SQLskills Immersion Event

IEAzure: Azure VMs and Azure SQL Database

Module 6: Understanding and Using Azure SQL Database Managed Instance

Tim Radney

Tim@SQLskills.com

Overview

- What sets Azure SQL Managed Instance apart?
- Azure SQL Managed Instance Features
- Azure SQL Managed Instance Technical Specs
- Azure SQL Managed Instance Pricing
- Azure SQL Managed Instance High Availability
- Azure SQL Managed Instance Provisioning
- Azure SQL Managed Instance Use Cases
- Migration Options

Overview

- What sets it apart?
- Features
- Technical Specs
- Pricing
- High Availability
- Provisioning
- Use Cases
- Migration Options

What is SQL Database Managed Instance

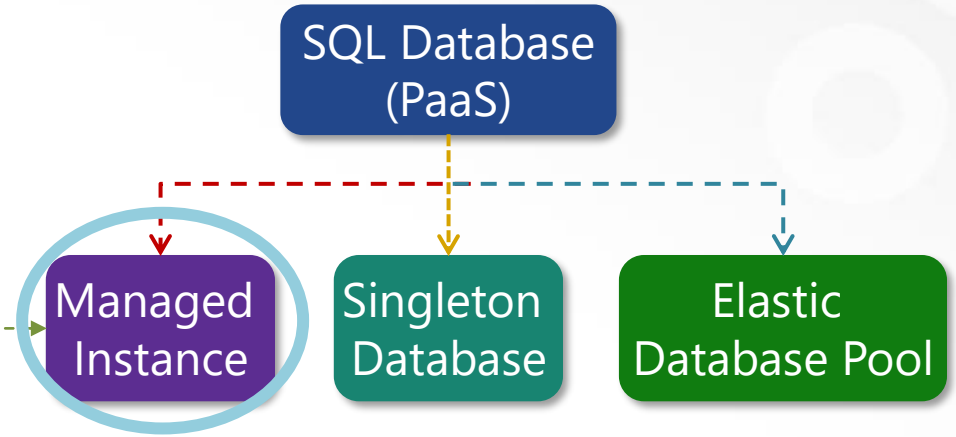
- **Introduced at Build in Spring 2017, released in Public Preview on March 6th, 2018 - GA for General Purpose Oct 2018, GA for Business Critical Dec 2018**
- **Bridges the Azure gap between Azure SQL Database and SQL Server on an Azure VM**
- **Supports backward compatibility to SQL Server 2008 databases**
  - Direct migration from SQL Server 2005 databases are supported, compatibility levels will be updated to SQL Server 2008 (100)

What is SQL Database Managed Instance

- **Managed Instance is built upon an instance-scoped programming model**
  - This makes Managed Instances more compatible with on-premises SQL Server
- **Single and elastic databases are built on a database-scoped programming model**

What is SQL Database Managed Instance?

Deployment option that enables frictionless migration for SQL Server application and modernization in a fully-managed service



Easy Lift and Shift

- Fully-fledged SQL instance with nearly 100% compatibility with on-prem

Full Managed PaaS

- Built on the same PaaS service infrastructure
- All PaaS features

Full Isolation and Security

- Native VNET implementation
- Private IP Addresses

New Business Model

- Competitive
- Transparent
- Frictionless

What Sets Managed Instance Apart?

- **Provides an entire SQL Server instance experience**
  - All the databases within the instance are on the same server
  - Full support for cross-database queries
    - This is important for many applications
- **SQL Server Agent built in**
  - No Agent support was a huge drawback for many customers in Azure SQL DB, had to use Azure Automation, Elastic Jobs, PowerShell, on-premises

What Sets Managed Instance Apart?

- **Service Broker**
  - Message-based communication platform
  - Not available in Azure SQL Database
- **Transactional Replication**
  - Can be a publisher or subscriber
- **Change Data Capture**
- **SQL Server Auditing**
- **Common Language Runtime (CLR)**
- **Database Mail**

What Sets Managed Instance Apart?

- **Use familiar SQL features in SQL Database Managed Instance**
  - Native backup and restore
  - Cross-database queries and transactions
  - Global ##temp tables are supported
  - Broad security features including TDE, SQL Audit, Always Encrypted and Dynamic Data Masking
  - SQL Agent, Database Mail, and Alerts for workload orchestration improved awareness
  - Enablers including Change Data Capture, Service Broker, Transactional Replication, and CLR
  - DMVs, XEvents, and Query Store for troubleshooting
  - Encryption-in-flight - (aka Transport Layer Security TLS)

Additional Features

- **Managed Instance Auditing**
  - Tracks database events and writes them to an audit log in your Azure storage account
  - Helps maintain regulatory compliance, gain insight into discrepancies, and understand database activity
- **Data encryption in motion**
  - Uses Transport Layer Security to encrypt data in motion

Additional Features

- **Always Encrypted**
  - Encrypts data within the database
  - Only those with the encryption keys can decrypt the data
  - Provides unparalleled data security against breaches
- **Dynamic Data Masking**
  - Limits sensitive data exposure by masking it to non-privileged users
  - You select how much of the sensitive data to reveal
  - Policy-based security feature that hides sensitive data in a result set – think of it as more of a privacy feature

Additional Features

- **Row-level security**
  - You control access to rows in a database table based upon the user executing the query
  - Drastically simplifies the design and coding of security within applications
- **Azure Active Directory integration**
  - Allows you to centrally manage identities of database users and other Microsoft services
  - Azure Active Directory supports multi-factor authentication
- **COPY_ONLY URL-based backups**
  - Considerations for TDE, must be disabled or BYOK

Technical Specs

- General Purpose service tier, business applications with typical performance and HA requirements
- Azure Premium remote storage up to 8TB
- Up to 100 databases per instance
- vCores: Gen 5: 4, 8, 16, 24, 32, 40, 64, 80
  - Processor Intel E5-2673 v4 (Broadwell) 2.3 GHz
- Minimum storage 32GB
- IOPS 500-7,500 per data file, IOPS grow with storage size
- Non-readable secondary replica for HA

Technical Specs

- **Business Critical service tier, business applications with high performance and HA requirements**
- **Azure Premium local storage up to 4TB**
  - 1TB for 4, 8, 16 vCores, 2TB for 24 vCores, 4TB for 32, 40, 64, 80 vCores
- **Up to 100 databases per instance**
- **vCores: Gen 5: 4, 8, 16, 24, 32, 40, 64, 80**
  - Processor Intel E5-2673 v4 (Broadwell) 2.3 GHz
- **Minimum storage 32GB**
- **Super fast storage**
- **In-Memory OLTP**
- **Three secondary replicas for HA: read scale out replica plus two secondary replicas**

Pricing: Azure Hybrid Benefit

- **Convert on-premises license with SA to MI licenses**
  - 1 Standard Edition license = 1 General Purpose vCore
  - 1 Enterprise license = 4 Managed Instance General Purpose 4 vCore
  - https://azure.microsoft.com/en-us/pricing/hybrid-benefit/
  - Azure Hybrid Benefit for SQL Server provides SQL Server Enterprise Edition customers with Software Assurance four cores in the cloud for every one core they own on-premises when selecting the Managed Instance General Purpose option.
- **Pricing Options**
  - https://azure.microsoft.com/en-us/pricing/details/sql-database/managed/

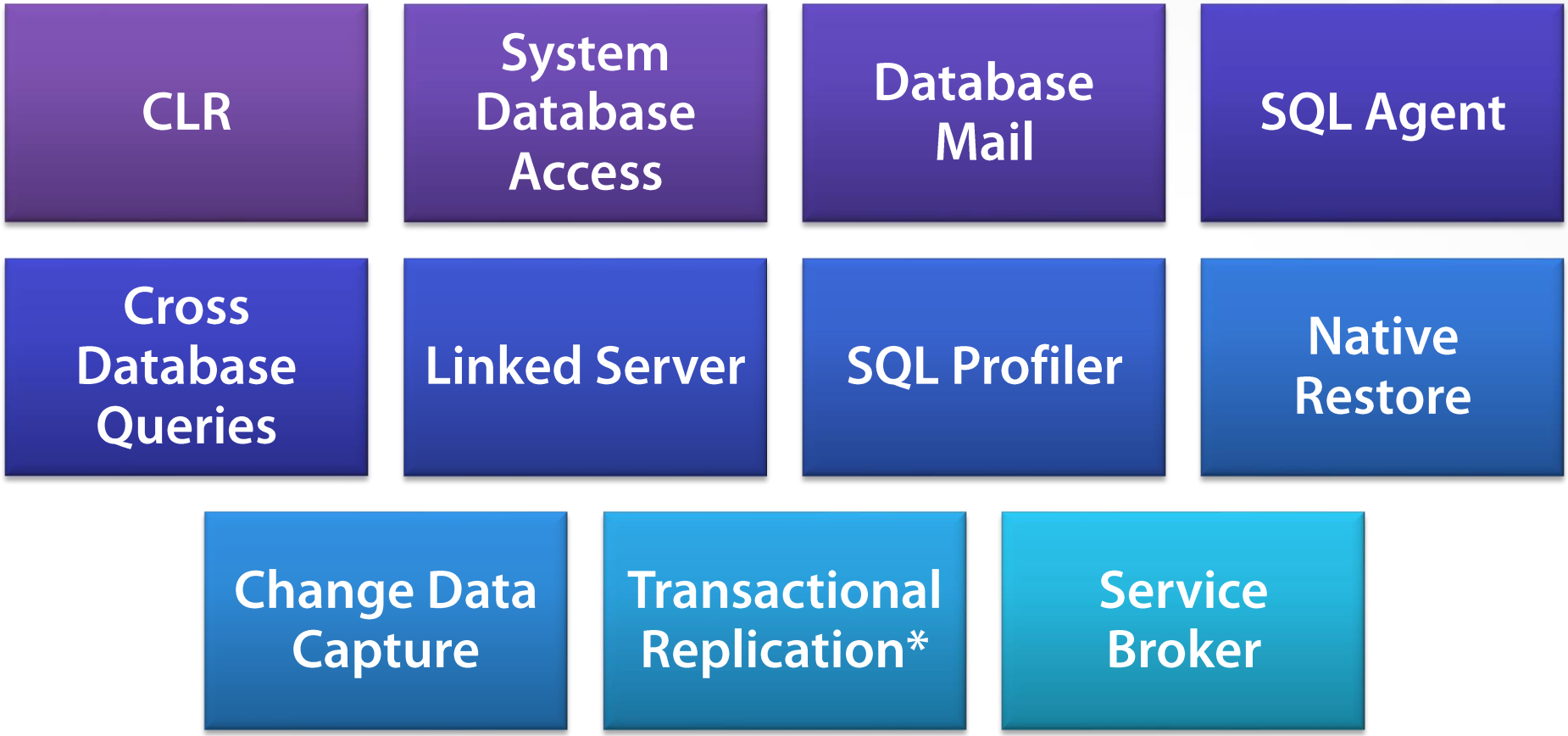
Compared to SQL Server on a VM

- Advanced Threat Protection
- Ease to scale (compute and storage)
- Elastic Query support
- Full integration with Azure Monitor and Azure Advisor
- OS and SQL Server up-to-date (Evergreen)
- Encryption-in-flight (aka Transport Layer Security TLS)
- Change data capture
- Common language runtime (CLR) - see CLR differences
- Cross-database transactions - see Linked server differences
- Database mail
- Distributed partition views

Compared to SQL Server on a VM

- Modifying system data
- OPENDATASOURCE / OPENQUERY / OPENROWSET - see T-SQL differences
- Resource governor
- RESTORE statements - see Restore differences
- Server configuration settings - see T-SQL differences
- Service Broker - see Service Broker differences
- Event notifications
- SQL Server Agent - see SQL Server Agent differences
- Cross-database queries - Yes, plus Elastic queries
- SQL Server Profiler
- SQL Server Auditing - see Auditing differences

Compared to SQL Server on a VM



What's Not Available

- OS Level Access
- Restarting SQL Server / Agent
- Provides Engine Only
  - No MDS/DQS
  - SSIS -> ADFv2
  - SSRS -> VM or PowerBI
- Linked Servers (Only to SQL Server)
- DTC Across Instances
- Database Snapshots
- Database Maintenance Plans
- File Stream
- File Tables
- Extended Procs
- PolyBase
- Stretch Database
- Log Shipping
- Always On FCI or AGs
- Policy Based Management/MDW

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

User Database File Layout

- Data file default size is 16MB with 16MB auto growth
- File size limit is 8TB in General Purpose
- Log file default size is 8MB with 16MB auto growth
- Additional data files/filegroups can be added
- Only using an ALTER DATABASE statement
  - The FILENAME clause is not permitted
- Paths and File Names are chosen for you
- Multiple log files are not supported (and should not be needed)
- A backup with multiple files/filegroups can be restored
- Each user database has a FILESTREAM filegroup for In-Memory OLTP checkpoint files

Tempdb Data Files

- **Multiple tempdb data files are created automatically**
- **Default data file and log file sizes are 16MB**
- **Default auto-growth for data files is set to 256MB**
- **Default auto-growth for the log file is set to 64MB**
  - These settings can be adjusted for your workload if needed
- **Additional tempdb data files can be created if needed**
- **Files can only be created using an ALTER DATABASE statement**
  - The FILENAME clause is not permitted
- **Well-known tempdb tuning 'fixes' are on by default**
  - Trace flag 1117 and 1118
- **Tempdb Best Practice**
  - Restrict tempdb from growing too large by specifying a maximum file size

Managed Instance: HA

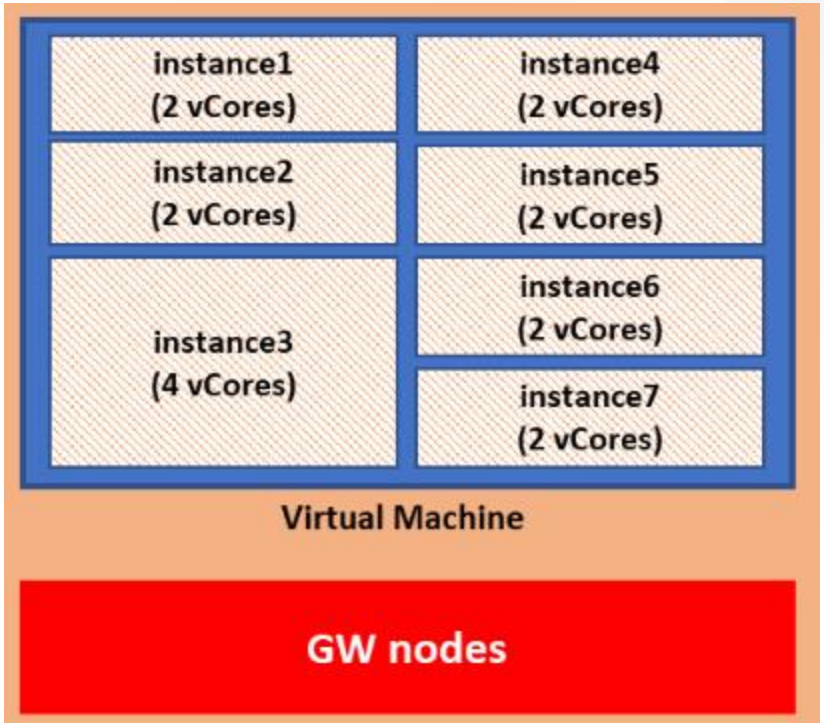
- **Standard/General Purpose availability**
  - 99.99% SLA
  - Architecture model has separation of compute and storage layers
  - Two availability models
    - Stateless compute layer that runs sqlserver.exe and contains only transient and cached data (plan cache, buffer pool, column store pool), operated by Azure Service Fabric that controls health of node and performs failover
    - Stateful data layer with database files (.mdf/.ldf) stored in Premium Storage. Guarantees no data loss of committed data. Azure Storage has built-in data availability/redundancy that ensures every record in log file or page in data file is preserved if SQL Server process crashes
  - If a critical issue is detected in Sql Server process, Azure Service Fabric will move the stateless SQL Server process to another stateless compute node. New nodes start with a cold cache

Managed Instance: HA

- **Premium/Business Critical availability**
  - 99.99% SLA
  - Architecture model integrates compute and storage on the single node. Both the SQL Server Database Engine process and underlying mdf/ldf files are together with local SSD storage
  - HA is implemented using Always On Availability Groups
    - Every database is a cluster of database nodes with a primary database for read/write workloads and three secondary nodes containing copies of data
    - Read scale-out can be enabled to offload reporting to a secondary replica
      - You must explicitly activate when creating the database or afterwards
      - Connections will be routed according to the ApplicationIntent configured in the application's connection string
      - If Read Scale-Out is disabled or set in an unsupported service tier, all connections are directed to the read-write replica

Managed Instance Pools

- New preview resource
- Allows for smaller instances
- Pre-provision compute resources based on migration needs
- Example – 8 vCores can be deployed as two 2 vCore and one 4 vCore instances
- Ability to host 2 vCore instances
- Predictable and fast instance deployments (up to 5 minutes)
- Minimal IP address allocation
- https://docs.microsoft.com/en-us/azure/sql-database/sql-database-instance-pools



Managed Instance Pools

- **Instance pools support 8, 16, 24, 32, 40, 64, and 80 vCores**
- **Managed instances inside pools support 2, 4, 8, 16, 24, 32, 40, 64, and 80 vCores**
- **Supported storage sizes between 32 GB and 8TB, except**
  - 2 vCore 32GB and 640 GB
  - 4 vCore 32GB and 2TB

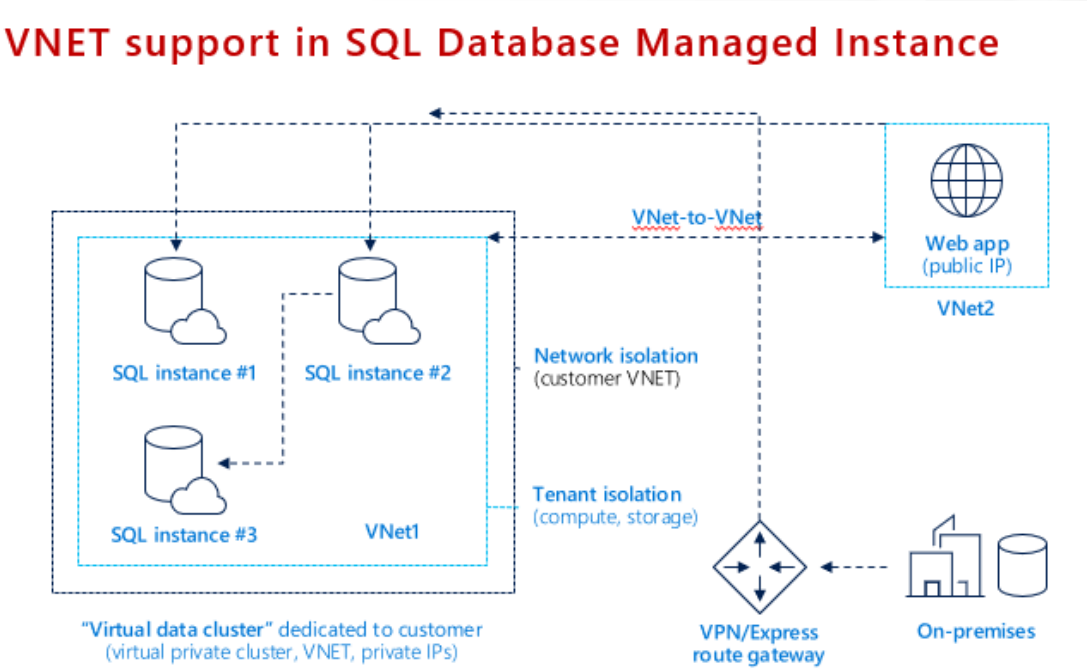
- **Preview terms**
  - General Purpose only
  - No scaling of sizes
  - PowerShell only for deployment
  - Instances created outside the pool cannot be migrated
  - Reserved instance pricing is not available

Managed Instance Provisioning

- **Create a virtual network**
- **Create a route table**
  - Add a route – must be specific
    - Address = 0.0.0.0/0
    - Next hop type = Internet
- **Create a dedicated subnet or use default subnet for Managed Instance**
  - Should consider creating a subnet for a jump box to use in this environment
- **Update Managed Instance subnet to use route table**
- **Create your Managed Instance**
- **Create your jump box to use for connecting and testing**
- **https://www.youtube.com/watch?v=gw4cvKT83Xs**

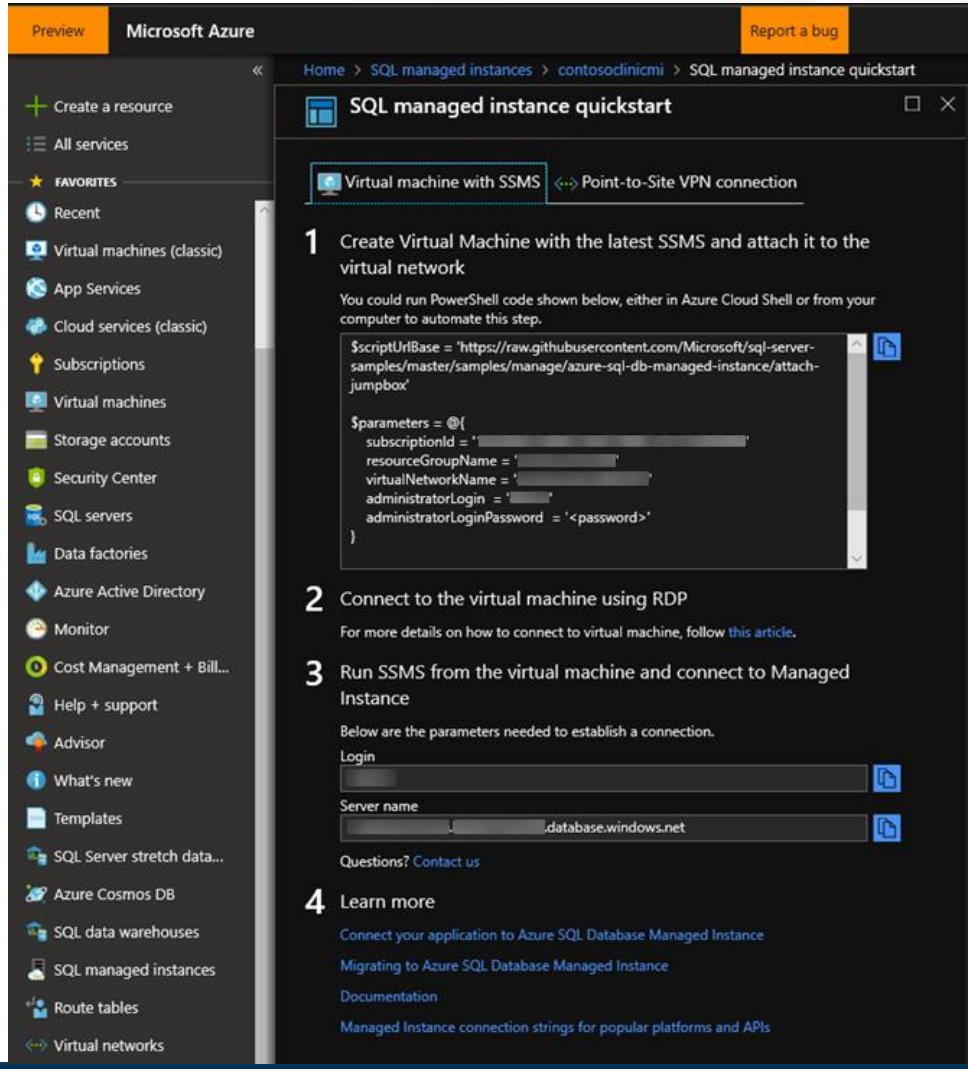
Dedicated Resources Through Customer Isolation

- Enable full isolation from other tenants without resource sharing
- Promote secure communication over private IP addresses with native VNET integration
- Enable your on-premise identities on cloud instances, through integration with Azure Active Directory and AD Connect



Managed Instance Provisioning

- Leverage VPN hardware or software-based VPN that would be installed on a client machine
- Create a 'jump box' virtual machine to be used as a management machine
- Must leverage the same resource group name and virtual network name
- Connect using SSMS or Azure Data Studio connecting with the server, login, and password
- Password can be reset in the Azure Portal



Identifying a Managed Instance

Property	Value	Comment
`@@VERSION`	Microsoft SQL Azure (RTM) - 12.0.2000.8 2018-03-07 Copyright (C) 2018 Microsoft Corporation.	Same as Azure SQL Database
`SERVERPROPERTY ('Edition')`	SQL Azure	Same as Azure SQL Database
`SERVERPROPERTY ('EngineEdition')`	8	Uniquely identifies Managed Instance
`@@SERVERNAME, SERVERPROPERTY ('ServerName')`	Full instance DNS name in the following format:..database.windows.net, where is name provided by the customer, while is auto-generated part of the name guaranteeing global DNS name uniqueness (“wcus17662feb9ce98”, for example)	Example: my-managed-instance. wcus17662feb9ce98.database. windows.net

Demo

Azure Portal – Step through provisioning a Managed Instance

Monitoring

- **Majority of SQL Server DMVs are available**
  - System information and feature usage information
  - Instance and database level configuration and performance
    - Data and log space usage, tempdb
    - Wait statistics, sys.dm_exec_requests, sys.dm_exec_query_stats, virtual file stats, missing indexes, and more
  - Troubleshooting information
    - Ring Buffer information, extended events, sys.dm_os_performance_counters
- **Azure SQL Database Managed Instance specific DMVs**
  - sys.dm_feature_switches
  - sys.dm_cloud_database_resource_stats
  - sys.dm_cloud_database_wait_stats
  - sys.dm_internal_resource_governor
  - sys.dm_db_missing_index_group_stats_query
  - sys.resource_stats_raw
  - sys.resource_usage
  - sys.dm_os_job_object
  - sys.dm_db_resource_stats
  - sys.dm_hadr_fabric

SQL Database Deployment Model Overview

	Azure SQL Database		
	'Single'	Elastic Pools	Managed Instance
Best for	New apps, with a 'one database per app pattern' and resources guaranteed at DB level	New SaaS apps or modernizing existing apps to SaaS, resource sharing across DBs of existing LOB apps for higher efficiency	Modernizing large number of existing SQL Server apps from on-premises or IaaS
Tiering	▪ Basic: designed for apps with light workloads ▪ Standard: mid-level performance and business continuity ▪ Premium: low IO latency workloads and higher business continuity		▪ General Purpose ▪ "Business Critical"
Unit of Monetization	DTU – "Database Throughput Unit" – measure of database performance that blends CPU, memory and I/O.	eDTU – elastic "Database Throughput Unit" – measure of database performance that blends CPU, memory and I/O.	▪ vCore for compute ▪ GBs for storage ▪ IOPs for IO
Pricing vs. Competitors	▪ Basic – very cheap because it priced to accommodate web customers ▪ Standard – comparable pricing but not easily explainable to customer ▪ Premium – expensive due to additional replicas and IOs		▪ Priced lower compared to AWS

Managed Instance: Use Cases

- **When you need more than singleton or elastic pools can provide, but still want a managed environment, features such as:**
  - Cross database query
  - SQL Server Agent
  - Database Mail
  - Service Broker, and more
- **Managed Instance GA pricing should be somewhat comparable with IaaS. For example, a D16 (16 vCPU, 64GB RAM) with three P40 disk is approx. $3,348 while a Gen 5 (16 vCore, 88GB RAM) instance with 6TB of storage would be approx. $2,981 for compute and storage.**
  - However, Managed Instance means you don't have to worry about patching the OS or SQL Server, and you have built in HA with a non-readable secondary. You have to build that out yourself in IaaS and pay for the compute.

Migration Options

- **Native SQL Server backup and restore**
  - Requires using Azure Blob Storage with backup to URL
- **Azure Database Migration Service (DMS)**
  - Uses a simple, self guided migration process
  - Provides a comprehensive assessment for pre-migration steps
  - You can migrate at scale from multiple sources to your target database
  - Must have VPN or Express Route
- **Pre-stage databases to an Azure VM**
  - Mirroring
  - Log-shipping
  - Extend and AG
  - Replication
  - Manually with backup and restore

Restore Considerations

- Point-in-time restores must be performed using the Azure Portal
- Restoring automated backups from within SSMS is not allowed
- You can only restore using the Azure Portal
- COPY_ONLY, URL-based full backups can be restored to a Managed Instance only
- Cannot be restored on-prem as Managed Instance uses a higher build
- Databases with multiple log files cannot be restored
- Secondary log files must be removed prior to backing up and restoring to a Managed Instance
- Can restore backups in a specific DB Compatibility
- Supports back to SQL Server 2005

Demo

Migrate on-premises to Azure MI using Backup to URL, navigate around SSMS looking at Managed Instance differences

Migration Options – Common QA

- **How many of my applications can I migrate today?**
  - Most of them, because Managed Instance is compatible
    - Cross-database queries and transactions, linked servers to SQL Server, .NET CLR modules, Service Broker, Change Data Capture, and transactional replication
    - Choice of instance collations and instance time zone, R services are all in the pipeline
- **Will my IT face a steep learning curve or feel a loss of control?**
  - No because Managed Instance lets you modernize at your own pace
    - DMVs, Xevents, Query Store, SQL Agent and database mail, sysadmin privileged and Resource Governor
    - Built-in HA replaces on-premises setups, replace MDW with Azure Monitor and Log Analytics
    - SQL Auditing, Row Level Security, TDE, Always Encrypted, and Dynamic Data Masking
    - Network security with VNETs and private IPs, integrated auth with Azure AD

Migration Options – Common QA

- **Can I manually backup my MI databases?**
  - Yes, using copy_only
- **Can I restore MI databases back to on-premises?**
  - No, manual backups cannot be restored back to on-premises SQL Server, MI is vNext.
  - You can export data tier application and import data tier application to on-premises
  - You can use transactional replication with Managed Instance being the publisher and on-premises the subscriber

Database Compatibility Based Certification

- **Microsoft Database compatibility level protection**
  - Full functional protection once assessment tool runs clean
  - Maintaining backward compatibility is very important to the SQL Server team
  - Query Plan shape protection
- **Migrate databases and keep/set source Database Compatibility Level on the target**

Key Takeaways

- Azure SQL Database Managed Instance help bridge the gap between Azure SQL Database and on-premises SQL Server
- Managed Instance are currently in public preview
- The goal is to provide 100% surface area compatibility of on-premises SQL Server
- Manage Instances have all the benefits of Azure Platform as a Service

Review

- **What we covered**
  - What sets Azure SQL Managed Instance apart?
  - Azure SQL Managed Instance Features
  - Azure SQL Managed Instance Technical Specs
  - Azure SQL Managed Instance Pricing
  - Azure SQL Managed Instance High Availability
  - Azure SQL Managed Instance Provisioning
  - Azure SQL Managed Instance Use Cases
  - Migration Options

References

- Announcement Blog
- Azure SQL Database
- SQL Database Managed Instance
- Azure Hybrid Benefit for SQL Server
- Azure Database Migration Service
- Migration Guide
- SQL Server Integration Services

Questions!