Azure Virtual Machine

- For PaaS services: Yes, need to opt-in
  - Failover groups DR
  - DR between SQL Server 2022 and SQL Managed Instance
  - Geo-Restore

PaaS services
Azure SQL Database and Managed Instance

Automated backups in Azure SQL

Overview of service

Backups

Customer manages

IaaS - Infrastructure as a Service

SQL Server on Azure Virtual Machines

Microsoft manages

PaaS - Platform as a Service

Azure SQL Managed Instance

Azure SQL Database

SQL Server on Azure
Virtual Machines

Backups for Azure IaaS services

Backup options for SQL Server on Azure VM

Automated Backup through the SQL IaaS Agent extension

- Uses SQL Server managed backup under the covers
- Stores backups in Azure blob storage
- Limited configuration and monitoring options
- No additional charges other than those associated with storage

Azure Backup for SQL VMs

- Enterprise-class backup solution
- Centrally manage backups for multiple servers
- Stores backups in a Recovery Services Vault
- Additional costs associated with the service

Manual backup

- Continue to use your own tools and processes
- Choose any storage method (local disk, URL, Azure file shares)
- Consider Azure file shares with SMB multichannel for very large DBs
- No additional charges other than those associated with storage

Azure SQL
Managed Instance

Azure SQL Database

Backups for Azure PaaS services

Backup options for SQL PaaS services

Backup retention

- **Short-term retention** (STR): **1-35 days**
- **Long-term retention** (LTR): **Up to 10 years**

Backup frequency

- **Full backup**: every **week**
- **Differential** backup: every **12 hours**
- **Transaction log** backup: every **~15 minutes**

Backup storage redundancy

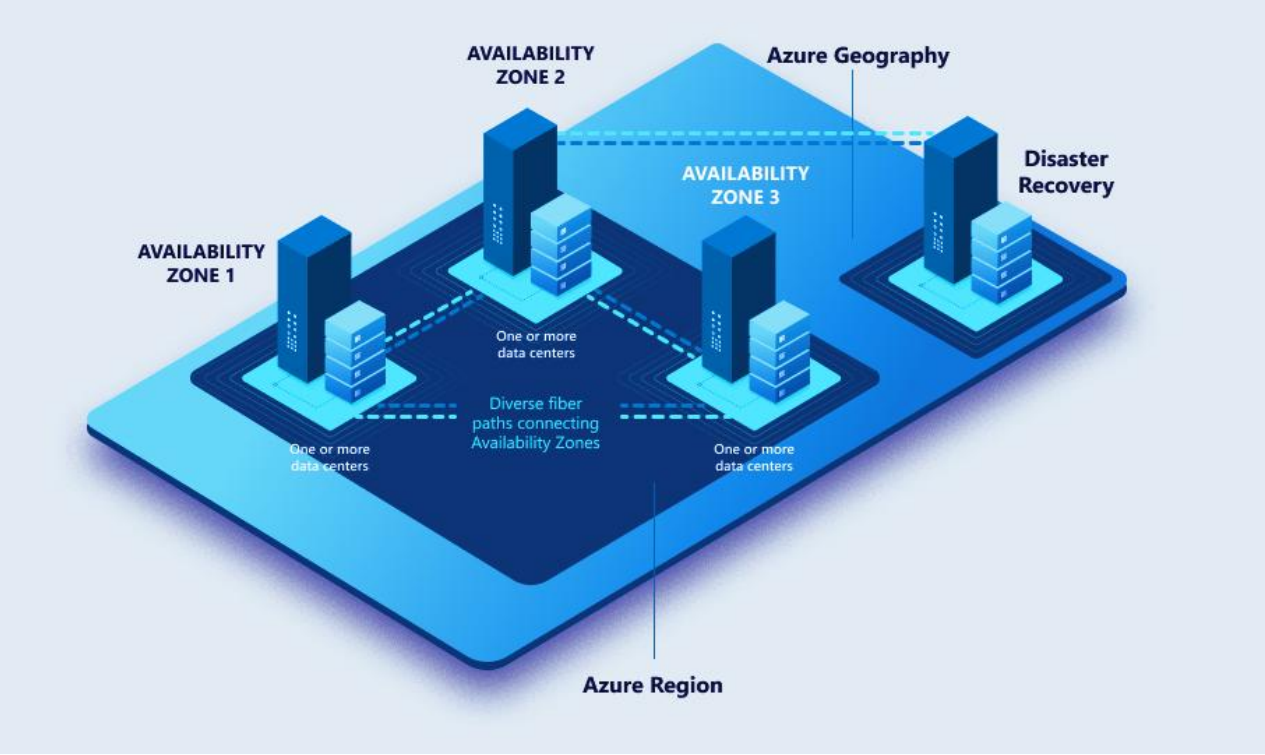
- Locally redundant storage (LRS)
- Zone-redundant storage (ZRS)
- Geo-redundant storage (GRS)
- Geo-zone-redundant storage (GZRS)

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. The same building (local) - **LRS**
2. Within the same region but across several buildings (zones) - **ZRS**
3. Across paired regions (geo) - **GRS**
4. Across several buildings AND paired regions (geo-zone) - **GZRS**



Backup costs

Short Term Retention (STR) backup storage

- Backup storage usage up to the reserved instance storage size is free of charge.
  - For example, for provisioned 8TB data storage, you get 8TB STR backup storage for free.
- Type of redundancy used influences the price (LRS, ZRS, GRS, GZRS)

Long Term Retention (LTR) backup storage

Charged for usage:

- Type of redundancy used (LRS, ZRS, GRS, GZRS)
- Backup storage consumed (GB/hour)

LTR is cheaper than STR considerably. Use Azure pricing calculator for details.

Backup transparency – msdb (for SQL MI)

Using msdb should be as simple as it is for the On-prem.

The main table msdb.dbo.backupset will support all typical information, with some differences that are cloud specific (e.g. machine name, user name path to backup are not needed in Azure).

MSDB shows backup taken automatically by Azure, AND manually through IS_COPY_ONLY column

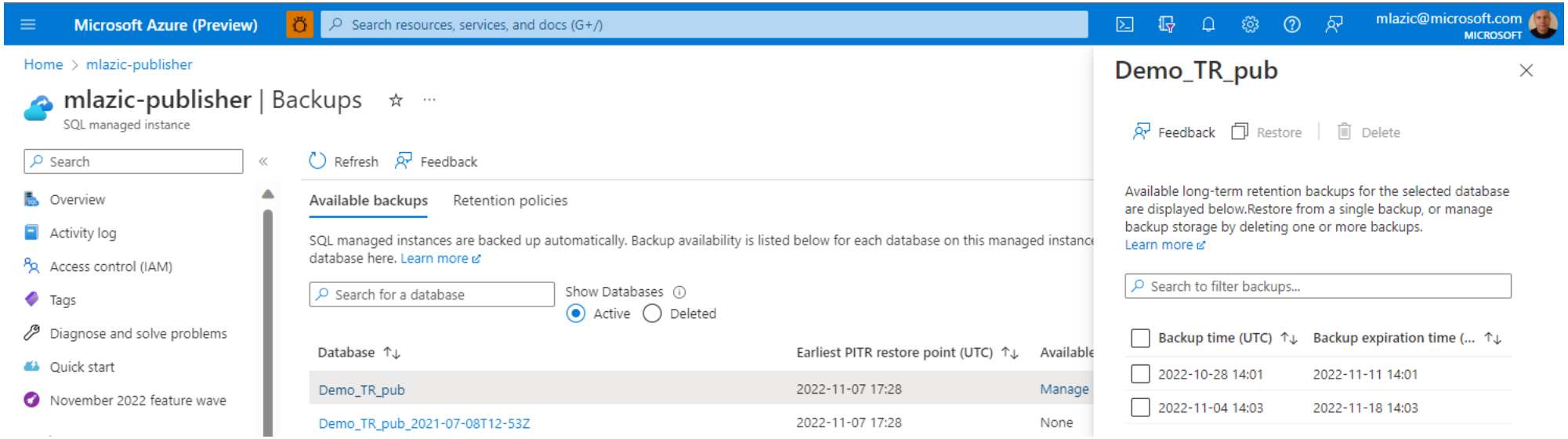
```
-- all backups
SELECT DB_NAME(DB_ID(database_name)), [type], is_copy_only, backup_size, compressed_backup_size, first_lsn, last_lsn, checkpoint_lsn, database_backup_lsn, backup_start_date, backup_finish_date, backup_size, compressed_backup_size
FROM msdb.dbo.BACKUPSET
where DB_NAME(DB_ID(database_name)) = 'MIBackupInfoTestDB'

-- full backups
SELECT DB_NAME(DB_ID(database_name)), [type], is_copy_only, backup_size, compressed_backup_size, first_lsn, last_lsn, checkpoint_lsn, database_backup_lsn, backup_start_date, backup_finish_date, backup_size, compressed_backup_size
FROM msdb.dbo.BACKUPSET
where DB_NAME(DB_ID(database_name)) = 'MIBackupInfoTestDB' and [type] = 'D'

-- diff backups
SELECT DB_NAME(DB_ID(database_name)), [type], is_copy_only, backup_size, compressed_backup_size, first_lsn, last_lsn, checkpoint_lsn, database_backup_lsn, backup_start_date, backup_finish_date, backup_size, compressed_backup_size
FROM msdb.dbo.BACKUPSET
where DB_NAME(DB_ID(database_name)) = 'MIBackupInfoTestDB' and [type] = 'I'

-- log backups
SELECT DB_NAME(DB_ID(database_name)), [type], is_copy_only, backup_size, compressed_backup_size, first_lsn, last_lsn, checkpoint_lsn, database_backup_lsn, backup_start_date, backup_finish_date, backup_size, compressed_backup_size
FROM msdb.dbo.BACKUPSET
where DB_NAME(DB_ID(database_name)) = 'MIBackupInfoTestDB' and [type] = 'L'

-- user backups
SELECT DB_NAME(DB_ID(database_name)), [type], is_copy_only, backup_size, compressed_backup_size, first_lsn, last_lsn, checkpoint_lsn, database_backup_lsn, backup_start_date, backup_finish_date, backup_size, compressed_backup_size
FROM msdb.dbo.BACKUPSET
where DB_NAME(DB_ID(database_name)) = 'MIBackupInfoTestDB' and [type] = 'D' and is_copy_only = 1
```

Backup transparency – Portal

To see your LTR backups you can use our Portal client.

For a selected instance

1. Go to Backups, and databases where the LTR policy is enabled will have a visible *Manage* button
2. Click the *Manage* button
3. A side menu with a list of all previously taken Full backups will open



Do I still need to worry about Backup/Restore?

Short answer:

- For IaaS services: Yes, but can be automated
  - Automated schedule to Azure Blob Storage
  - You are still responsible for verifying consistency of your backups (DBCC CHECKDB and restores)

IaaS services
SQL Server in Azure Virtual Machine

- For PaaS services: No*
  - Backups are automatically taken (Full Recovery Model) to short term and long-term retention storage
  - *Perform periodical point-in-time restore for validation

PaaS services
Azure SQL Database and Managed Instance

Shared Responsibility: Backup/Restore (PaaS)

Azure responsibility

- Maintain automated backup chain for the configured retention period
- Manage long-term backups based on the configured long-term retention policy
- Monitor backup process health

DBA responsibility

- N/A

Shared Responsibility: Backup/Restore (PaaS)

Azure responsibility

- Provide point-in-time restore capability to any point in time within the configured retention period
- Provide long-term backup retention

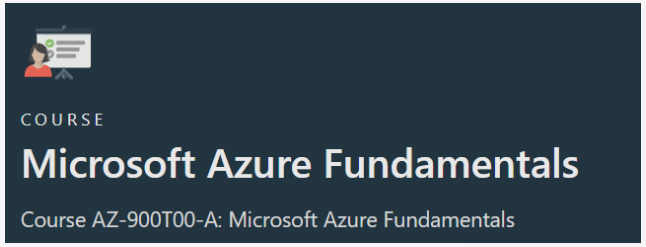
DBA responsibility

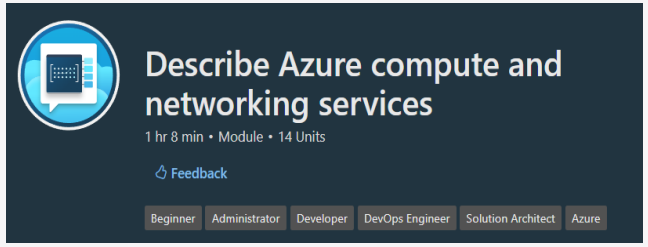
- Optionally perform periodical point-in-time restore for validation

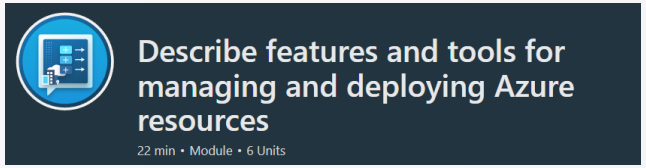
Additional Resources

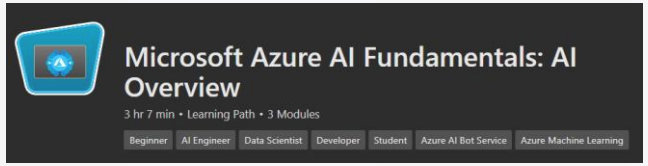
Azure free online courses

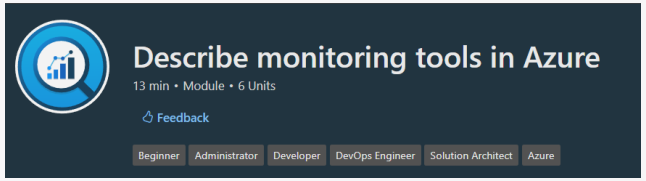
https://learn.microsoft.com/training/browse/

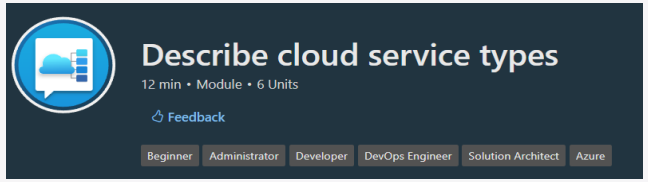


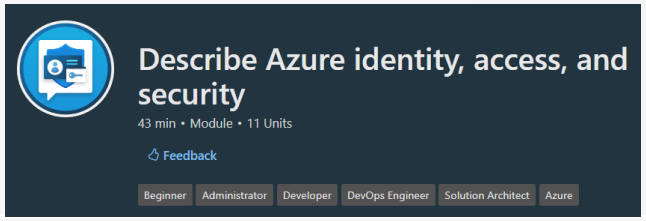


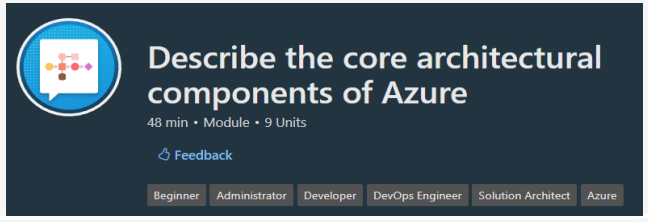












Experience Azure SQL for free

Azure SQL Managed Instance

aka.ms/freesqlMI

What's included

- **1 instance** per Azure subscription
- **4 or 8 vCores** of GP compute
- **750 vCore hours** per month
- **64 GB data** storage
- **64 GB backup** storage

Use it for 12 months

Use this free offer to support your migration proof of concepts for **12 months.**

You're in control

- Optimize your monthly available vCore hours by **stopping** and **starting** the instance when necessary.

Azure SQL Database

aka.ms/SQLfreeoffer

What's included

- **1 Azure SQL Database** per Azure subscription
- **100,000 vCore seconds** per month.
- **32 GB data** storage
- **32 GB backup** storage

No time limits

- Apply this free offer for the **life** of your **subscription**.

Need more? No problem.

- Stick with the default **auto-pause** option or continue usage for additional charges.

Your feedback is important to us

Evaluate this session at:

www.PASSDataCommunitySummit.com/evaluation

Thank you

Please Freel free to reach out to us.

- Niko Neugebauer nneugebauer@microsoft.com
- Dani Ljepava danil@microsoft.com
- Erin Stellato erinstellato@microsoft.com
- Pam Lahoud SQLGoddess@microsoft.com