Microsoft

An introduction to

# Azure SQL

The family of SQL cloud databases

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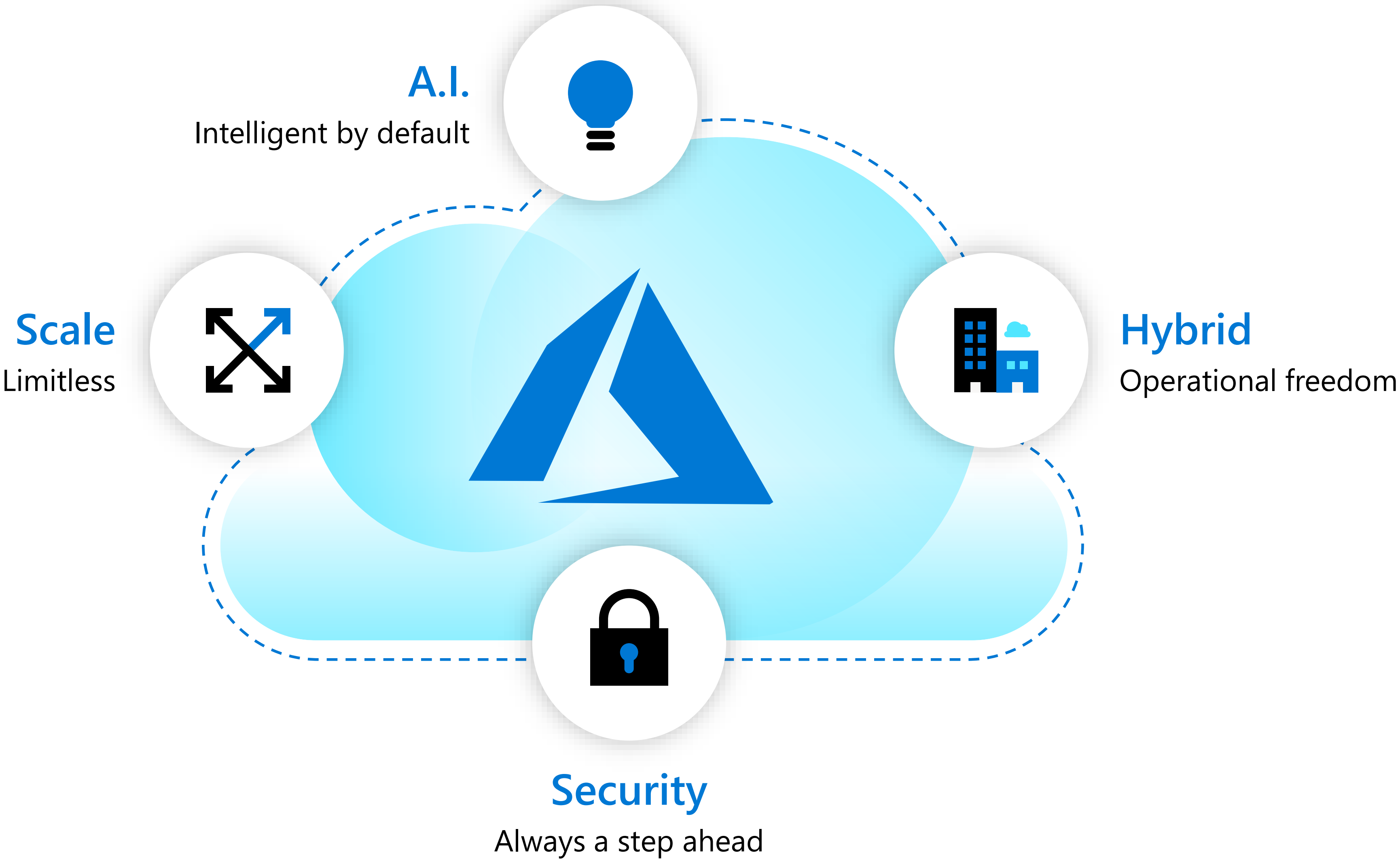
# Be future-ready with Azure



# Introducing Azure SQL

## The family of SQL cloud databases

Providing flexible options for

- Migration
- Modernization
- Development

# Azure SQL

## The family of SQL cloud 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

| Infrastructure-as-a-Service | Platform-as-a-Service | |
|---|---|---|

**Azure is the cloud that knows SQL Server best**

# 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

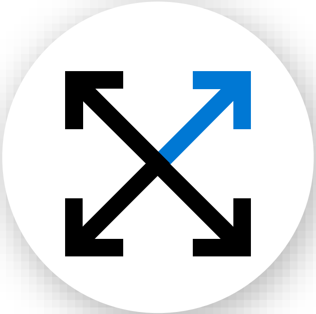
# Azure SQL

## 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

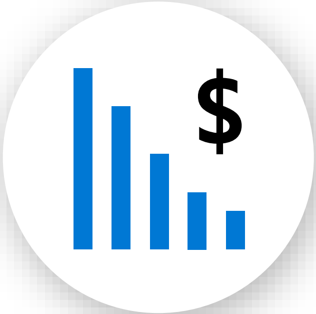


Rapidly adapt to changing requirements with Hyperscale storage up to 100 TB

### 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**

# Overview of SQL Services on Azure

## What SQL Services are available on Azure?

Azure SQL allows you to create and manage your SQL Server resources from a single view, ranging from fully managed PaaS databases to IaaS virtual machines with direct OS and database engine access. All deployment options enable you to bring your on-premises licenses to Azure using Azure Hybrid Benefit

- **Databases**
  - Single databases are optimized for modern application development of new cloud-born applications. Databases provide a fully managed SQL experience with extensive and easy to use manageability features

- **Managed Instances**
  - Managed instances provide the PaaS benefits of SQL databases with added capabilities that were previously only available in SQL virtual machines. This includes a native virtual network and near 100% compatibility with on-premises SQL Server

- **SQL virtual machines**
  - SQL virtual machines offer an IaaS architecture with extensive control over SQL Server and the underlying OS. Deployments include a management resource that focuses on SQL configuration and enables license updates with no server downtime

# Overview of SQL PaaS

## Why you should use PaaS instead of IaaS

- **Automatic backups**
  - SQL Database automatically performs full, differential, and transaction log backups of Azure SQL databases to enable you to restore to any point in time. For single databases and pooled databases, you can configure SQL Database to store full database backups to Azure storage for long-term backup retention. For managed instances, you can also perform copy-only backups for long-term backup retention
- **Point-in-time restores**
  - All SQL Database deployment options support recovery to any point in time within the automatic backup retention period for any Azure SQL database
- **Active geo-replication**
  - Single database and pooled databases allow you to configure up to four readable secondary databases in either the same or globally distributed Azure data centers
- **Auto-failover groups**
  - All SQL Database deployment options allow you to use failover groups to enable high availability and load balancing at global scale, including transparent geo-replication and failover of large sets of databases, elastic pools, and managed instances
- **Zone-redundant databases**
  - SQL Database allows you to provision premium or business critical databases or elastic pools across multiple availability zones. Because these databases and elastic pools have multiple redundant replicas for high availability, placing these replicas into multiple availability zones provides higher resilience, including the ability to recover automatically from the datacenter scale failures without data loss
- **Automatic performance monitoring and tuning**
  - Automatic index management: Identifies indexes that should be added in your database, and indexes that should be removed
  - Automatic plan correction: Identifies problematic plans and fixes SQL plan performance problems

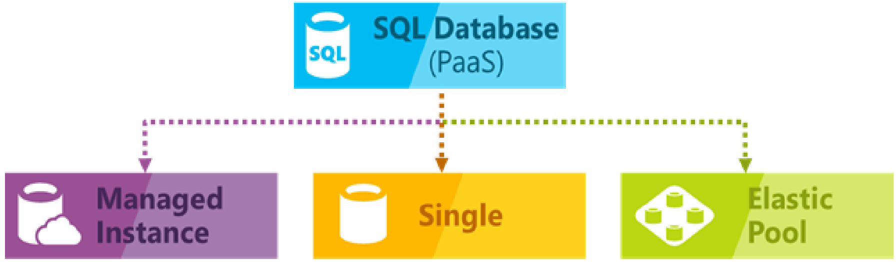
# Overview of SQL PaaS

## Why you should use PaaS instead of IaaS

- **Built-In security features**
  - Data discovery & classification
  - Vulnerability assessment
  - Threat detection
  - Can be included in the Azure Security Center
  - Auditing
  - Data encryption
  - Azure Active Directory integration (also includes multi-factor authentication)
  - Compliance certification

# Overview of SQL PaaS

## The family of SQL cloud databases

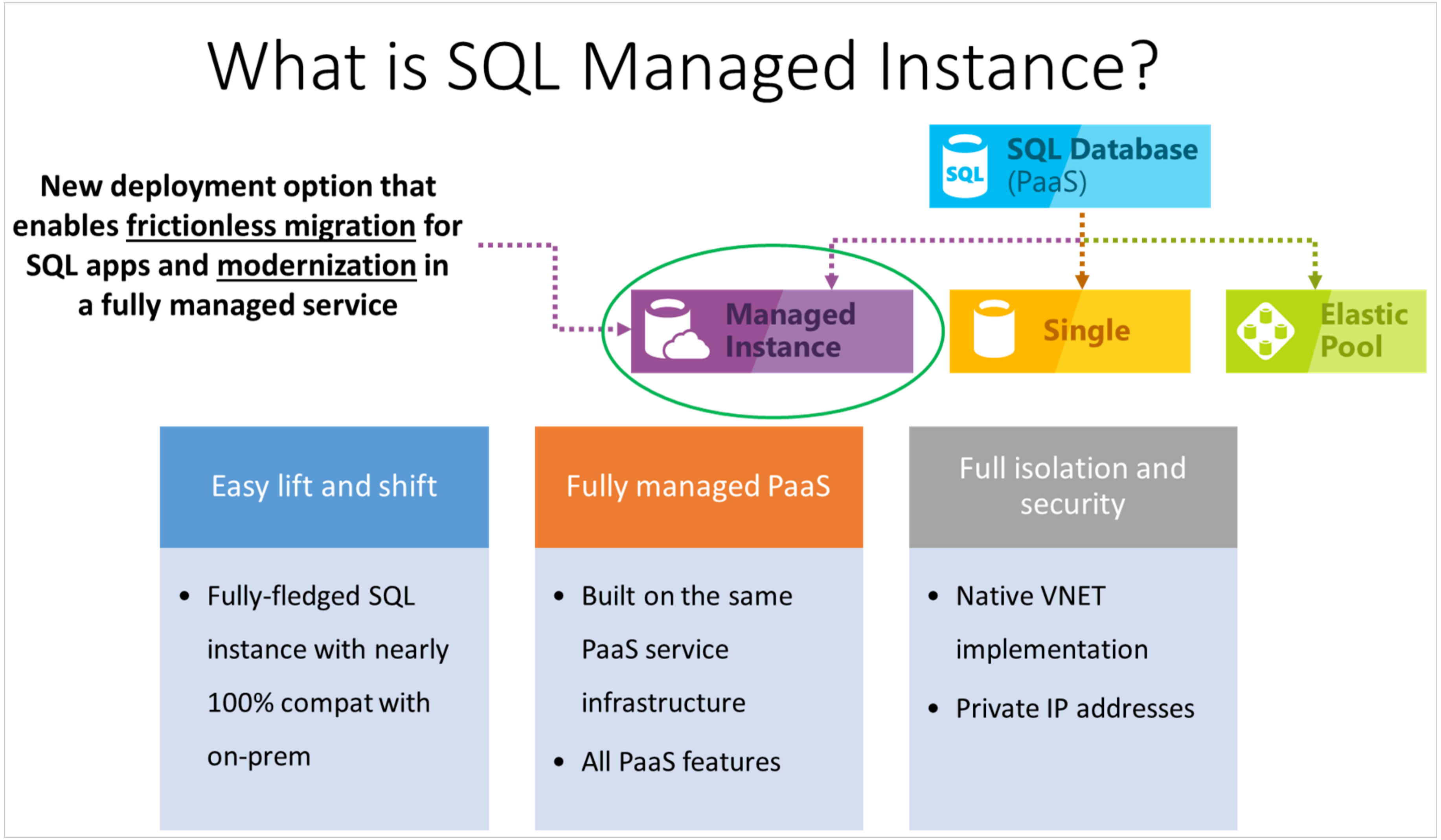



Decide which service fits to your needs:

- Managed Instance
- Single
- Elastic Pool

# Managed Instance

## Nearly 100% compatible to SQL Server On-Premise



# Managed Instance

## Nearly 100% compatible to SQL Server On-Premise

Managed instance is a deployment option of Azure SQL Database, providing near 100% compatibility with the latest SQL Server on-premises (Enterprise Edition) Database Engine, providing a native virtual network (VNet) implementation that addresses common security concerns, and a business model favourable for on-premises SQL Server customers.

The managed instance deployment model allows existing SQL Server customers to lift and shift their on-premises applications to the cloud with minimal application and database changes.

At the same time, the managed instance deployment option preserves all PaaS capabilities (automatic patching and version updates, automated backups, high-availability

# Managed Instance

## Nearly 100% compatible to SQL Server On-Premise

- **Purchasing models**

The vCore-based purchasing model for managed instances gives you flexibility, control, transparency, and a straightforward way to translate on-premises workload requirements to the cloud. This model allows you to change compute, memory, and storage based upon your workload needs. The vCore model is also eligible for up to 30 percent savings with the Azure Hybrid Benefit for SQL Server.

- Gen5 Logical CPUs are based on Intel E5-2673 v4 (Broadwell) 2.3-GHz processors, fast NVMe SSD, hyper-threaded logical core, and compute sizes between 4 and 80 cores

# Azure SQL Database

## Perfect choice for modern cloud applications

Single database represents fully-managed isolated database that is perfect choice for the modern cloud applications and microservices that need a single reliable data source. A single database is similar to a contained databases in Microsoft SQL Server database engine.

Additionally, you can move a single Azure SQL database to an elastic pool.
Elastic pool is a collection of Single databases with a shared set of resources such as CPU or memory. Single databases can be moved into and out of an elastic pool.

# Azure SQL Database

## Perfect choice for modern cloud applications

Purchasing models:

- The vCore-based purchasing model lets you choose the number of vCores, the amount or memory, and the amount and speed of storage. The vCore-based purchasing model also allows you to use Azure Hybrid Benefit for SQL Server to gain cost savings

- The DTU-based purchasing model offers a blend of compute, memory, IO resources in three service tiers to support lightweight to heavyweight database workloads. Compute sizes within each tier provide a different mix of these resources, to which you can add additional storage resources

# SQL PaaS comparison

## Comparison of basic SQL server features

| SQL Feature | Single databases and elastic pools | Managed instances |
|---|---|---|
| **Always On Availability Groups** | High availability is included with every database. Disaster recovery is discussed in Overview of business continuity with Azure SQL Database | High availability is included with every database and cannot be managed by user. Disaster recovery is discussed in Overview of business continuity with Azure SQL Database |
| **Automatic backups** | Yes. Full backups are taken every 7 days, differential 12 hours, and log backups every 5-10 min | Yes. Full backups are taken every 7 days, differential 12 hours, and log backups every 5-10 min |
| **BACKUP command** | No, only system-initiated automatic backups | Yes, user initiated copy-only backups to Azure Blob Storage (automatic system backups cannot be initiated by user) |
| **Collation - database** | Yes | Yes |
| **Collation - server/instance** | No, default logical server collation SQL_Latin1_General_CP1_CI_AS is always used | Yes, can be set when the instance is created and cannot be updated later |
| **Common language runtime - CLR** | No | Yes, but without access to file system in CREATE ASSEMBLY statement |
| **Database mail - DbMail** | No | Yes |
| **Filestream** | No | No |

# SQL PaaS comparison

## Comparison of basic SQL server features

| | | |
|---|---|---|
| **Linked servers** | No – use Elastic query | Yes. Only to SQL Server and SQL Database without distributed transactions |
| **Linked servers that read from files (CSV, Excel)** | No. Use BULK INSERT or OPENROWSET as an alternative for CSV format | No. Use BULK INSERT or OPENROWSET as an alternative for CSV format. Track this requests on Managed Instance Feedback item |
| **Logins and users** | Yes, but CREATE and ALTER login statements do not offer all the options (no Windows and server-level Azure Active Directory logins). EXECUTE AS LOGIN is not supported - use EXECUTE AS USER instead. SQL logins are supported | Yes, with some differences. Windows logins are not supported and they should be replaced with Azure Active Directory logins. SQL logins are supported |
| **Modifying system databases** | No | Yes |
| **Recovery models** | Only Full Recovery that guarantees high availability is supported. Simple and Bulk Logged recovery models are not available | Only Full Recovery that guarantees high availability is supported. Simple and Bulk Logged recovery models are not available |
| **SQL Server Agent** | No – use Elastic jobs | Yes, but with limitations |
| **SQL Server Analysis Services (SSAS)** | No, Azure Analysis Services is a separate Azure cloud service | No, Azure Analysis Services is a separate Azure cloud service |
| **SQL Server Integration Services (SSIS)** | Yes, with a managed SSIS in Azure Data Factory (ADF) environment, where packages are stored in SSISDB hosted by Azure SQL Database and executed on Azure SSIS Integration Runtime (IR) | Yes, with a managed SSIS in Azure Data Factory (ADF) environment, where packages are stored in SSISDB hosted by Azure SQL Database and executed on Azure SSIS Integration Runtime (IR) |
| **SQL Server Reporting Services (SSRS)** | No – use Power BI instead | No – use Power BI instead |
| **VNET integration** | Partial, it enables restricted access using VNet Endpoints | Yes, Managed Instance is injected in customer's VNet. See subnet and VNet |

https://docs.microsoft.com/en-us/azure/azure-sql/database/features-comparison

# SQL on IaaS

## Feels like home

SQL Server on Azure virtual machines enables you to use full versions of SQL Server in the Cloud without having to manage any on-premises hardware.

You will have the full control over your SQL server installation, and you have to fully manage (install, update, backup and operate) those installation.

With this deployment model you can use all benefits from the Azure platform which is included in their IaaS services like:

- Global distributed network
- Independent cooling- and power infrastructure
- High availability for IaaS workloads
- Unlimited resources of compute and storage
- Speed of deployment and scalability
- …

# SQL on IaaS

## Comparison to SQL PaaS

| SQL Server in Azure VM | Azure SQL Database |
| --- | --- |
| Need a specific version of SQL Server or Windows | Don’t need a specific version of SQL Server or Windows |
| Need instance-level SQL features (e.g. Agent Job, Linked Servers, DTC) | Don’t need instance-level SQL features |
| Ok configuring/managing SQL Server and Windows (patching, high availability, backups) | Don’t want to configure and manage SQL Server or Windows |

| SQL Server in Azure VM | Azure SQL Database |
| --- | --- |
| You access a VM with SQL Server installed | You access a database |
| You manage SQL Server and Windows (patching, high availability, backups) | Database is fully managed |
| You select the SQL Server and Windows version and edition | Runs latest SQL Server version with Enterprise edition |
| Different VM sizes: A0 (1 core, 1GB mem, 100GB) to G5 (32 cores, 512GB mem, 32TB) | Different DB sizes: Basic (2GB, 5tps) to Premium (500GB, 735tps) |
| VM availability SLA: 99.95%  (No SQL SLA) | DB availability SLA: 99.99% |

# SQL on IaaS

## Possible HA setups with IaaS

- Which SQL HA architecture can I run on SQL IaaS?
  - Always On Availability Groups
    - Without shared storage
    - Using Azure cloud witness
    - Extend (stretch) On-Premise configuration to Azure for backup and disaster recovery purpose
      - Using new SQL server software assurance benefits
    - Works with SQL Server Standard- and Enterprise Edition
  - SQL Failover Cluster (FCI)
    - With shared storage (new feature since 07/2020)
      - Using Azure shared disks
    - Works with SQL Server Standard- and Enterprise Edition

# Azure Hybrid Use Benefit

## Get the most out of your SQL server licenses

The Azure Hybrid Benefit for SQL Server provides

- The ability to move your licenses to a fully managed PaaS product. Azure is the only cloud that provides this ability. Amazon Web Services Relational Database Service (RDS) is not eligible for bring-your-own-license (BYOL) and must be offered as "license-included."

- Four cores in the cloud for every one core on-premises for Enterprise edition customers in the General Purpose or Hyperscale service tiers.

- 180 days of dual-use rights to apply to current deployment (on-premises or on third-party cloud) and in Azure to allow for data migration.

For a hosted solution with maximum savings, combine the Azure Hybrid Benefit for SQL Server with the Azure Hybrid Benefit for Windows Server

https://azure.microsoft.com/en-us/pricing/hybrid-benefit/faq/

# Azure Hybrid Use Benefit

## Get the most out of your SQL server licenses

| LICENSE FOOTPRINT | RIGHTS |
|---|---|
| SQL Server Enterprise edition core with Software Assurance | vCore-based SQL Database options:<br>• Base rate on either General Purpose, business critical, or Hyperscale tier<br>• 1 core on-premises for 4 cores in General Purpose or Hyperscale tier<br>• 1 core on-premises for 1 core in Business Critical<br>SQL Server in Azure Virtual Machines:<br>• 1 core on-premises for 1 core Enterprise edition in Azure Virtual Machines |
| SQL Server Standard edition core with Software Assurance | vCore-based SQL Database options:<br>• Base rate on General Purpose or Hyperscale tier only<br>• 1 core on-premises for 1 core in General Purpose or Hyperscale tier<br>SQL Server in Azure Virtual Machines:<br>• 1 core on-premises for 1 core Standard edition in Azure Virtual Machines |

# SQL Server SA benefits

## Get the most out of your SQL server licenses

Starting Nov 1st 2019, every Software Assurance customer of SQL Server will be able to use **three enhanced benefits** for any SQL Server release that is still supported by Microsoft:

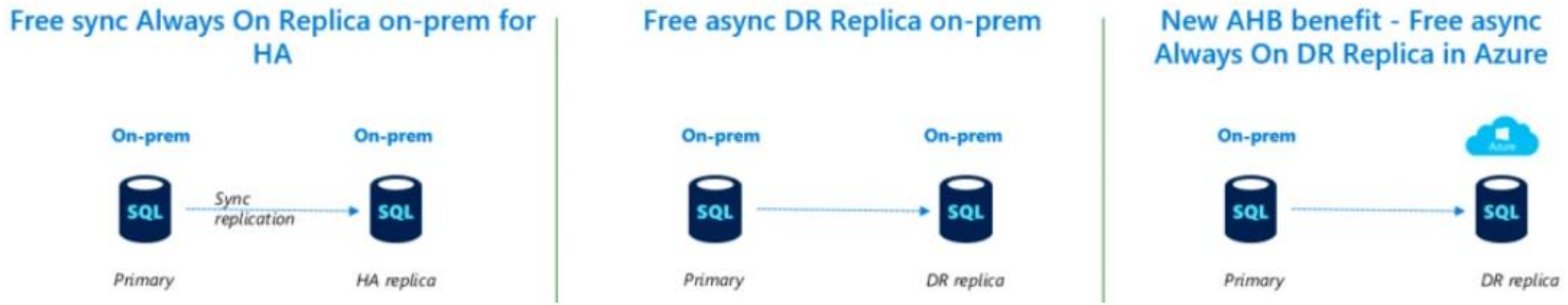
- **Failover servers for high availability** – Allows customers to install and run passive SQL Server instances in a separate operating system environment (OSE) or server for high availability on-premises in anticipation of a failover event. Today, Software Assurance customers have one free passive instance for either high availability or DR

- **Failover servers for disaster recovery** NEW – Allows customers to install and run passive SQL Server instances in a separate OSE or server on-premises for disaster recovery in anticipation of a failover event

- **Failover servers for disaster recovery in Azure** NEW – Allows customers to install and run passive SQL Server instances in a separate OSE or server for disaster recovery in **Azure** in anticipation of a failover event

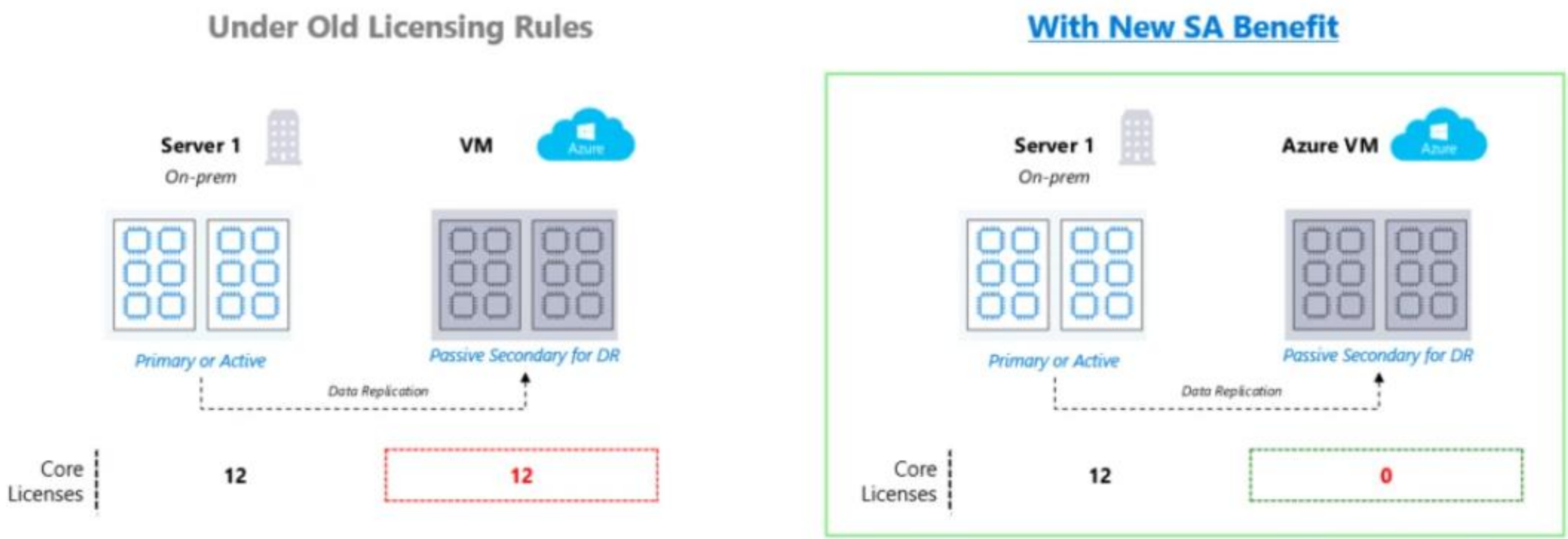
# SQL Server SA benefits

## Get the most out of your SQL server licenses



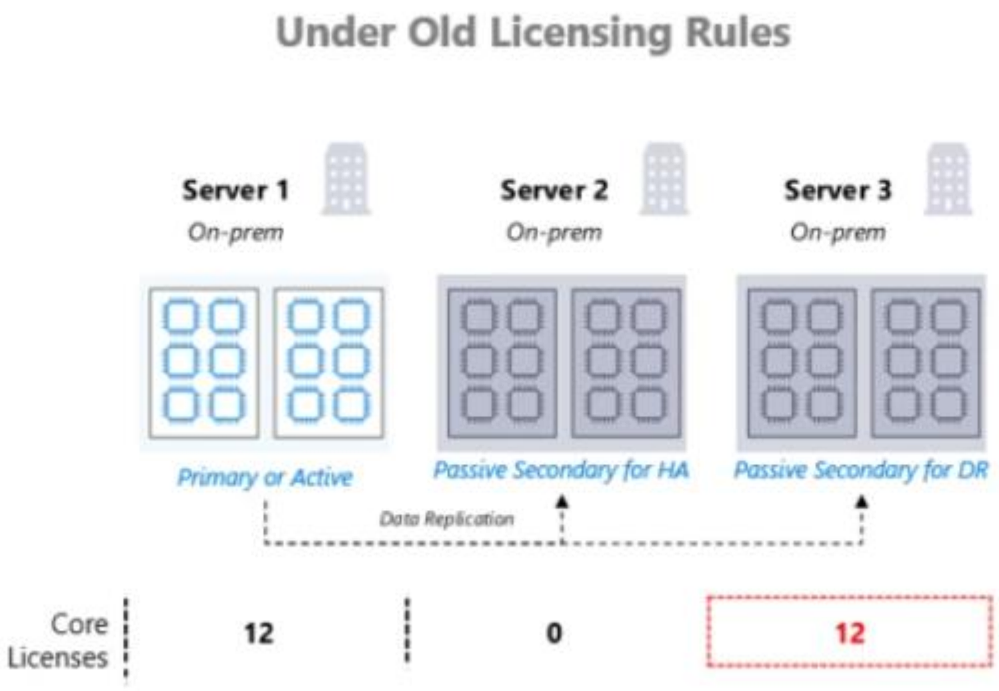
# SQL Server SA benefits

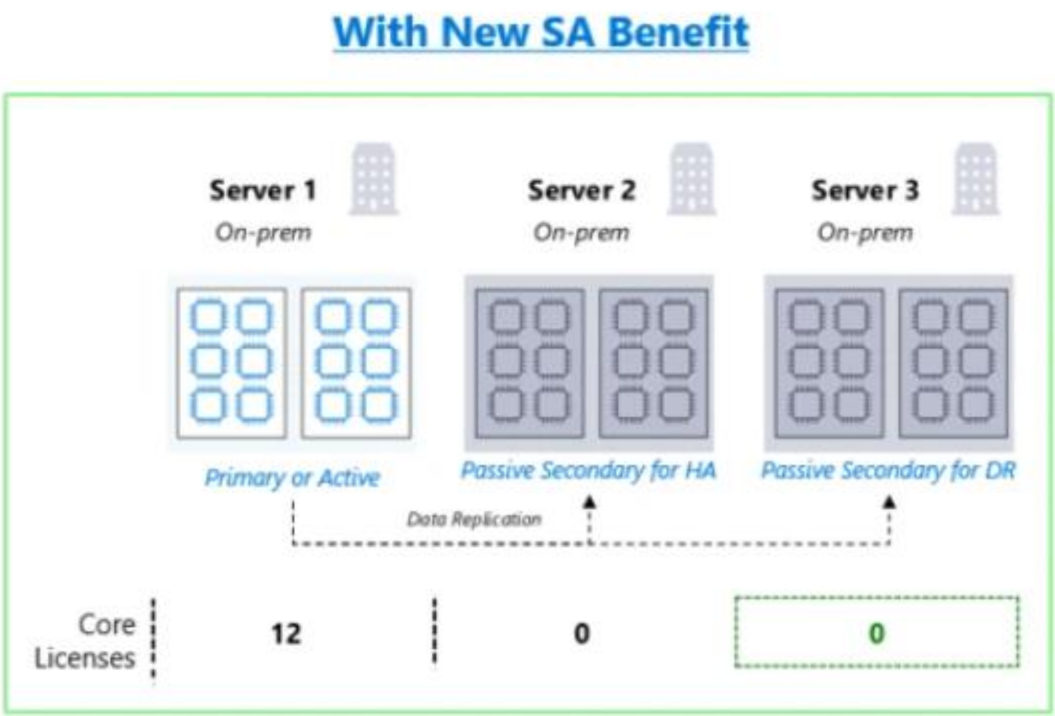
## Get the most out of your SQL server licenses



# SQL Server SA benefits

## Get the most out of your SQL server licenses



# SQL Server SA benefits

## Get the most out of your SQL server licenses

In addition to the high availability and disaster recovery benefits, the following operations are allowed on the passive replicas:

- Database consistency checks
- Log backups
- Full backups
- Monitoring resource usage data

# Data Migration

## How can I migrate my databases to Azure?

- **DMA**
  - The Data Migration Assistant (DMA) 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. DMA recommends performance and reliability improvements for your target environment and allows you to move your schema, data, and uncontained objects from your source server to your target server

- **ADMS**
  - Azure Database Migration Service is a fully managed service designed to enable seamless migrations from multiple database sources to Azure data platforms with minimal downtime (online migrations)

# Data Migration

## Overview of DMA capabilities

- Assess on-premises SQL Server instance(s) migrating to Azure SQL database(s). The assessment workflow helps you to detect the following issues that can affect Azure SQL database migration and provides detailed guidance on how to resolve them.

    - Migration blocking issues: Discovers the compatibility issues that block migrating on-premises SQL Server database(s) to Azure SQL Database(s). DMA provides recommendations to help you address those issues.
    - Partially supported or unsupported features: Detects partially supported or unsupported features that are currently in use on the source SQL Server instance. DMA provides a comprehensive set of recommendations, alternative approaches available in Azure, and mitigating steps so that you can incorporate them into your migration projects.
    - Discover issues that can affect an upgrade to an on-premises SQL Server
    - Discover new features in the target SQL Server platform that the database can benefit from after an upgrade

# Data Migration

## Overview of DMA capabilities

### Supported source and target versions

DMA replaces all previous versions of SQL Server Upgrade Advisor and should be used for upgrades for most SQL Server versions. Supported source and target versions are:

### 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

### Targets

- SQL Server 2012
- SQL Server 2014
- SQL Server 2016
- SQL Server 2017 on Windows and Linux
- SQL Server 2019
- Azure SQL Database single database
- Azure SQL Managed Instance
- SQL server running on an Azure Virtual Machine

# Data Migration

## Overview of ADMS capabilities

- Azure Database Migration Service is designed to support different migration scenarios (source/target pairs) for both offline (one-time) and online (continuous sync) migrations. The scenario coverage provided by Azure Database Migration Service is being extended over time. New scenarios are being added on a regular basis

- With Azure Database Migration Service, you can do an offline or an online migration.
  With *offline* migrations, application downtime begins at the same time that the migration starts. To limit downtime to the time required to cut over to the new environment when the migration completes, use an *online* migration. It's recommended to test an offline migration to determine whether the downtime is acceptable; if not, do an online migration

# Data Migration

## Overview of ADMS capabilities

### Offline (one-time) migration support

The following table shows Azure Database Migration Service support for offline migrations.

| Target | Source | Support | Status |
|---|---|---|---|
| **Azure SQL DB** | SQL Server | ✓ | GA |
| | RDS SQL | X | |
| | Oracle | X | |
| **Azure SQL DB MI** | SQL Server | ✓ | GA |
| | RDS SQL | X | |
| | Oracle | X | |
| **Azure SQL VM** | SQL Server | ✓ | GA |
| | Oracle | X | |
| **Azure Cosmos DB** | MongoDB | ✓ | GA |
| **Azure DB for MySQL** | MySQL | X | |
| | RDS MySQL | X | |
| **Azure DB for PostgreSQL - Single server** | PostgreSQL | X | |
| | RDS PostgreSQL | X | |
| **Azure DB for PostgreSQL - Hyperscale (Citus)** | PostgreSQL | X | |
| | RDS PostgreSQL | X | |

# Data Migration

## Overview of ADMS capabilities

### Online (continuous sync) migration support

The following table shows Azure Database Migration Service support for online migrations.

| Target | Source | Support | Status |
|---|---|---|---|
| **Azure SQL DB** | SQL Server | ✓ | GA |
| | RDS SQL | ✓ | GA |
| | Oracle | X | |
| **Azure SQL DB MI** | SQL Server | ✓ | GA |
| | RDS SQL | ✓ | GA |
| | Oracle | X | |
| **Azure SQL VM** | SQL Server | X | |
| | Oracle | X | |
| **Azure Cosmos DB** | MongoDB | ✓ | GA |
| **Azure DB for MySQL** | MySQL | ✓ | GA |
| | RDS MySQL | ✓ | GA |
| **Azure DB for PostgreSQL - Single server** | PostgreSQL | ✓ | GA |
| | Azure DB for PostgreSQL - Single server* | ✓ | GA |
| | RDS PostgreSQL | ✓ | GA |
| | Oracle | ✓ | Public preview |
| **Azure DB for PostgreSQL - Hyperscale (Citus)** | PostgreSQL | ✓ | GA |
| | RDS PostgreSQL | ✓ | GA |

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