

# Plan and Implement Data Platform Resources

Introduction to deploying Azure resources, choosing an appropriate database offering, configuring Azure resources, and migration strategies for Azure

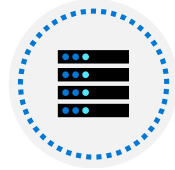
# Objectives

- Deploy resources using manual methods
- Recommend an appropriate database offering based on requirements
- Configure Azure SQL resources
- Evaluate and implement a strategy for moving a database to Azure SQL

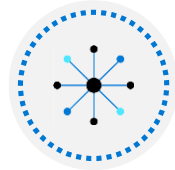
# Deploy IaaS Solutions with Azure SQL



# Objectives



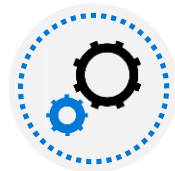
Explore the basics of SQL Server in an Infrastructure as a Service (IaaS) Offering



Learn the available options for provisioning and deployment



Explore performance and security options available



Understand the high availability and disaster recovery options

# Azure SQL platform offerings



## SQL Server on Azure Virtual Machines

Best for lift and shift and/or workloads requiring OS-level access

**Infrastructure-as-a-Service**



## Azure SQL Managed Instance

Best for modernizing existing apps

**Platform-as-a-Service**



## Azure SQL Database

Best for supporting modern cloud apps



Best for extending apps to IoT edge

**Edge Computing**

## Azure SQL enabled by Azure Arc

Run Azure SQL on premises and in multicloud environments

**Elimination of Hardware and Software**

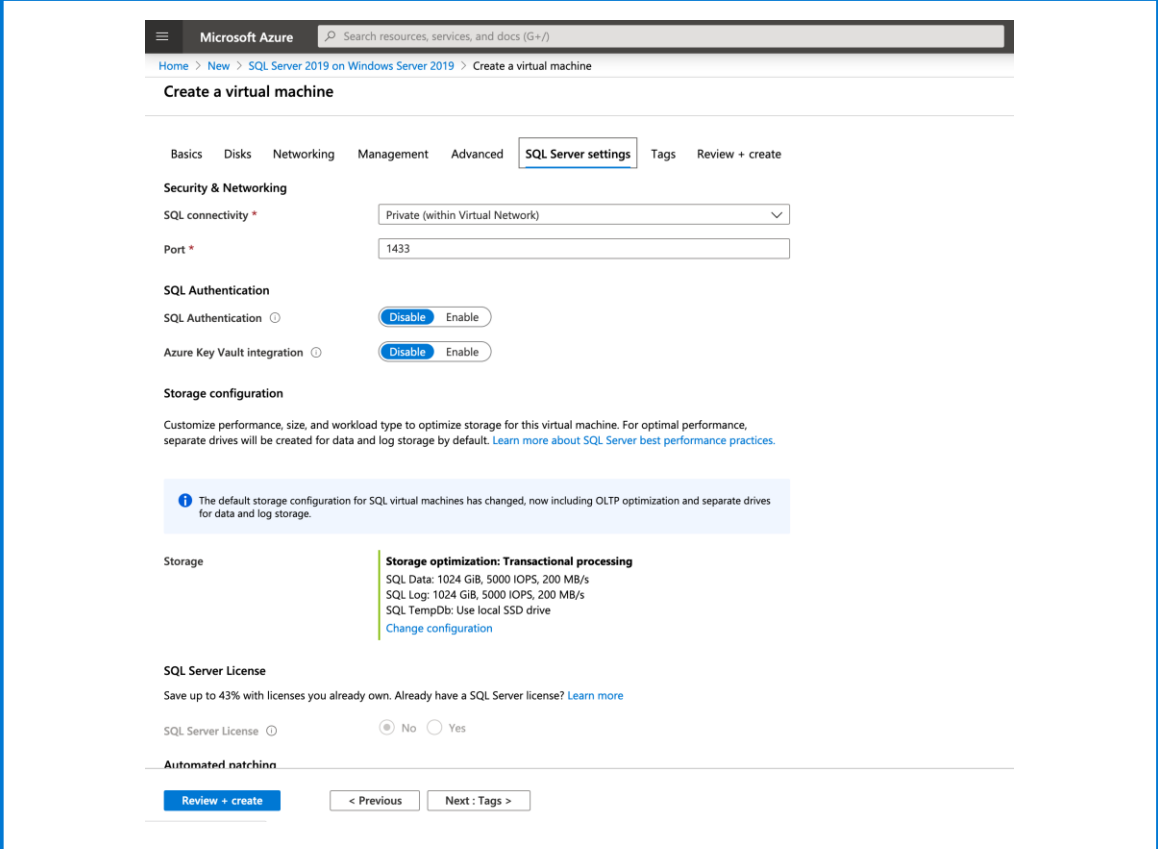
**Operational Efficiency & Savings**

**Improved Business Agility**

# Azure deployment options

You can deploy Azure resources using the following methods:

- Using the Azure Portal
- Running PowerShell or Azure CLI scripts
- Deploying Azure Resource Manager templates



The screenshot displays the 'Create a virtual machine' page in the Microsoft Azure portal, specifically the 'SQL Server settings' tab. The page is divided into several sections for configuring the SQL Server instance on the VM.

**Microsoft Azure** Search resources, services, and docs (G+ /)

Home > New > SQL Server 2019 on Windows Server 2019 > Create a virtual machine

**Create a virtual machine**

Basics Disks Networking Management Advanced **SQL Server settings** Tags Review + create

**Security & Networking**

SQL connectivity \* Private (within Virtual Network)

Port \* 1433

**SQL Authentication**

SQL Authentication ☐ Disable ☒ Enable

Azure Key Vault integration ☐ Disable ☒ Enable

**Storage configuration**

Customize performance, size, and workload type to optimize storage for this virtual machine. For optimal performance, separate drives will be created for data and log storage by default. [Learn more about SQL Server best performance practices.](#)

**Storage**

**Storage optimization: Transactional processing**

SQL Data: 1024 GiB, 5000 IOPS, 200 MB/s  
SQL Log: 1024 GiB, 5000 IOPS, 200 MB/s  
SQL TempDb: Use local SSD drive  
[Change configuration](#)

**SQL Server License**

Save up to 43% with licenses you already own. Already have a SQL Server license? [Learn more](#)

SQL Server License ☒ No ☐ Yes

**Automated natchinn**

[Review + create](#) < Previous Next : Tags >

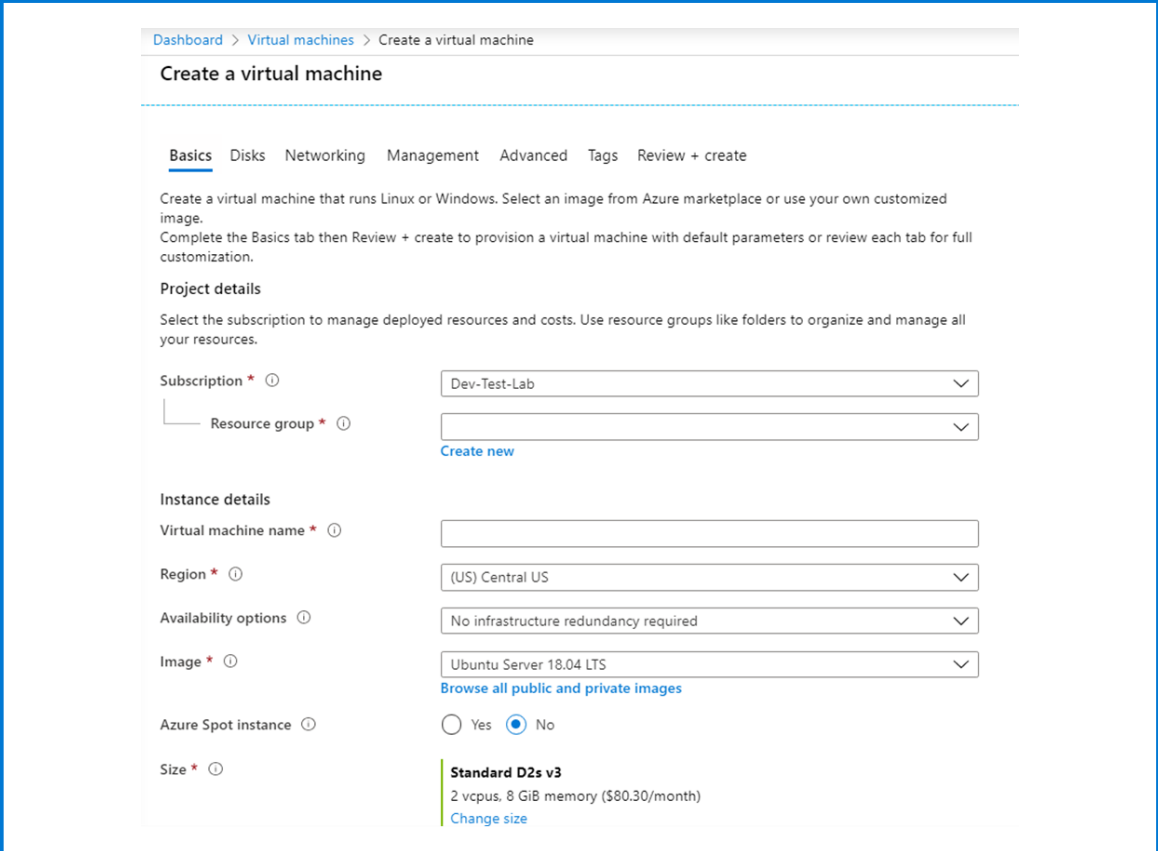
# Deploying from the Azure portal

This method is useful for single VM deployments

The portal provides step by step instructions for deployment

This is a manual process

Not easily repeatable in a consistent matter



The screenshot shows the 'Create a virtual machine' page in the Azure portal. The breadcrumb navigation at the top reads 'Dashboard > Virtual machines > Create a virtual machine'. The page title is 'Create a virtual machine'. Below the title, there are tabs for 'Basics', 'Disks', 'Networking', 'Management', 'Advanced', 'Tags', and 'Review + create'. The 'Basics' tab is selected. The page contains the following sections and fields:

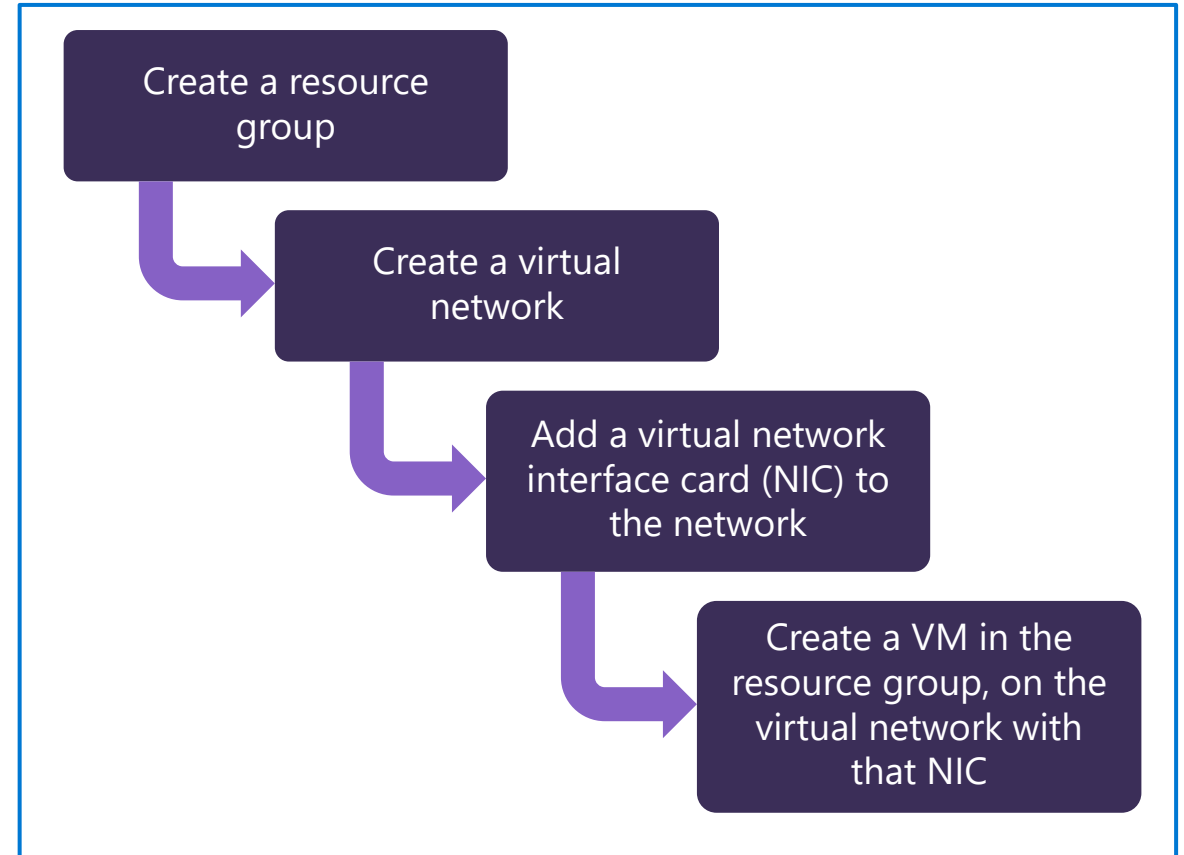
- Project details:** A description stating 'Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization.' Below this is a sub-section 'Project details' with the instruction 'Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.' It includes a 'Subscription' dropdown menu (set to 'Dev-Test-Lab') and a 'Resource group' dropdown menu (with a 'Create new' link below it).
- Instance details:** This section includes:
  - 'Virtual machine name' text input field.
  - 'Region' dropdown menu (set to '(US) Central US').
  - 'Availability options' dropdown menu (set to 'No infrastructure redundancy required').
  - 'Image' dropdown menu (set to 'Ubuntu Server 18.04 LTS', with a 'Browse all public and private images' link below it).
  - 'Azure Spot instance' radio buttons (set to 'No').
  - 'Size' dropdown menu (set to 'Standard D2s v3', with a 'Change size' link below it). The selected size is detailed as '2 vcpus, 8 GiB memory (\$80.30/month)'.

# Deployment using PowerShell/Azure CLI

While not as flexible as using ARM templates, PowerShell and the Azure CLI provide a repeatable methodology for deploying resources

Using PowerShell or the Azure CLI are an imperative framework, which means they indicate a specific order of operations to execute

This approach can offer flexibility and ease of use for some situations compared to the relative complexity of ARM templates





# Azure Resource Manager templates

ARM Templates provide a repeatable, declarative process for deploying Azure resources at scale

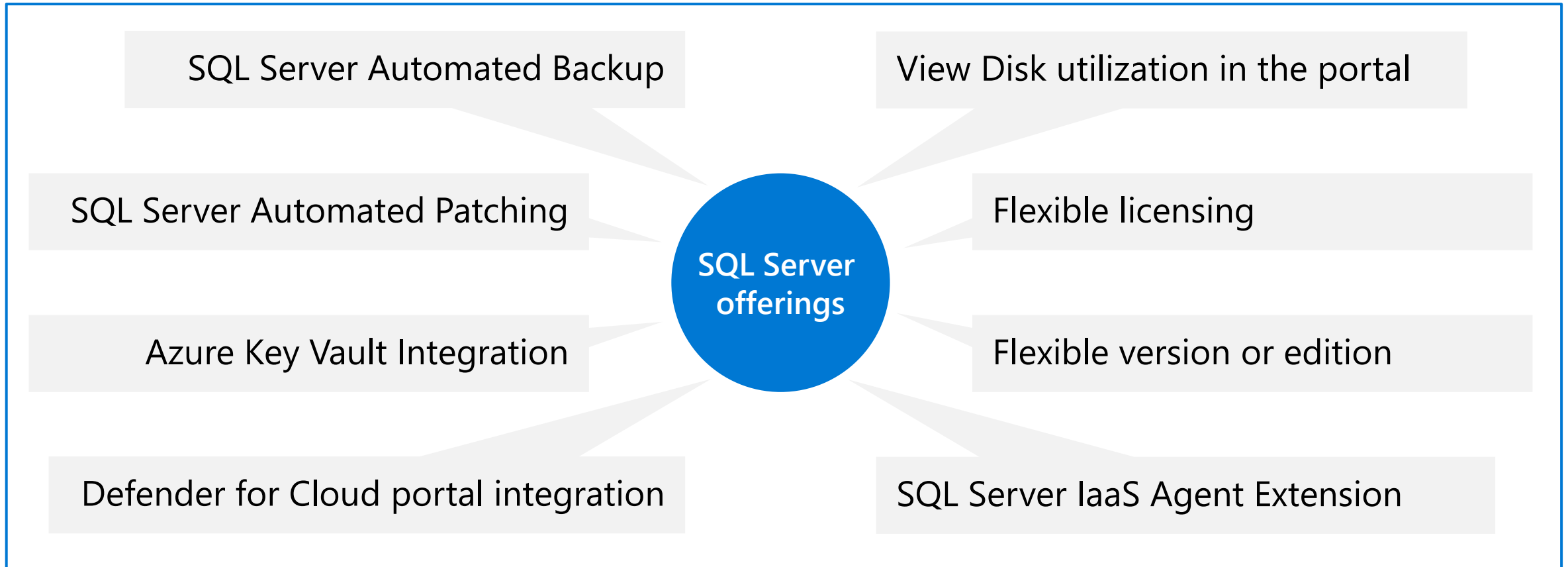
Allow for integration with popular continuous integration and deployment CI/CD tools

Allow you to create nearly any Azure resource or option

JSON

```
"resources": [  
  {  
    "type": "Microsoft.Storage/storageAccounts",  
    "apiVersion": "2016-01-01",  
    "name": "mystorageaccount",  
    "location": "westus",  
    "sku": {  
      "name": "Standard_LRS"  
    },  
    "kind": "Storage",  
    "properties": {}  
  }  
]
```

# SQL Server IaaS Agent Extension



# SQL Server licensing models in Azure

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## Without Software Assurance

Use a SQL Server image from the marketplace and pay-per-minute. This is known as Pay as You Go licensing

## With Azure Hybrid Licensing Benefit your options are

- Bring Your Own License (BYOL) – this is check box in the Azure Portal
  - Manually installing SQL Server on a Windows or Linux VM
  - Uploading a SQL Server VM image (VHD) to Azure and deploying that image as an Azure VM
-

# Azure Virtual Machine families

- **General purpose:**  
Balanced CPU to memory ratio
- **Memory optimized:**  
High memory to CPU ratio
- **Storage optimized:**  
High disk throughput provided by local storage
- **Compute optimized:**  
High CPU to memory ratio
- **High performance compute:**  
Most powerful CPU

Type	Sizes
General purpose	B, Dsv3, Dv3 Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2
Compute optimized	Fsv2
Memory optimized	Esv3, Ev3, Easv4, Eav4, Mv2, M, DSv2, Dv2
Storage optimized	Lsv2
GPU	NC, NCv2, NCv3, ND, NDv2(Preview), NV, NVv3, Nvv4
High performance compute	HB, HBv2, HC, H

# Azure Virtual Machine sizing

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**A Series** – Entry-level for dev/test

**Bs Series** – Economical bursting

**D Series** – General purpose compute

**Dc Series** – Protect data in use

**E Series** – In-memory hyper-threaded applications optimized

**F Series** – Compute optimized

**G Series** – Memory and storage optimized

**H Series** – High performance computing

**Ls Series** – Storage optimized

**M Series** – Memory optimized

**Mv2 Series** – Largest memory optimized

**N Series** – GPU enabled

# SQL Server configuration

Configure specific SQL Server settings like Security and Networking, SQL Authentication preferences, SQL instance settings, and other options.

The image displays two screenshots of the Azure portal's 'Create a virtual machine' wizard, specifically the 'SQL Server settings' tab. The left screenshot shows the 'SQL Server settings' tab with sections for 'Security & Networking', 'SQL Authentication', 'Storage configuration', and 'SQL instance settings'. The 'SQL Authentication' section is highlighted with a red box, showing 'SQL Authentication' and 'Azure Key Vault integration' both set to 'Disable'. The 'SQL instance settings' section is also highlighted with a red box, showing 'Default configuration' with 'MAXDOP: 0', 'SQL Server memory limits: 0 - 2147483647 MB', and 'Collation: SQL\_Latin1\_General\_CP1\_CI\_AS'. The right screenshot shows the 'SQL Server License' section with 'SQL Server License' set to 'No'. Below this, the 'Automated patching' section is highlighted with a red box, showing 'Automated patching' set to 'Enabled' with a patching window of 'Sunday at 2:00'. The 'Automated backup' section is also highlighted with a red box, showing 'Automated backup' set to 'Disable'. At the bottom, the 'R Services(Advanced Analytics)' section shows 'SQL Server Machine Learning Services (In-Database)' set to 'Disable'. Navigation buttons at the bottom include 'Review + create', '< Previous', and 'Next : Tags >'.

Home > Azure SQL > Select SQL deployment option >

### Create a virtual machine

Basics Disks Networking Management Advanced **SQL Server settings** Tags Review + create

#### Security & Networking

SQL connectivity \* Private (within Virtual Network) v

Port \* 1433

#### SQL Authentication

SQL Authentication ☐ ☒ Disable ☐ Enable

Azure Key Vault integration ☐ ☒ Disable ☐ Enable

#### Storage configuration

Customize performance, size, and workload type to optimize storage for this virtual machine. For optimal performance, separate drives will be created for data and log storage by default. [Learn more about SQL Server best performance practices.](#)

Storage Not available [Change configuration](#)

#### SQL instance settings

Customize additional SQL instance settings including collation, MAXDOP, server memory limit and optimize for ad-hoc workload.

Instance settings

**Default configuration**

MAXDOP: 0  
SQL Server memory limits: 0 - 2147483647 MB  
Collation: SQL\_Latin1\_General\_CP1\_CI\_AS  
[Change SQL instance settings](#)

#### SQL Server License

Save up to 43% with licenses you already own. Already have a SQL Server license? [Learn more](#)

SQL Server License ☐ ☒ No ☐ Yes

#### Automated patching

Set a patching window during which all Windows and SQL patches will be applied.

Automated patching ☐ ☒ Enabled  
Sunday at 2:00  
[Change configuration](#)

#### Automated backup

Automated backup ☐ ☒ Disable ☐ Enable

#### R Services(Advanced Analytics)

SQL Server Machine Learning Services (In-Database) ☐ ☒ Disable ☐ Enable

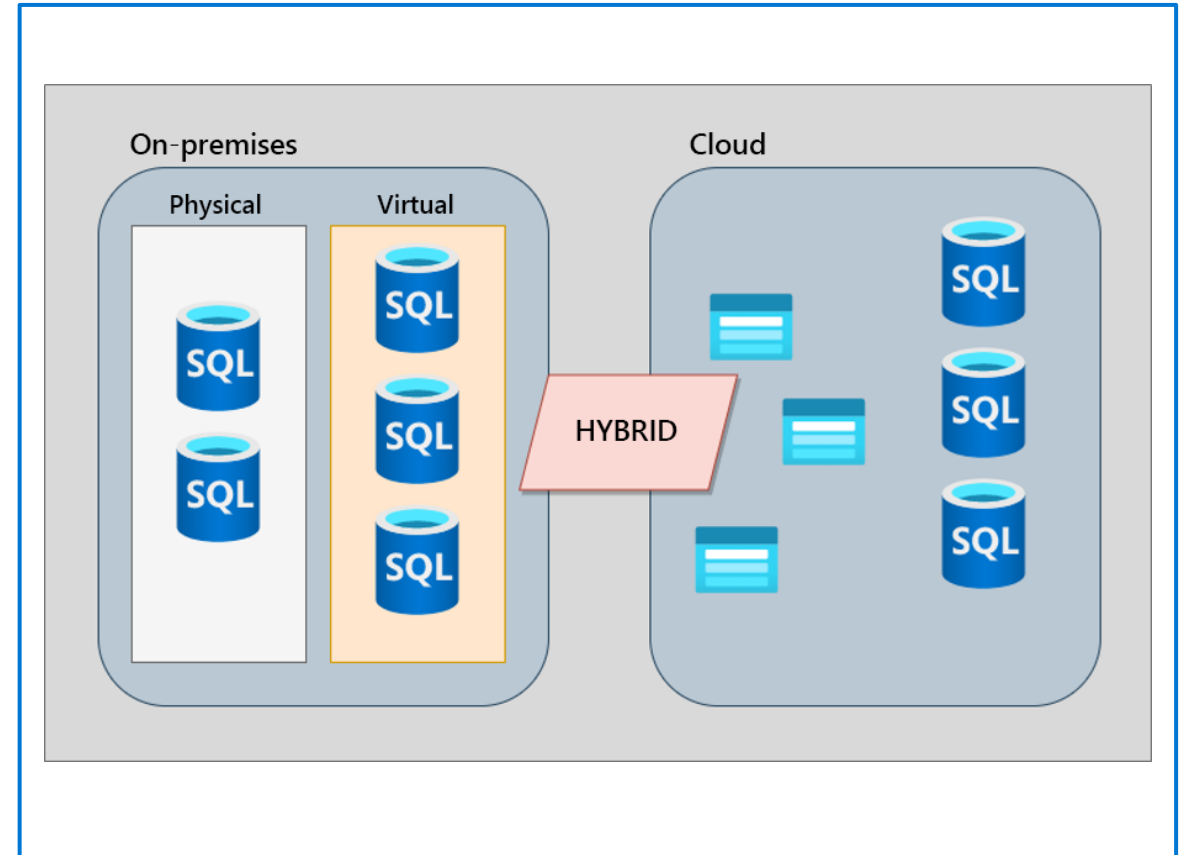
[Review + create](#) < Previous Next : Tags >

# Understand hybrid scenarios

Organizations commonly have a mixture of physical and virtualized deployments of SQL Server

Offers the benefits of both on-premises and cloud services – extends on-prem solutions

Cloud component is usually used for storage or SQL Server VMs

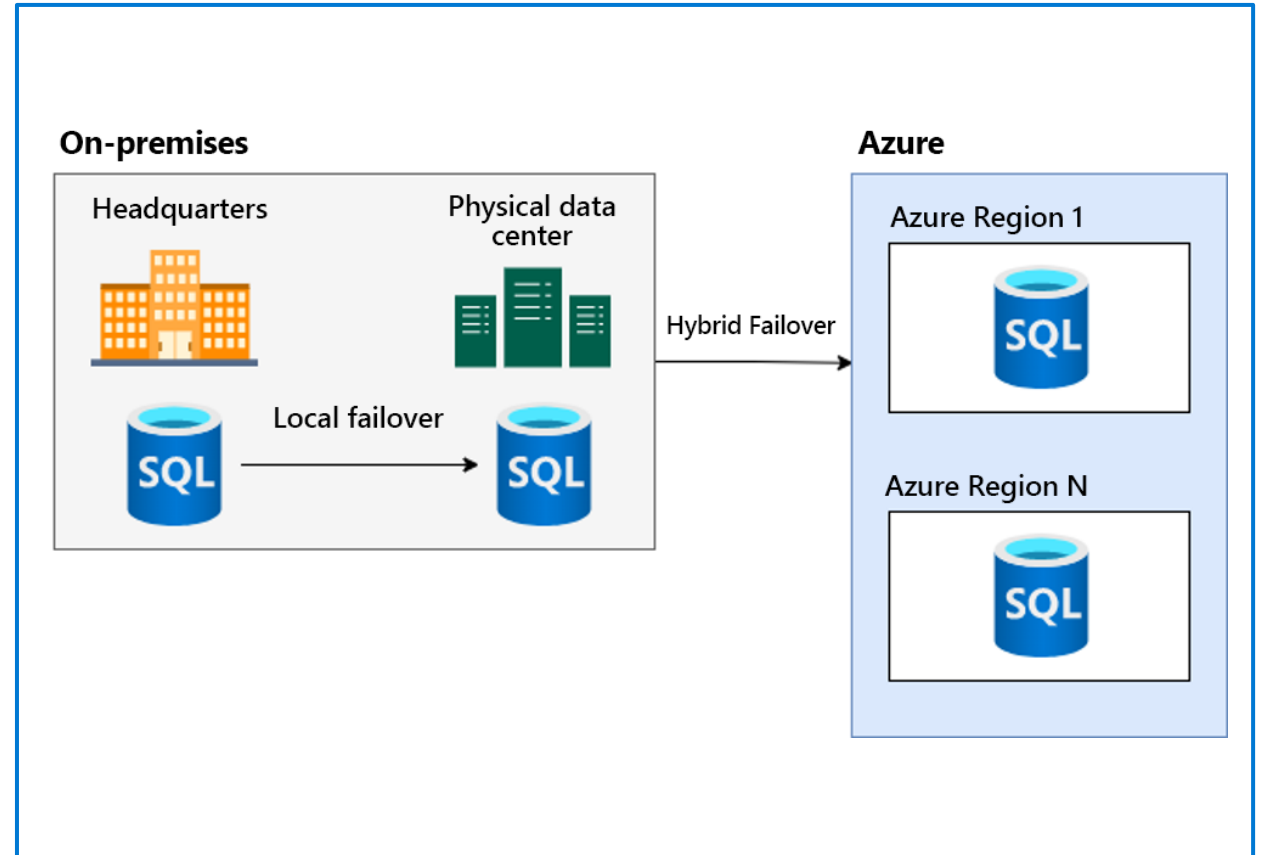


# Hybrid scenarios for SQL Server – Disaster Recovery

Most common scenario for a hybrid deployment of SQL Server.

Organizations ensure business continuity during catastrophic events.

Azure is used for DR failover (to one or more regions) while the regular day-to-day processing continues to use on-premises servers for local high availability.





# Hybrid scenarios for SQL Server – SQL Server backups

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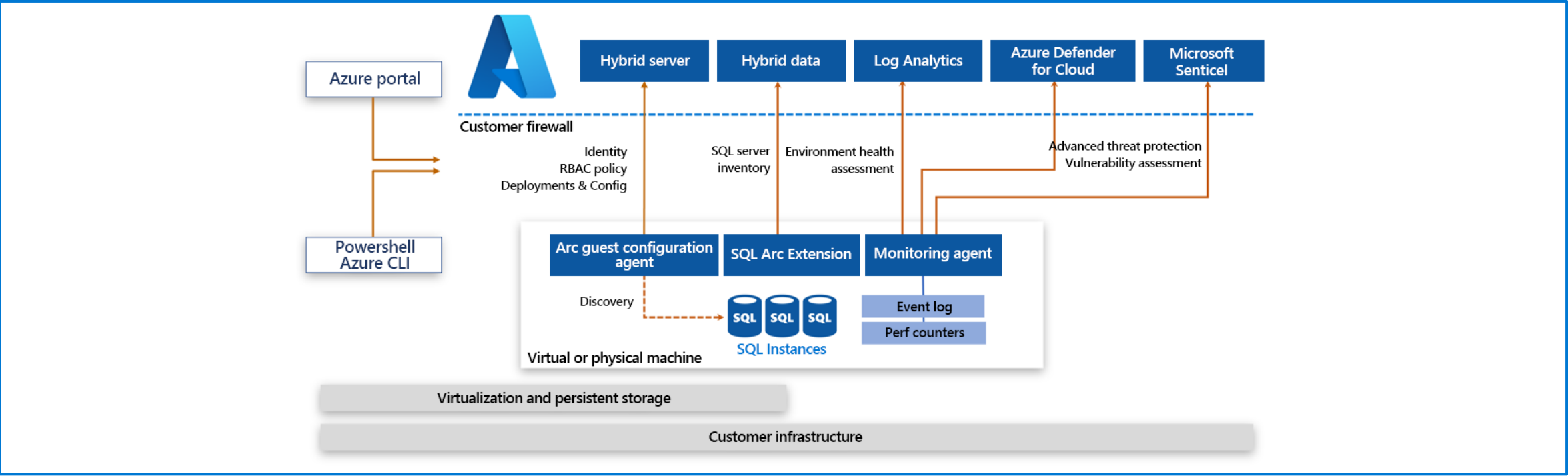
## SQL Server backups

- Backups may go directly into Azure Storage via URL or Azure file share (SMB)
  - Protects against data loss when on-site backup storage fails
  - Can be restored to virtual machines in Azure and tested as part of Disaster Recovery procedures
- 

## Azure Storage

- Store on-premises SQL Server data files for user databases - user files and not system databases
  - In the case of local storage failure, the user files are safely stored in the cloud, preventing data loss
  - Built in reliability guarantees stored files in the cloud are more resilient
-

# Hybrid scenarios for SQL Server – Azure Arc enabled SQL Servers



**Extends and centralizes**

**Enables the inventory**

**Security threat introspection**

# Azure Virtual Machine storage

## Each Azure VM has two or more disks:

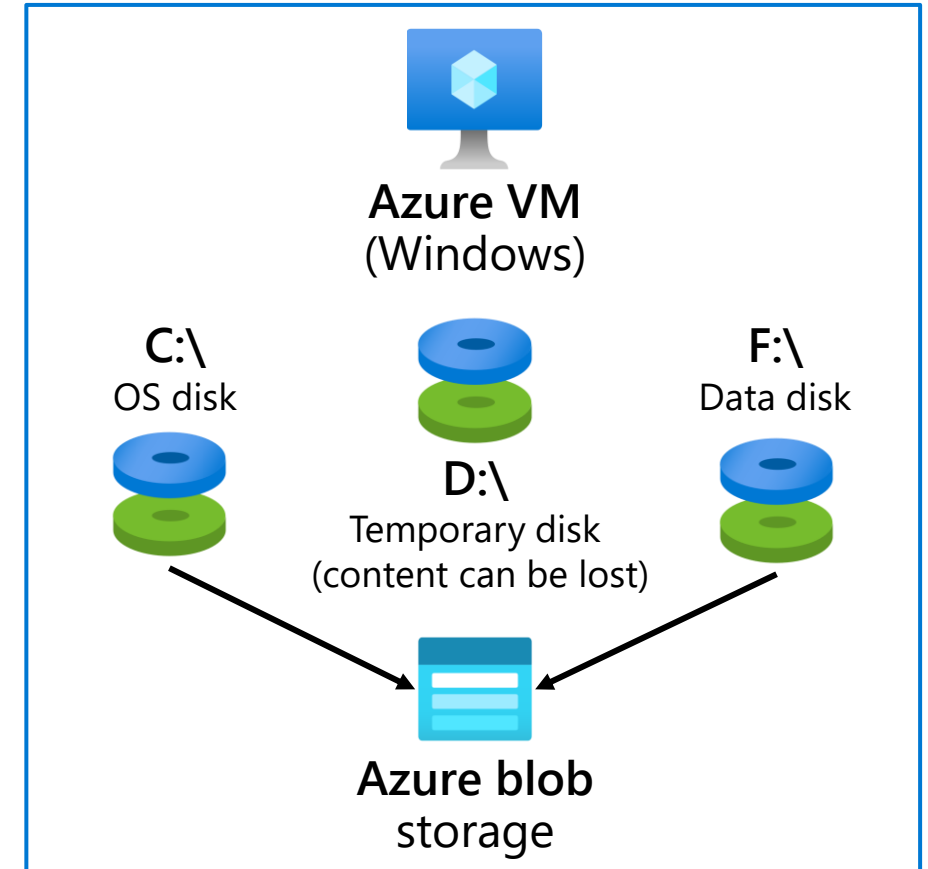
- OS disk
- Temporary disk
- Data disks (optional)

## OS and data disks reside in Azure-based storage service:

- Standard (HDD, SSD)
- Premium (SSD)
- Ultra (SSD)

## When creating an Azure VM, you can choose between:

- Managed disks (recommended)
- Unmanaged disks



# Azure Virtual Machine storage cont'd

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SQL Server workloads on Azure should use Premium SSD or Ultra SSD

You should separate transaction logs and data files onto their own volumes, with read-caching enabled on the data file volumes

You can stripe multiple disks using Storage Spaces or Logical Volume Management to get increased IOPs and storage volumes

# Performance consideration – Table and index partitioning

- Can improve query performance of large tables, while improving performance and scalability
- Used when the table becomes large enough that starts compromising query performance
- Maintenance operations on a partitioned table will reduce maintenance duration

**Four main components required:** filegroups, partition function, partition schema and table

```
-- Partition function
CREATE PARTITION FUNCTION PartitionByMonth (datetime2)
AS RANGE RIGHT
-- The boundary values defined is the first day of each month
FOR VALUES ('20210101', '20210201', '20210301',
            '20210401', '20210501', '20210601', '20210701',
            '20210801', '20210901', '20211001', '20211101',
            '20211201');

-- The partition scheme below will use the partition function cre
CREATE PARTITION SCHEME PartitionByMonthSch
AS PARTITION PartitionByMonth
TO (FILEGROUP1, FILEGROUP2, FILEGROUP3, FILEGROUP4,
    FILEGROUP5, FILEGROUP6, FILEGROUP7, FILEGROUP8,
    FILEGROUP9, FILEGROUP10, FILEGROUP11, FILEGROUP12);

-- Creates a partitioned table called Order that applies Partitio
CREATE TABLE Order ([Id] int PRIMARY KEY, OrderDate datetime2)
ON PartitionByMonthSch (OrderDate) ;
GO
```

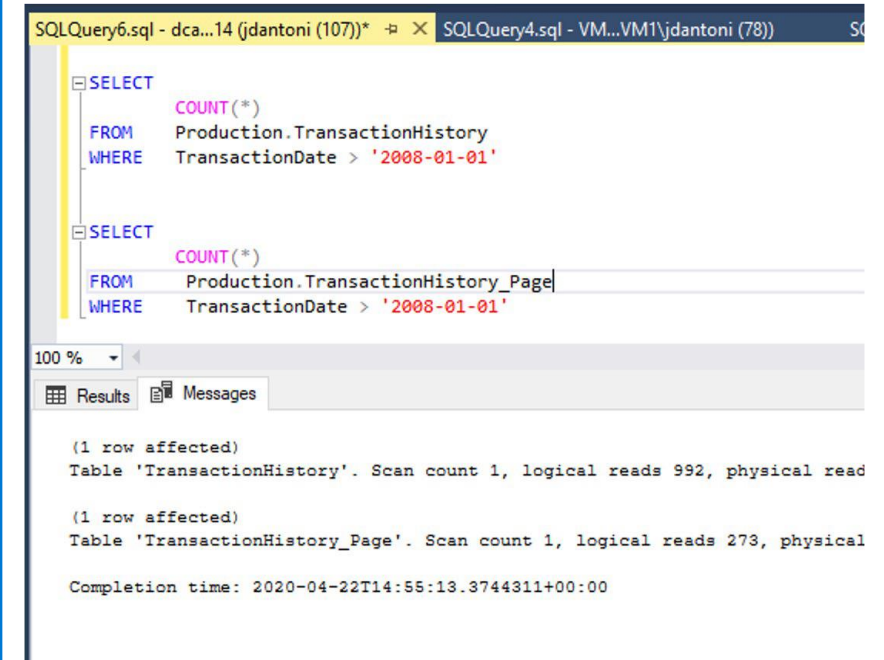
# Performance consideration – Data compression

In this example, both tables have clustered and nonclustered indexes

*Production.TransactionHistory\_Page* table is **page compressed**

The query against the page compressed object performs **27% fewer logical reads** than the uncompressed table

Compression is implemented at the index, table or partition level



```
SQLQuery6.sql - dca...14 (jdantoni (107))* X SQLQuery4.sql - VM...VM1\jdantoni (78)) SQ

SELECT COUNT(*)
FROM Production.TransactionHistory
WHERE TransactionDate > '2008-01-01'

SELECT COUNT(*)
FROM Production.TransactionHistory_Page
WHERE TransactionDate > '2008-01-01'

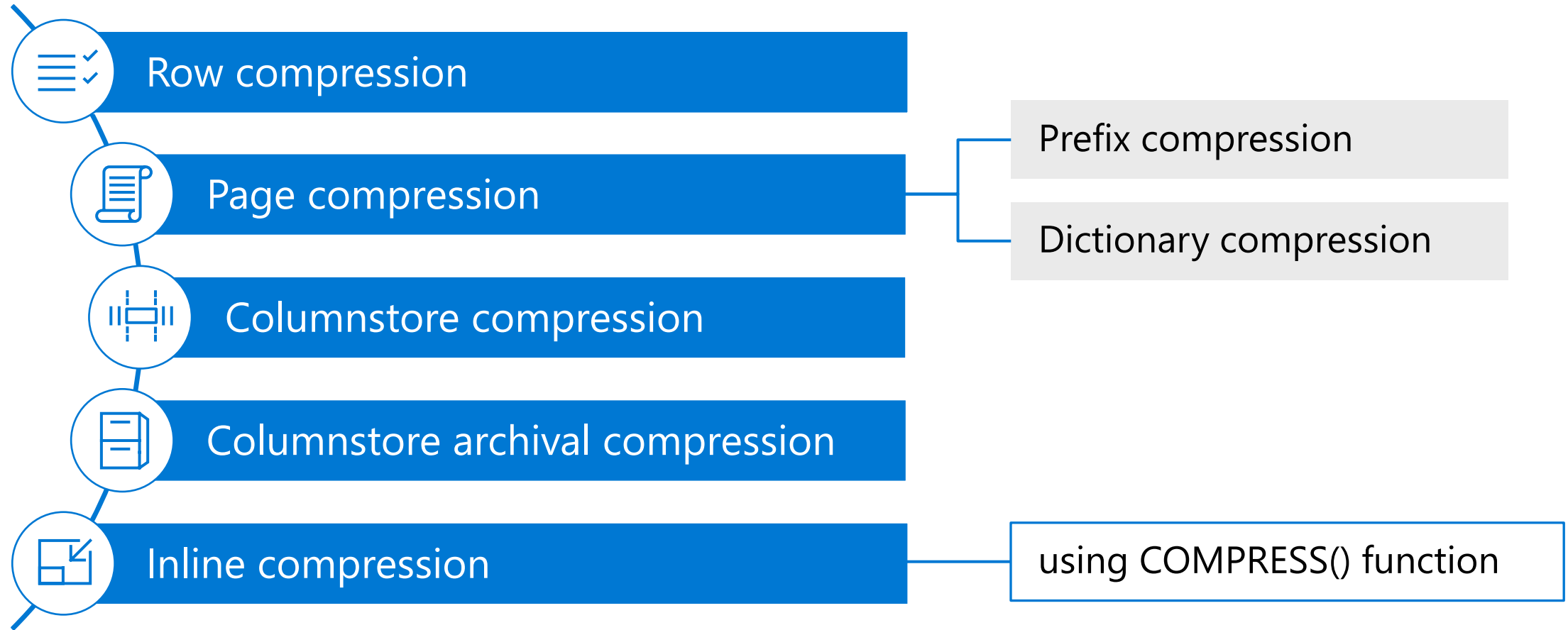
100 %
Results Messages

(1 row affected)
Table 'TransactionHistory'. Scan count 1, logical reads 992, physical read

(1 row affected)
Table 'TransactionHistory_Page'. Scan count 1, logical reads 273, physical

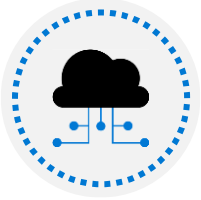
Completion time: 2020-04-22T14:55:13.3744311+00:00
```

# Performance consideration – Data compression cont'd



# Performance consideration – Additional options

---



## **For overall production workload:**

- Enable backup compression
- Enable instant file initialization for data files
- Limit autogrowth of the database
- Disable autoshrink/autoclose for the databases
- Move all databases to data disks, including system databases
- Move SQL Server error log and trace file directories to data disks
- Set max SQL Server memory limit
- Enable lock pages in memory
- Enable optimize for adhoc workloads for OLTP heavy environments
- Enable Query Store
- Schedule SQL Server Agent maintenance jobs
- Monitor and manage the health and size of the transaction log files



# Azure platform High Availability (HA) and Disaster Recovery (DR)

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## Availability sets

Protection from planned or unplanned Azure maintenance events and local hardware outage

## Availability zones

Protection from datacenter failures

## Paired Azure regions

Protection from regional failures while preserving data residency and compliance boundaries

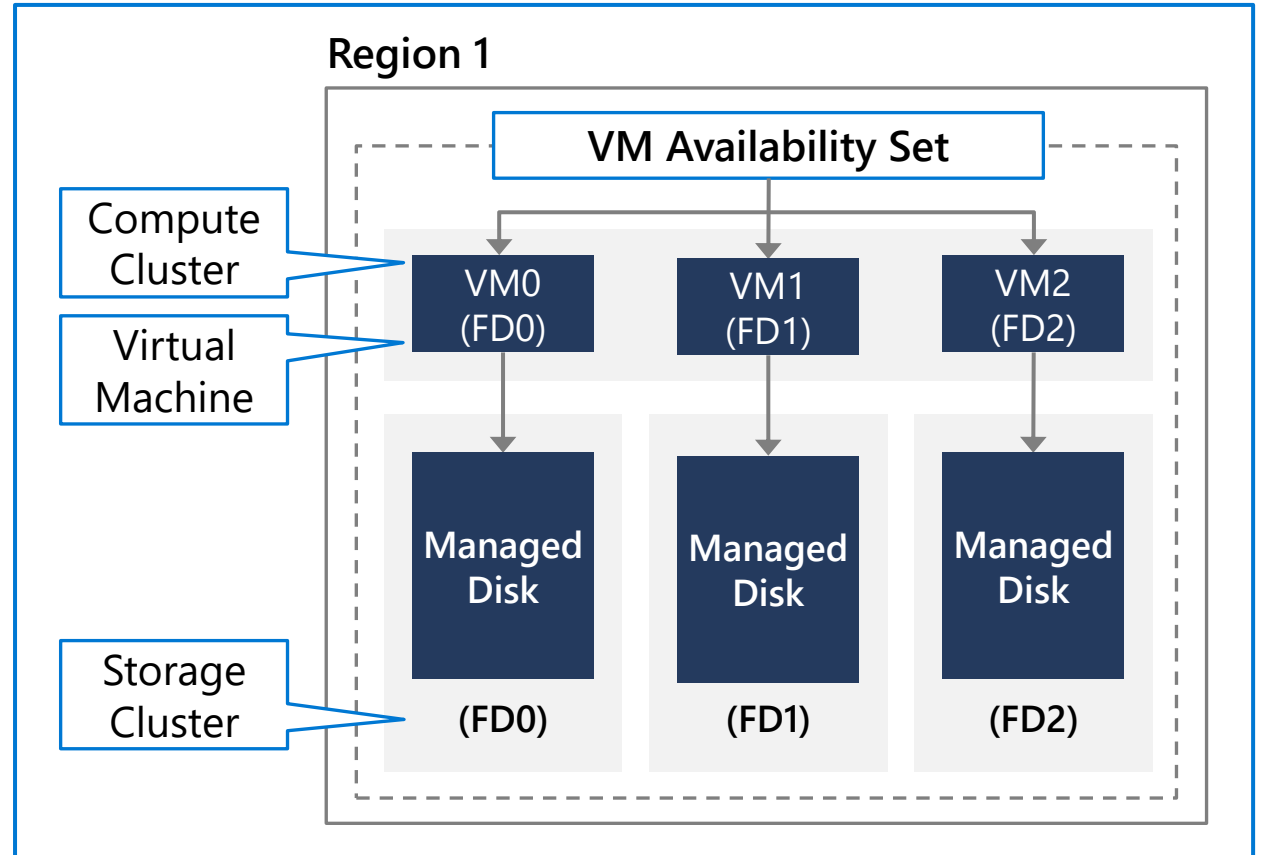
If a multi-region disaster happens, one region in each pair will be prioritized for recovery

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# Availability sets

Provide increased availability for multi-VM deployments by ensuring the VM are deployed to different physical hosts

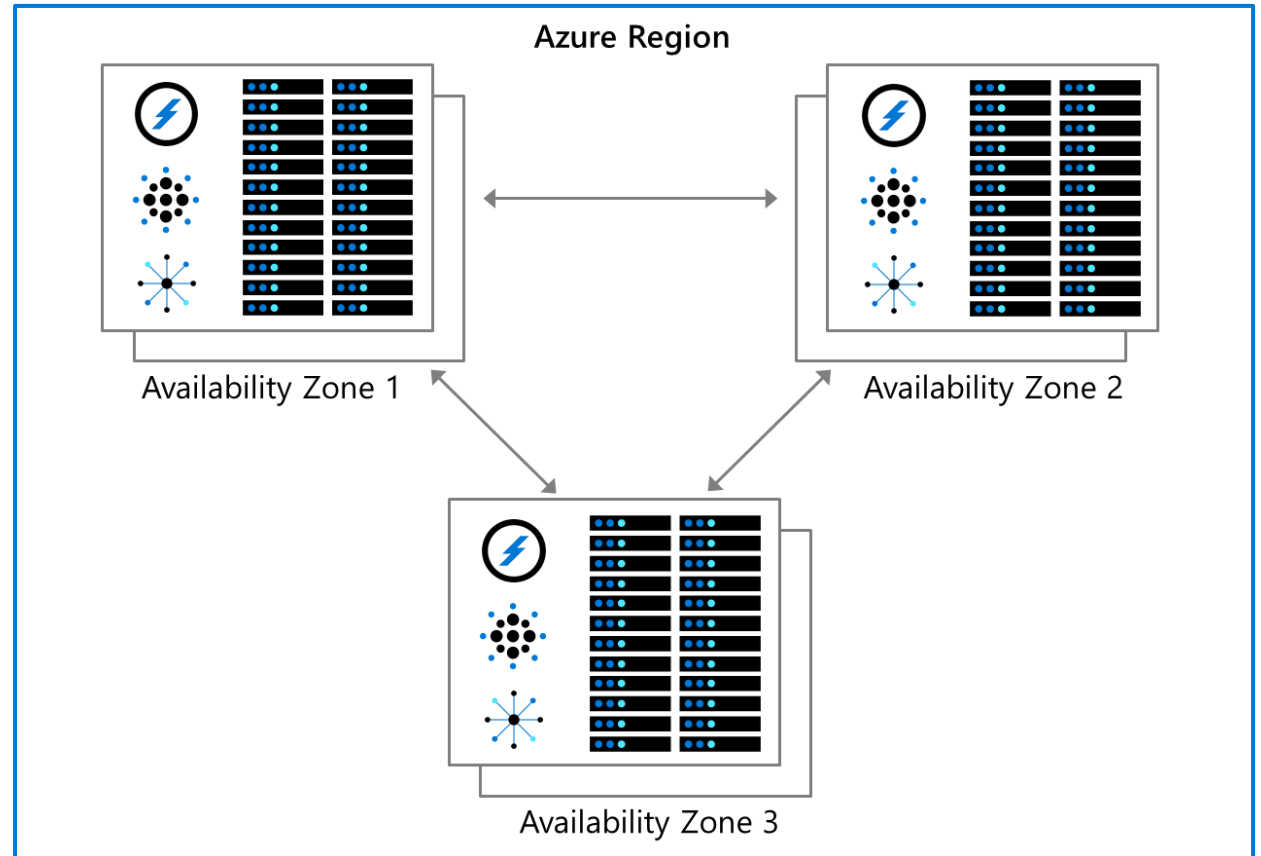
Use **fault domains** and **update domains** to protect workloads against host update failure and single points of hardware failure



# Availability zones

Allow workloads to be deployed to different data centers in the same Azure region

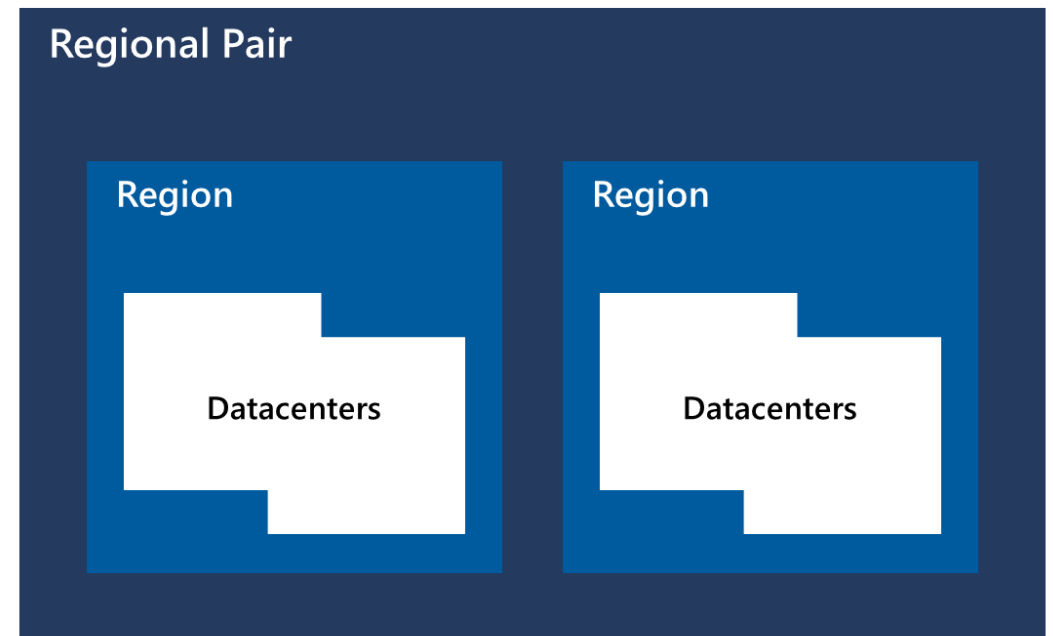
The latency between availability zones is low, and generally allows for **synchronous** data replication



# Paired Azure regions

- All Azure regions have a “paired” region in which deployments and updates are applied
- If a multi-region disaster happens, one region in each pair will be prioritized for recovery
- Regional pairs are set and cannot be changed

## Geography

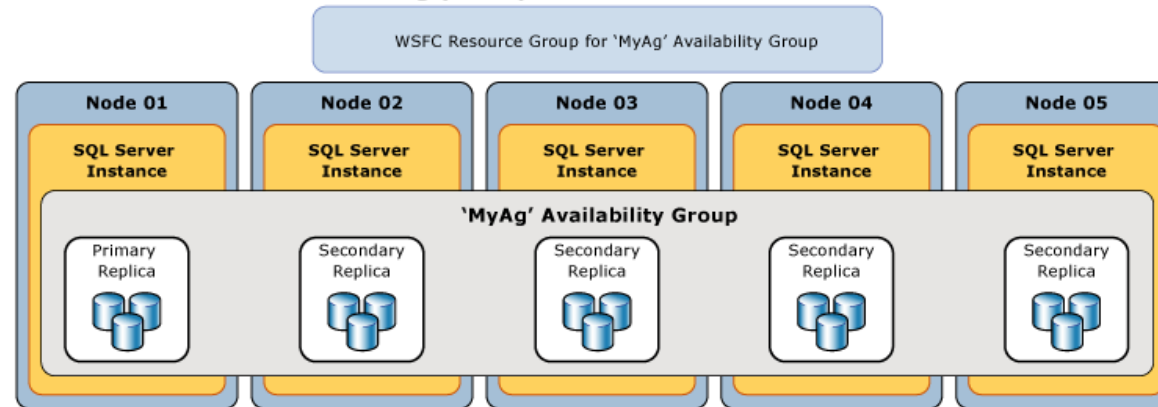


# Always On Availability Groups

Database transactions are committed to the primary replica, and then the transactions are sent either synchronously or asynchronously to all secondary replicas

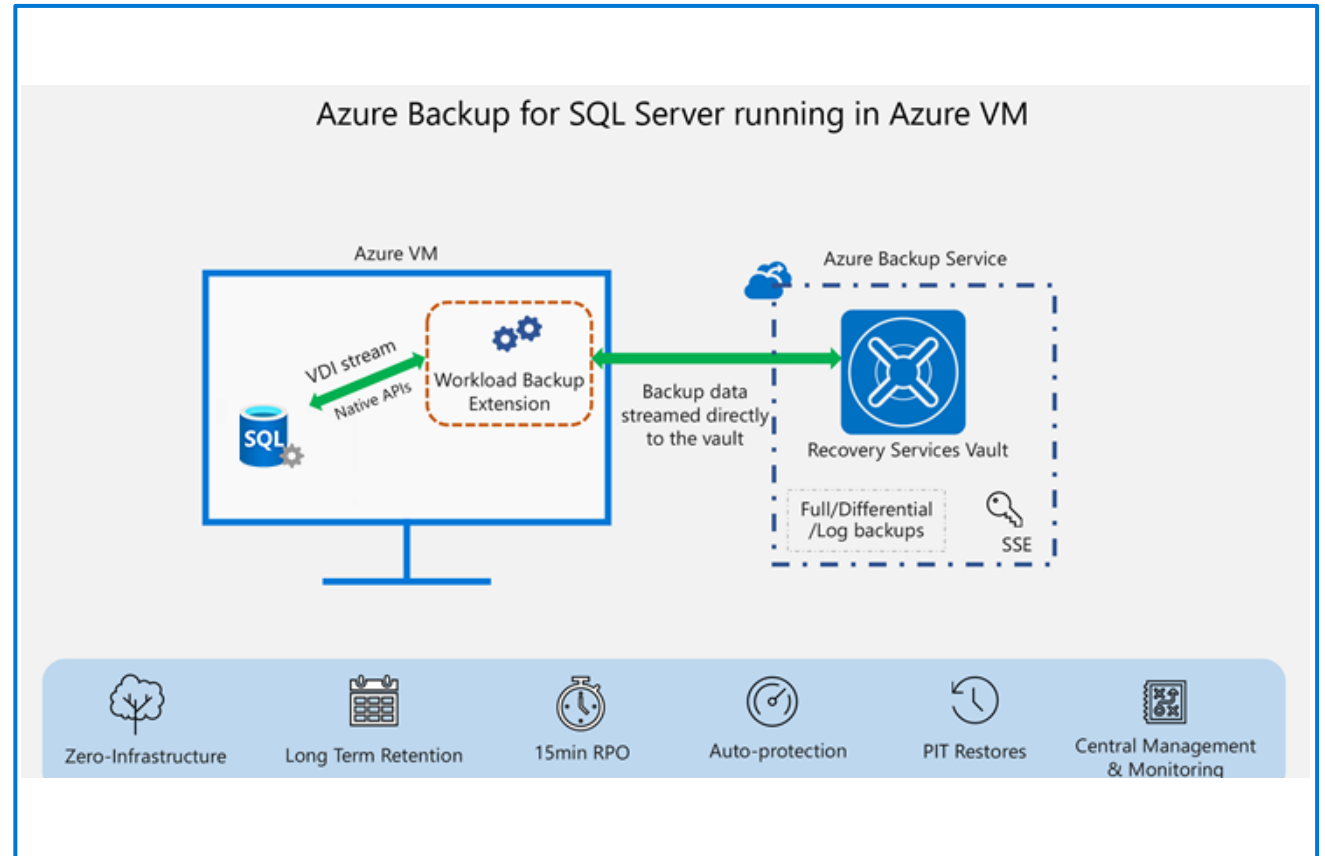
- **Asynchronous** mode - If the secondary replicas are geographically separate
- **Synchronous** mode - If the replicas are within the same Azure region

Windows Server Failover Clustering (WSFC) Cluster



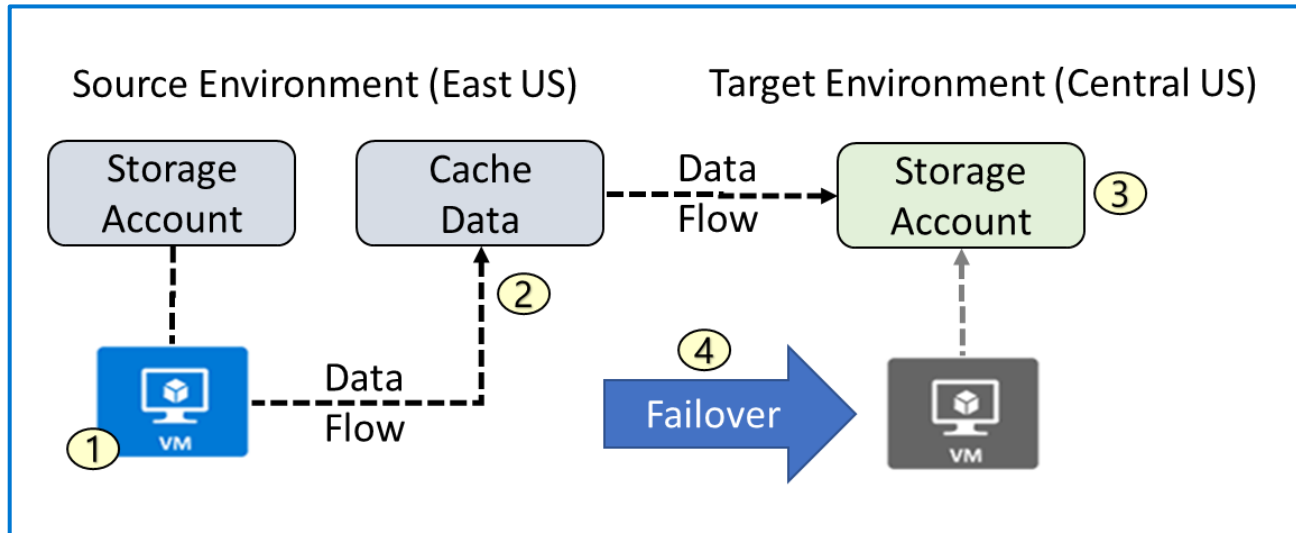
# Azure Backup for SQL Server

- Provides long-term data retention, automated management and additional data protection
- Offers a more complete backup feature set
- Requires an agent to be installed on the virtual machine
- Central location to manage and monitor the backups



# Azure Site Recovery (ASR)

- Low-cost solution that performs block level replication of your Azure virtual machine
- Better suited for migrations with some allowed downtime
- Use with Availability Groups to provide a lower RPO



1. VM is registered with Azure Site Recovery
2. Data is continuously replicated to cache
3. Cache is replicated to the target storage account
4. During failover the virtual machine is added to the target environment

# Instructor led labs: Provision a SQL Server on an Azure Virtual Machine

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Explore the Azure Portal

Deploy a SQL Server on an Azure Virtual Machine

Connect to SQL Server on an Azure Virtual Machine



# Deploy PaaS Solutions with Azure SQL



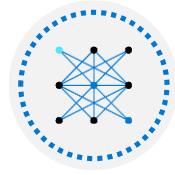
# Objectives



Gain an understanding of SQL Server in a Platform as a Service (PaaS) offering



Understand PaaS provisioning and deployment options



Understand elastic pools



Examine Managed Instances



Configure a template for PaaS deployment

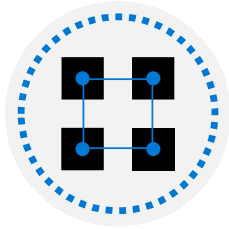
# Azure SQL Database deployment models

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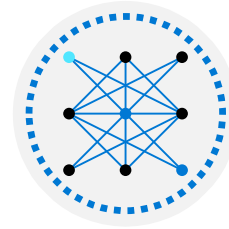
## Single Database

A fully managed and isolated database that is managed and billed independently



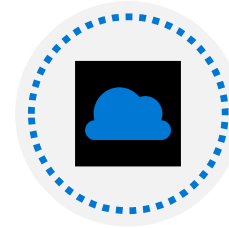
## Elastic Pool

A collection of databases that share a pool of resources



## Hyperscale

A single database deployment that supports very large volumes of data



## Serverless

Allows you to spend less for databases that do not need to be running 24x7

# Azure SQL Database service tier options

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## Service tier options – DTU

The original model which uses a formula using memory, storage, and IO resources to assign a service tier

Three different service tiers:

- **Basic**
- **Standard**
- **Premium**

## Platform as a service tiers – vCore

Allows you to choose a number of virtual CPUs, which have a fixed relationship to memory and storage provided by the database

Three different service tiers:

- **General Purpose**
  - **Hyperscale**
  - **Business Critical**
-

# Deploy single database via Azure portal

## Create SQL Database

Microsoft

Create a SQL database with your preferred configurations. Complete the Basics tab then go to Review + Create to provision with smart defaults, or visit each tab to customize. [Learn more](#)

### Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \* ⓘ

Resource group \* ⓘ

[Create new](#)

### Database details

Enter required settings for this database, including picking a logical server and configuring the compute and storage resources

Database name \*

Server ⓘ

[Create new](#)

Want to use SQL elastic pool? \* ⓘ ☐ Yes ☒ No

Compute + storage \* ⓘ

**General Purpose**  
Gen5, 2 vCores, 32 GB storage  
[Configure database](#)

[Review + create](#) [Next : Networking >](#)

# Deploy single database via PowerShell/Azure CLI

## PowerShell:

```
# Create a server firewall rule that allows access from the specified IP range

$serverFirewallRule = New-AzSqlServerFirewallRule -ResourceGroupName $resourceGroupName `
-ServerName $serverName `
-FirewallRuleName "AllowedIPs" -StartIpAddress $startIp -EndIpAddress $endIp

# Create a blank database with an S0 performance level

$database = New-AzSqlDatabase -ResourceGroupName $resourceGroupName `
-ServerName $serverName `
-DatabaseName $databaseName `
-RequestedServiceObjectiveName "S0" `
-SampleName "AdventureWorksLT"
```

## Azure CLI:

```
# Configure a firewall rule for the server

az sql server firewall-rule create \
--resource-group $resourceGroupName \
--server $servername \
-n AllowYourIp \
--start-ip-address $startip \
--end-ip-address $endip

# Create a database in the server

az sql db create \
--resource-group $resourceGroupName \
--server $servername \
--name mySampleDatabase \
--sample-name AdventureWorksLT \
--edition GeneralPurpose \
--family Gen4 \
--capacity 1 \
```

# Deploy single database via Azure Resource Manager templates

```
#Define Variables for parameters to pass to template
$projectName = Read-Host -Prompt "Enter a project name"
$location = Read-Host -Prompt "Enter an Azure location (i.e. centralus)"
$adminUser = Read-Host -Prompt "Enter the SQL server administrator username"
$adminPassword = Read-Host -Prompt "Enter the SQL server administrator password" -AsSecureString
$resourceGroupName = "${projectName}rg"

#Create Resource Group and Deploy Template to Resource Group
New-AzResourceGroup -Name $resourceGroupName -Location $location

New-AzResourceGroupDeployment -ResourceGroupName $resourceGroupName `
  -TemplateUri "https://raw.githubusercontent.com/Azure/azure-quickstart-templates/master/101-sql-logical-serv
  -administratorLogin $adminUser -administratorLoginPassword $adminPassword

Read-Host -Prompt "Press [ENTER] to continue ..."
```

<https://raw.githubusercontent.com/Azure/azure-quickstart-templates/master/101-sql-logical-server/azuredeploy.json>

# Azure SQL Database backups

---

## Backup schedule:

- A weekly full backup
- A differential backup every 12 hours
- A transaction log backup every 5-10 minutes based on log utilization

## Retention:

- **vCore and Basic Databases:** 7-day default retention, that can extend to 35 days
- **Standard and Premium Databases:** 35-day retention period
- **Long Term Retention (LTR):** Keep backups up to 10 years on Azure blob storage



# Restoring an Azure SQL Database

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- Cannot manually restore a database utilizing the T-SQL command RESTORE DATABASE.
- Not possible to restore over an existing database.

**Existing database must be dropped or renamed prior to initiating the restore.**

Restore options:

Azure portal

PowerShell or Azure CLI

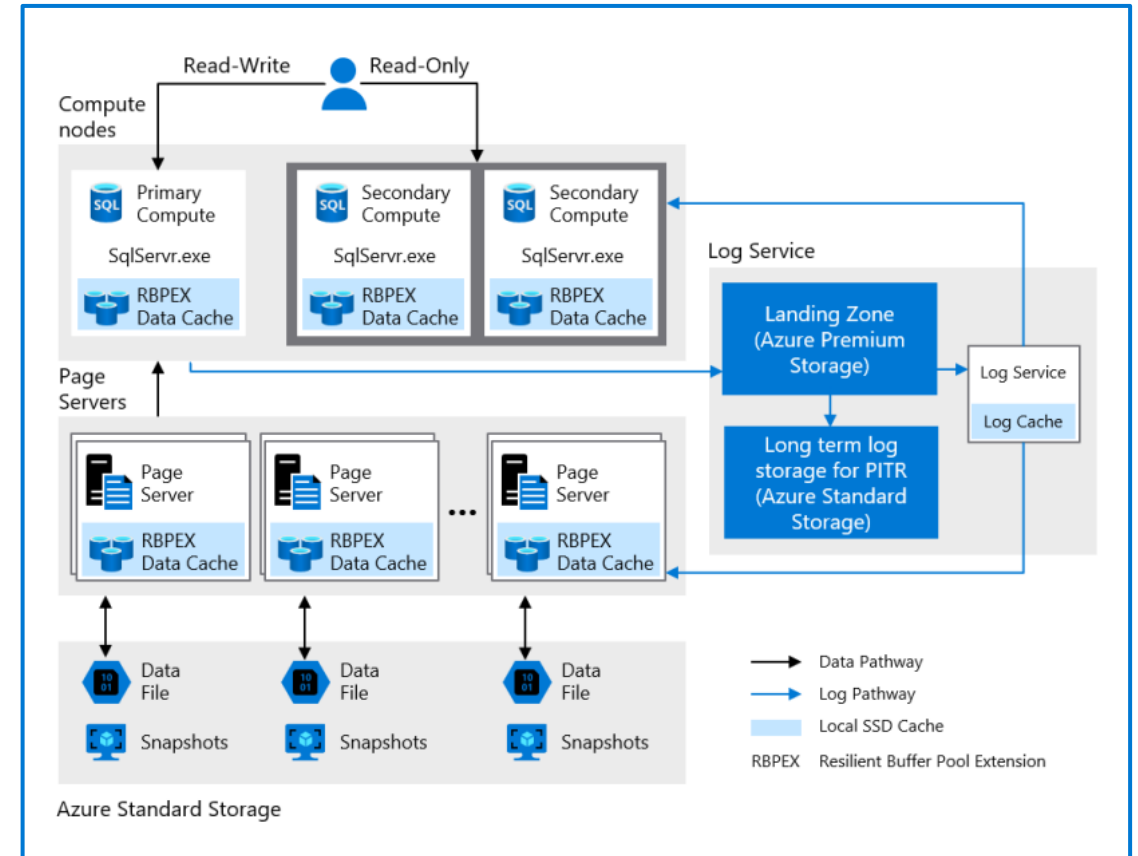
# Hyperscale SQL Database

Designed for very large OLTP databases

Able to auto-scale independently storage and compute with no limits

Restores in minutes rather than hours and days

Scale up or down in real time to accommodate workload changes



# Hyperscale use cases

Large on-premises SQL Server databases that you want to modernize their apps by moving to the cloud

Using Azure SQL Database and want to significantly expand the potential for database growth

Workloads that need both high performance and high scalability

Home > SQL databases > Create SQL Database >

## Configure

[Feedback](#)

### Service and compute tier

Select from the available tiers based on the needs of your workload. The vCore model provides a wide range of configuration controls and offers Hyperscale and Serverless to automatically scale your database based on your workload needs. Alternately, the DTU model provides set price/performance packages to choose from for easy configuration. [Learn more](#)

Service tier

[Databases originally created in Hyperscale](#)

Compute Hardware

Select the hardware configuration based on confidential computing hardware depends on

Hardware Configuration

Save money

Already have a SQL Server License? Save with a license you already own with Azure Hybrid Benefit. Actual savings may vary based on region and performance tier. [Learn more](#)

☐ Yes ☒ No

vCores [How do vCores compare with DTUs?](#)

2

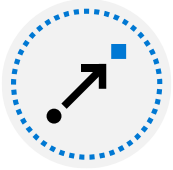
**Service tier dropdown menu:**

- Hyperscale (On-demand scalable storage)
- vCore-based purchasing model
  - General Purpose (Scalable compute and storage options)
  - Hyperscale (On-demand scalable storage)**
  - Business Critical (High transaction rate and high resiliency)
- DTU-based purchasing model
  - Basic (For less demanding workloads)
  - Standard (For workloads with typical performance requirements)
  - Premium (For IO-intensive workloads)

[Change configuration](#)

# Hyperscale performance considerations

---



Nearly instantaneous database backups (based on file snapshots stored in Azure Blob storage) regardless of size with no IO effect on compute resources

---



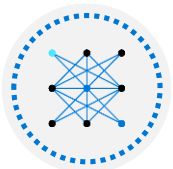
Fast database restores – minutes rather than hours or days (not a size of data operation)

---



Rapid scale out – provision one or more read-only replicas for offloading read workload and for use as hot-standbys

---



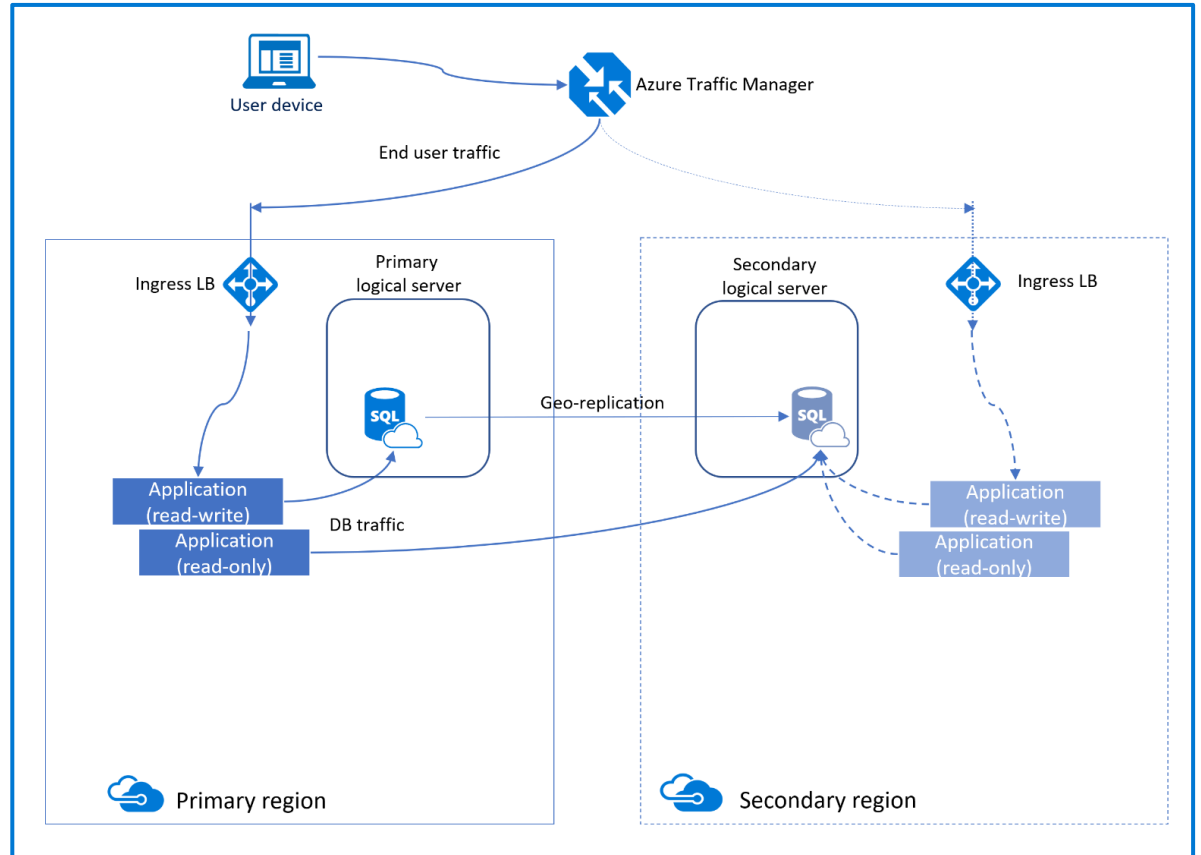
Rapid scale up – scale up your compute resources to accommodate heavy workloads when needed, and then scale the compute resources back down when not needed

# Active geo-replication

Provides automatic **asynchronous** replication of committed transactions on primary database to secondary database in the Azure using **snapshot isolation**

Utilizes **Always on Availability Groups** and **Active Geo-replication**

Provides a **readable secondary copy** of your database, no matter your service tier



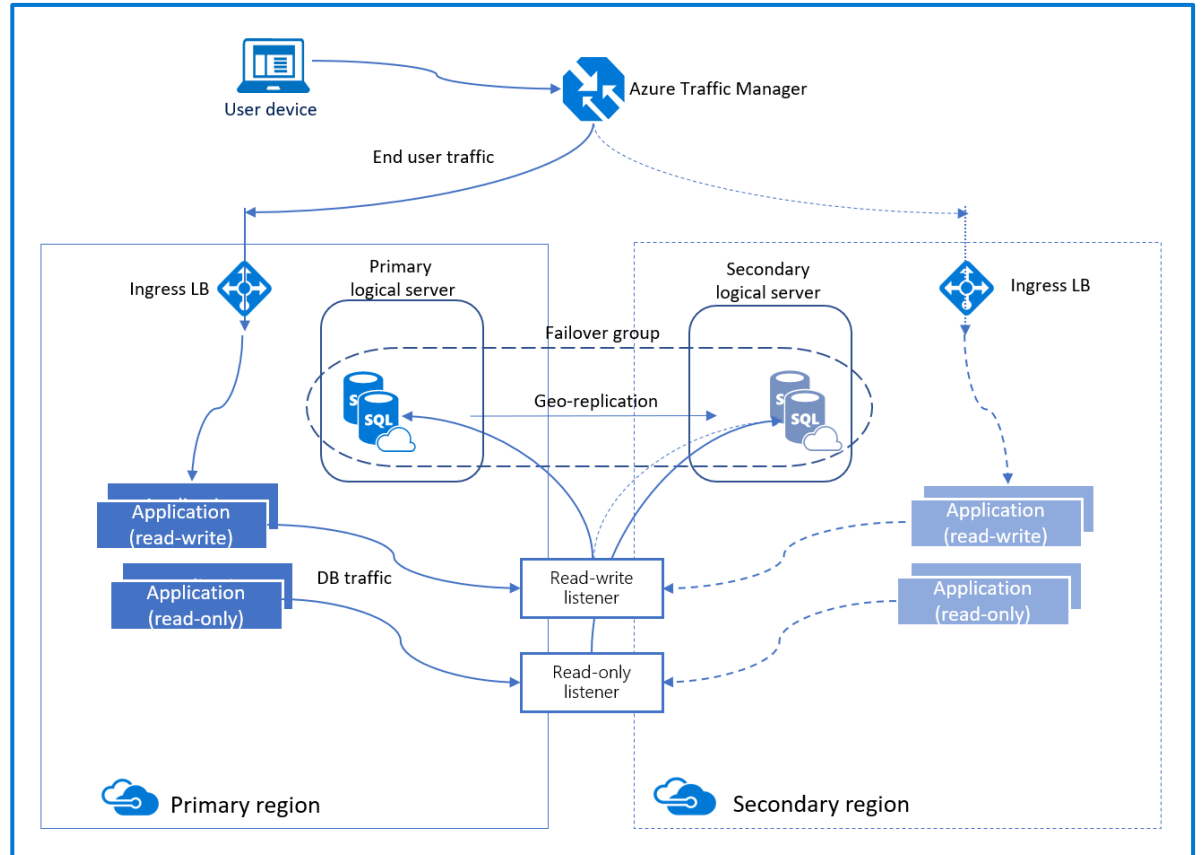
# Failover groups

Builds on the geo-replication feature

Provides for automatic failover

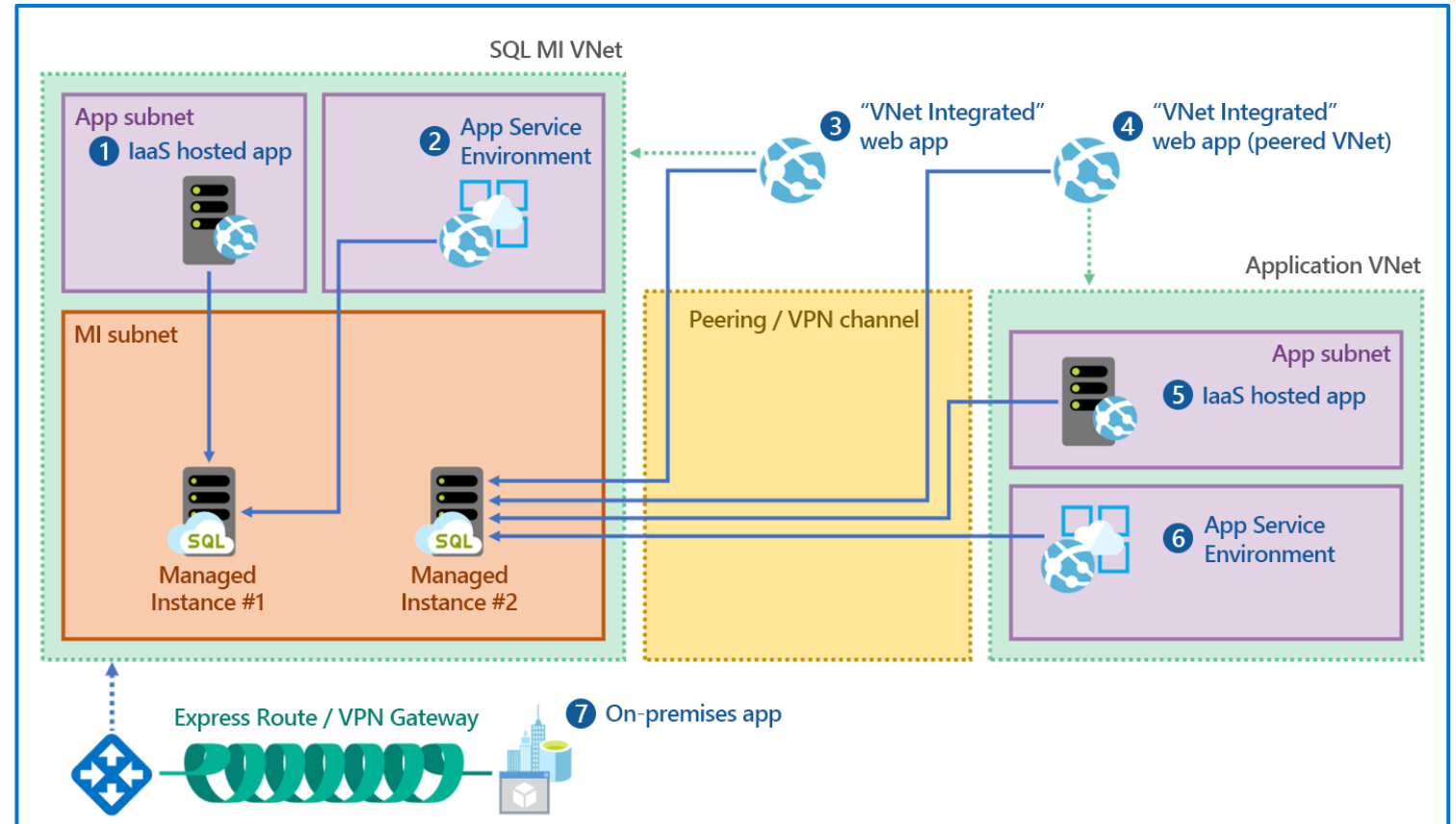
Allows a single connection string to connect to the group

Multiple databases can be in the same failover group



# Azure managed networking

- SQL Managed Instance is deployed into a virtual cluster in a Virtual Network
- Connections must come from its virtual network or a peered network

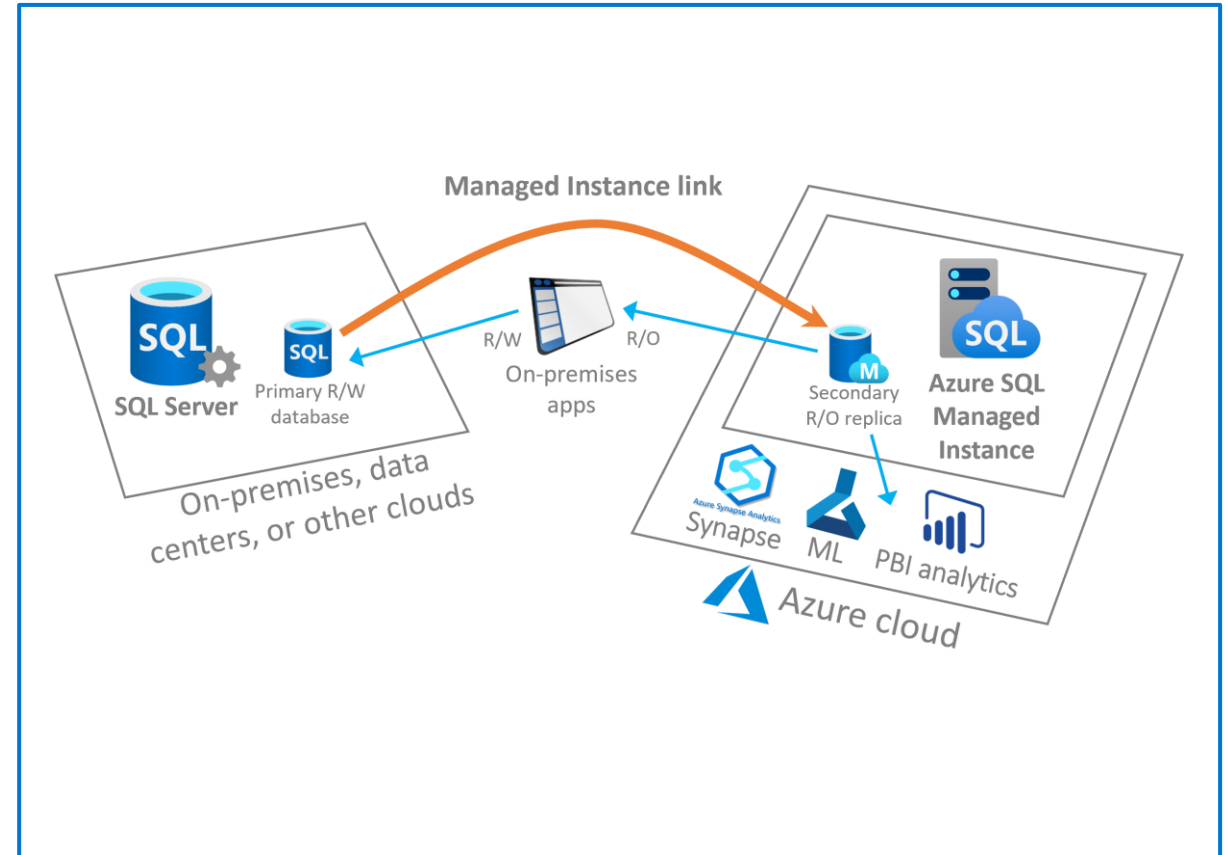


# Azure SQL Managed Instance link

Connects your SQL Servers hosted anywhere to SQL Managed Instance, providing hybrid flexibility and database mobility

## Supported scenarios:

- Use Azure services without migrating to the cloud
- Offload read-only workloads to Azure
- Migrate to Azure



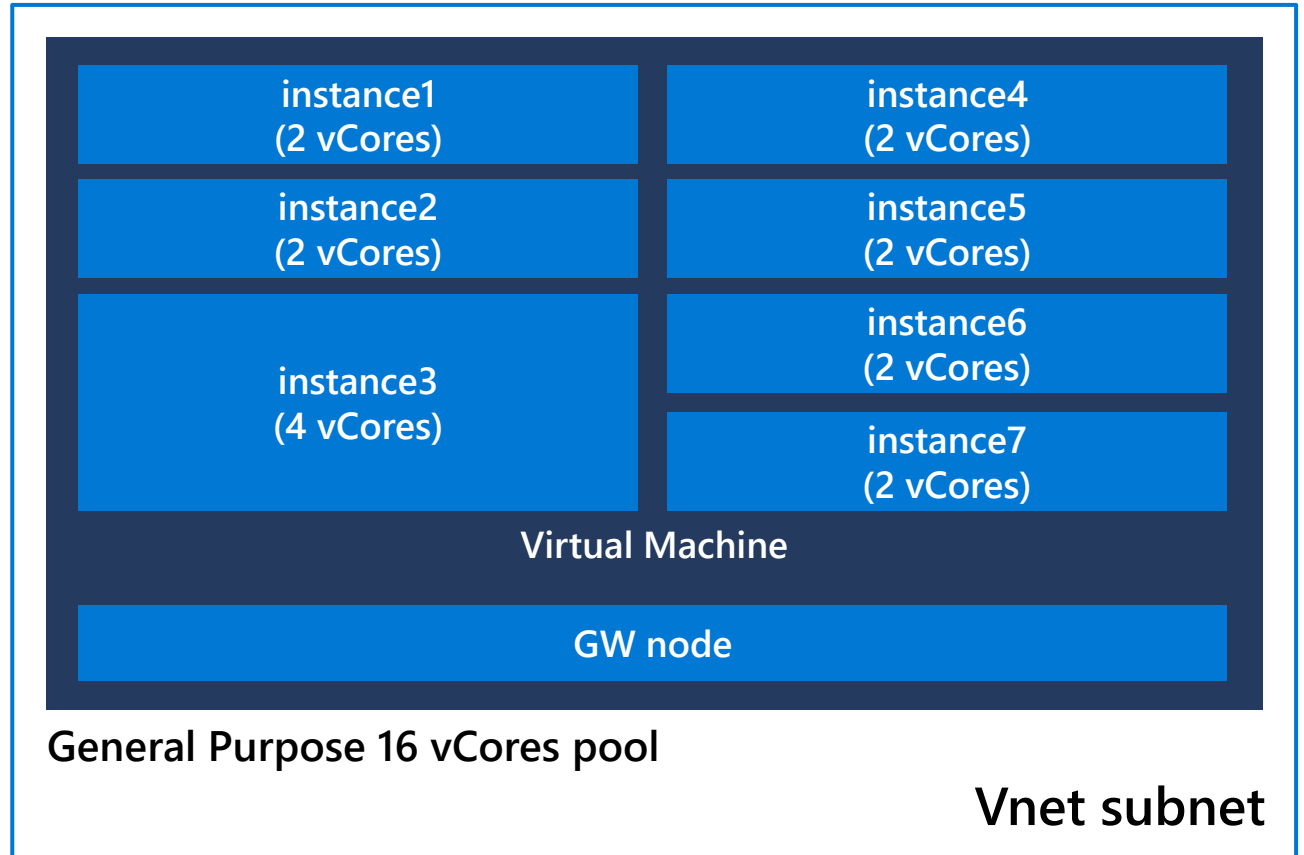


# Azure SQL Managed Instance – Instance Pools

This feature supports multiple managed instances on the same virtual machine

## Benefits

- Ability to host 2-vCore instances.
- Only for instances in the instance pools
- Predictable and fast instance deployment time.
- Minimal IP address allocation



# Azure SQL Managed Instance backups

---

Nearly the same as Azure SQL Database.

## Backup schedule:

- A weekly full backup
- A differential backup every 12 hours
- A transaction log backup every 5-10 minutes based on log utilization

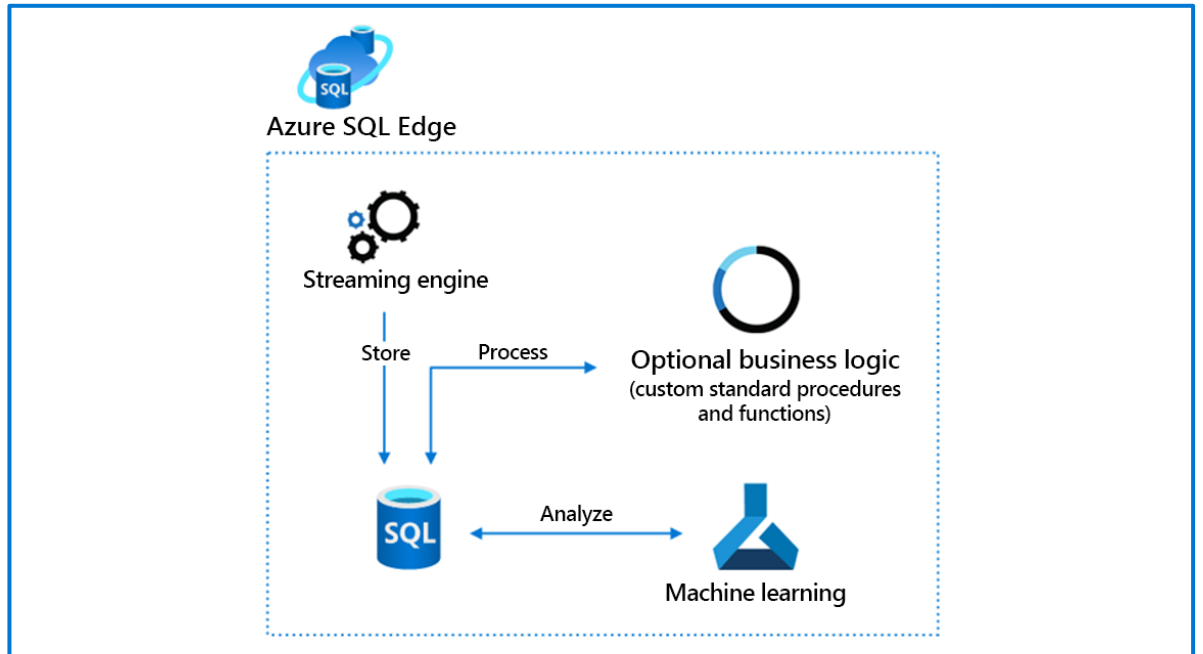
- **Retention:** 7-day default retention, that can extend to 35 days
- Backups are stored in geo-redundant storage accounts
- Ability to perform manual COPY\_ONLY backups to Azure blob storage

# Azure SQL Edge

Optimized relational database engine geared for IoT and IoT Edge deployments. It is a containerized Linux application that runs on a process based on ARM64 or x64

## Recommended scenarios:

- To capture continuous data streams in real time
- Integrate the data in a comprehensive organizational data solution
- Synchronize and connect to back-end systems
- Overcome connectivity limitations
- Overcome slow or intermittent broadband connection



# Instructor led labs: Provision an Azure SQL Database

---

Create a Virtual Network

Deploy an Azure SQL Database

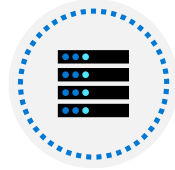
Connect to an Azure SQL Database using Azure Data Studio

Query an Azure SQL Database using SQL Notebook

# Evaluate Strategies for Migrating to Azure SQL



# Objectives



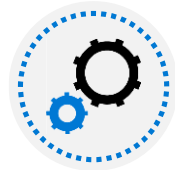
How SQL Server Compatibility Level affects database behavior



Microsoft's support policy for SQL Server



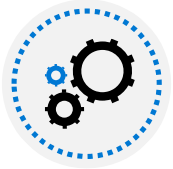
The differences between private and public preview



Describe the various options when you are performing a migration

# Compatibility level

---



Database level setting

---



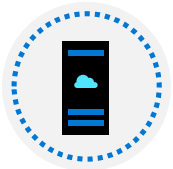
Currently (SQL Server 2019/Azure Services) supports compatibility levels 100-150 (2008-2019)

---



Allow query optimizer behavior and most T-SQL syntax to maintain behavior of older versions of database engine

---



Effects behavior of the given database, and not the entire server

# SQL Server support model

---

**SQL Server releases are in primary support for five years**

This means performance, security, and functional updates in Cumulative Updates

**SQL Server provides extended support for the next five years**

Security fixes will be addressed during this period



# Currently supported releases of SQL Server

---



SQL  
Server 2022

SQL  
Server 2019

SQL  
Server 2017\*

SQL  
Server 2016\*

SQL  
Server 2014\*

\*Extended Support

# Compatibility level-based certification for applications

---



Applications should stop certifying for specific version or platform  
(for example, SQL Server 2019 or Azure SQL Database)

---



Azure PaaS service versions are evergreen (always latest) so it makes the most sense to  
certify to a compatibility level

---



Any application certification process should be aimed at a certification level

# Type of Azure preview

---



**Private preview** – Your subscription needs to be added to allowed list in order use the feature. May or may not have portal support

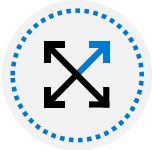
---



**Public preview** – Visible either in the portal, or at <https://azure.microsoft.com/updates/>

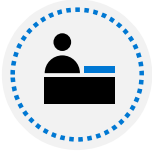
# Preview feature caveats

---



May be limited to specific regions

---



Preview features are often at discounted pricing

---



May not have full GUI support

---

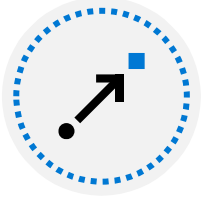


Different support policies than GA features

---

# Migrating to Azure

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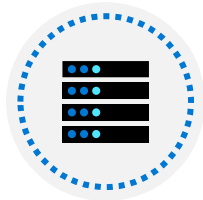
Most IaaS migrations are “Lift and Shift” - the on-premises architecture is recreated in Azure and workloads and data are migrated. Consider “Lift and Modernize”

---



The **Azure Migrate** tool automates migration allowing you to automatically migrate all of your workloads and data to VMs running in Azure

---



The **Azure Migrate** tool can discover your environment and optionally execute a migration of your databases

# Database Migration Assistant (DMA)

---



Assesses your environment for moving from on-premises to either IaaS or PaaS

---



Detects issues that can affect SQL Server version upgrades or migration to Azure SQL Database or Managed Instance

---



Assesses the T-SQL code in your application to identify breaking changes

---



Recommends new features that would benefit your database

---



Can also migrate your database either to a VM, Azure SQL Database or Managed Instance

# SQL Server migration tools

---

Azure SQL Database	Azure SQL Managed Instance	SQL Server on Azure Virtual Machines
<p><b>Offline:</b> Azure SQL Migration extension for Azure Data Studio, Azure Database Migration Service, Azure Migrate, BACPAC file (import), BCP, SQL Data Sync, Azure Data Factory, transactional replication</p>	<p><b>Online:</b> Azure SQL Migration extension for Azure Data Studio, Azure Database Migration Service, Azure Migrate, Log Replay Service, Managed Instance link</p> <p><b>Offline:</b> Native backup/restore, BACPAC file (import), BCP, transactional replication, Azure Data Factory</p>	<p><b>Online:</b> Azure SQL Migration extension for Azure Data Studio, Azure Database Migration Service, Azure Migrate, distributed availability group</p> <p><b>Offline:</b> Native backup/restore, BACPAC file (import), BCP, detach/attach, log shipping, Database Migration Assistant (DMA)</p>

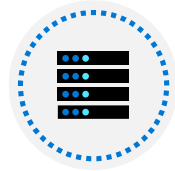
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# Migrate SQL Workloads to Azure SQL Database





# Objectives



Explore options for migrating to Azure SQL Database



Learn how to migrate to an Azure SQL Database



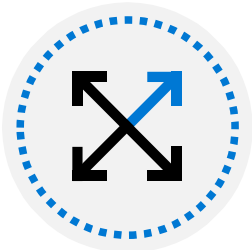
Understand service continuity to Azure SQL Database

# Migration benefits of SQL Server to Azure SQL Database

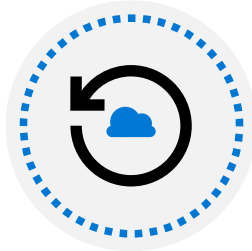
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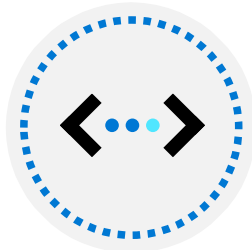
Backup and recovery



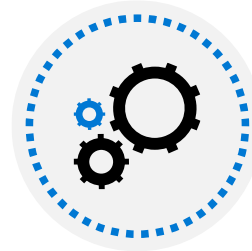
Service scalability



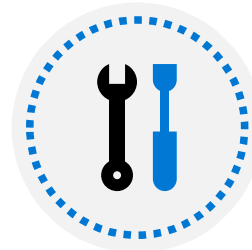
High availability



Security



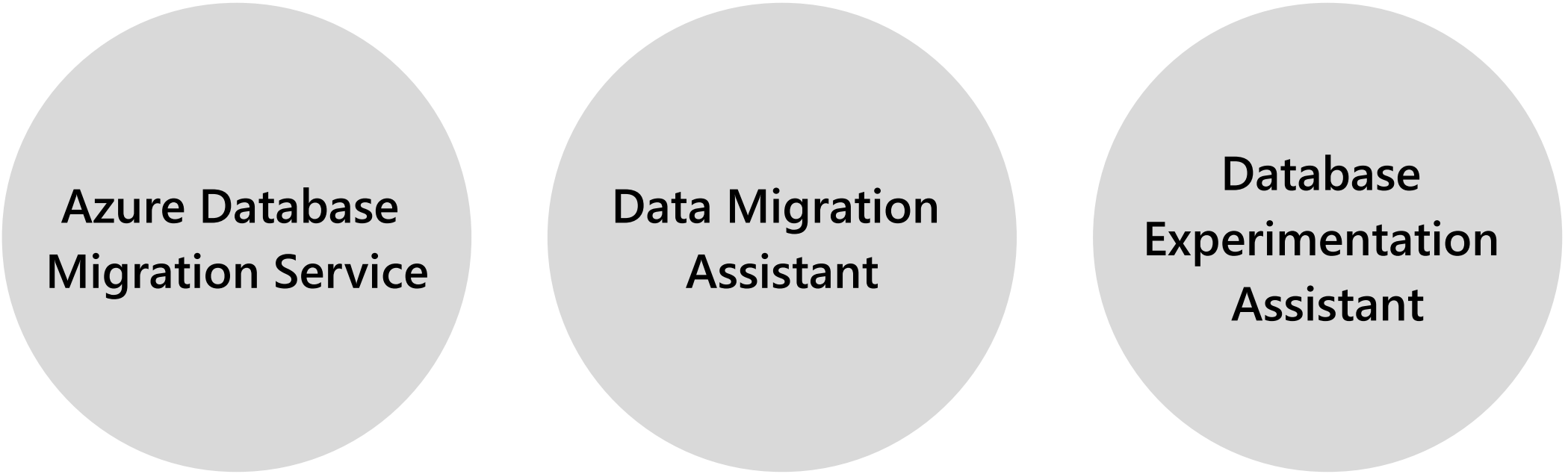
Disaster recovery



Licensing

# Tools to support your migration planning from SQL Server to Azure SQL Database

---



**Azure Database  
Migration Service**

**Data Migration  
Assistant**

**Database  
Experimentation  
Assistant**

# What is Data Migration Assistant?

---

Helps you upgrade to a modern data platform by detecting compatibility issues that can impact database functionality in your new version of SQL Server or Azure SQL Database.

## Supported Sources

- SQL Server 2005
  - SQL Server 2008
  - SQL Server 2008 R2
  - SQL Server 2012
  - SQL Server 2014
  - SQL Server 2016
  - SQL Server 2017 on Windows
- 

## Supported Targets

- SQL Server 2012
  - SQL Server 2014
  - SQL Server 2016
  - SQL Server 2017 on Windows and Linux
  - Azure SQL Database
  - Azure SQL Managed Instance
-

# Data Migration Assistant Configuration

## Data Migration Assistant Wizard

Installation wizard is simple and just requires you to accept the license

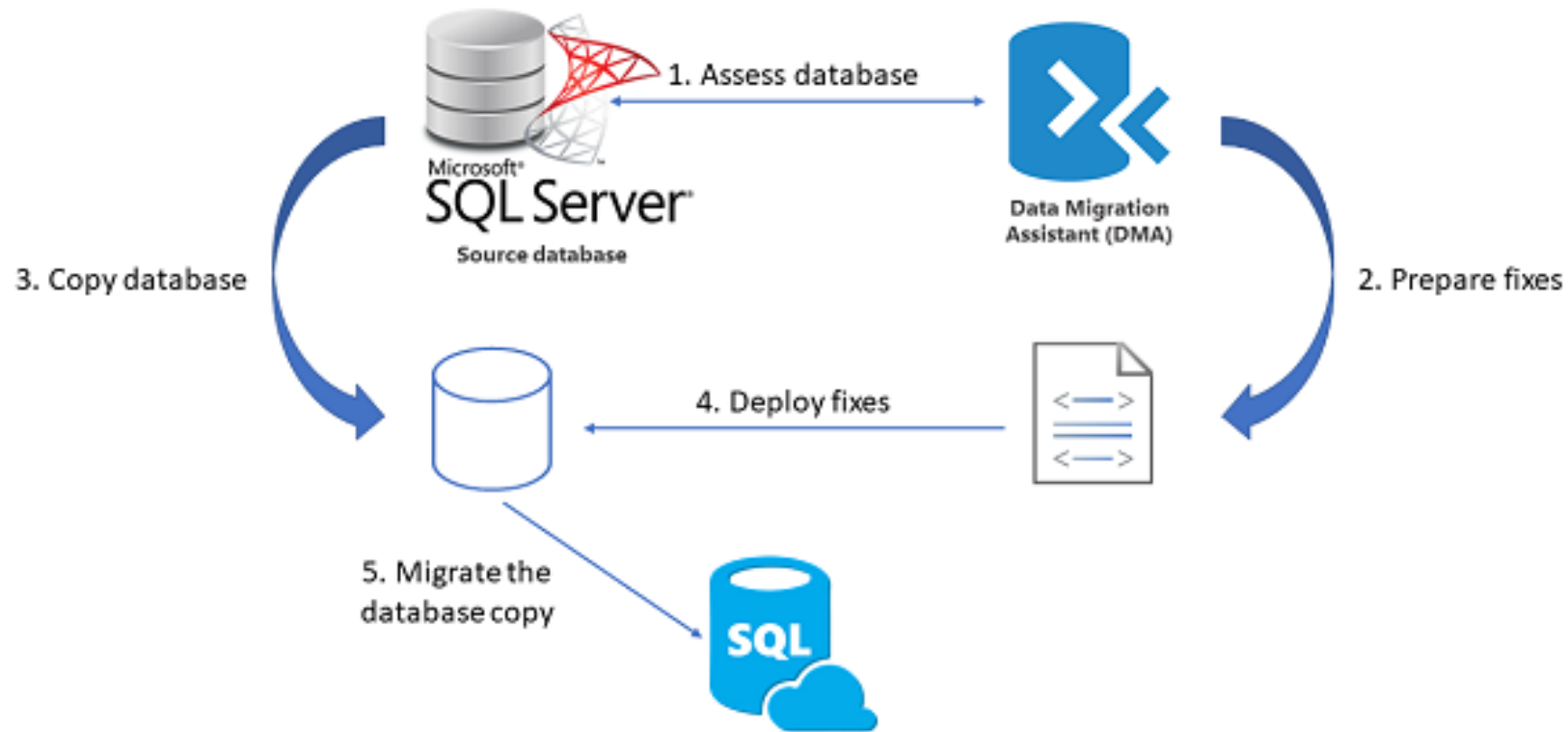
## Advanced configuration

You can fine-tune certain behavior of Data Migration Assistant by setting configuration values

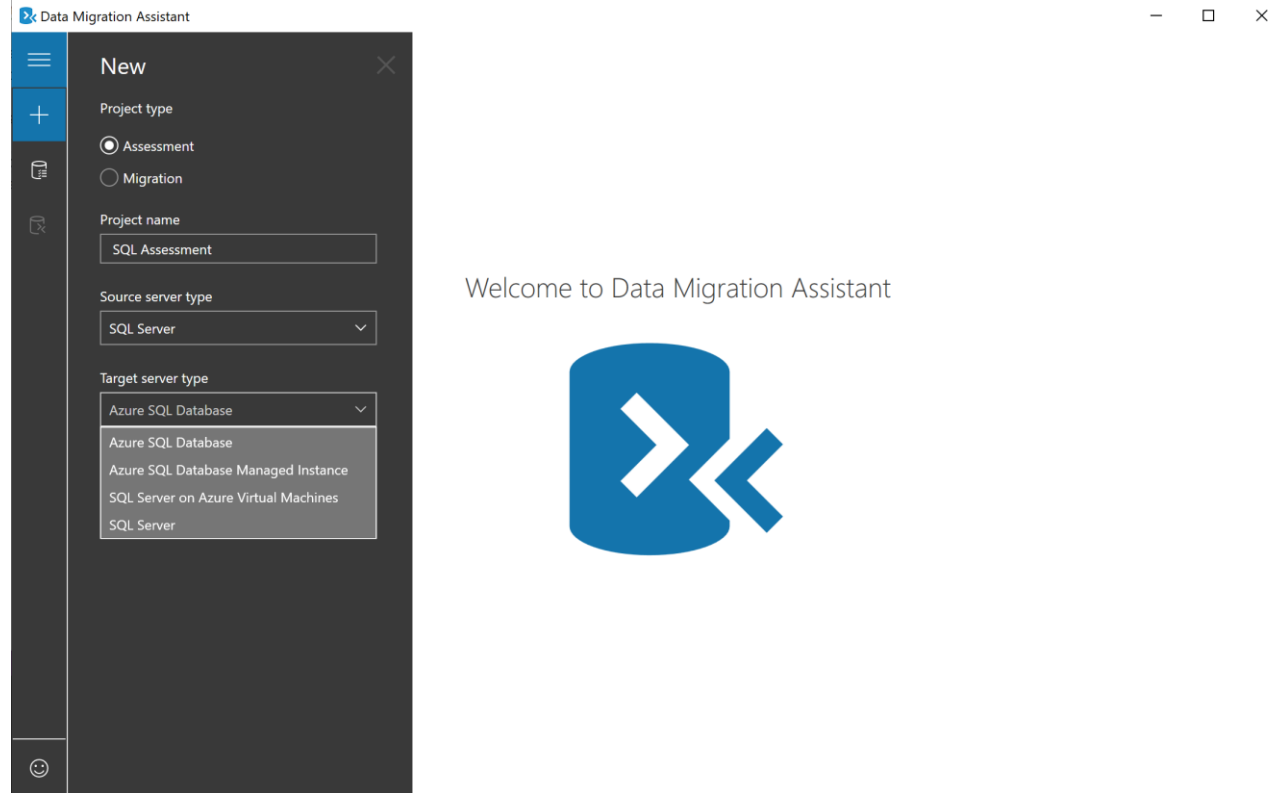
Advanced Configuration can include:

Parallel assessment	Parallel migration	Connection time-out
<pre>&lt;advisorGroup&gt; &lt;workflowSettings&gt; &lt;assessment parallelDatabases="8" /&gt; &lt;/workflowSettings&gt; &lt;/advisorGroup&gt;</pre>	<pre>&lt;advisorGroup&gt; &lt;workflowSettings&gt; &lt;migration parallelDatabases="8" /&gt; &lt;/workflowSettings&gt; &lt;/advisorGroup&gt;</pre>	<pre>&lt;appSettings&gt; &lt;add key="ConnectionTime out" value="15" /&gt; &lt;/appSettings&gt;</pre>

# Migrate using Data Migration Assistant



# Using Data Migration Assistant



# What is Database Experimentation Assistant?

---

## Database Experimentation Assistant (DEA)

Enables A/B testing between the source system and the target system to evaluate a targeted version of SQL Server for a specific workload.

## DEA outputs

Metrics include:

- Queries that have compatibility errors
- Degraded queries and query plans
- Other comparison data

The three tasks of the Database Experimentation Assistant are:

### Capture workloads

Capture trace file information from a production server to capture real world workloads.

### Replay workloads

Replay the captured trace files against a source and target server to generated information against each version.

### Analyze workloads





View the results so that a workload performance comparison can be made between the source and target workloads.

---



# Working with Database Experimentation Assistant

There are main 3 high level tasks that you perform

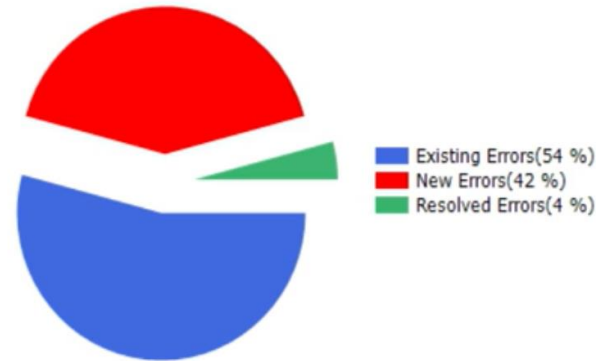
Tasks	Captures	Replays	Analyze
  All Captures  All Replays  Analysis Reports	<p>You should define:</p> <ul style="list-style-type: none"><li>• Trace name</li><li>• Duration</li><li>• SQL Server instance name</li><li>• Database name</li><li>• Path to store source trace file on SQL Server machine</li></ul>	<p>You should define:</p> <ul style="list-style-type: none"><li>• Replay name</li><li>• Controller machine name</li><li>• Path to source trace file on controller</li><li>• SQL Server instance name</li><li>• Path to store target trace file on SQL Server machine</li></ul>	<p>You should define:</p> <ul style="list-style-type: none"><li>• Report name</li><li>• Trace for Target 1 SQL Server</li><li>• Trace for Target 2 SQL Server</li></ul>

# Analyzing Database Experimentation Assistant Output

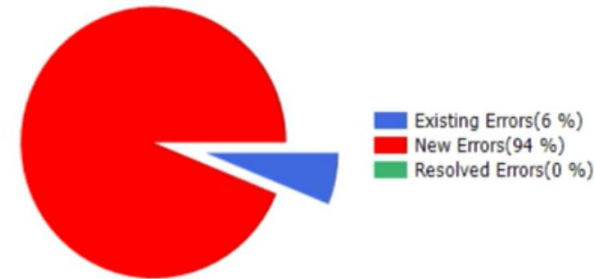
## Error Queries

Source	SQL2008SOURCE
Target	SQL2016SOURCE

Errors by Distinct Queries



Errors by Execution Count



Errors Type	Query Count
Existing Errors	13
New Errors	10
Resolved Errors	1

Error Type	Execution Count
Existing Errors	751
New Errors	11453
Resolved Errors	1

**Existing Errors** : Errors in source sever that continue to exist in target server  
**Resolved Errors** : Errors that existed in source server but resolved in target server.  
**New Errors** : New Errors found on target server

\*One Error Text message shown for unique combination of Query and Error Code

# What is Azure Database Migration Service?

---

Data  
Migration  
Assistant

SQL Server  
Migration  
Assistant

Database  
Experimenta  
tion  
Assistant

MongoDB

SQL Server

Oracle

DB2

MySQL

PostgreSQL

# Prerequisites for using Azure Database Migration Service

---



Ensure the TCP/IP protocol is enabled in SQL Server

---



Configure your Windows Firewall for database engine access

---



When using a firewall appliance in front of your source databases, add firewall rules

---



Create an Azure Virtual Network (VNet) for Azure Database Migration Service by using the Azure Resource Manager deployment model








---



Ensure that your VNet Network Security Group (NSG) rules don't block the following communication ports: 443, 53, 9354, 445, 12000

# Create an instance of Azure Database Migration Service

Report a bug



MICROSOFT

Home > Subscriptions > LearnAI Training Subscription - Resource providers

Subscription

Subscriptions

Resource providers

Deployments

Properties

Resource locks

Support + troubleshooting

Subscription - Resource providers

Search (Ctrl+ /)

Register Unregister Refresh

Microsoft.DataMigration

PROVIDER	STATUS
Microsoft.DataMigration	NotRegistered

Create Migration Service

Service Name

Enter service name

Subscription

Subscription

Select a resource group

Select existing...

Create new

Location

Brazil South

Virtual network

Select or create virtual network

Pricing tier

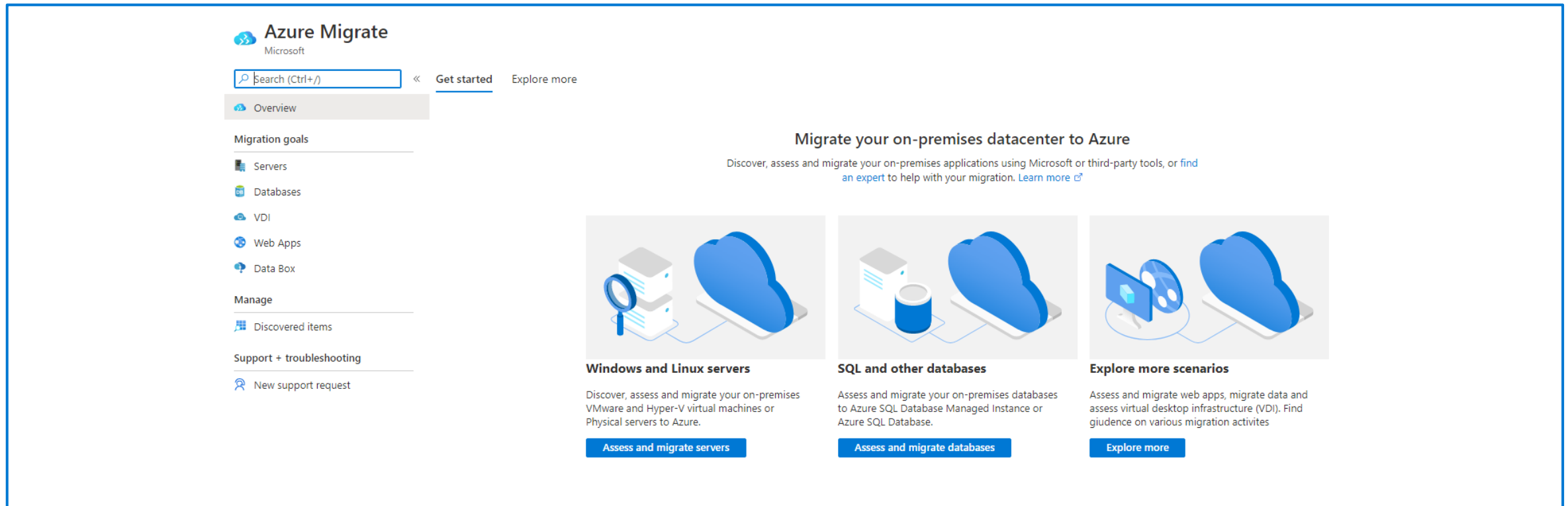
Standard: 1 vCores

Azure Database Migration Service quick start template

Experience our database migration service with pre-created source and target

# What is Azure Migrate?

Azure Migrate provides a dashboard for a suite of migration tools.



The screenshot displays the Azure Migrate dashboard. On the left, a sidebar contains the 'Azure Migrate' logo with the Microsoft name, a search bar, and navigation links for 'Overview', 'Migration goals' (Servers, Databases, VDI, Web Apps, Data Box), 'Manage' (Discovered items), and 'Support + troubleshooting' (New support request). The main content area is titled 'Migrate your on-premises datacenter to Azure' and includes a sub-header: 'Discover, assess and migrate your on-premises applications using Microsoft or third-party tools, or find an expert to help with your migration. Learn more'. Below this, three cards are presented: 'Windows and Linux servers' (with an icon of a server and a magnifying glass), 'SQL and other databases' (with an icon of a server and a database cylinder), and 'Explore more scenarios' (with an icon of a server and a VDI monitor). Each card contains a brief description of the migration process and a corresponding 'Assess and migrate' or 'Explore more' button.

**Azure Migrate**  
Microsoft

Search (Ctrl+/) << **Get started** Explore more

Overview

**Migration goals**

- Servers
- Databases
- VDI
- Web Apps
- Data Box

**Manage**

- Discovered items

**Support + troubleshooting**

- New support request

**Migrate your on-premises datacenter to Azure**

Discover, assess and migrate your on-premises applications using Microsoft or third-party tools, or find an expert to help with your migration. [Learn more](#)

**Windows and Linux servers**

Discover, assess and migrate your on-premises VMware and Hyper-V virtual machines or Physical servers to Azure.

[Assess and migrate servers](#)

**SQL and other databases**

Assess and migrate your on-premises databases to Azure SQL Database Managed Instance or Azure SQL Database.

[Assess and migrate databases](#)

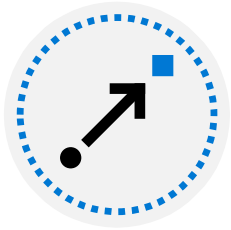
**Explore more scenarios**

Assess and migrate web apps, migrate data and assess virtual desktop infrastructure (VDI). Find guidance on various migration activities

[Explore more](#)

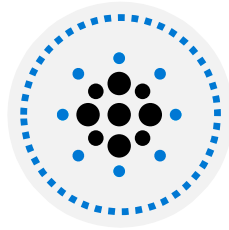
# What is Azure Migrate?

---



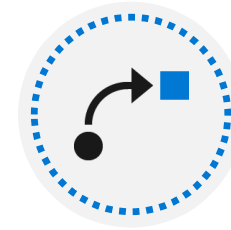
## Azure Migrate

It can be used for migrations to Azure SQL Server Virtual Machines.



## Assessment

You can use the Azure Migrate Service to perform assessment of source systems.



## Migrations

You can also use the Azure Migrate Service to perform the actual migration from VMware virtual machines.



Not to be confused with the Azure Database Migration Service.

# Exploring the Database Migration Guide

Data migration

Migrate to ▾

Migrate from ▾

Migration tools ▾

Resources ▾

## Azure Database Migration Guides

Step-by-step guidance for modernizing your data assets.

SQL Server to

SQL Server (upgrade)

Azure SQL Database

Azure SQL Managed Instance

SQL Server on Azure VMs

Azure Synapse Analytics

Migrate SQL Server to Azure video

Oracle to

Azure Database for PostgreSQL

SQL Server

Azure SQL Database

Azure SQL Managed Instance

SQL Server on Azure VMs

Azure Synapse Analytics

Db2 to

SQL Server

Azure SQL Database

Azure SQL Managed Instance

SQL Server on Azure VMs

Access to

SQL Server

Azure SQL Database

MySQL to

Azure Database for MySQL

SQL Server

Azure SQL Database

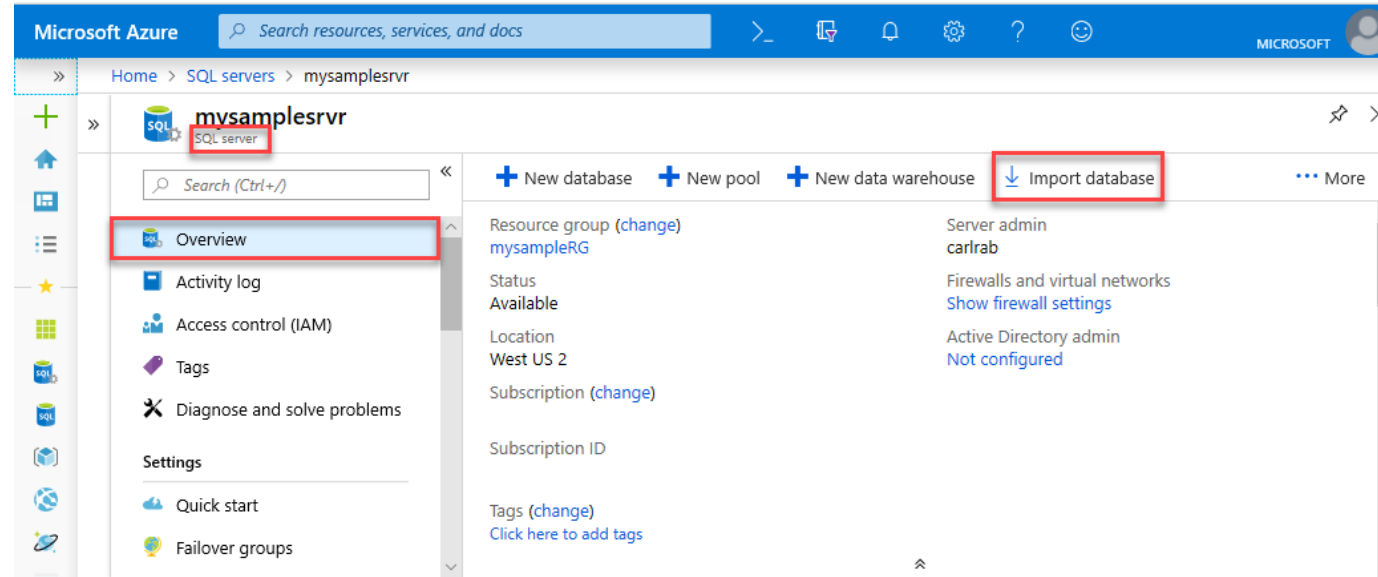
SAP ASE to

SQL Server

Azure SQL Database



# Migrate using the BACPAC



```
SqlPackage.exe /a:import /tcs:"Data Source=mynewserver20170403.database.windows.net;Initial  
Catalog=myMigratedDatabase;User  
Id=<your_server_admin_account_user_id>;Password=<your_server_admin_account_password>"  
/sf:AdventureWorks2008R2.bacpac /p:DatabaseEdition=Premium /p:DatabaseServiceObjective=P6
```

# Migrate using transactional replication

## Transactional replication

Transactional replication can be used to push out changes to data to a remote SQL Server.

## When to use it

Use transactional replication when you need to minimize downtime and do not have an Always On on-premises deployment.

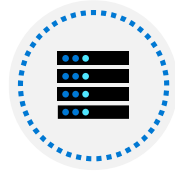
Three steps to migrate using transactional replication:

Distribution database	Create a publication	Create a subscription
Performed on the source database that will be migrated to a SQL Server hosted on an Azure Virtual Machine	You can selectively choose the tables within a database that you wish to publish. It can be the whole database or specific tables and views	On the SQL Server on the Azure Virtual Machine, you create a subscription that will host the migrated data

# Migrate SQL Workloads to Azure SQL Managed Instance



# Objectives



Explore options for migrating to Azure SQL Managed Instance



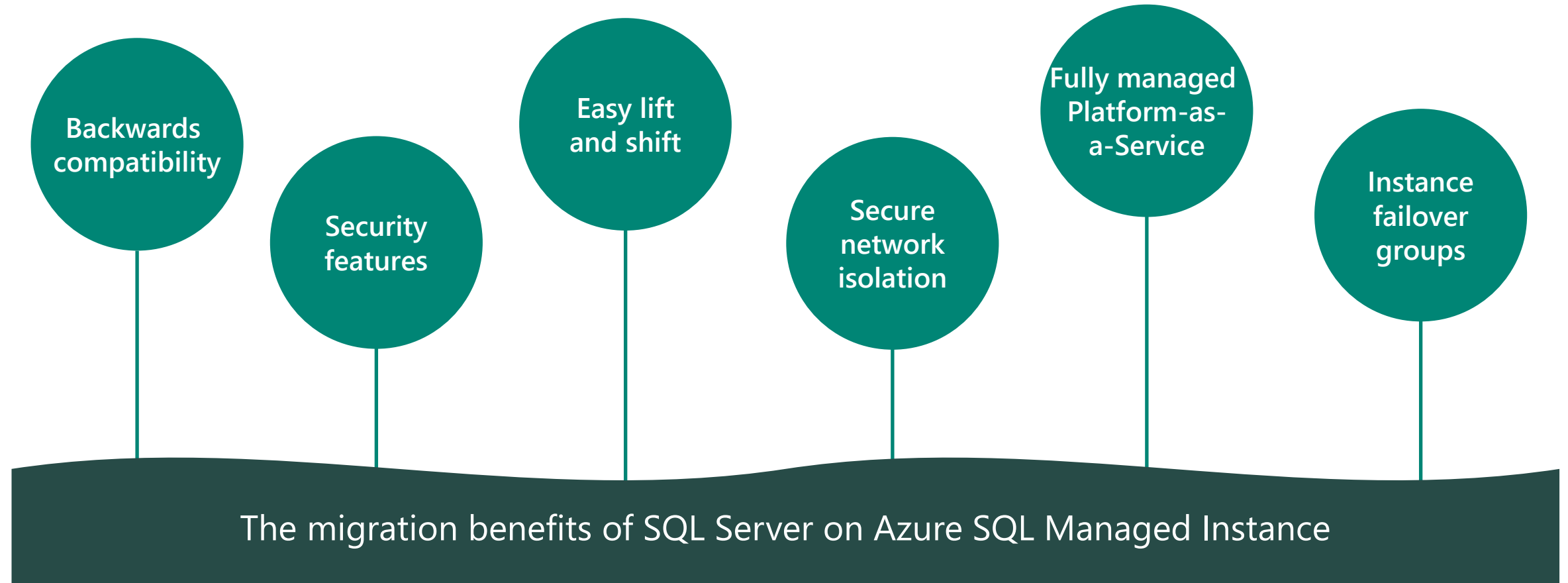
Synchronize data to Azure SQL Managed Instance



Considerations of migrating to Azure SQL Managed Instance

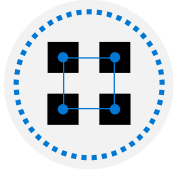
# The migration benefits of SQL Server on Azure SQL Managed Instance

---



# Tools to support migration planning from SQL Server to Azure SQL Managed Instance

---



Azure Database Migration Service

---



Data Migration Assistant

---



Database Experimentation Assistant

# Evaluating SQL Managed Instance compatibility

- **Features supported Azure SQL Managed Instance include:**
  - Cross-database queries
  - Cross-database transactions
  - Linked servers
  - CLR
  - Global temp tables
  - Instance level views
  - Service Broker
- **Use the Data Migration Assessments to establish any compatibility issues**

# Migrate using backup and restore from URL

---

BACKUP	CREDENTIAL	LIST	RESTORE	CHECK
Backup the database to an URL that points to an Azure storage account	Create a credential that accesses the storage account from SQL Managed Instance using Shared Access Signature (SAS)	Run the RESTORE FILELISTONLY FROM URL command to identify which backup to restore	Use the RESTORE DATABASE command to restore the database onto the managed instance	You can run SQL commands to check for the status of the restore operation to complete



# Managing encrypted databases

## Transparent data encryption

A SQL Server technology that ensures databases are encrypted at rest and can only be read when the certificate used to encrypt the data is leveraged to decrypt the database and database backups.

## Transparent data encryption and Azure Key Vault

Allows you to encrypt the Database Encryption Key (DEK) with a customer-managed asymmetric key called the TDE Protector. This is also known as Bring Your Own Key (BYOK) support.

## Steps to manually migrate the certificate:

Locate certificate	Backup the certificate	Copy and upload certificate
Use a Transact-SQL statement to get the database name and the certificate for each database.	Use the BACKUP CERTIFICATE statement to create a backup to a file location of your choice.	Copy the certificate to a personal information exchange and then upload to a managed instance.

# Connectivity options with on-premises servers

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Create a secure connection to your virtual network from an individual client computer.



Site to site is used to connect an entire on-premises site to the Azure network.



Create private connections between Azure datacenters and on-premises infrastructure.

# Options to synchronize data to and from SQL Managed Instance

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Backup  
and  
restore

BACPAC

Bulk Copy  
Program  
(BCP)

SQL Server  
Integration  
Services

Azure  
Data  
Factory

Transactional  
replication

# Synchronizing data using SSIS or Azure Data Factory

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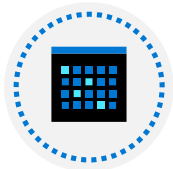
Continue leveraging your SSIS packages with Azure Data Factory or create a brand-new Azure Data Factory pipeline to execute your activities.



## **SQL Server Integration Services**

ETL tool of choice for migrating data from point A to point B and taking advantage of the powerful control flow and data flow capabilities.

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## **Azure Data Factory**

Azure Data Factory is essentially a fully-managed data integration as a service in the cloud that can be leveraged for your ELT workloads.

# Migrating SQL Server workloads using transactional replication

## Transactional replication

Can be used to push out changes to data to a remote SQL Server.

## When to use it

When you need to minimize downtime and do not have an Always On on-premises deployment.

## Steps to manually migrate the certificate:

Distribution database	Create a publication	Create a subscription
Performed on the source database that will be migrated to a SQL Server hosted on an Azure Virtual Machine.	You can selectively choose the tables within a database that you wish to publish. It can be the whole database or specific tables and views.	On the SQL Server on the Azure Virtual Machine, you create a subscription that will host the migrated data.

# Summary

## **Deploying IaaS solutions with Azure SQL:**

- Learn the available options for provisioning and deployment
- Deploy SQL Server on an Azure Virtual Machine

## **Deploying PaaS solutions with Azure SQL:**

- Understand the benefits of Platform as a Service offerings
- Understand the differences between Azure SQL offerings

## **Evaluating strategies for migrating to Azure SQL:**

- Describe the various options when you are performing a migration
- How SQL Server Compatibility Level affects database behavior

## **Migrating SQL workloads to Azure SQL Database:**

- Explore options for migrating to Azure SQL Database
- Understand service continuity to Azure SQL Database

## **Migrating SQL workloads to Azure SQL Managed Instance:**

- Explore options for migrating to Azure SQL Managed Instance
- Considerations of migrating SQL Managed Instance