Microsoft

Azure Architects Connect

SQL on Azure

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Microsoft

An introduction to

Azure SQL

The family of SQL cloud databases

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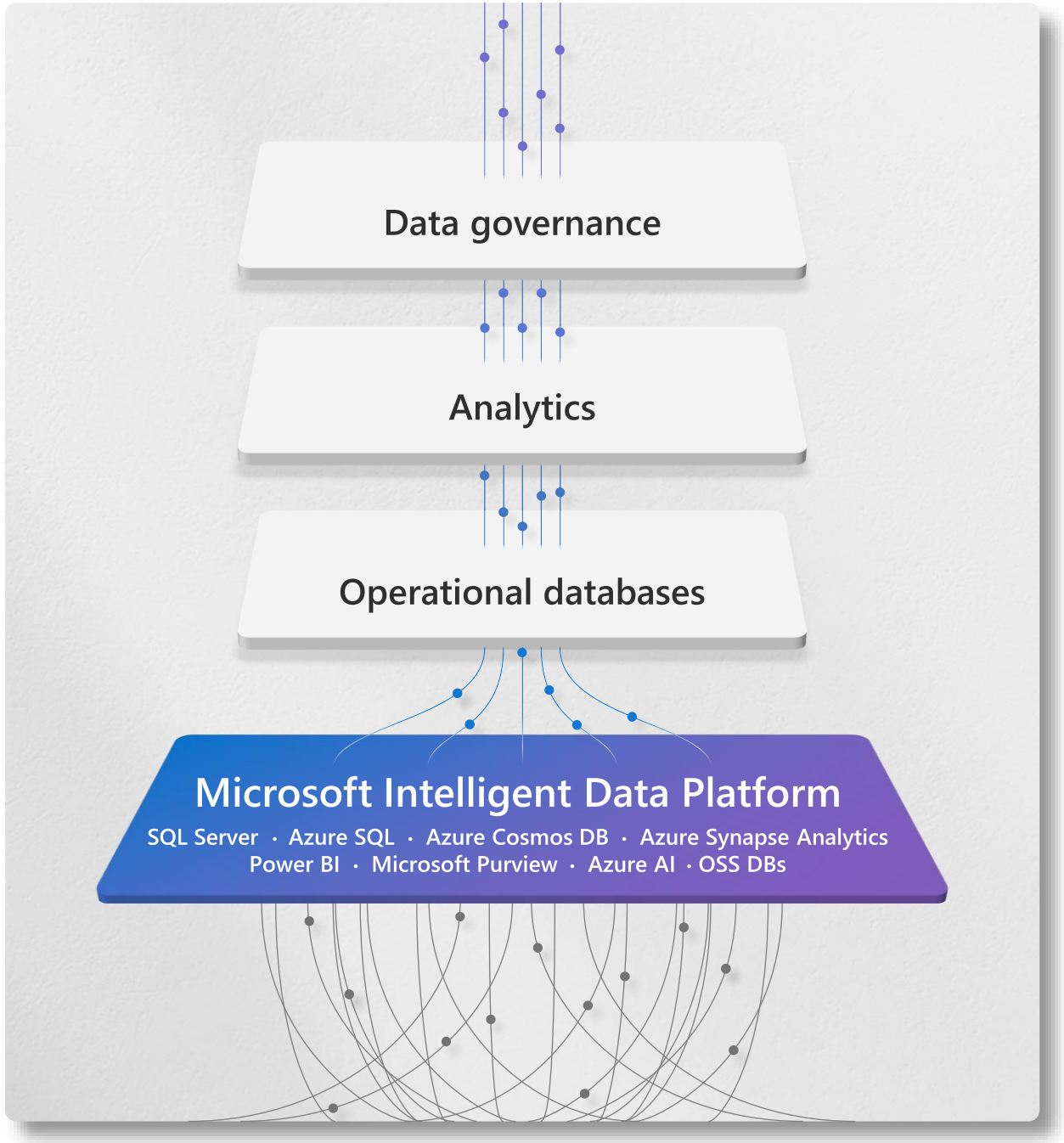
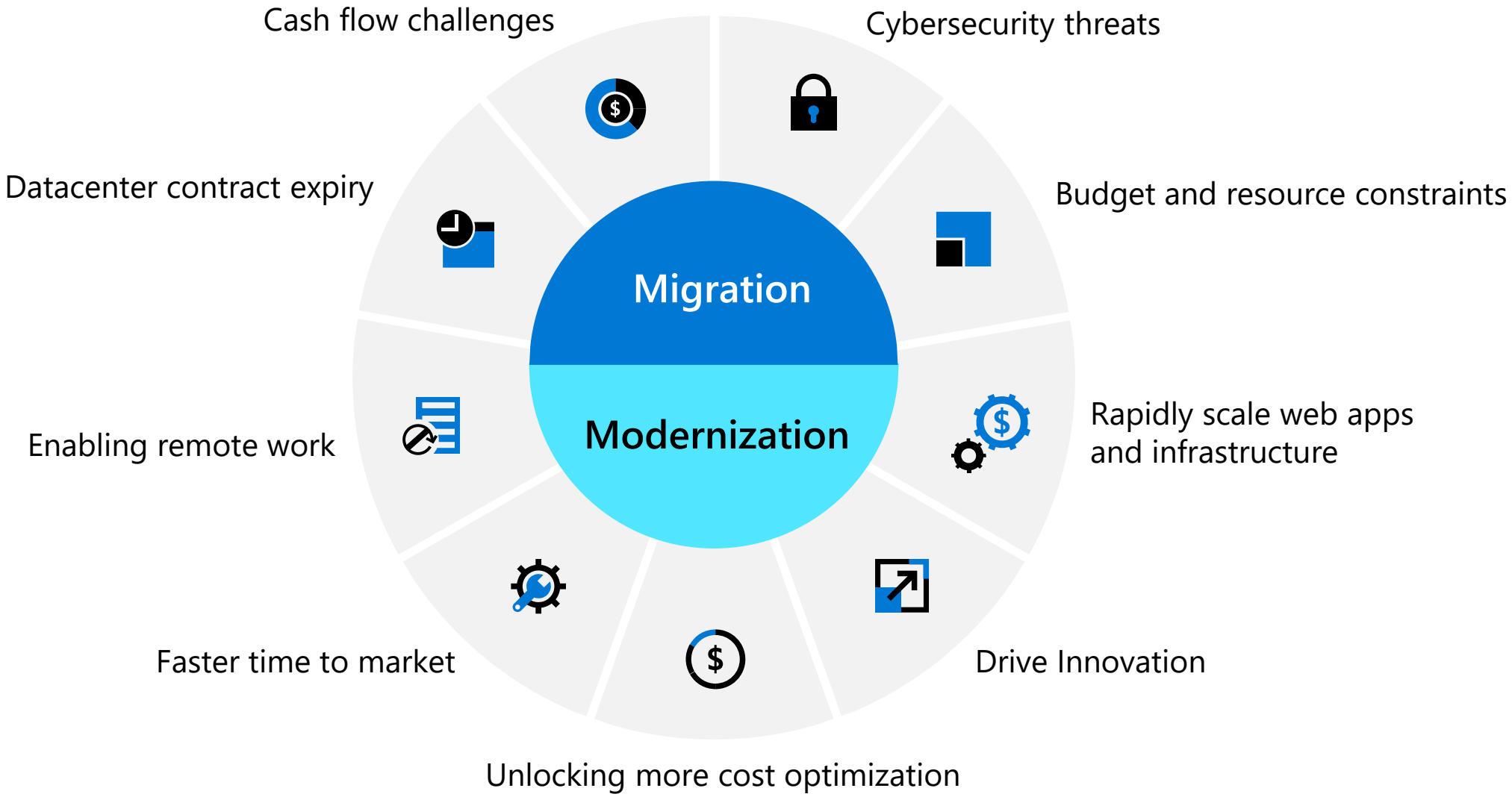
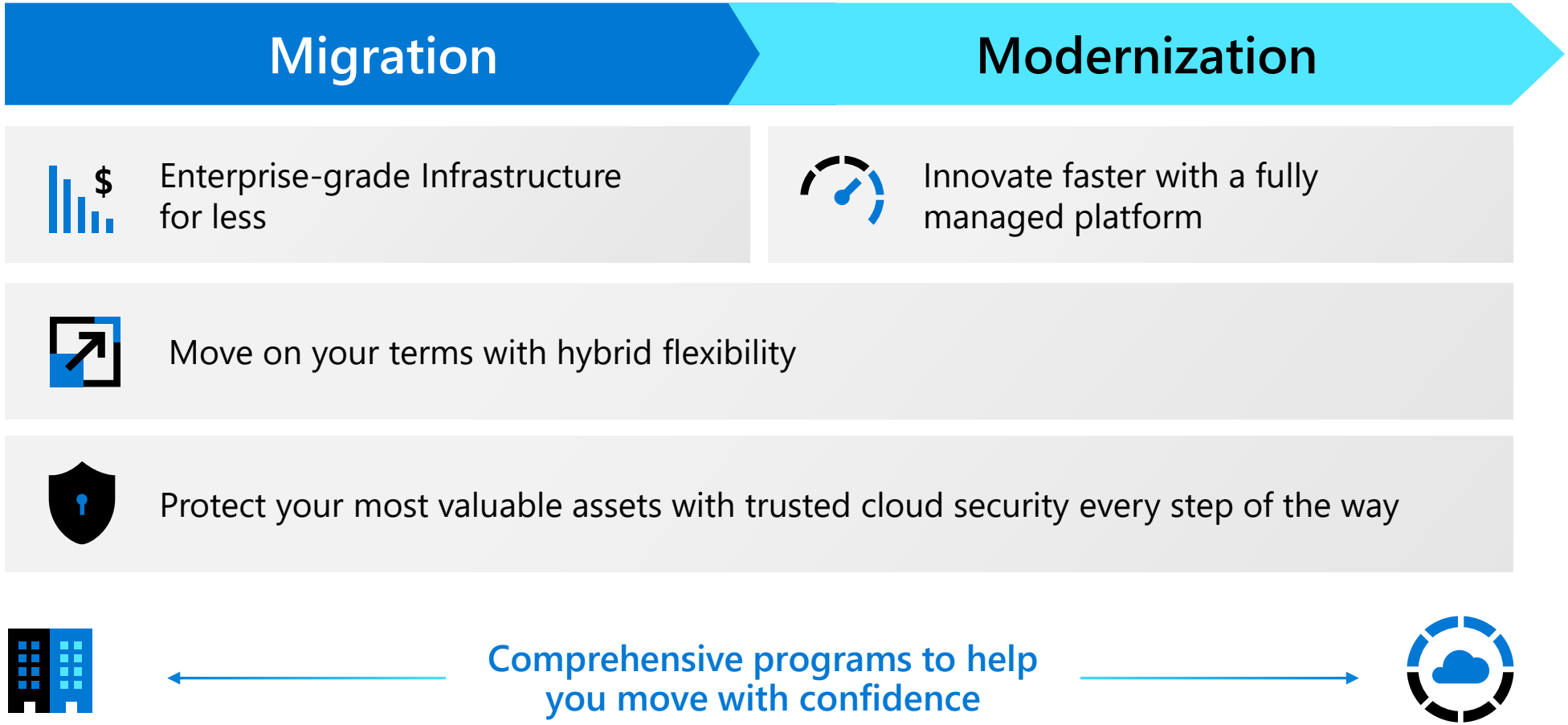
Introducing Microsoft Intelligent Data Platform



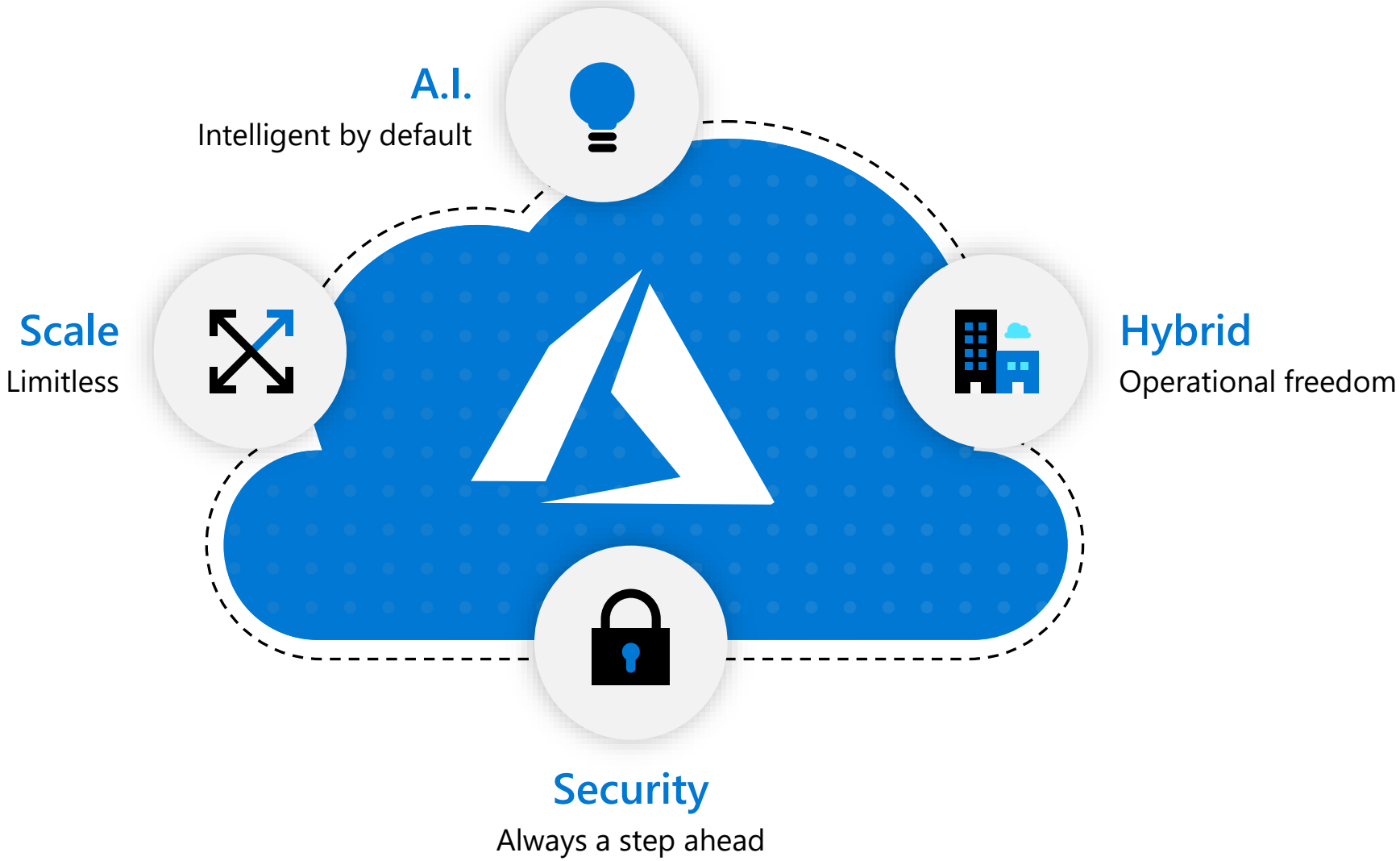
Migration and modernization triggers



Why should customers migrate and modernize to Azure?



Be future-ready with Azure



Introducing Azure SQL

The family of SQL cloud databases

Providing flexible options for

Migration

Modernization

Development

Azure SQL is the best choice for SQL Server workloads

Run any workload anywhere on the industry-leading SQL Server engine

Fully-managed and always up to date

Be more productive with **AI-powered features** that automate tasks and optimize performance for you

Use your existing SQL experience in the cloud

Build on what you know with a **consistent code base** and deploy it anywhere from edge to cloud

Save with the lowest total cost of ownership

Get more cloud for less with **leading price-performance** and savings up to 85% off pay-as-you-go rates with **Azure Hybrid Benefit**.

Protect your data with built-in, real-time intelligent security

Secure your data with layers of protection, built-in controls, **intelligent threat detection**, and the **broadest set of compliance offerings**

The only cloud with evergreen SQL

Software is continually updated and never requires patches

Azure SQL Deployment Options

Azure SQL

The family of SQL cloud to edge databases

SQL Server on Azure Virtual Machines

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

Azure SQL Managed Instance

Best for modernizing existing apps

Azure SQL Database

Best for supporting modern cloud apps

Azure SQL Edge

Best for extending apps to IoT edge

Infrastructure-as-a-Service | **Platform-as-a-Service** | **Edge Computing**

Azure SQL enabled by Azure Arc

Run Azure SQL on premises and in multi-cloud environments

Azure Arc SQL Managed Instance

Run PaaS Azure SQL on premises and multi-cloud

Azure is the cloud that knows SQL Server best

Azure SQL Database is built for modern cloud apps

Customer challenge
I want to build a modern multi-tenant SaaS apps and scale independently when needed

Solution
Azure SQL Database is a highly scalable cloud database service with built-in high availability and machine learning

Key features
Single database or elastic pool

Hyperscale storage (100TB+)

Serverless compute

Fully managed service

Private link

High availability with AZ isolation

Business continuity at scale

Azure differentiators
Industry highest availability SLA of 99.995%

Industry only business continuity SLA with 5 second RPO and 30 second RTO

Price-performance leader for mission-critical workloads while costing up to 86 percent less than AWS RDS (GigaOm)

BMI

Broadcast Music, Inc. (BMI) uses Azure SQL Database Hyperscale to scale on demand and speed up song matching without managing on-premises infrastructure.

Azure SQL Managed Instance eases cloud migration

Customer challenge
I want to migrate to the cloud, remove management overhead and take advantage of leading features

Solution
SQL Managed Instance combines leading security features with SQL Server compatibility and instance model designed for on-premises customers

Key features

Available as single instance or instance pool

SQL Server surface area (vast majority)

Native virtual network support

Fully managed service

On-premise identities enabled on cloud instances, through integration with Azure Active Directory and AD Connect

Azure differentiators

Near zero downtime migration using log shipping

Fully managed business continuity with failover groups

Projected return on investment of 238 percent over three years[1]

The best of SQL Server with the benefits of a managed service

KOMATSU

Komatsu easily migrated 1.5 TBs of data thanks to near complete compatibility with SQL Server

1. Forrester Consulting. The Total Economic Impact™ of Microsoft Azure SQL Database Managed Instance.

SQL Managed Instance - Is it SQL Server?

- ✓Pre-installed SQL with abstraction from OS and Infrastructure
- ✓It is the same engine but *versionless*
- ✓Almost 100% compatible T-SQL language
- ✓Fully Managed Service = SQL+cloud to automate
- ✓SQL Server Agent and Database Mail
- ✓Replication and Resource Governor
- ✓Service Broker, Distributed Transactions, Linked Servers, SQLCLR
- ✓Machine Learning Services
- ✓Doesn’t come with SSRS, SSAS, or SSIS*
- ✓Support hosting MDS, SSIS & SSRS databases

aka.ms/azuretsqldiff

*Can host the SSIS catalog but packages are executed with Azure Data Factory

SQL Server on Azure VMs

SQL Server on Azure VMs provides the promise of the cloud while maintaining OS control

Customer challenge

I want to migrate to the cloud as fast as possible but maintain operating system control

Solution

Get the combined performance, security, and analytics of SQL Server, backed by the flexibility, security, and hybrid connectivity of Azure with SQL Server on Azure VMs

Key features

SQL Server and OS server access

Expansive SQL and OS version support

File stream, DTC, and Simple Recovery model available

Automated manageability features for SQL Server

Automatic security patching

Point in time restore with Azure Backup

Azure differentiators

Free Extended Security Updates for SQL Server 2012/R2

478 percent overall return on an Azure IaaS investment over three years[1]

Allscripts®

Healthcare software manufacturer saves costs when reusing licenses while moving 600 on-premises VMs to Azure

1. Forrester Consulting. The Total Economic Impact™ of Microsoft Azure IaaS

Recommended SQL VM Series

Edsv5-series

- Best all-purpose SQL Server virtual machine
- Good remote throughput
- Large local drives with high local/cached throughput
- **Offers best price-performance for SQL Server workloads**

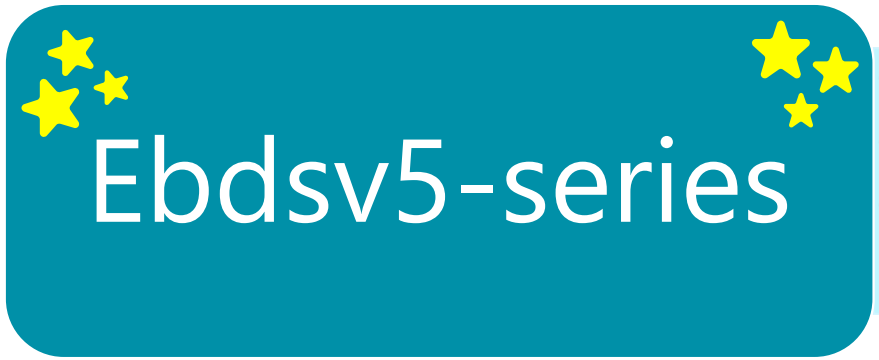
Mv2-series*

- Highest I/O throughput and memory available in Azure
- Great for mission critical OLTP and high-end data warehouse workloads
- Expensive – it is recommended to start with Edsv4 first if possible

Ddsv5-series

- Entry level SQL Server virtual machine
- Good choice for dev/test workloads
- Works for smaller production database environments

Recommended SQL VM Memory Optimized Series



- Highest remote I/O throughput available in Azure
- Large local drives with high local/cached throughput
- **Offers the best price-performance for SQL Server workloads**

Or better yet, this one which went GA on April 5th!
#DoubleSprinklesVMs

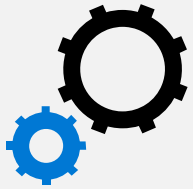
https://aka.ms/AzureSQLVMPricePerf

SQL Server on Azure VMs

SQL Server on Azure VMs Resource Provider

Resource Provider brings the functionality of Azure Marketplace images to SQL Server instances self-installed on Azure Virtual Machines

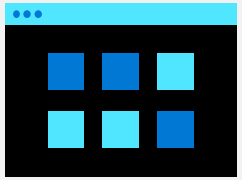
Comprehensive feature set



Self-installed VMs registered with RP now can access automation features in Azure Marketplace images

Leverage auto-backup and auto-patching to avoid time-consuming admin and VM customization

Dashboard view for VM awareness



Azure VMs are now discoverable on the new Azure SQL blade in Azure Marketplace

Easily manage your SQL VM and SQL PaaS deployments from one central location

Simple license conversions

Self-installed VMs with RP can be easily converted to PAYG images

Save money by converting variable workloads with Software Assurance to PAYG images

Straightforward compliance

Self-installed VMs with RP automatically indicate usage of Azure Hybrid Benefit

Ensure compliance with Azure terms and conditions without any extra effort

Learn more aka.ms/sqlvm_rp and aka.ms/sqlvm_rp_documentation

Deployment options for Azure SQL

SQL Server on Azure virtual machines

SQL virtual machine

SQL Server and OS server access

Expansive SQL And OS version support

Automated manageability features for SQL Server

Azure SQL Database

Single database

Hyperscale storage (up to 100TB)

Serverless compute

Fully managed service

Elastic pool

Resource sharing between multiple databases to price optimize

Simplified performance management for multiple databases

Fully managed service

Azure SQL Managed Instance

Single instance

SQL Server surface area (vast majority)

Native virtual network support

Fully managed service

Instance pool

Pre-provision compute resources for migration

Enables cost-efficient migration.

Ability to host smaller instances (2Vcore)

Currently in public preview

Azure SQL Edge

Edge gateways and devices

Containerized Microsoft SQL database engine on ARM64 and x64 edge devices

Time-series, data streaming and AI capabilities

Native integration with Azure services

The three flavors of Azure SQL – when to use which

Whether you're looking to migrate to IaaS or PaaS or deploy on a hybrid platform, Azure SQL has you covered. Azure SQL offers three core deployment options for moving your SQL Server workloads to the cloud. The following diagram outlines which option will best meet your needs and summarizes key differences in manageability.

Do you need

- Full access to operating and file system of a VM
- SQL versions 2008-2019?
- Microsoft Distributed Transaction Coordinator?
- PolyBase/File stream?
- SSRS/SSAS?
- Linked server to third-party DBMS?

No

Do you need

- Capabilities at instance level?
- Cross-DB transactions?
- Linked Server to SQL?
- Service Broker
- Event Notifications
- Transactional Replication
- CLR Integration
- SQL Agent?
- SSIS?

No

Are you using just the database engine features of SQL Server?

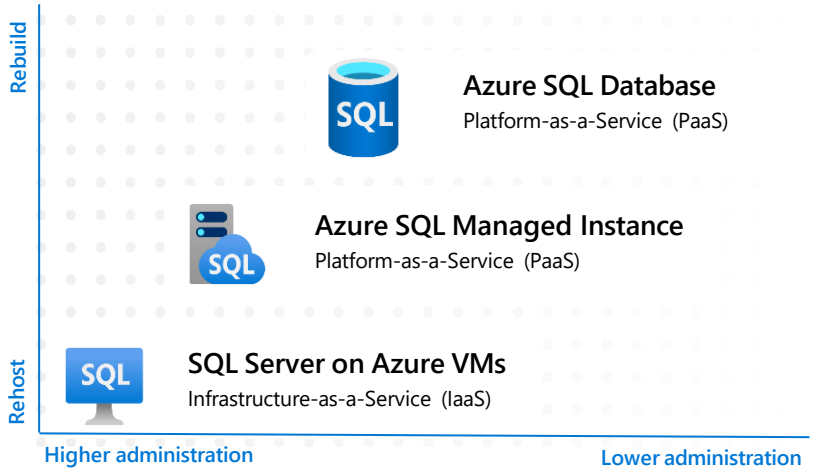
Yes → SQL Server on Azure VMs

Yes → Azure SQL Managed Instance

No

Yes → Azure SQL Database

Cloud migration effort and administration continuum

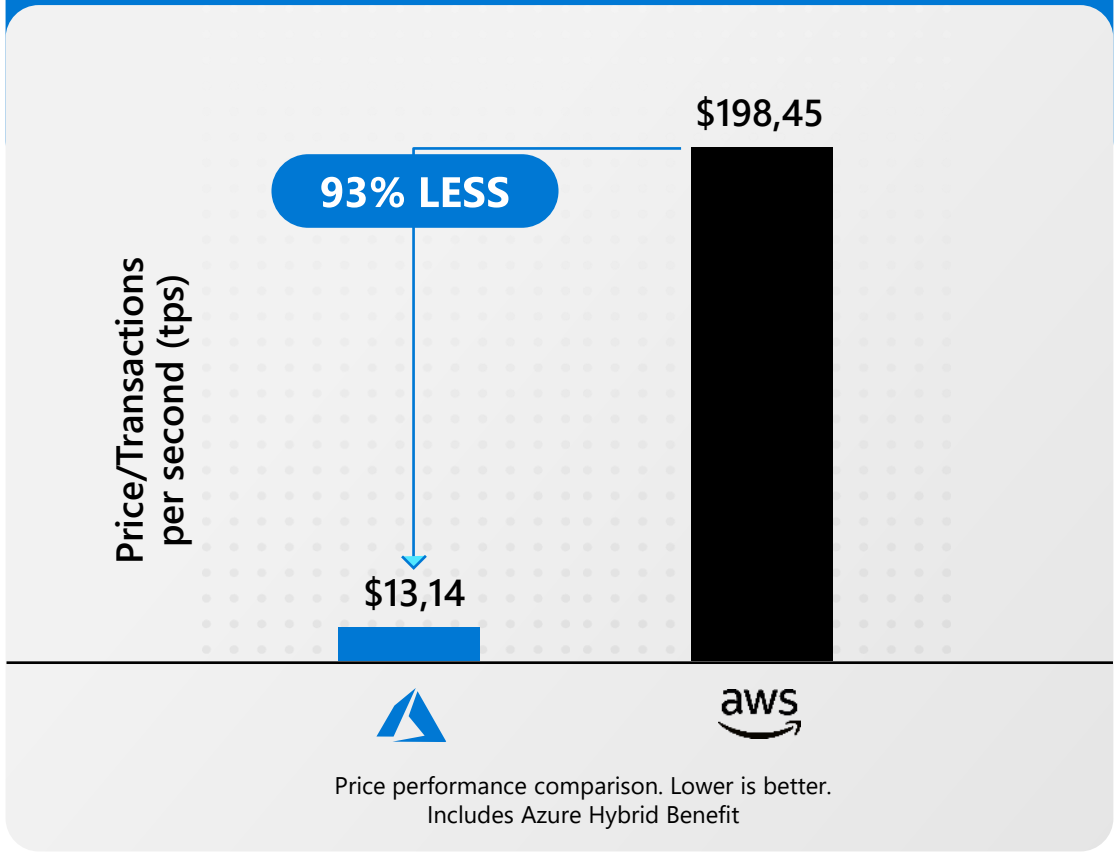


Azure SQL gives you cloud database options that meet your needs

- Lift-and-shift your SQL workloads to SQL Server on Azure VMs with ease and maintain them with 100% SQL Server compatibility and operating system-level access.
- Modernize your existing SQL Server applications at scale on a fully managed Azure SQL Managed Instance.
- Build modern cloud applications on the intelligent, managed Azure SQL Database that includes serverless compute.

Azure SQL provides more price-performance value

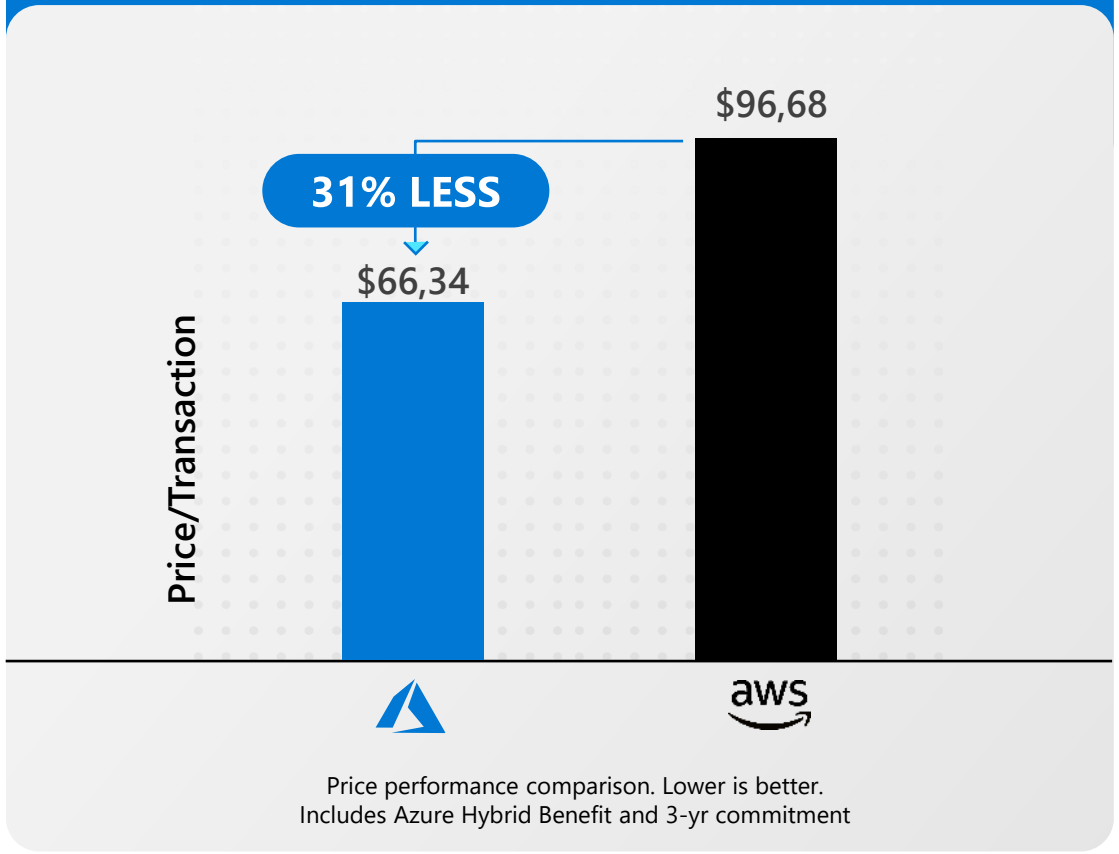
Azure SQL Managed Instance vs SQL Server on AWS RDS
MSOLTPE Benchmark
April 2022



Price performance comparison. Lower is better.
Includes Azure Hybrid Benefit

Source: Principled Technologies

SQL Server on Azure VM vs SQL Server on AWS EC2
Transactional Field Test Benchmark
April 2022



Price performance comparison. Lower is better.
Includes Azure Hybrid Benefit and 3-yr commitment

Source: GigaOm

Hybrid options

Azure SQL Edge enables real-time processing at the edge with a secure, small-footprint database.

Customer challenge

I want to be able to store, process, and analyze data at the edge to overcome latency and security concerns.

Solution

Azure SQL Edge is a containerized SQL database engine optimized for IoT with data streaming, time series, and ML capabilities built-in.

Key features

Streaming capability using the same constructs as Azure Stream Analytics

Built-in machine learning capabilities through ONNX runtime

Familiar Transact-SQL (T-SQL) programming surface area

Native integration with other Azure services such as Azure Machine Learning, and Azure SQL

Azure differentiators

Deploy and manage across a large number of edge devices via Azure IoT Hub and the Azure Portal

Store, process, and analyze relational and non-relational, such as JSON and time-series, data

---

FUGRO

Global geo-data specialist reduces time to process and deliver reports from offshore locations from two weeks to eight minutes.

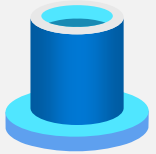
Azure hybrid destinations for SQL Server

Azure Arc-enabled SQL Managed Instance

Azure SQL Managed Instance
on any infrastructure
Fully managed, evergreen SQL Server
Cloud billing model for on-premises

SQL Server on Arc-enabled servers

Organize, inventory
Azure Defender for advanced security
Free SQL Assessment service



Azure Arc-enabled data services

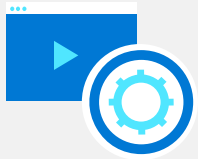
Cloud experience for data workloads anywhere

GENERALLY AVAILABLE Azure SQL Managed Instance

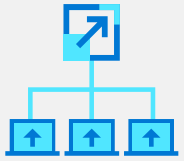
PUBLIC PREVIEW Azure Database for PostgreSQL

Support all connectivity modes

Always current



As-a-Service



Elastic scale

Unified management

Any hardware, any Kubernetes

SQL Managed Instance is Azure Arc enabled

Some scenarios may require a hybrid approach:

Data latency

Regulations

Distributed compute

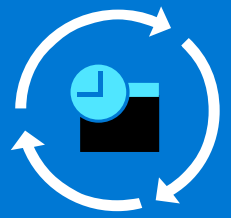
Multi-cloud

Bring Azure innovation and cloud benefits on-premises, multi-cloud, and at the edge with Azure Arc enabled SQL Managed Instance

"I really like the SQL version control, which helps reduce the time that senior administrators must spend upgrading all those different versions."

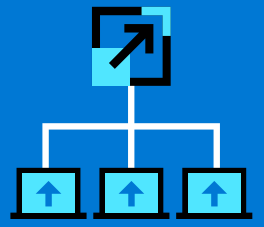
Kristina Melo, IT Manager, Ferguson Enterprises

Key Benefits



Always current

Access the latest Azure features and capabilities for on-premises data workloads



Elastic scale

Dynamically scale up or out your data workloads based on capacity

Unified management

Gain a single view of your data across on-premises and cloud environments

Licensing & Cost Saving

Disclaimer: I am not a lawyer

Key offers lower total cost of Azure SQL ownership

Azure Hybrid Benefit

Maximize existing investments in on-premises licenses with discounted rates on Azure SQL Database. Save up to 59% vs. AWS.

Reserved capacity

Reserve Azure SQL resources in advance and save up to 33%. Combine with Azure Hybrid Benefit for savings up to 80%.

Dev/test pricing

Save up to 55% versus list prices, eligible with active Visual Studio subscriptions .

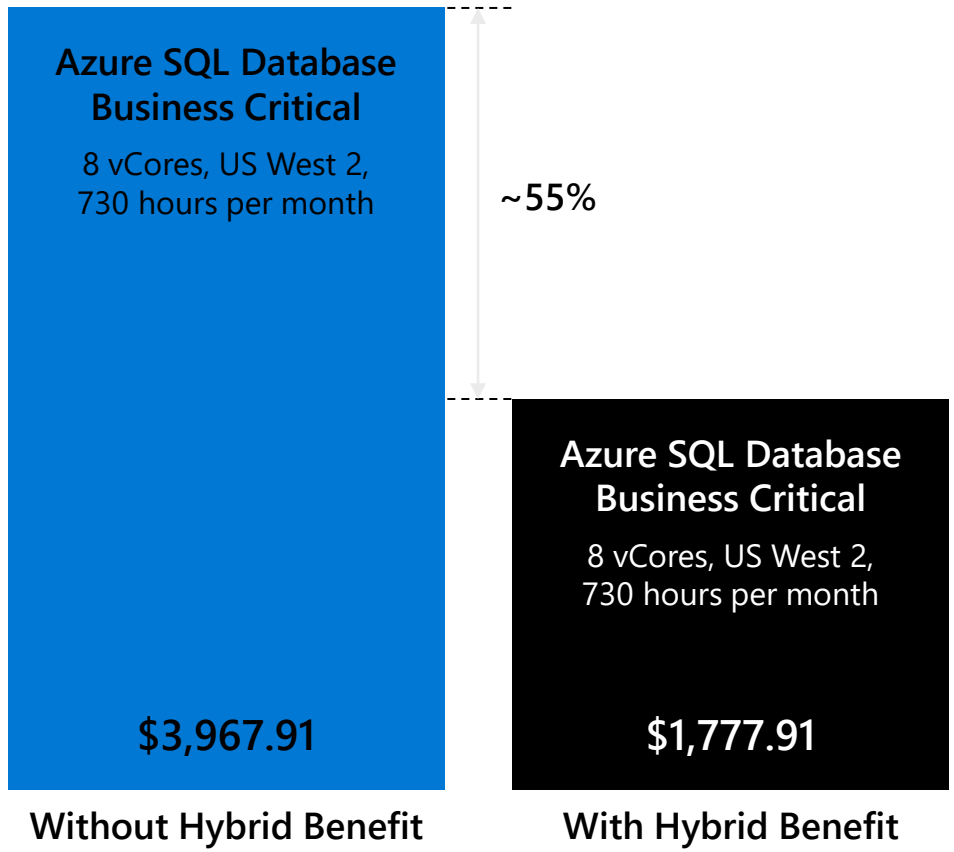
Extended Security Updates

Get free extended security updates for SQL Server 2012 and 2012 R2 for three years when running on Azure Virtual Machines.

Azure Hybrid Benefit for SQL Server

Azure-only benefit for customers with active SA or subscriptions on SQL cores

- Significantly reduce the costs of running SQL IaaS and PaaS in Azure
- Pay only the 'base rate' in Azure on SQL IaaS, SQL DB PaaS, and ADF v2 SSIS
- Available for SQL Server core licenses only
- Customers can use their cores on-premises, **OR** as vCores in Azure
- However, cores can be used on-premises and in Azure simultaneously for up to 180 days, to allow for migration



Azure Hybrid Benefit for SQL terms

Qualified license	Azure Data Service[1]	Ratio of cores : vCores
SQL Server Enterprise (core)	Azure SQL Database (Managed Instance, Elastic Pool and Single Database) – General Purpose	1 Core License : 4 vCores
	Azure SQL Database (Managed Instance, Elastic Pool and Single Database) – Business Critical	1 Core License : 1 vCore
	Azure SQL Database (Managed Instance and Single Database) - Hyperscale	1 Core License : 4 vCores
	Azure Data Factory and SQL Server Integration Services (Standard)	1 Core License : 4 vCore
	Azure Data Factory and SQL Server Integration Services (Enterprise)	1 Core License : 1 vCore
	SQL Server Standard Virtual Machines	1 Core License[2] : 4 vCPU
	SQL Server Enterprise Virtual Machines	1 Core License : 1 vCPU
SQL Server Standard (core)	Azure SQL Database (Managed Instance, Elastic Pool and Single Database) – General Purpose	1 Core License : 1 vCore
	Azure SQL Database (Managed Instance, Elastic Pool and Single Database) – Business Critical	4 Core License : 1 vCore
	Azure SQL Database (Managed Instance and Single Database) – Hyperscale	1 Core License : 1 vCore
	Azure Data Factory SQL Server Integration Services (Standard)	1 Core License : 1 vCore
	Azure Data Factory SQL Server Integration Services (Enterprise)	4 Core License : 1 vCore
	SQL Server Standard Virtual Machines	1 Core License : 1 vCPU
	SQL Server Enterprise Virtual Machines	4 Core License : 1 vCPU

1. Azure Hybrid Benefit is not available in the serverless compute tier of Azure SQL Database
2. Subject to a minimum of four Core Licenses per Virtual Machine

Introducing…

Centrally-managed Azure Hybrid Benefit

- **Same benefit** allowing eligible licenses to be applied to Azure for cost savings compared with pay-as-you-go hourly rates
- **New experience** for centrally assigning the benefit and managing it in the Azure Portal

Centrally-managed Azure Hybrid Benefit

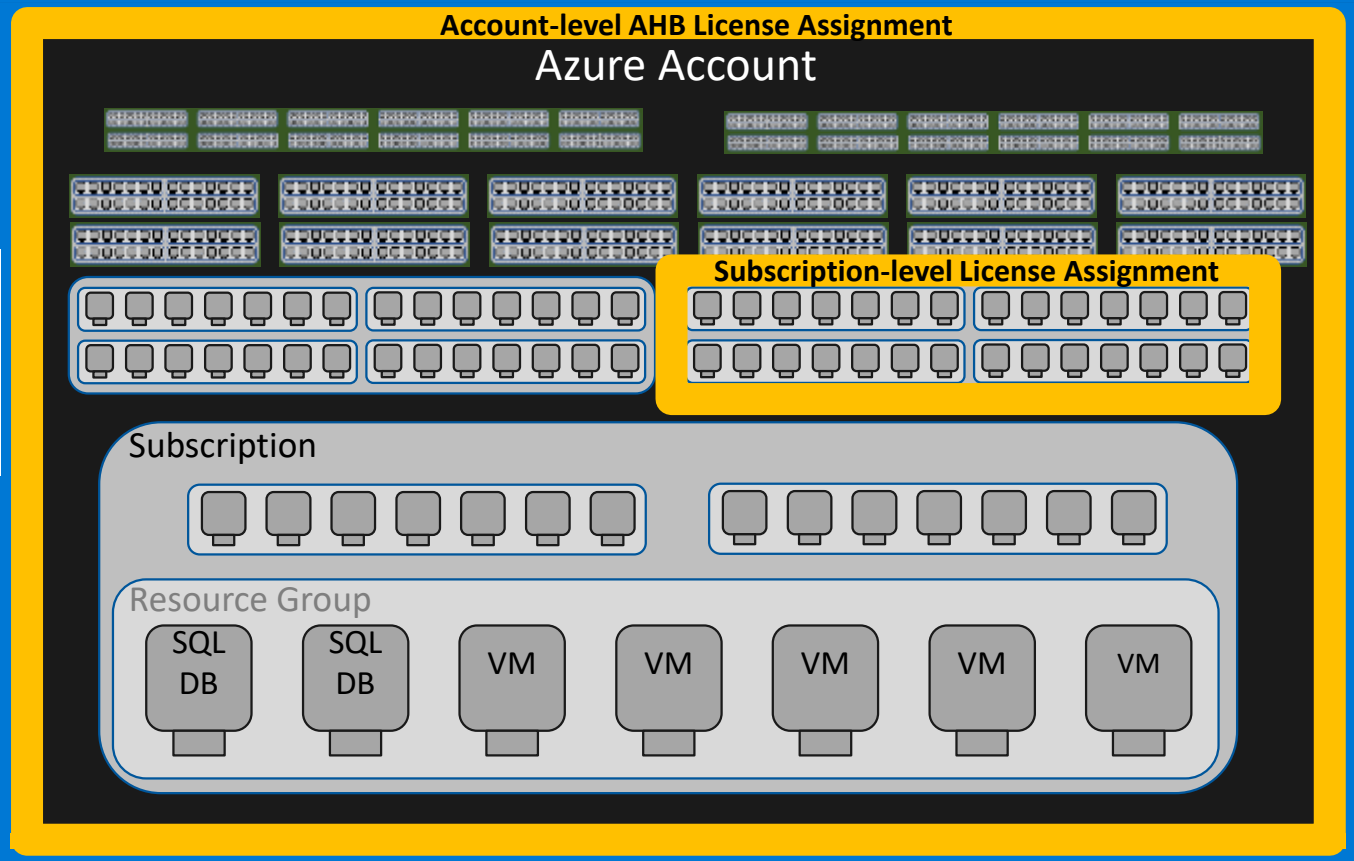
Customer procurement role purchases WS/SQL SA and subscriptions with Azure Hybrid Benefit (AHB).

Admin assigns AHB licenses at overall account and subscription levels.

Customer enjoys system-optimized cost savings by using AHB instead of PAYG

Problem 1: Managing AHB by resource is cumbersome, prone to error, and doesn't scale

Solution 1: Manage AHB by overall account or subscription rather than by resource



Problem 2: Compliance concerns from dev-ops applying AHB

Solution 2: Admin role able to sustain better license awareness

SQL Server Developer Edition

more here

For demonstration purposes, licensed developers as well as unlicensed users (defined as those who have access to the company's internal network) can install and use SQL Server Developer edition software to demonstrate internally developed applications created by appropriately licensed developers.

Advantages

1. It is free – although the commercially licensed version of SQL Server is often less expensive that other leading database products anyway, you cannot get it cheaper than for zero cost. While it may only be used for non-operational purposes, the developer edition is still a good way of trying out new functions, testing, training, and so on.
2. It is fully loaded – it has all the same functions as the licensed SQL Server 2016 Enterprise edition, not a cut down version. This is important if you are using it to build applications that will eventually become real products or services.
3. It is unlimited – you can deploy any number of copies on an unlimited number of devices, including virtual machines hosted on multitenant infrastructure.
4. It is easily downgradeable – you can use the license to access SQL Server 2014 Developer Edition, without having to acquire a separate license for it.

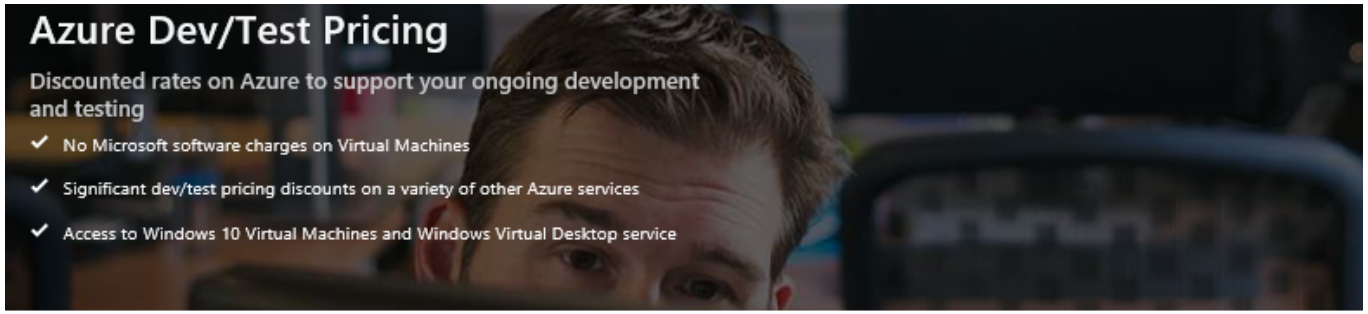
The SQL Server Developer edition includes the same functionality included with SQL Server Enterprise edition, which is a superset of the Standard and Business Intelligence editions. Consequently, developers need to be cautious about using higher-level edition features if a lower-level edition will be used in production.

Disadvantages

1. Usage is restricted – design, development, testing and demonstration of programs using the SQL database engine are all permitted, as long as the user has permanent access to the license owner's internal network. Therefore, while you could demonstrate an app to a client, you could not let that client play around with it themselves afterwards. Using the license in any other way, such as to support a commercial software installation, would constitute a breach of the license terms.
2. Microsoft gets access to your data – it is mandatory with any non-commercial installation of SQL Server that all your usage data covering performance, errors, feature use, IP addresses, device identifiers and more, is sent to Microsoft. There are no exceptions. This will likely rule it out for any company that deals with particularly sensitive data.
3. There is a risk of side effects using SQL Server 2016 Developer Edition instead of the real edition for operational use in the future. Although features are the same, the binaries may differ – who knows? This is unavoidable, so thorough final testing is essential to ensure you can sidestep any potential conflicts.
4. No other licenses are included – just because you are licensed to use SQL Server, does not mean you are licensed to run the operating system or any other software running underneath or alongside it. So unless you only need it for a short period, in which case you could potentially use a free trial version of an OS like Windows Server or Windows 10, you need to make sure you have commercial licenses for all the relevant software.
5. Compliance may be complex – SQL Server 2016 Developer Edition can also be licensed through the Microsoft Developer Network (MSDN). This has several advantages, including licensing for the underlying operating system and additional test and development tools such as Visual Studio. However, MSDN requires that all users, including sales people or support staff who access that SQL Servers, possibly need additional licenses. This can make it expensive. Not only that, all the installation files for the VSDE and MSDN routes are identical, so you need to prove which one you have installed. Otherwise, you will not get the benefit of the doubt.

Visual Studio Subscriptions

No Microsoft software charges on Virtual Machines! Only on Azure!

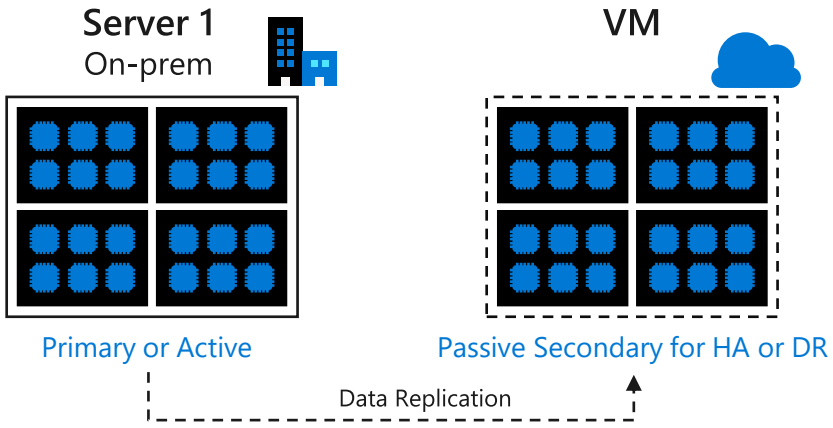


	FOR INDIVIDUALS	FOR TEAMS (ENTERPRISE AGREEMENT CUSTOMERS)	FOR TEAMS (ALL OTHER CUSTOMERS)
Dev/Test pricing options	Monthly Azure credits for Visual Studio subscribers	Enterprise Dev/Test	Pay-As-You-Go Dev/Test
Number of instances allowed	One per Visual Studio subscriber	Unlimited	Unlimited
Monthly credit included*	$50, $100, or $150	None	None
Billing options	No credit card required Credit card billing for overages (invoicing available)	Always billed to the Enterprise Agreement Consumes prepaid Azure Monetary Commitment funds, if available	Credit card billing (invoicing available)
Billed usage	Overages are billed, after the monthly credit is consumed	All usage is billed	All usage is billed
Allowed to run Windows 10 Virtual Machines	✓	✓	✓
Service Level Agreement	Only for Azure DevOps and Application Insights	Only for Azure DevOps and Application Insights	Only for Azure DevOps and Application Insights
Licensing terms	Restricted to dev/test use only For use by active Visual Studio subscribers, and by end users providing feedback and performing acceptance tests	Restricted to dev/test use only For use by active Visual Studio subscribers, and by end users providing feedback and performing acceptance tests	Restricted to dev/test use only For use by active Visual Studio subscribers, and by end users providing feedback and performing acceptance tests

HA/DR benefits for SQL Server only on Azure

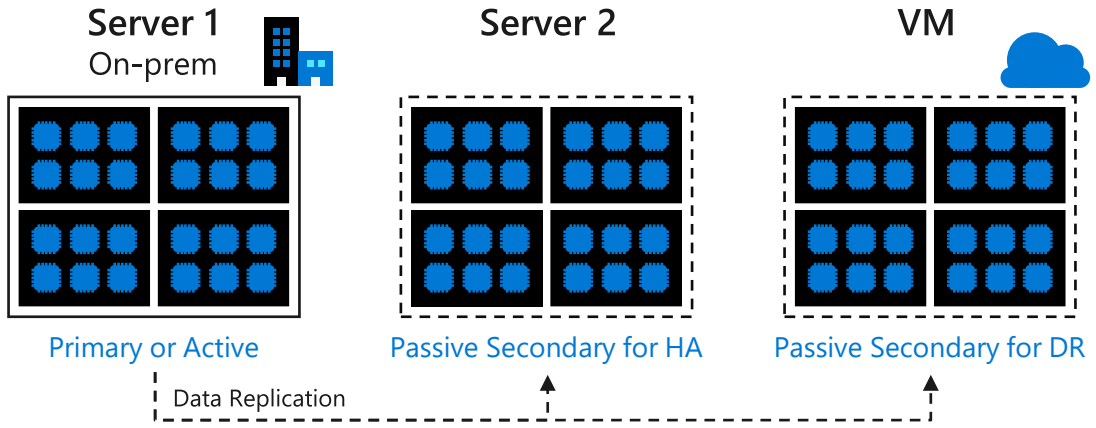
Save on Azure by not needing to license the passive server

SA benefit with disaster recovery replica



Core licenses	24	0
Additional cost	$30,756	$0

New SA benefit with two secondary replicas

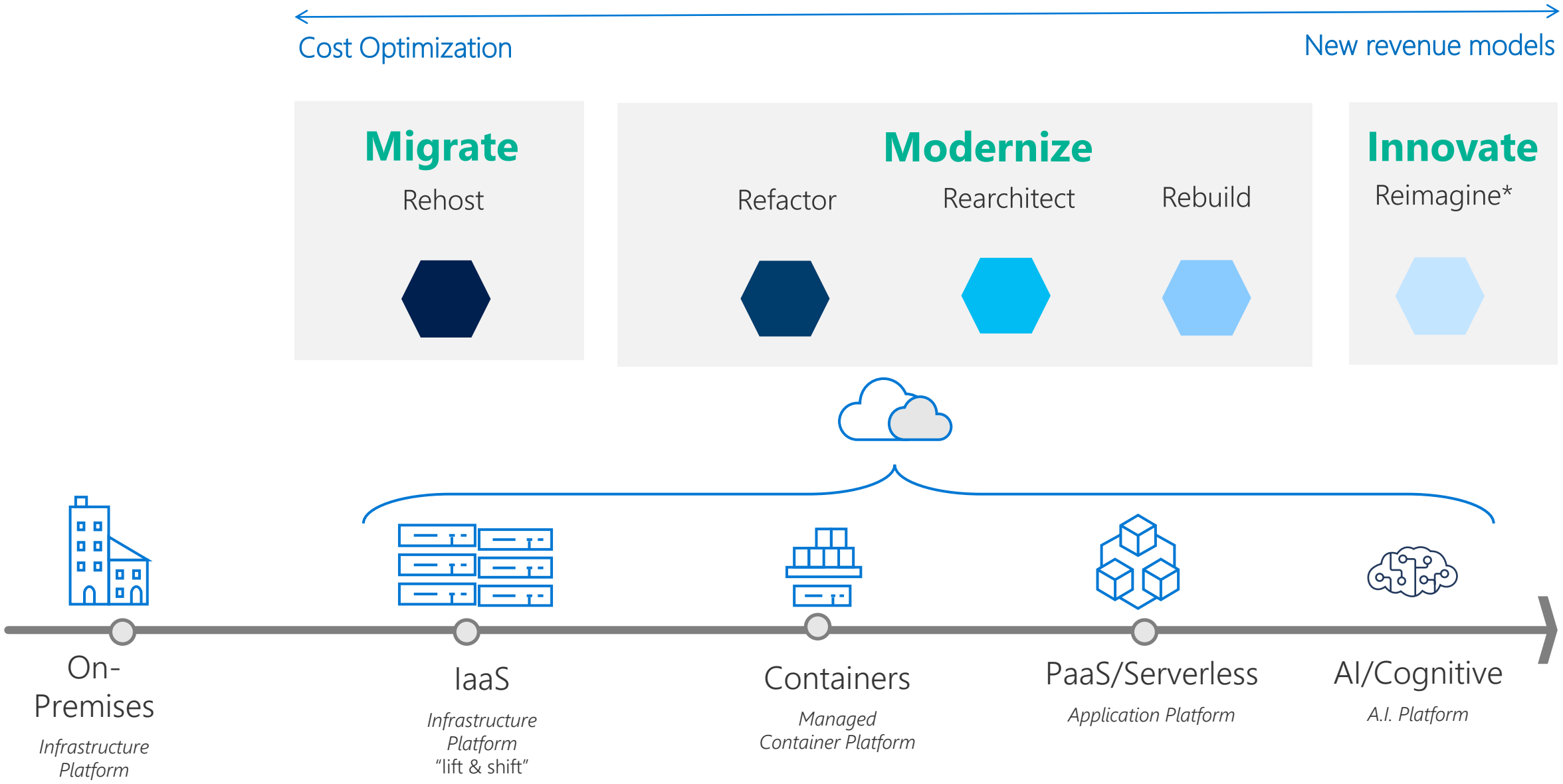


Core licenses	24	0	0
Additional cost	$30,756	$0	$0

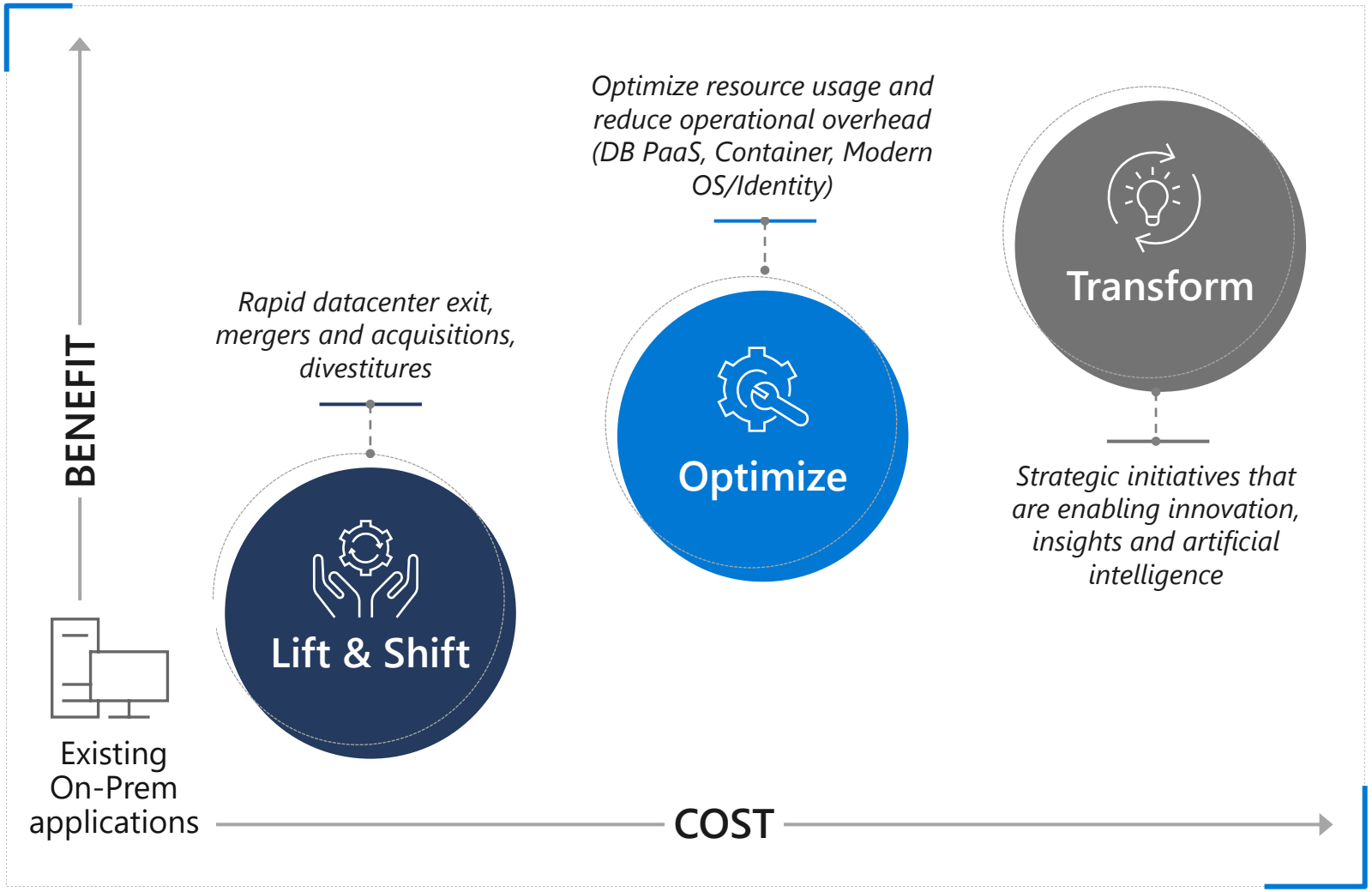
Use Azure SQL IaaS Agent Extensions to Register VM for Free DR

Migration to Azure

Application Journey to the Cloud



Migration Strategy vs cost/benefit



Highlights

- Choose a migration strategy on an **application -by-application basis**
- Choose a migration approach that has **highest business value with an acceptable cost and risk profile**
- **Optimize** has **best overall value to IT** (Platform capabilities, Process Automation and reduced security risk)
- Modernization has **highest ROI to business** but also higher risk and cost (development and operations)

Azure Cloud Migration Cost Optimization Trajectory

IaaS & AVS (Azure VMWare)

Right sizing
- Compute & Storage
- VM instance

Elasticity
- Auto scaling
- Start Stop config
- Dev/Test pricing

License optimization
- Azure Hybrid Benefits (SQL Multiplier)
- Dedicated hosts (Unlimited virtualization rights)
- SQL EE to SQL Std

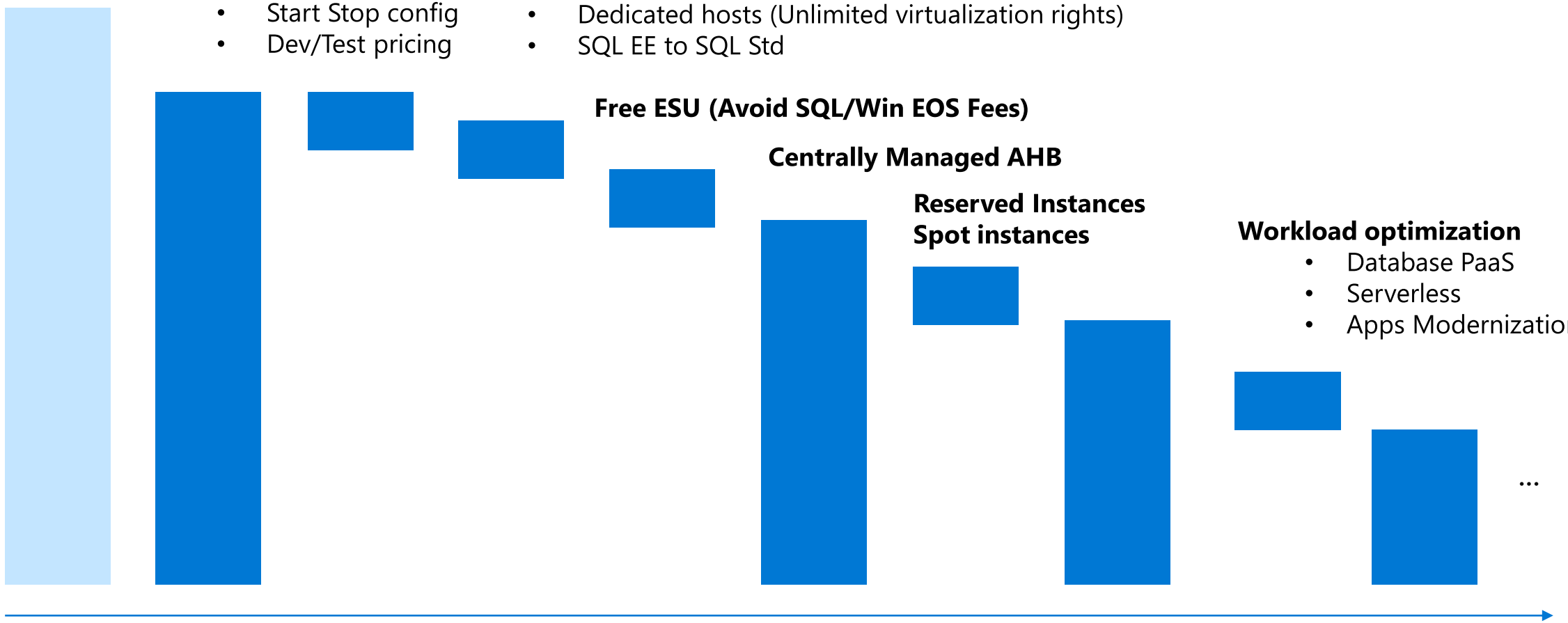
Free ESU (Avoid SQL/Win EOS Fees)

Centrally Managed AHB

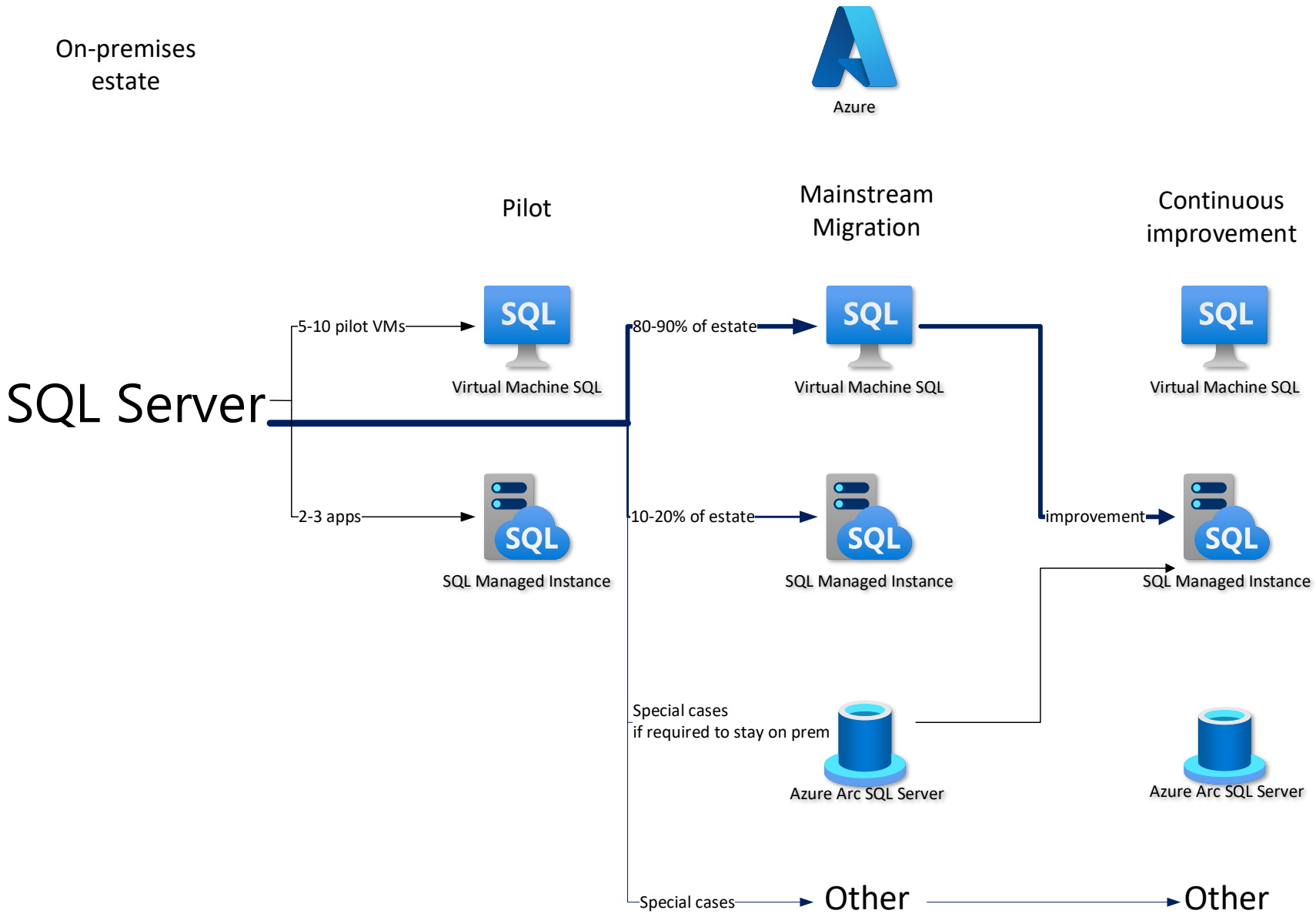
Reserved Instances
Spot instances

Workload optimization
- Database PaaS
- Serverless
- Apps Modernization

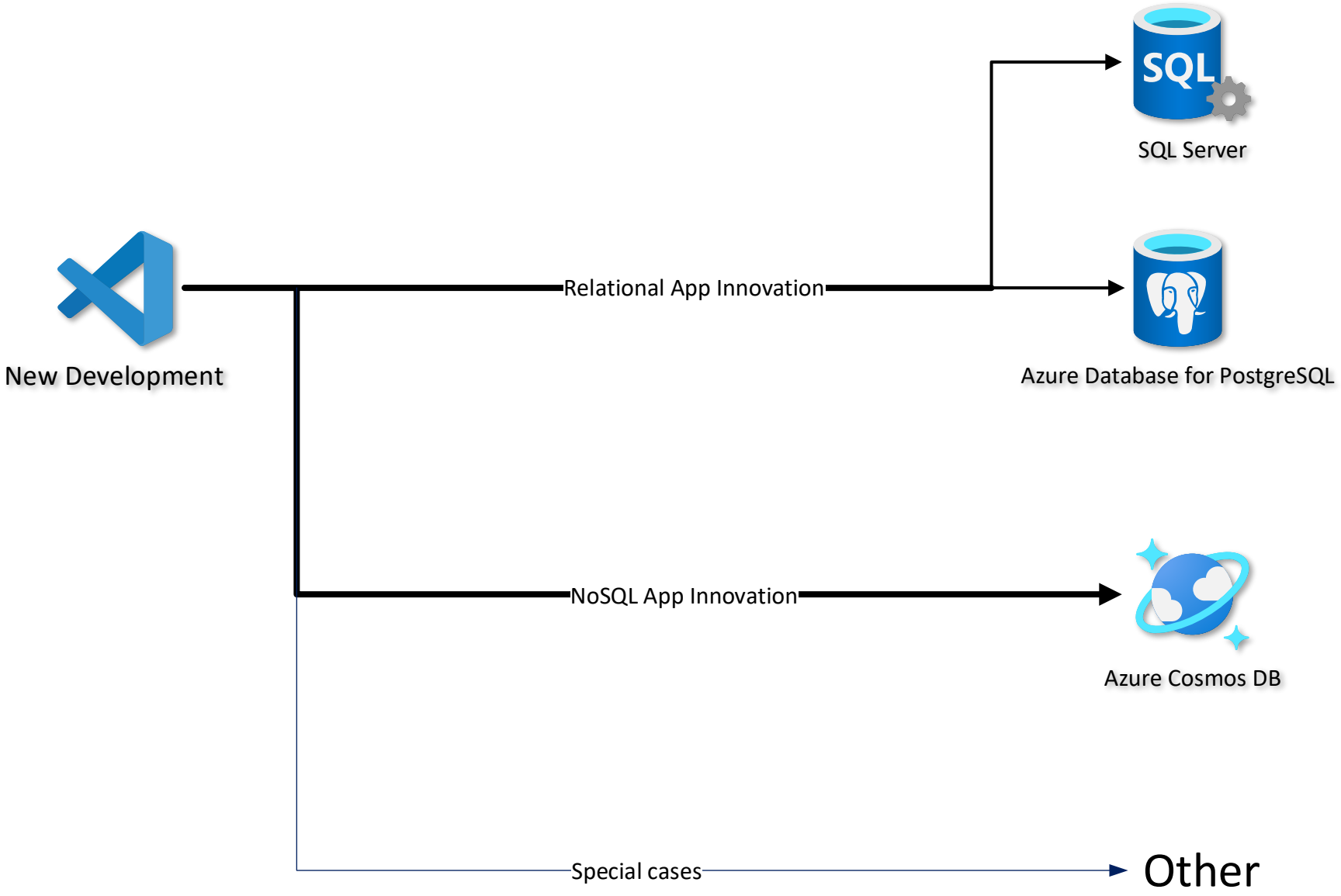
...



Large scale migration strategy

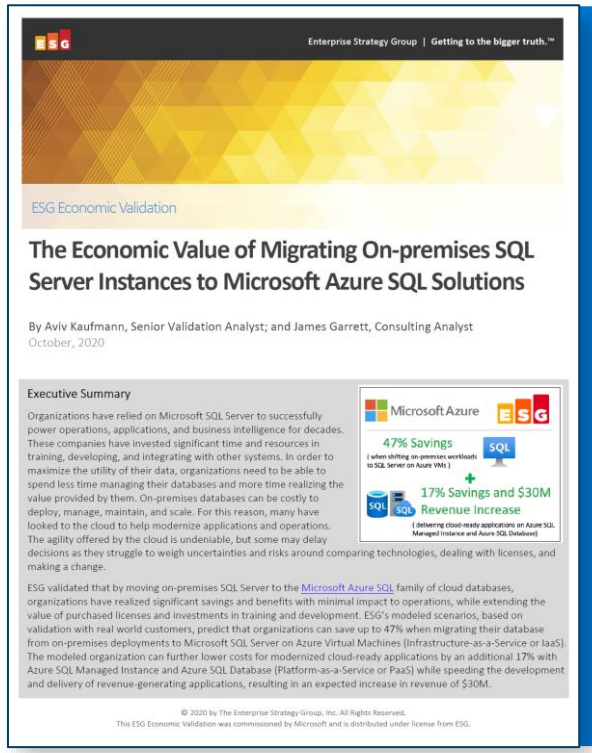


New app development



Migrate to IaaS, continue to PaaS and boost your ROI

Enterprise Strategy Group examined potential cost savings and business benefits enterprises would achieve from migrating on-premises workloads to Azure SQL, first to IaaS then to PaaS.



Key report benefits and findings[1]

Up to 47%
Cost savings on Azure SQL VMs vs on-premises SQL Server

Modernizing on Azure SQL yields even **greater** benefits…

+17%
Additional cost savings on Azure SQL managed databases vs Azure SQL VMs

53%
Lower cost of application administration

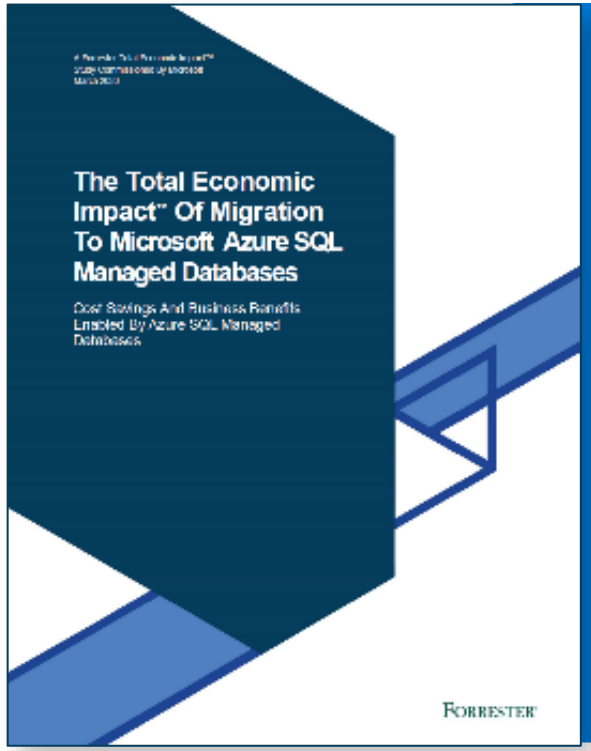
90%
Lower cost of systems administration

+$30M
Additional revenue due to faster time to market

[1] Results are based on interviewed customers. "The Economic Value of Migration On-premises SQL Server Instances to Microsoft Azure SQL Solutions," a commissioned study conducted by The Enterprise Strategy Group on behalf of Microsoft, October 2020.

Modernize directly onto PaaS for maximum benefit

Forrester Consulting examined potential cost savings and business benefits enterprises would achieve from migrating on-premises workloads to fully managed Azure SQL Database and Azure SQL Managed Instance



Key report benefits and findings[1]

238% Total ROI
3 years after initial investment & migration to Azure SQL's managed databases

3 months or less
Payback post migration

25%
Increase in productivity for IT teams

40%
Improvement in productivity for in-house DBAs

$10.9M
Savings from avoided hardware, network, storage and ongoing maintenance costs

"We needed our DBAs and IT staff to focus on improving the customer experience and other things critical to our company, not on patching databases and trying to manage our own infrastructure."

Chief architect, financial services company
Head of development, technology company

[1] Results are for a composite organization based on interviewed customers. "The Total Economic Impact™ of Migration to Microsoft Azure SQL Managed Databases," a commissioned study conducted by Forrester Consulting on behalf of Microsoft, March 2020.

SQL SERVER MIGRATION TO AZURE

OUTCOMES

TOOLS

Discover & Assess

- Inventory database assets, and application stack discovery
- Assess your databases, Apps and components
- Choose Deployment Model
- Build a migration plan / pilot

Microsoft Assessment Planning Toolkit

Azure Migrate

Azure Data Studio (ADS)

Data Migration Assistant (DMA)

Migrate

- Build identity, network, storage and compute infrastructure
- Migrate Security and Logins
- Migrate your workloads

Azure Migrate

Azure Data Studio (ADS)

Azure Database Migration Service (DMS)

Data Migration Assistant (DMA)

Tools Matrix Overview

Tools / Capability	Data Migration Assistant (DMA) ASSESS + MIGRATE	Azure Data Studio (SQL Migration Extension (ADS) ASSESS + MIGRATE	Azure Database Migration Service (DMS) MIGRATE	Azure Migrate (At Scale) DISCOVERY + ASSESS + MIGRATE
Assess SQL data estate	YES	YES	NO	Centralize HUB in azure Upload your DMA outputs to Azure Migrate
Migrate SQL server to **PAAS** Azure SQL Database or Azure SQL Managed Instance (Q2)	YES : Azure SQL DB	YES : Azure SQL MI	YES : Azure SQL DB & Azure SQL MI	Not directly : refer to DMS or ADS
Migrate SQL Server to **IAAS** Azure SQL VM (Q2)	YES	YES	YES	YES Lift & Shift possible
ONLINE / OFFLINE Migration (Q3)	OFFLINE (Azure SQL DB & Azure SQLVM)	ONLINE (Azure SQLMI & Azure SQLVM) + OFFLINE (Azure SQLMI & Azure SQLVM)	ONLINE (Azure SQLMI) + OFFLINE (Azure SQL MI & Azure SQL DB & Azure SQL VM)	ONLINE + OFFLINE as it rely on DMS
From Source To Destination **: PUSH or PULL**	PUSH	PUSH or PULL	PULL	Depend if you choose DMS or ADS
UI / CmdLine	UI & CmdLine	UI & Scripting (poweshell+CLI)	UI Azure Portal & Cmdline(az dms)	UI Azure Portal & Azure PowerShell cmdlets
Platform	Window	**Cross-platform:** Windows/Macs OS/Linux	Azure	Azure
Where to find it ?	Download and Install	Download and Install	Azure Service	Azure Service

Tools for every stage of workload migration

	Discover	Migrate	Optimize
Microsoft	Azure Migrate Movere Database Migration Assistant	Azure Site Recovery Azure Database Migration Service Azure Data Box	Azure security and management (e.g., backup, monitoring, security assessment, cost management with Azure Cost Management)

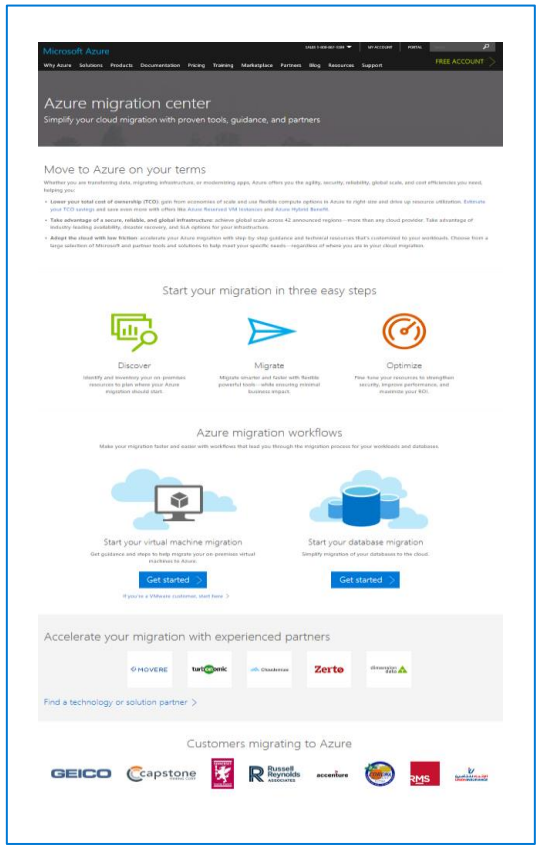
Partners

MOVERE
VEEAM
Zerto
CloudAtlas®
Cloudamize
turbonomic
CloudEndure®
CloudRecon®
ATTUNITY
DATOMETRY
Informatica
CloudPilot®

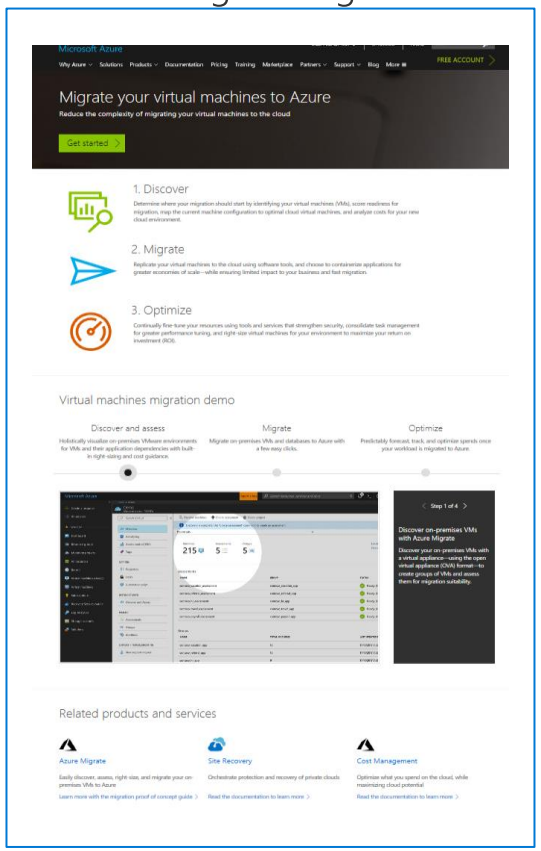
Use the mix of tool(s) that best meet your requirements

Azure migration center
Your comprehensive, evergreen resource

Build your case, find others like you

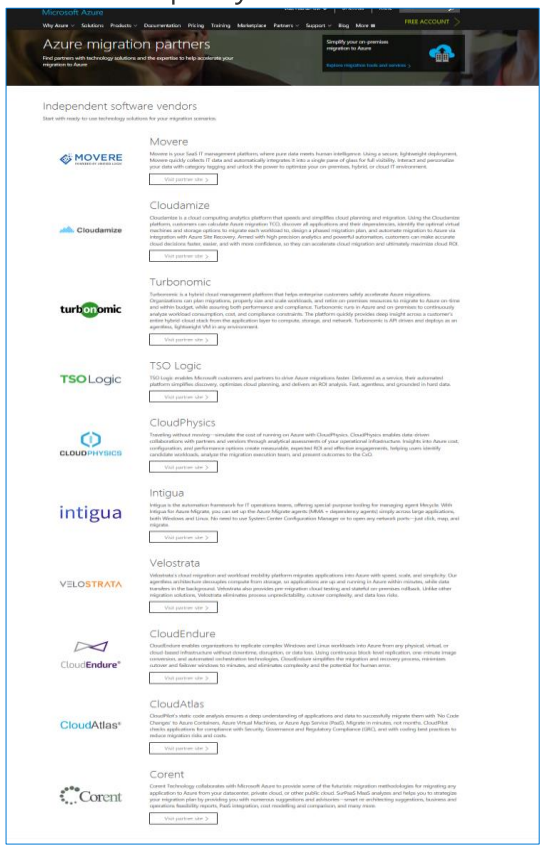


Server migration guidance



Database migration guidance

3rd party tool choices



https://azure.microsoft.com/en-us/migrate/

Get started today!

Web pages

- Azure SQL family
  - SQL Server on Azure Virtual Machines
  - Azure SQL Managed Instance
  - Azure SQL Database
  - Azure SQL Edge
- Choose Your Azure SQL database tool
- Azure Hybrid Benefit for SQL Server
- Azure Database Migration Service
- Migration guide

3rd party studies

- ESG Economic Value report on migrating to Azure SQL
- Principled Technologies price-performance study
- Forrester Consulting Total Economic Impact™ study

Other Resources – infographics

- Infographic: Azure SQL family
- Azure SQL Jumpstart Guide
- Infographic: Forrester Consulting Total Economic Impact™ study

Microsoft

#AzureSQL

Inside Availability for Azure SQL

Ralph Kemperdick, Cloud Solution Architect, Data

Inspired by the work of:

Bob Ward, Principal Architect

Microsoft Azure Data

Availability capabilities and tasks

Availability capabilities

- Auto and user-controlled BACKUP/RESTORE
- Built-in HADR and read replicas
- Availability Zones
- Geo-replication and Failover Groups
- Database Availability
- Replication
- CDC (Preview in Azure Database[NEW])
- Database Consistency

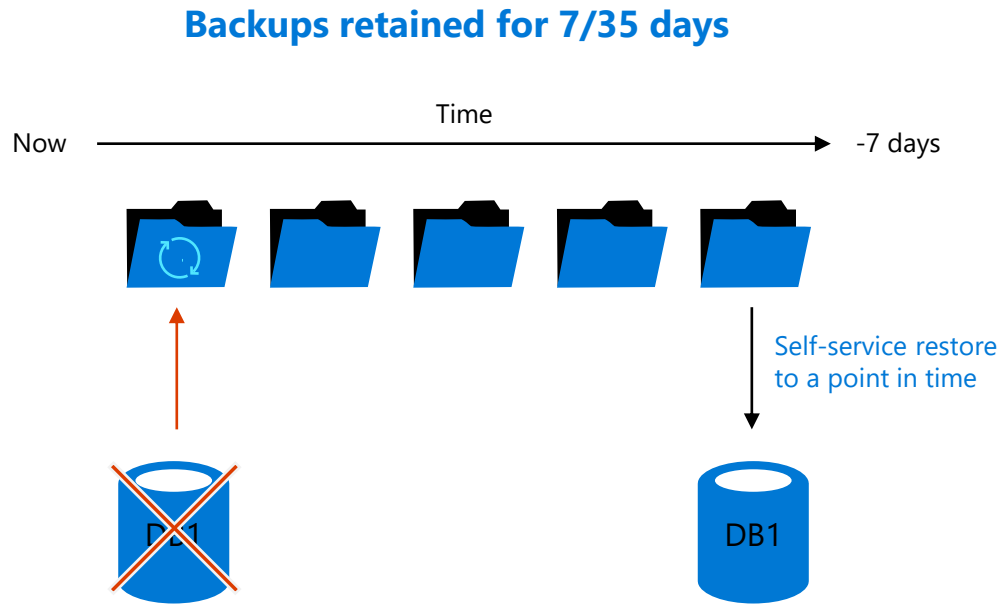
Availability tasks

- Choose Edition for RTO and RPO requirements
- Configure HADR
- Monitoring Availability

Backup and restore

Auto backups and Point in Time Restore (PITR)

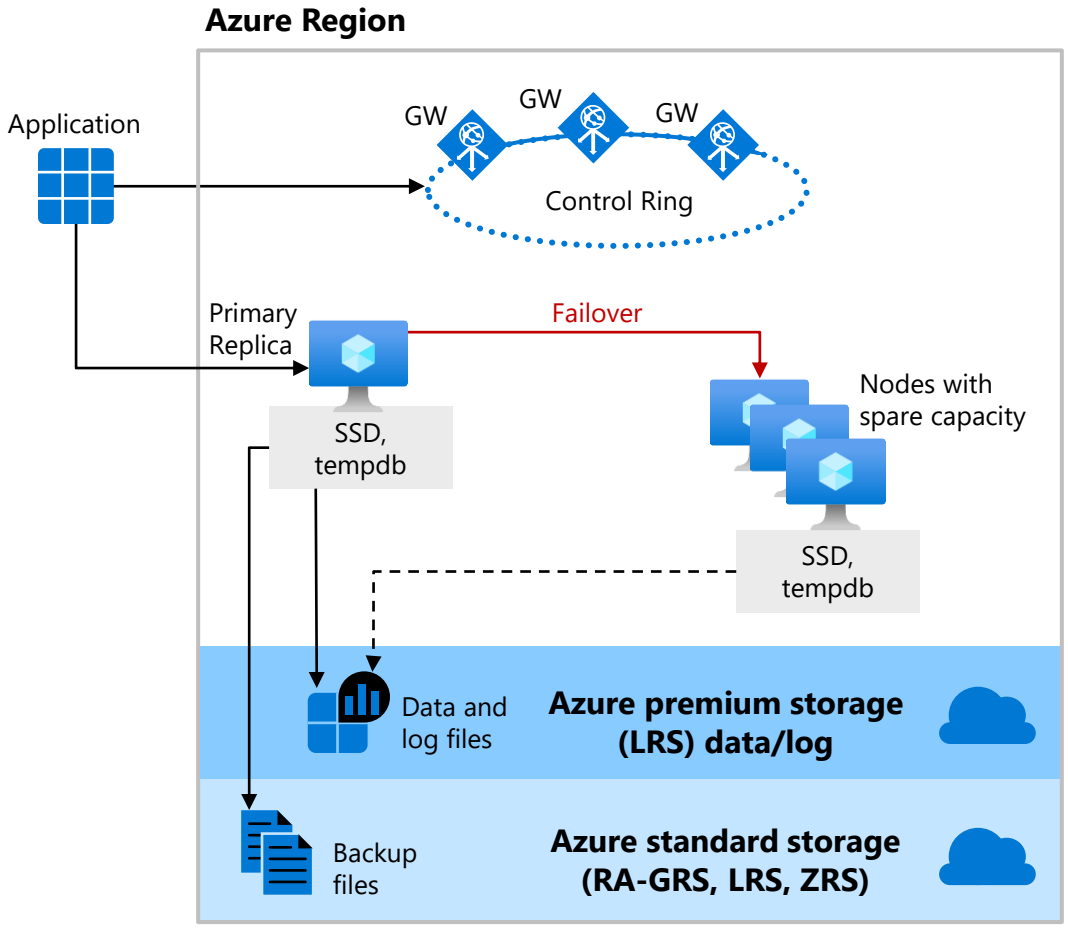
- Full Database backup once a week
- Log Backups every 5-10 minutes
- Differential Backups every 12-24 hours
- Backup files on Azure storage with RA-GRS replicated
  - Can optionally select LRS or ZRS
- Backup Integrity checks
- Restore to new database
- Long-term retention (up to 10 years) of backups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



Manual COPY_ONLY Backup/Restore with Managed Instance

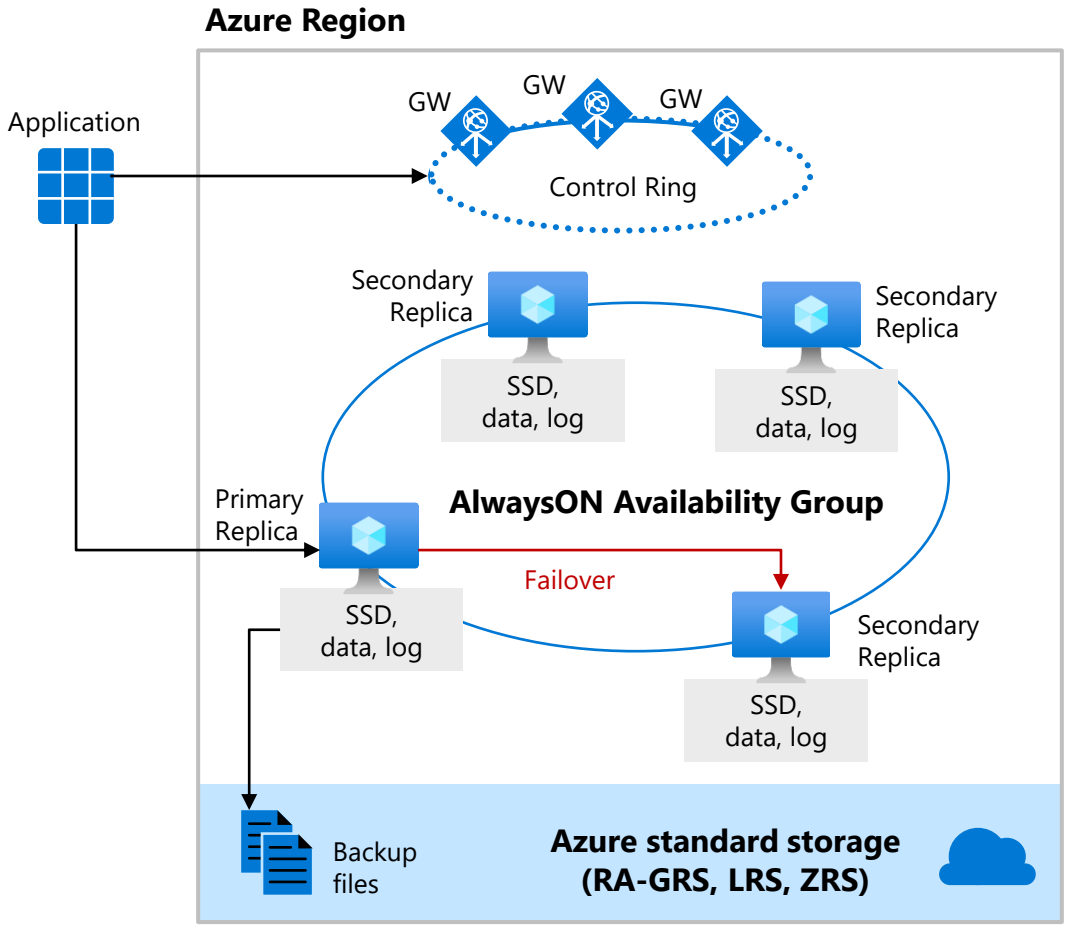
General Purpose High Availability

- Behaves like Failover Cluster Instance
- Remote storage provides data redundancy within a datacenter
- Backup files are in a different location with geo-redundancy
- Failover decisions based on SQL and Service Fabric
- Recovery time depends on spare capacity
- Connectivity redirection built-in



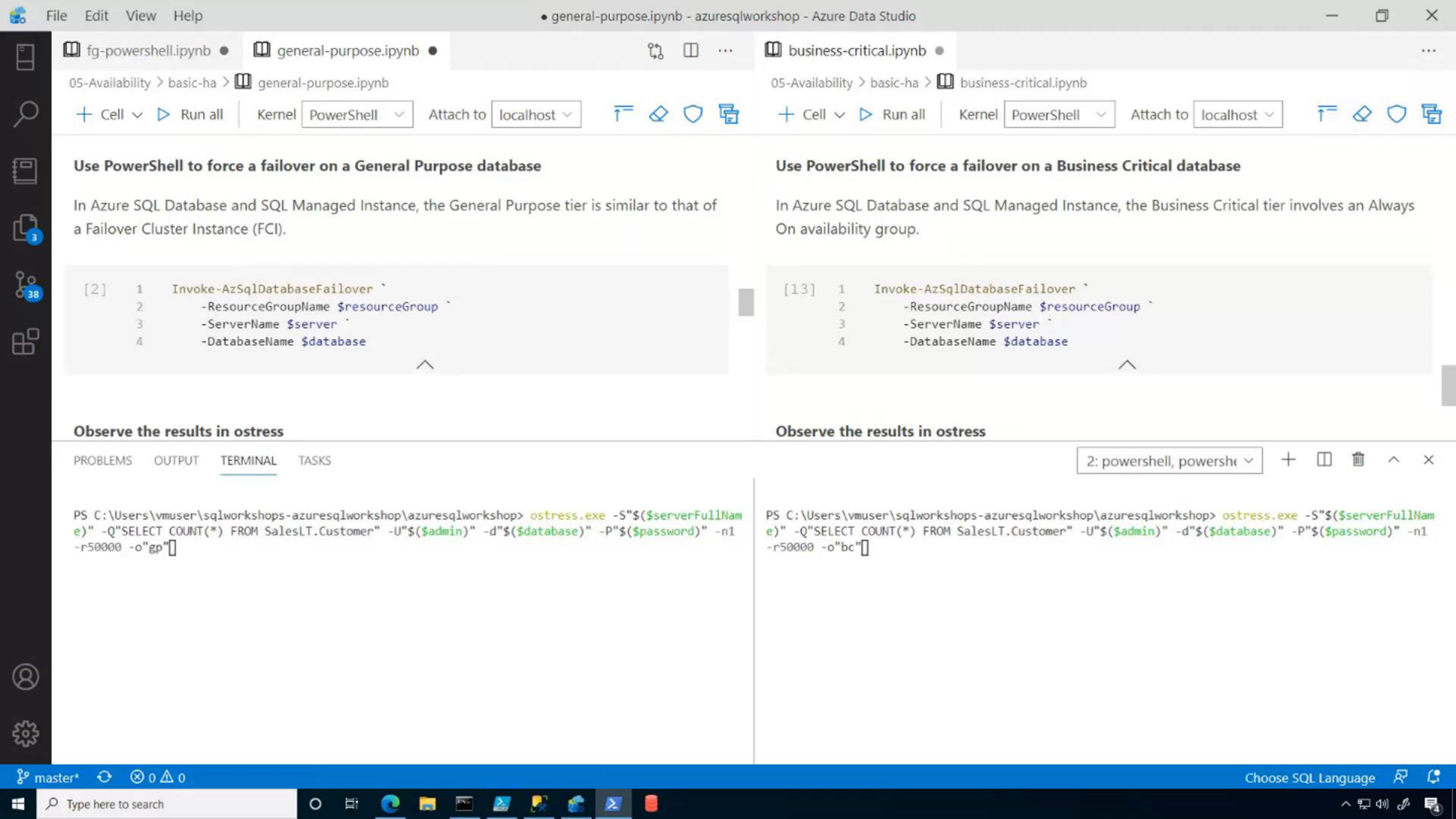
Business Critical High Availability

- 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



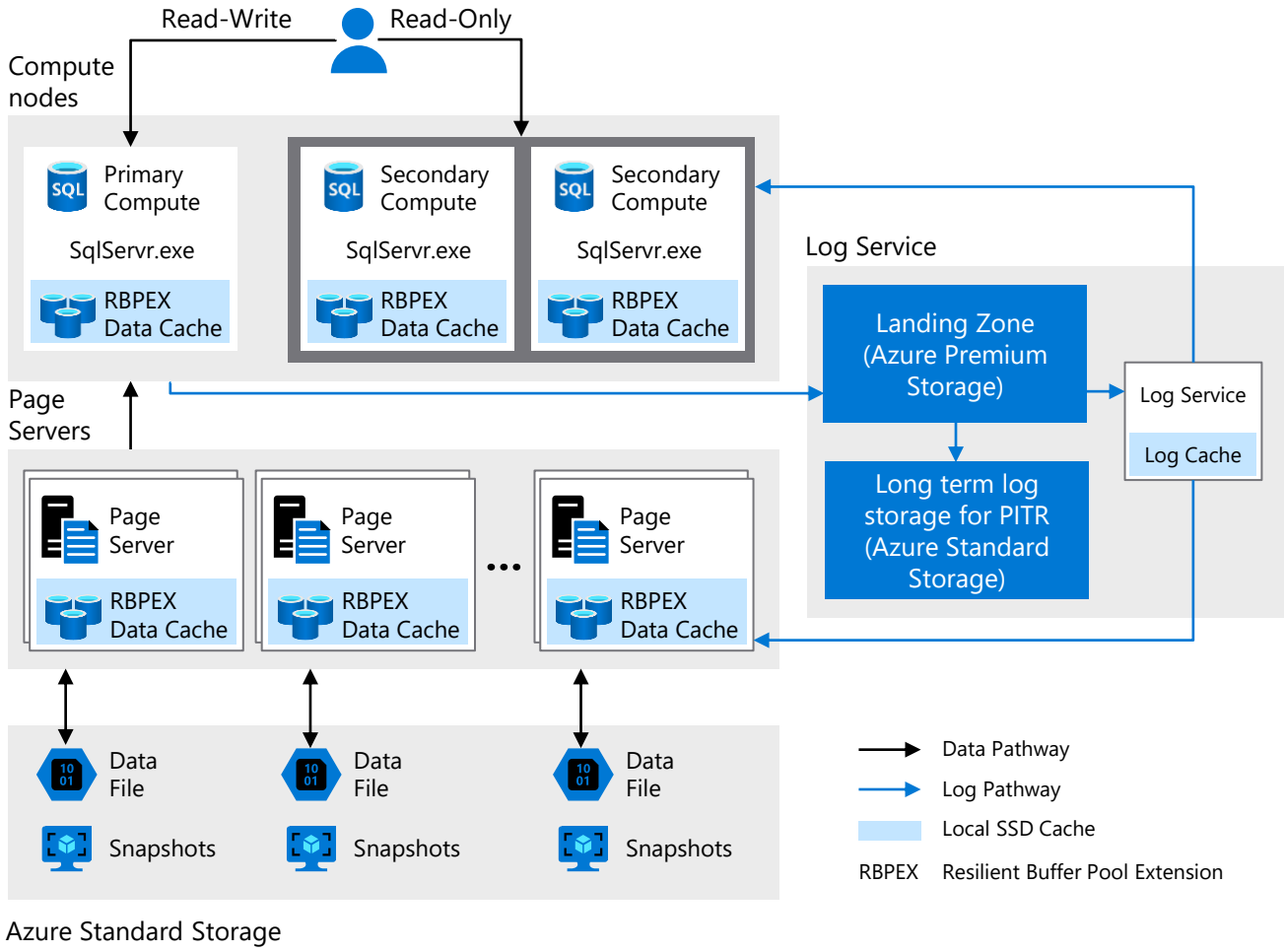
Microsoft

Demo
Faster failovers with Business critical


File Edit View Help
• general-purpose.ipynb - azuresqlworkshop - Azure Data Studio
fg-powershell.ipynb
general-purpose.ipynb
business-critical.ipynb
05-Availability > basic-ha > general-purpose.ipynb
05-Availability > basic-ha > business-critical.ipynb
Cell
Run all
Kernel PowerShell
Attach to localhost
Use PowerShell to force a failover on a General Purpose database
In Azure SQL Database and SQL Managed Instance, the General Purpose tier is similar to that of a Failover Cluster Instance (FCI).
[2]
Invoke-AzSqlDatabaseFailover `
-ResourceGroupName $resourceGroup `
-ServerName $server `
-DatabaseName $database
Use PowerShell to force a failover on a Business Critical database
In Azure SQL Database and SQL Managed Instance, the Business Critical tier involves an Always On availability group.
[13]
Invoke-AzSqlDatabaseFailover `
-ResourceGroupName $resourceGroup `
-ServerName $server `
-DatabaseName $database
Observe the results in ostress
Observe the results in ostress
PROBLEMS OUTPUT TERMINAL TASKS
2: powershell, powershe
PS C:\Users\vmuser\sqlworkshops-azuresqlworkshop\azuresqlworkshop> ostress.exe -S"$($serverFullName)" -Q"SELECT COUNT(*) FROM SalesLT.Customer" -U"$($admin)" -d"$($database)" -P"$($password)" -n1 -r50000 -o"gp"
PS C:\Users\vmuser\sqlworkshops-azuresqlworkshop\azuresqlworkshop> ostress.exe -S"$($serverFullName)" -Q"SELECT COUNT(*) FROM SalesLT.Customer" -U"$($admin)" -d"$($database)" -P"$($password)" -n1 -r50000 -o"bc"
master*
0 0
Choose SQL Language
Type here to search

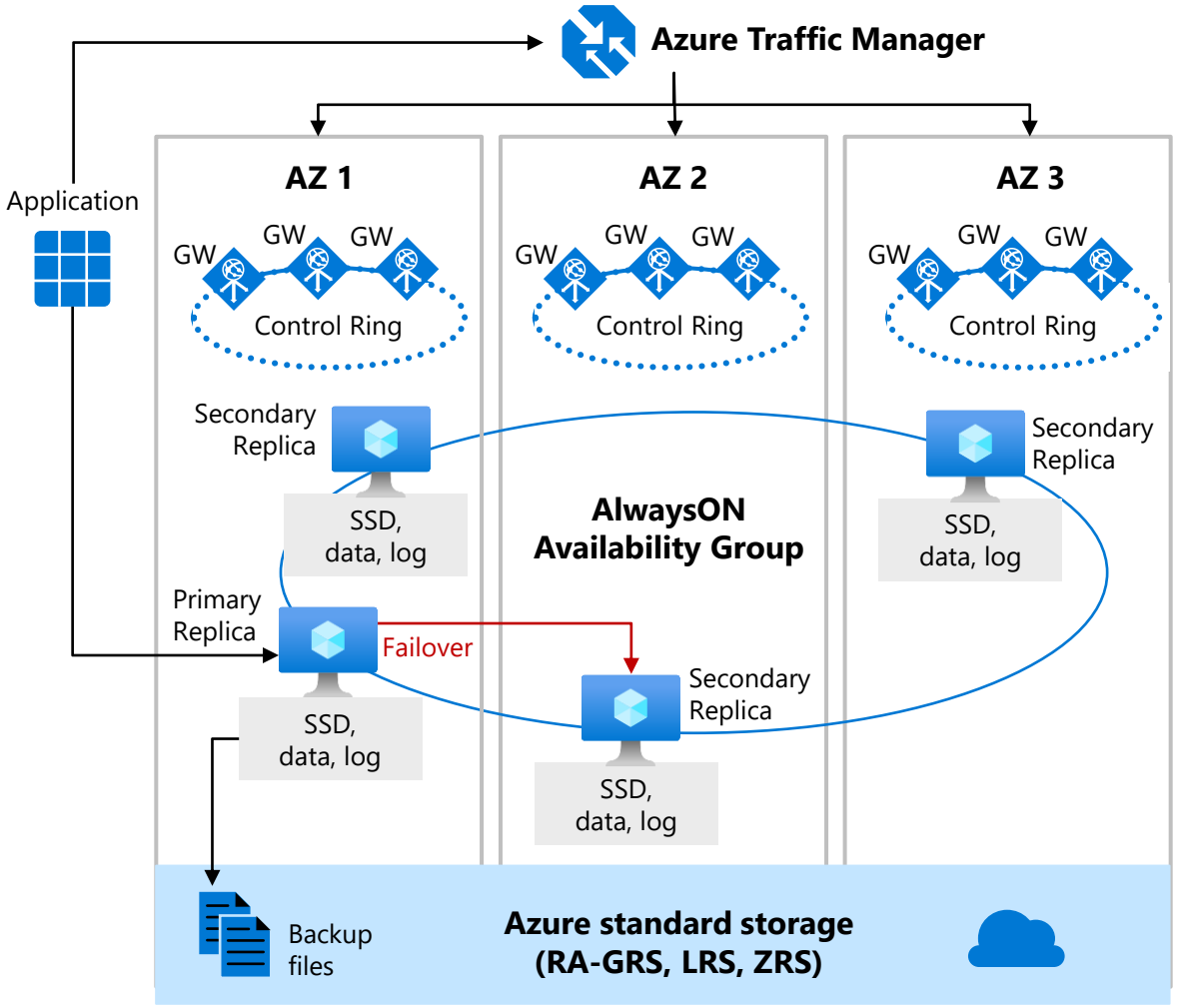
Hyperscale High Availability

- Paired page servers
- Redundant log and data through Azure Storage
- Backup/Restore snapshots
- Log Service feeds replicas
- 0 to 4 secondary replicas for read scale and failover
- Named replicas (Preview)NEW
- Automatic failover based on SQL and Service Fabric
- Recovery time depends on existence of replicas



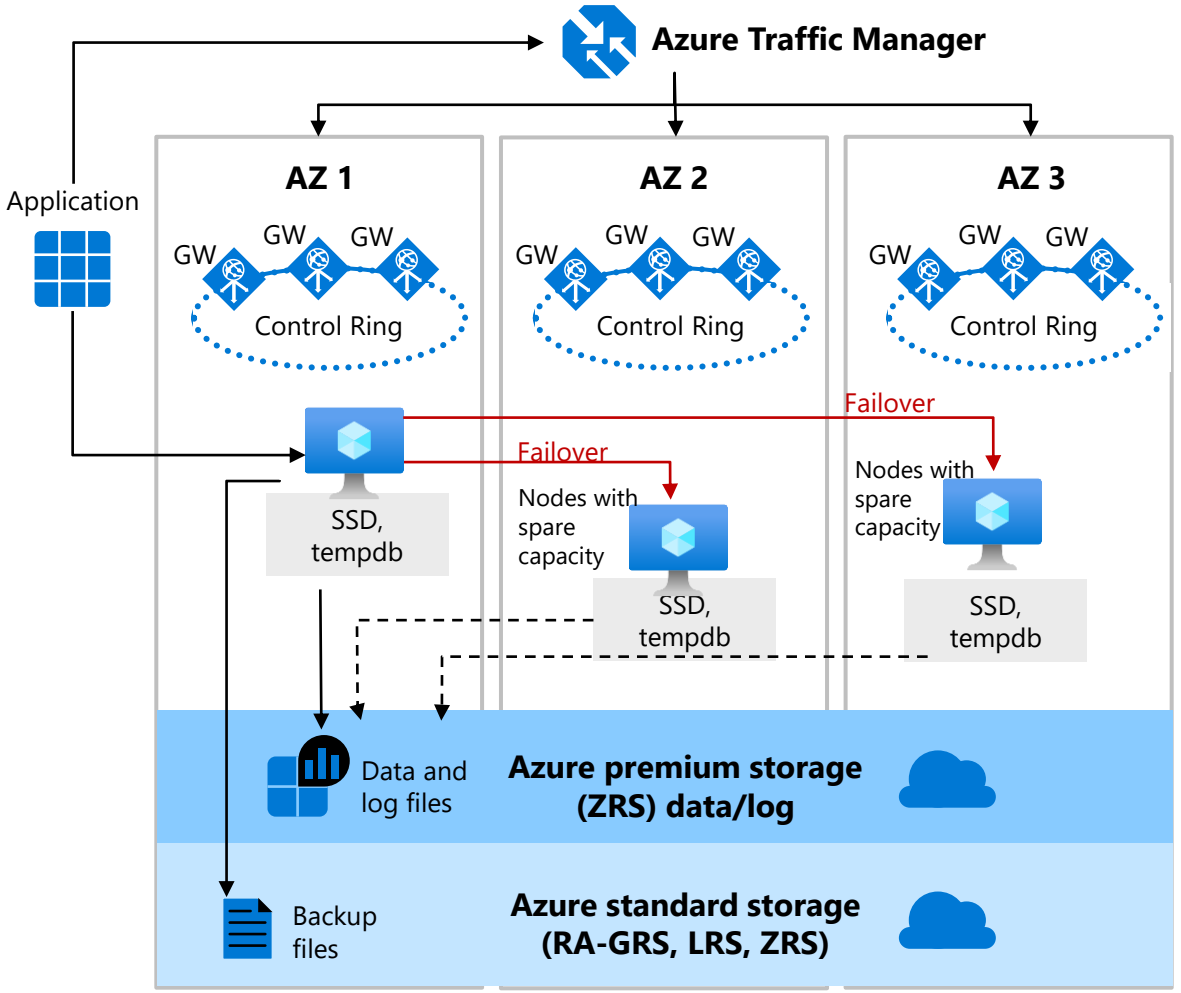
Zone redundancy – Business Critical

- Replicas are automatically created across zones
- Synchronous replication
- Database resilient to zonal outage
- Free for Business Critical & Premium



Zone redundancy – General Purpose

- Currently in preview for SQL Database (provisioned and serverless)
- Remote storage is zone redundant
- Guaranteed compute capacity in other Availability Zones
- Database resilient to zonal outage
- For pricing details visit the pricing pages for single databases and elastic pools



Service Level Agreement (SLA)

Service tier	Single zone SLA	Multiple zones SLA
Basic, Standard, General Purpose	99.99%	N/A
Premium, Business critical	99.99%	99.995%
Hyperscale w/ 0 replicas	99.5%	N/A
Hyperscale w/ 1 replica	99.9%	N/A
Hyperscale w/ 2+ replica	99.99%	N/A

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

SLA for Azure SQL Database

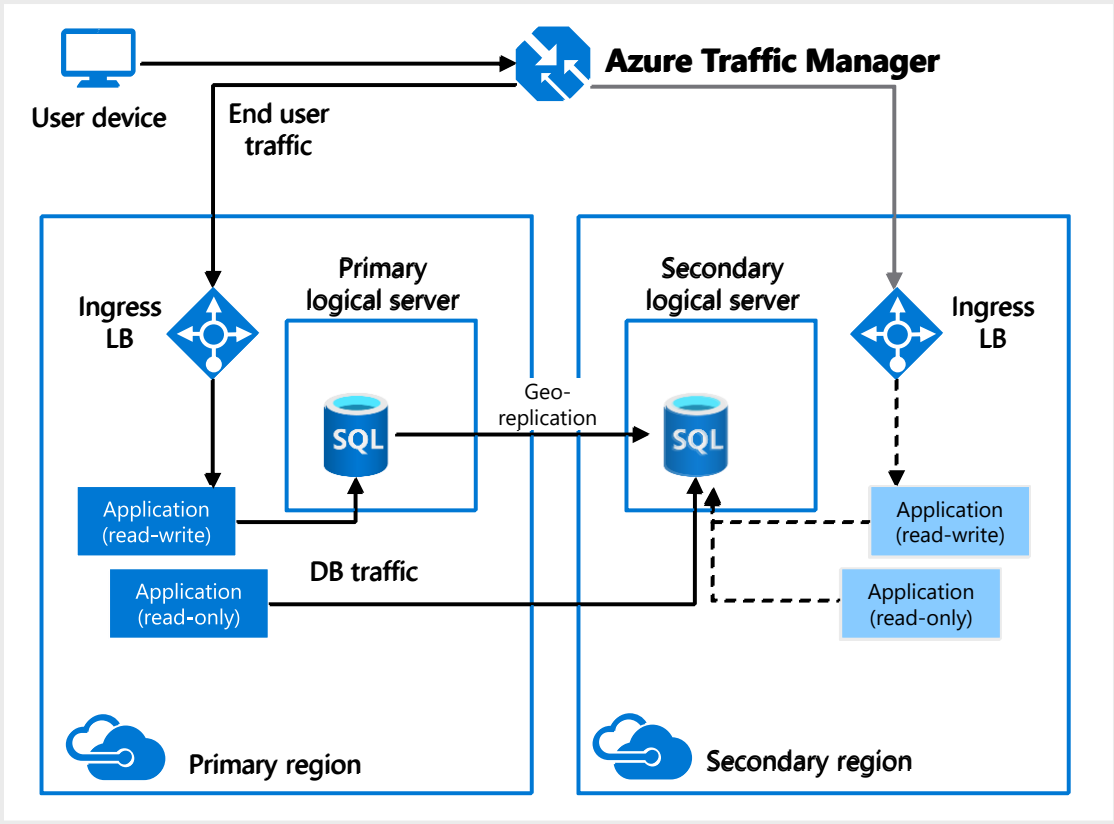
SLA for Azure SQL Managed Instance

Active geo-replication vs auto-failover groups

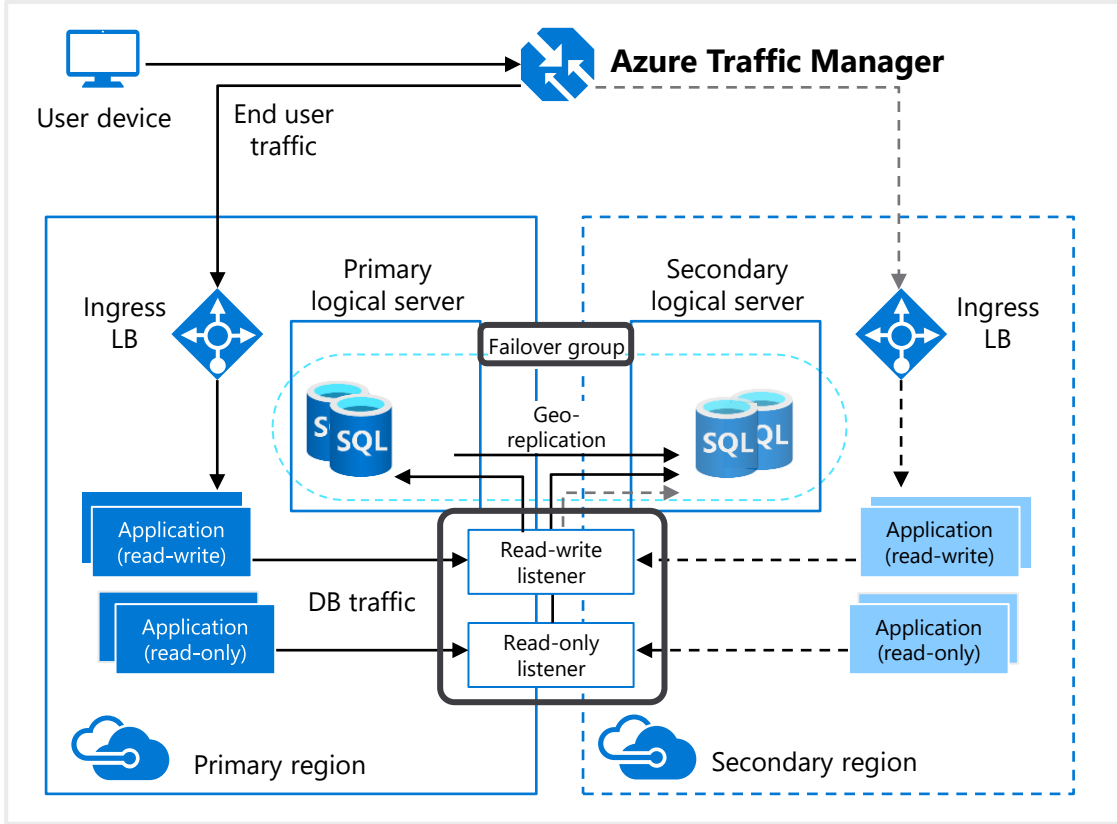
	Geo-replication	Auto-failover groups
Automatic failover	No	Yes
Fail over multiple databases simultaneously	No	Yes
Update connection string after failover	Yes	No
Managed instance supported	No	Yes
Can be in same region as primary	Yes	No
Multiple replicas	Yes	No
Supports read-scale	Yes	Yes

Active geo-replication vs auto-failover groups

Geo-replication



Auto-failover groups



Database availability and consistency

Availability

- You cannot set OFFLINE and EMERGENCY
- RESTRICTED_USER access allowed
- Dedicated Admin Connection (DAC) allowed
- Accelerated Database Recovery on by default

Consistency

- Multiple copies of data and backups
- Users can execute DBCC CHECKDB (no repair)
- Database CHECKSUM on by default
- Auto Page Repair when possible
- Data integrity error alert monitoring
- Backup and restore integrity checks
- “lost write” and “stale read” detection
- Repair without notification if no impact
- Proactive notification to customers

Accelerated Database Recovery (ADR)

How it works

- Uses a Persisted Version Store (PVS)
- Independent of locking and isolation levels
- Rollback faster than you can react
- Undo recovery faster than you can look it up
- Transaction log truncation not tied to active transactions

Key questions

- Does it require more space?
- Will it affect performance?
- Will I still see versions in tempdb?
- How does it work with HA?

Read the paper

Microsoft

Demo
Accelerated Database Recovery

Making the right choices

- ✓ Decide if you need long-term backups
- ✓ Decide on your RTO and RPO needs
- ✓ Review the Azure SQL SLA
- ✓ Do you need read replicas?
- ✓ Do you need Availability Zones?
- ✓ Do you need geo HADR or Failover Groups?
- ✓ Is your application ready?

Monitoring availability

Region and Datacenter availability

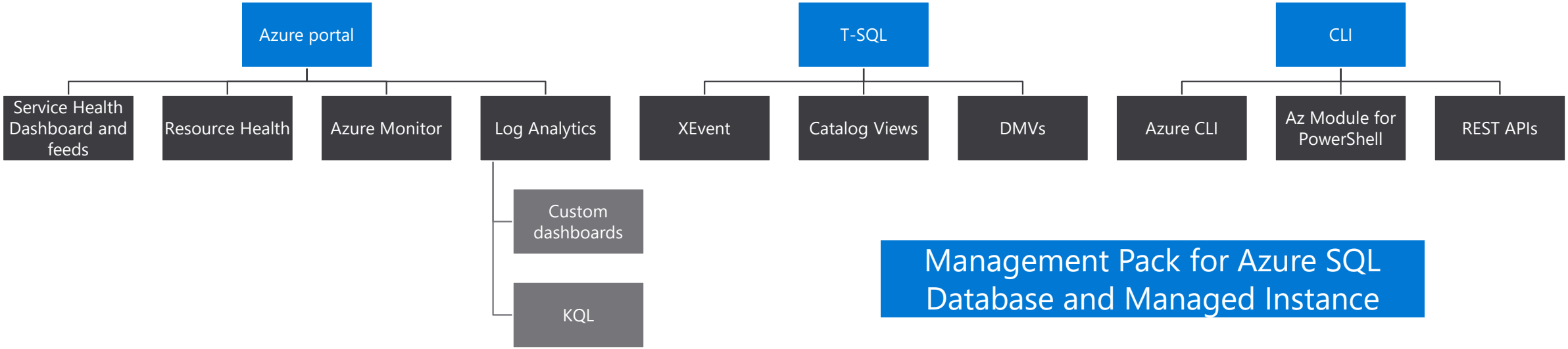
Server availability

Database availability

Backup/Restore history

Replica Status

Failover reasons



Management Pack for Azure SQL Database and Managed Instance

Summary

- **Automated Backups** with PITR
- **Built-in HA** including read replicas
- **Go further** with Zone Redundancy and multi-region HA
- Configure per your **SLA** and RPO/RTO needs
- **Monitor** with the Azure portal, T-SQL, and CLI

Resources

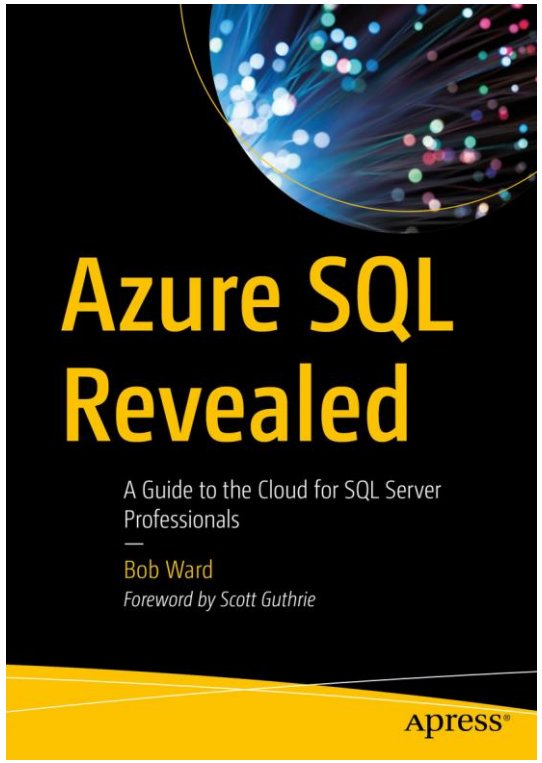
Microsoft Learn: Azure SQL fundamentals learning path
aka.ms/azuresqlfundamentals

Select the Azure SQL Workshop
aka.ms/sqlworkshops

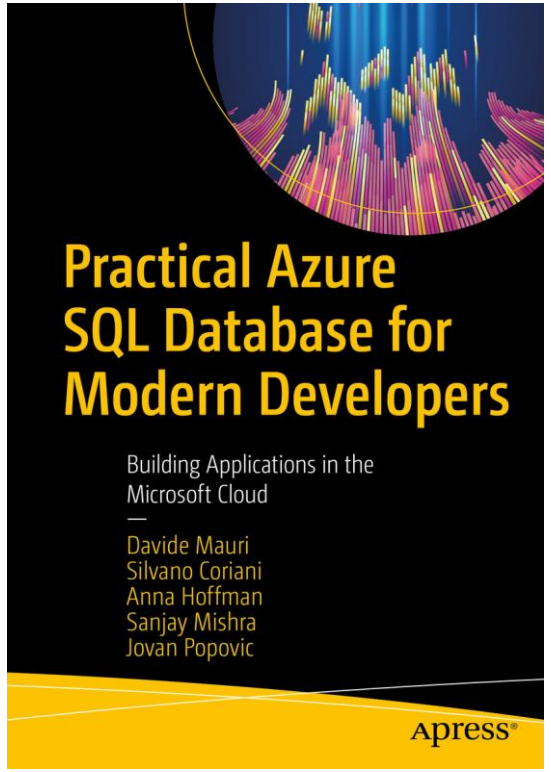
How to choose tool
aka.ms/chooseazuresql

Azure SQL documentation
aka.ms/azuresqldocs

More videos from our team
aka.ms/azuresql4beginners
aka.ms/azuresqlyt



aka.ms/azuresqlbook



aka.ms/azuresqlfordevelopers

Resources

Decision Trees when to use which Azure Data Service
https://albero.cloud/

Notes on Azure Synapse Disaster Recovery Architecture
https://www.linkedin.com/pulse/some-notes-azure-synapse-disaster-recovery-andrei-zaichikov/

Database SLAs and refunds
https://azure.microsoft.com/de-de/support/legal/sla/

PostgreSQL Options and SLAs
https://docs.microsoft.com/en-us/azure/postgresql/single-server/overview-postgres-choose-server-options

MySQL - Flexible Server High availability
https://docs.microsoft.com/en-us/azure/mysql/flexible-server/overview#high-availability-within-and-across-availability-zones

Call to Action

Get your free Azure Service today
https://azure.microsoft.com/de-de/free/

Fortbildung zum Thema Azure
https://aka.ms/learn

Become a Azure certified Data Engineer
https://docs.microsoft.com/de-de/learn/certifications/roles/data-engineer

Microsoft

Thank you

Microsoft

Appendix

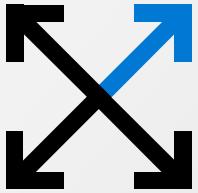
Azure SQL

Azure SQL Database and Azure SQL Managed Instance

Streamline app modernization

Accelerate app modernization with minimal code changes on the only cloud with evergreen SQL

Hyperscale demanding workloads

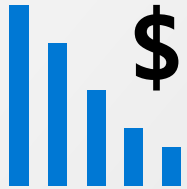


Rapidly adapt to changing requirements with Hyperscale storage up to 100 TB

Optimize price-performance with serverless compute

Build modern apps your way with flexible compute options that include auto-scaling serverless. Pay only for what you use.

Save with the best total cost of ownership



Meet mission critical requirements while costing up to 86% less than the competition

Built-in AI

Optimizes performance and durability for you

Advanced data security

Secure your data with layers of protection, built-in controls and leading compliance

Always On reliability

Maximize uptime with built-in high availability and an industry-leading availability SLA up to 99.995%

Azure SQL

SQL Server on Azure Virtual Machines

Save with the best total cost of ownership

Pay up to 84% less than AWS

Rehost onto an industry-leading database

Built on an enterprise-grade, unified data platform

Experience high performance on any operating system

High performance virtual machines for SQL Server on Linux and Windows

Protect your data and ease maintenance

Automatic security updates and built-in availability

Get the performance, security, and analytics of SQL Server backed by the flexibility and hybrid connectivity of Azure

Azure SQL

Azure SQL Edge

Time series, data streaming and AI

Stream, store, and analyze IoT data and apply business logic using built-in AI & ML capabilities

Native data movement to Azure

Consistent app development and management from cloud to data center to edge

Your choice of platform

Run SQL on your choice of platform Including ARM 64 and x64 architecture

Unparalleled performance & security

Flexible high availability and industry-leading data protection and security tools

Simplified pricing for IoT

$10 per month/device or as low as $60 per year/device for a 3-year commitment*.

Azure SQL

Develop once

Consistent application development and management experience

SQL Server

Deploy anywhere

Simplify your architecture from ground to cloud to edge

Azure SQL Edge

Optimized for IoT edge gateways and devices, this small-but-mighty SQL engine enables real-time insights, in **connected, disconnected, or hybrid** environments

* Terms and conditions apply. See Azure.com for details.

High Availability with Flexible Server (MySQL)