

Building a Modern Database Architecture with Azure

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SQL
intersection

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Today's Agenda

- **Azure Fundamentals**
 - What is Azure?
 - Networking
 - Storage
 - Security
- **SQL Server VMs (IaaS)**
- **SQL Database (PaaS)**
- **Managed Instances**
 - A look at the new feature coming soon!

Github

- <http://github.com/grrlgeek/azure-sql-server>

What is Azure?

- **"Microsoft Azure is a growing collection of integrated cloud services that developers and IT professionals use to build, deploy, and manage applications through our global network of datacenters. With Azure, you get the freedom to build and deploy wherever you want, using the tools, applications, and frameworks of your choice."**
- **90% of Fortune 500 companies trust Azure**
- **40 regions worldwide**
- **50 compliance offerings**

Regions



Compliance

- **More certifications than any other cloud provider**
 - HIPAA/HITECH
 - HITRUST
 - PCI DSS
 - ISO 9000
- **You own and control your data**
- **Azure Trust Center - <https://www.microsoft.com/en-us/trustcenter/CloudServices/Azure>**

Categories of services



Compute



Networking



Storage



Web + Mobile



Containers



Data + Analytics



Databases



AI + Cognitive
Services



IoT



Security + Identity



Developer Tools



Monitoring +
Management

Cloud service models

- **IaaS**
 - Renting infrastructure
- **PaaS**
 - Services to create software, without worrying about infrastructure
- **SaaS**
 - Software delivered on an as-needed basis

Pizza as a Service

 You Manage
 Vendor Manages

Made at Home	Take and Bake	Pizza Delivered	Dine Out
Dining Table	Dining Table	Dining Table	Dining Table
Soda	Soda	Soda	Soda
Electric/Gas	Electric/Gas	Electric/Gas	Electric/Gas
Oven	Oven	Oven	Oven
Fire	Fire	Fire	Fire
Pizza Dough	Pizza Dough	Pizza Dough	Pizza Dough
Tomato Sauce	Tomato Sauce	Tomato Sauce	Tomato Sauce
Toppings	Toppings	Toppings	Toppings
Cheese	Cheese	Cheese	Cheese
Traditional On-Premises (On-Prem)	Infrastructure as a Service (IaaS)	Platform as a Service (PaaS)	Software as a Service (SaaS)

SQL Server as a Service

Traditional On-Premises (On-Prem)	Infrastructure as a Service (IaaS)	Platform as a Service (PaaS)	Software as a Service (SaaS)
SQL Server Engine Analysis Services Integration Services Reporting Services Physical servers or virtual servers	SQL Server Engine Analysis Services Integration Services Reporting Services Virtual servers	SQL Database SQL Data Warehouse MySQL PostgreSQL CosmosDB	Power BI Office 365 Dynamics 365

Management Tools

Portal

- Go to <http://portal.azure.com> to sign in
- GUI access to most Azure services
 - Azure portal availability chart - <https://azure.microsoft.com/en-us/features/azure-portal/availability/>
- Allows for role-based access control
- Mobile app for iOS and Android now available - <https://azure.microsoft.com/en-us/features/azure-portal/mobile-app/>

PowerShell

- **The preferred method for automation**
- **3-step process**
 - Install PowerShellGet – package manager
 - Install Azure PowerShell
 - Load the AzureRM module
- **Instructions:** <https://docs.microsoft.com/en-us/powershell/azure/install-azurerm-ps?view=azurerm-ps-4.0.0>
- **Documentation:** <https://docs.microsoft.com/en-us/powershell/azure/get-started-azureps?view=azurerm-ps-4.0.0>

Networking

Cross-premises connectivity

- **Point-to-site VPN**
 - Configured on each client computer
 - Doesn't require a compatible VPN device
 - Doesn't require an internet-facing IPv4 IP address
 - <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-howto-point-to-site-resource-manager-portal>
- **Site-to-site VPN**
 - Configure compatible VPN device with Azure VPN Gateway
 - VPN device must have an Internet-facing IPv4 IP address
 - <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-howto-site-to-site-resource-manager-portal>
- **Express Route**
 - Dedicated private connection facilitated by a connectivity provider
 - Connections don't go over public internet
 - Choice of bandwidth
 - "More reliability, faster speeds, lower latencies and higher security"
 - <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-introduction>
- **Azure Network Infrastructure:** <https://channel9.msdn.com/Blogs/Azure-and-the-Modern-Data-Center/Azure-Network-Infrastructure>

Virtual Networks

- A representation of your network inside Azure
- VNets can be connected to each other, and your on-premises network
- VNets can be divided into subnets
- VNet peering enables you to connect two VNets in the same region through the Azure backbone

Isolating resources within Azure

■ Subscriptions

- Divide up access to resources
- Assign users to subscriptions
- Enable role-based access within the subscription

■ Virtual Networks & Subnets

- Determine which resources can communicate with each other and other networks

■ Resource Groups

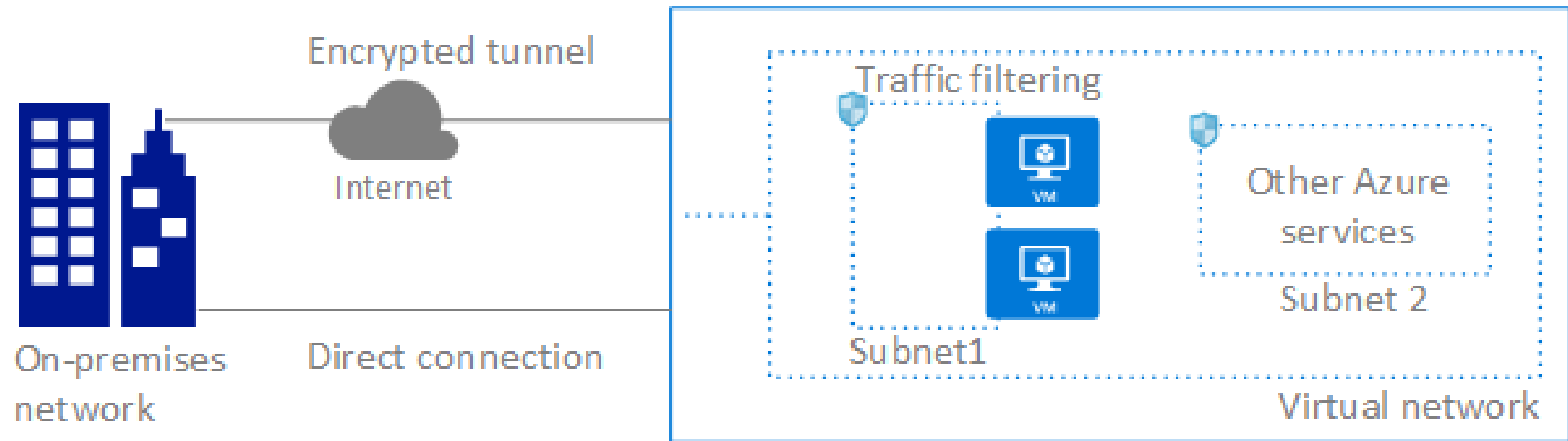
- Put resources into meaningful groups for management, billing, or affinity
- Resources belong to one group

■ Tags

- Metadata about any resource
- Up to 15 key:value pairs
- Common: Department, Resource Owner, Environment Type

- **Azure enterprise scaffold - prescriptive subscription governance** - <https://docs.microsoft.com/en-us/azure/azure-resource-manager/resource-manager-subscription-governance>





Microsoft
Azure

Storage

Storage

- Blob
- Table
- Queue
- File
- Disk
- Introduction - <https://docs.microsoft.com/en-us/azure/storage/common/storage-introduction>

Blob

- **Unstructured object storage**
- **Account > Container > Blob**
 - Block - optimized for streaming and storing cloud objects
 - Append - optimized for append operations
 - Page - optimized for representing IaaS disk and random writes

Table

- **Structured dataset storage**
- **NoSQL key:value storage**
- **Account > Table > Entity**

Queue

- Holds messages
- Account > Queue > Messages

File

- **SMB protocol**

Disk

- **For IaaS (VMs)**
- **HDD or SSD**
- **Unmanaged or Managed**

Storage replication for data safety

- **Set at the storage account level**
- **LRS - Locally redundant storage**
 - 3 copies within a single data center in a single region
- **ZRS - Zone redundant storage**
 - 3 copies in 2-3 data centers, in 1 or 2 regions
- **GRS - Geo-redundant storage**
 - Recommended level
 - 6 copies - 3 copies in primary region, 3 copies in secondary region
- **RA-GRS - Read-access geo-redundant storage**
 - Same as GRS, but the data in the secondary region has read access

Tool: Storage Explorer

- <http://storageexplorer.com/>

Demo

Security

Authentication

- **How do enterprise users connect to Azure and its services?**
- **Azure Active Directory**
 - PaaS offering
- **AD Connect**
 - Integrate on-premises Active Directory with Azure Active Directory
- **Active Directory Federation Services**
 - Users sign in to Azure AD-based services with their on-premises passwords
 - While on the corporate network, they don't have to enter their passwords again

Role based access control

The screenshot displays the Azure portal interface for managing role-based access control (RBAC) permissions. The main window is titled "RG-SQLvms - Access control (IAM)" and shows a list of resource groups on the left, including "RG-SQL2016Dev", "RG-SQLvms", and "SQLserver". The "Access control (IAM)" tab is selected in the left sidebar.

The "Add permissions" dialog is open, showing the following configuration:

- Role:** Security Reader
- Assign access to:** Azure AD user, group, or application
- Select:** newportaldev

The dialog also displays a list of selected members, including "Conf Room Camb 1CC 11/11106 Newport (10) AV", "Luke Newport", "NewPortal8413", and "newportaldev".

Below the list of members, the text reads: "Selected members: No members selected. Search for and add one or more members you want to assign to the role for this resource." and "If you are new to RBAC, learn more on our docs site."



Data options

Data Services in Azure

- **Transactional**

- IaaS VMs
- SQL Database



- **Analytical**

- SQL Data Warehouse
- Cosmos DB
- HD Insight
- Data Lakes
- Machine Learning



SQL Server VMs (IaaS)

Pricing and Licensing

- You're paying for two things

- Compute

- SQL licensing

- Gallery images
- Bring your own licensing

Sample pricing: D1-5 v2 series
SQL Server Enterprise Edition
October 2017

INSTANCE	CORES	RAM	OS	SOFTWARE	TOTAL
D1 v2	1	3.50 GiB	\$0.123/hr	\$1.50/hr	\$1.623/hr
D2 v2	2	7.00 GiB	\$0.246/hr	\$1.50/hr	\$1.746/hr
D3 v2	4	14.00 GiB	\$0.491/hr	\$1.50/hr	\$1.991/hr
D4 v2	8	28.00 GiB	\$0.983/hr	\$3/hr	\$3.983/hr
D5 v2	16	56.00 GiB	\$1.872/hr	\$6/hr	\$7.872/hr

Development & Testing

- **There is no "free" tier for testing**
- **Tips for managing costs**
 - Use low-cost VMs with standard (not premium) storage
 - Use SQL Server Developer Edition (image or BYOL)
 - Use DevTest Labs - <https://azure.microsoft.com/en-us/services/devtest-lab/>
 - Create reusable templates for VMs
 - Integrate with your CI tools
 - Set lab policies for auto start up and shut down times
 - Set caps on number and size of VMs

Setup and Planning

- **Performance best practices for SQL Server in Azure Virtual Machines**
 - VM size – DS2+ for Standard, DS3+ for Enterprise
 - Use Premium Storage, geo-replication disabled
 - Disk recommendations
 - I/O recommendations
 - Back up directly to blob storage
- <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/sql/virtual-machines-windows-sql-performance>

Resource Groups

- **Resource Groups are a way to group related objects and services**
- **Identify what vnet and subnet the VM will be in**
- **Identify what other resources it will be related to**
- **Create and use templates to quickly deploy test environments, or deploy test to QA, QA to production**

Network Security Group

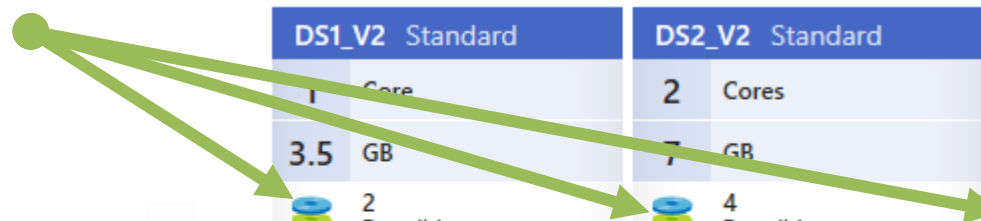
- **What firewall rules will be applied to the VM?**
- **Set your port (default 1433) for incoming**
















VM size

- **There are various series of VMs**
 - A, D, F series
 - Varied CPU types, counts, memory amounts, OS disk type & sizes
- **Minimum recommendations**
 - Standard/Web - DS2
 - Enterprise - DS3
- **Use premium storage**

Disks

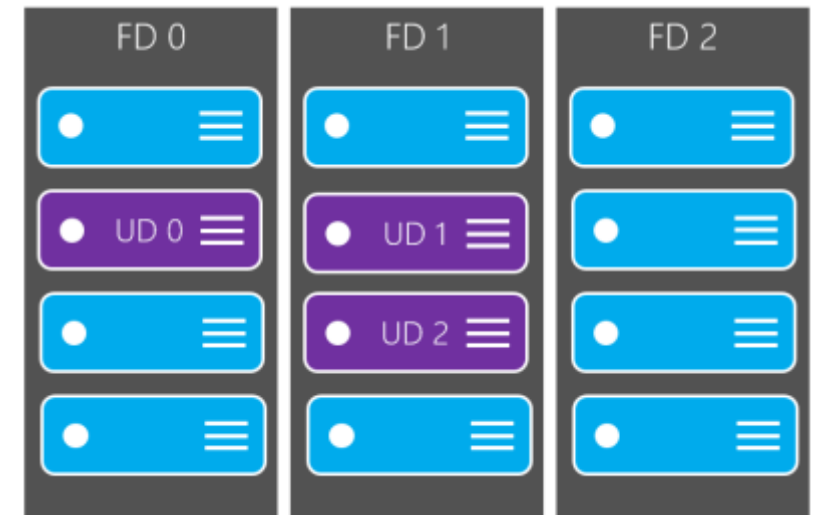
- The VM size determines how many disks you can attach and if they are standard or premium.
- The number of disks attached determines how many IOPs the server can perform.



DS1_V2 Standard	DS2_V2 Standard	DS3_V2 Standard
1 Core	2 Cores	4 Cores
3.5 GB	7 GB	14 GB
 2 Data disks	 4 Data disks	 8 Data disks
 3200 Max IOPS	 6400 Max IOPS	 12800 Max IOPS
 7 GB Local SSD	 14 GB Local SSD	 28 GB Local SSD
 Load balancing	 Load balancing	 Load balancing
 Premium disk support	 Premium disk support	 Premium disk support

Availability sets

- **Group two or more VMs in an availability set to provide redundancy**
 - Fault domains - common power source and physical switch.
 - Update domains - machines in the same update domain are restarted together.
- **Do I need this if I'm configuring a SQL Server HA method?**
 - Yes. If you create two VMs to add to an AG, for example, this guarantees they will be restarted separately for maintenance.



Workflow

Bring Your Own License

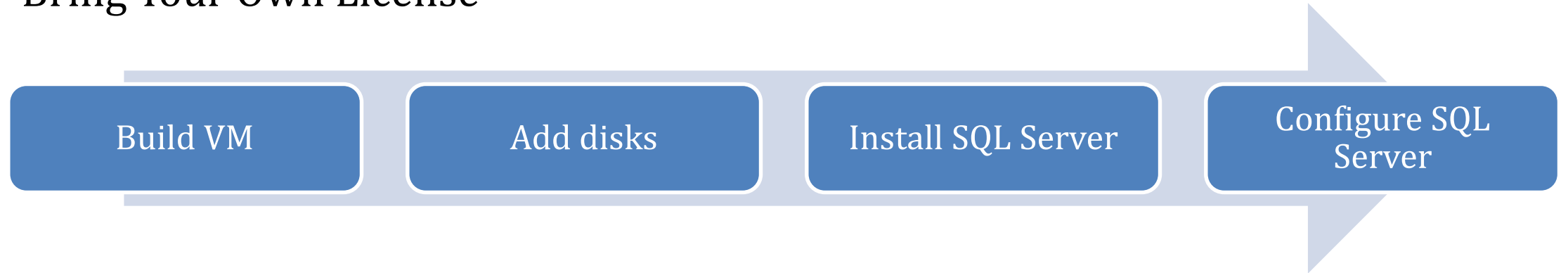


Image Gallery



Demo

Portal
PowerShell

Administration

- **What's different from on-premises SQL Server?**
- **Backup to URL is recommended**
 - Backing up to blob storage instead of a locally-attached disk

Scaling

- You can change your VM size - larger or smaller.
- Increase capacity when load increases; decrease size and costs when under-utilized.
- Is everything online?
 - Yes, if the region and cluster have the available resources.
 - If you attempt to resize a VM and get an allocation error, you need to shut down, resize, and restart.
 - If you have multiple VMs in an Availability Set, you need to shut down, resize, and restart all of them.
- Resize a Windows VM <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/resize-vm>

Demo

Portal
PowerShell

High Availability

- **What's supported in Azure?**

- Availability Groups
 - Create multiple Azure VMs and set up an AG
 - Can be sync or async
 - Requires a domain controller VM (unless you're using domain-independent AGs with Windows Server 2016 & SQL Server 2016)
- Failover Cluster Instances
 - Attached storage using Windows Server 2016 Storage Spaces Direct (S2D) to provide a software-based virtual SAN.
 - Storage supported by a third-party clustering solution - SIOS DataKeeper.
 - A two-node failover cluster running in Azure VMs with remote iSCSI Target shared block storage via ExpressRoute. (For example, NetApp Private Storage (NPS) exposes an iSCSI target via ExpressRoute with Equinix to Azure VMs.)
- Database Mirroring

Disaster Recovery

■ What's supported in Azure?

- Cross-region Availability Groups
 - Asynchronous
 - Manual failover
 - Requires vnet-to-vnet connectivity
- Database Mirroring
 - Asynchronous
 - Use certificates, not AD
- Backup and restore
 - DR is intended to protect you if you lose connectivity to a region, so ensure your backups are in more than one region!
 - The storage for your backups should be set up with GRS.

Security: Access

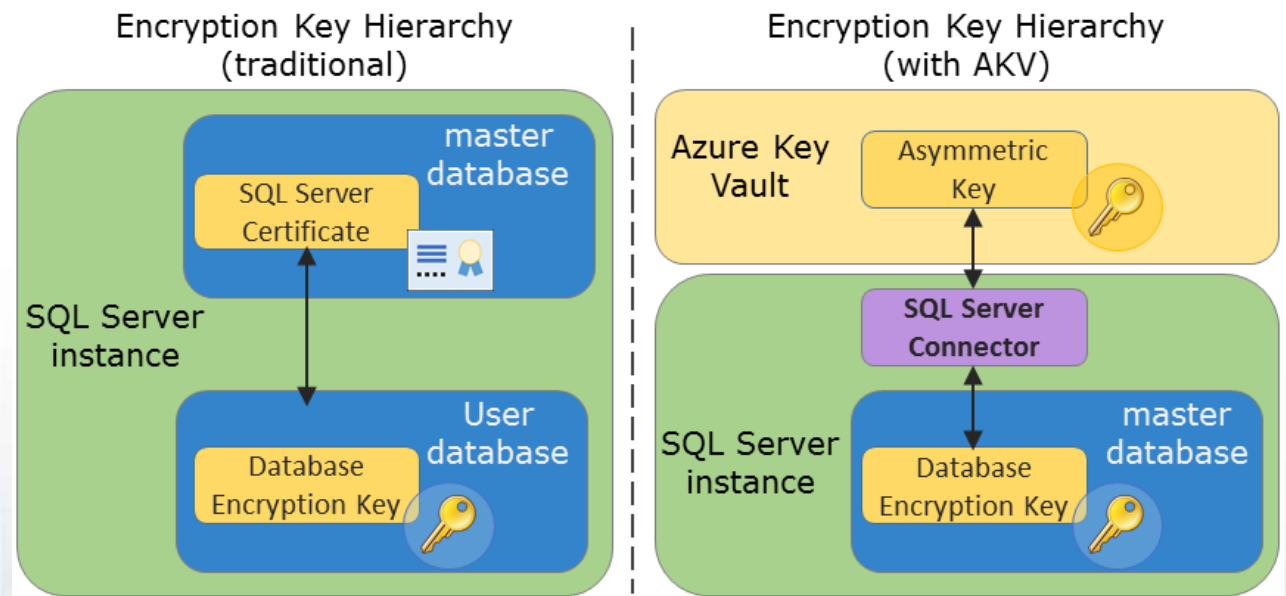
- **Access to the database goes through several layers, including the vnet, the subnet, and the NSG.**
- **Make sure each is configured properly to allow applications through, but nothing else.**
- **Database credentials can be configured to use AD or SQL authentication.**
 - When using a SQL Server image from the gallery, you choose the authentication method.
 - When using BYOL, you decide during setup.

Security: Data

- **No changes from on-premises**
- **Supported features**
 - Column-level encryption
 - Backup encryption
 - Transparent Data Encryption
 - Always Encrypted

Azure Key Vault

- **Store encryption keys outside of SQL Server, providing an extra layer of security.**
- **Compatible with**
 - Column-level encryption
 - Backup encryption
 - Transparent Data Encryption



Migrating data

- **Want to move your data from on-premises to Azure?**

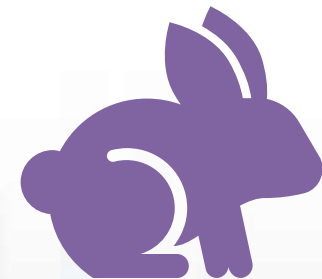
- Join an AG replica
- Transactional replication
- Log shipping
- Restore a backup
- Create a Hyper-V VHD & import
- Windows Import/Export services



Performance Tuning

- **What's different from on-prem? Nothing!**

- Indexes
- Statistics
- In-Memory OLTP
- DMVs
- Extended Events



Monitoring

■ Tools to monitor the VM

- Azure Diagnostics
 - <https://docs.microsoft.com/en-us/azure/monitoring-and-diagnostics/azure-diagnostics#virtual-machines-using-azure-diagnostics>
- Alert rules - per VM
 - <https://docs.microsoft.com/en-us/azure/monitoring-and-diagnostics/insights-alerts-portal>
- SCOM
 - https://blogs.msdn.microsoft.com/nicole_welch/2015/05/monitoring-azure-resources-with-scom/
- OMS
 - <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/extensions-oms>

■ Tools to monitor SQL Server health, performance

- What's different from on-prem? Nothing!

SQL Database (PaaS)

Cloud-first

- Our strategy for feature development is cloud-first
- Query Store, Adaptive Query Processing, and Automated Tuning were released to and tested in SQL Database first
- Most new features will follow this pattern!
- Roadmap: <https://azure.microsoft.com/en-us/roadmap/?category=databases>

Feature parity with SQL Server

■ Unavailable features

- Agent - jobs, alerts
- BACKUP, RESTORE, ATTACH, DETACH
- Change Data Capture
- CLR
- Database mail
- Database mirroring
- Data Quality Services, Master Data Services
- Database snapshots
- Filestream
- Policy-based Management, Resource Governor
- Service Broker
- Profiler

■ Unavailable T-SQL

- Cross-database queries
- Global temp tables
- Server-level roles, system tables, system views, DMVs
- USE

■ Some features only available in Premium tier

- In-Memory OLTP

Pricing and Licensing

- SQL Database tiers are based on DTUs
- Database Throughput Unit - "a blended measure of CPU, memory, I/O (data and transaction log I/O)"
- **Guaranteed performance**
 - When workload exceeds one of those resources, throughput is throttled
- **Doubling DTUs by increasing tiers will double the resources available**

How many DTUs do I need?

- **Migrating workloads**

- DTU Calculator - <http://dtucalculator.azurewebsites.net/>

- **New workloads**

- Start low, work up

Single databases and Elastic Pools

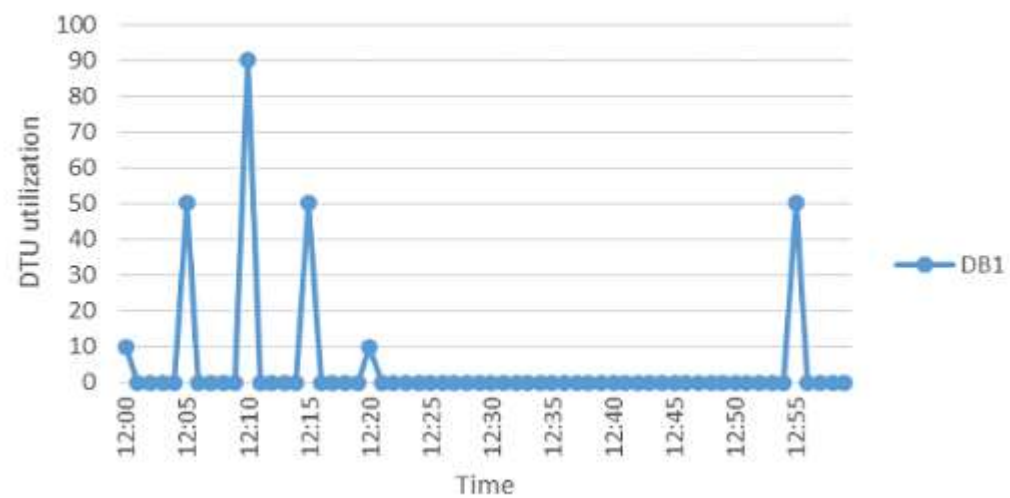
- **Single databases**

- DTUs are dedicated to one database

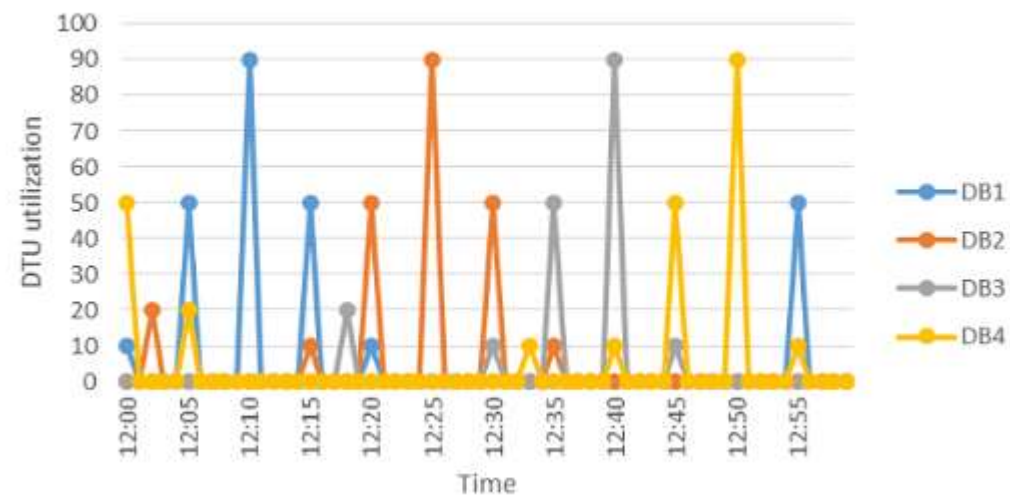
- **Elastic Pools**

- A group of databases that share a "pool" of DTUs
 - Designed for a group of databases with varying, unpredictable workloads
 - "If the sum of the DTUs of performance levels for single databases is more than 1.5x the eDTUs needed for the pool, then an elastic pool is more cost effective"
 - Can create and run elastic jobs

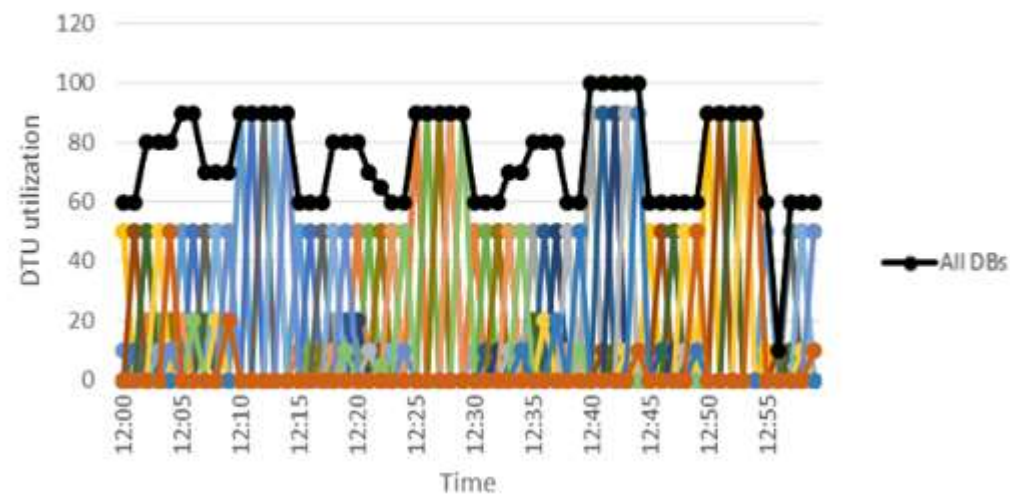
1 database



4 databases



20 databases



Elastic Pool Tools

■ Elastic Jobs

- Run T-SQL jobs against one or more databases in the pool
- <https://docs.microsoft.com/en-us/azure/sql-database/sql-database-elastic-jobs-getting-started>

■ Elastic Query

- Execute T-SQL queries against one or more databases in the pool
- <https://docs.microsoft.com/en-us/azure/sql-database/sql-database-elastic-query-overview>

■ Elastic Transactions

- Execute cross-database transactions *using ADO.NET*
- <https://docs.microsoft.com/en-us/azure/sql-database/sql-database-elastic-transactions-overview>

Setup

■ Planning

- Single or elastic pool
- Initial tier/DTUs
- SQL server to assign to
 - A logical grouping of SQL databases
 - Does not provide server-level settings like a SQL Server instance
 - Does not provide cross-database querying
- Security - what IP addresses/ranges will have access?
 - Set at the SQL server level

Demos - Single database

Portal

PowerShell

Demos - Elastic Pools

Portal

~~PowerShell~~

Administration

Backups

- **Performed automatically - part of the managed services through PaaS**
 - Full backup weekly
 - Differential every few hours
 - Transaction log every 5-10 minutes
- **Uses read-access geo-redundant storage**



Backup retention

- Up to 200% of your maximum provisioned database storage at no cost
- Basic - 7 days
- Standard, Premium - 35 days
- Long-term backup retention (preview) - up to 10 years

Restores

- **Can restore to a point-in-time using Portal or PowerShell**
- **How long will it take? Depends on:**
 - Database tier
 - Size of backup
 - Number of logs and transactions to be replayed
 - Amount of activity in the region

Demo – Restore

Portal
PowerShell

Index maintenance

- You can still run **ALTER INDEX REBUILD** and **ALTER INDEX REORGANIZE**
- **Without SQL Server Agent, need to find an alternative method**
 - Point an IaaS instance to the SQL Database and use SQL Server Agent
 - Azure Automation - PowerShell + T-SQL
- **Automatic Tuning offers automatic index management**

Replacing SQL Server Agent with Azure Automation

- **Automation is another PaaS offering**
- **Create one or more accounts; each account can have one or more runbooks**
- **Runbooks can be**
 - Graphical
 - PowerShell
 - PowerShell Workflow - "a Windows PowerShell script that uses Windows Workflow Foundation".
- **PowerShell scripts can be written to run T-SQL**
- **Use the Runbooks Gallery to find pre-configured Runbooks**
 - Update-SQLIndexRunbook
- **Enter parameters**
- **Schedule**

How scaling works

- **Changing the service tier and/or performance level of a database creates a replica of the original database at the new performance level, and then switches connections over to the replica.**
- **No data is lost during this process but during the brief moment when we switch over to the replica, connections to the database are disabled, so some transactions in flight may be rolled back.**
- **The length of time for the switch over varies, but is generally under 4 seconds is less than 30 seconds 99% of the time.**
 - If there are large numbers of transactions in flight at the moment connections are disabled, the length of time for the switch over may be longer.

Scaling limitations

- **Scaling up**

- If you upgrade to a higher tier or level, maximum database size doesn't change unless you specify it
- If upgrading a database with geo-replication enabled, the recommendation is to upgrade the secondaries first

- **Scaling down**

- The database size must not be larger than the maximum database size for the lower tier or level
- When you downgrade to a lower tier, your disaster recovery options (such as backup retention period) may change

Demo

Portal
PowerShell

High Availability & Disaster Recovery

High Availability

- Fully managed
- At least three copies of your data exist in the same region
- The database can and will be moved for patching and maintenance
- Applications need built-in resiliency!

Disaster Recovery

- **Backups**
- **Active geo-replication**
 - Up to four readable secondary databases in different region(s)
 - Each database is a separate charge, so be careful of tiers. Primary and secondary can be different.
 - Failover: manual
 - On failover, update application connection string to new server name
- **Failover groups**
 - One or more databases in a group
 - Can have a read-write listener or read-only listener
 - Failover: automatic or manual
 - On failover, if application is directed to listener name, no need to update connection string
 - If automatic is chosen, you can set a "grace period", which determines how long the system waits before initiating failover. This potentially reduces data loss.

After setup

- **Practice planned, manual failover**
 - <https://docs.microsoft.com/en-us/azure/sql-database/sql-database-geo-replication-portal#initiate-a-failover>
- **Ensure application connects and latency is acceptable**
- **Failover back to primary data center**

Your application will be disconnected from your database

- Patching occurs in the background
- Hardware can fail
- Services and regions can have outages
- Building resilient applications - <https://docs.microsoft.com/en-us/azure/architecture/resiliency/>
 - Determine RPO and RTO
 - Determine service SLAs and your application SLAs
 - Design for resiliency
 - Retry transient failures
 - Load balance
 - Replicate data
 - Degrade gracefully
 - Test for resiliency
 - Test for load

Working with geo-replication

- **Designing highly available services using Azure SQL Database -**
<https://docs.microsoft.com/en-us/azure/sql-database/sql-database-designing-cloud-solutions-for-disaster-recovery>
- **Active - Passive**
 - Best for read-write workloads, with low latency
- **Active - Active**
 - Best for read-heavy workloads, with read latency being most important

Security

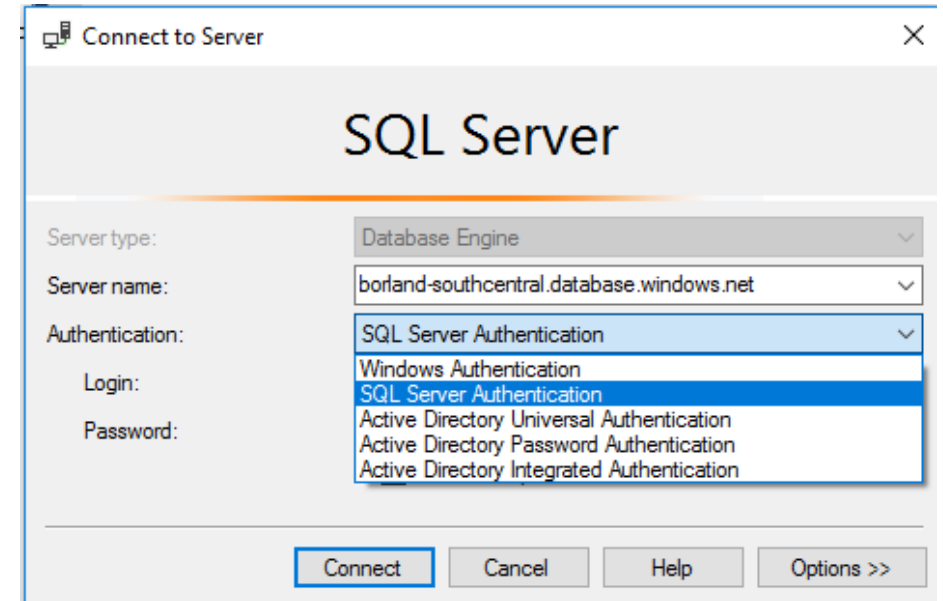
Access

■ SQL Authentication

- Standard username/password authentication.
- When you first create a SQL server, you create an admin login.
 - Use this credential to connect to any database on the server as dbo.
 - Use this credential to create logins at the server level or users in databases.

■ Azure Active Directory Authentication

- Requires Azure Active Directory.
- You can create one AD admin login per SQL server (in addition to the SQL admin login).
- Connect via integrated Windows authentication, using an Azure AD username and password, or application token authentication.

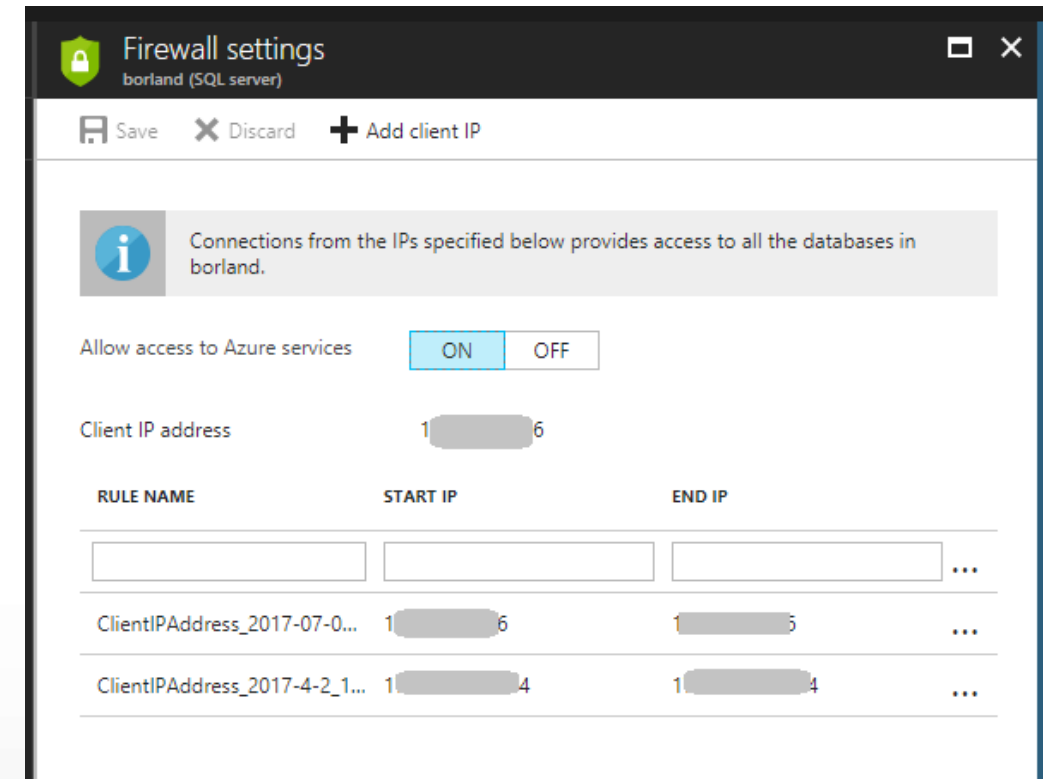


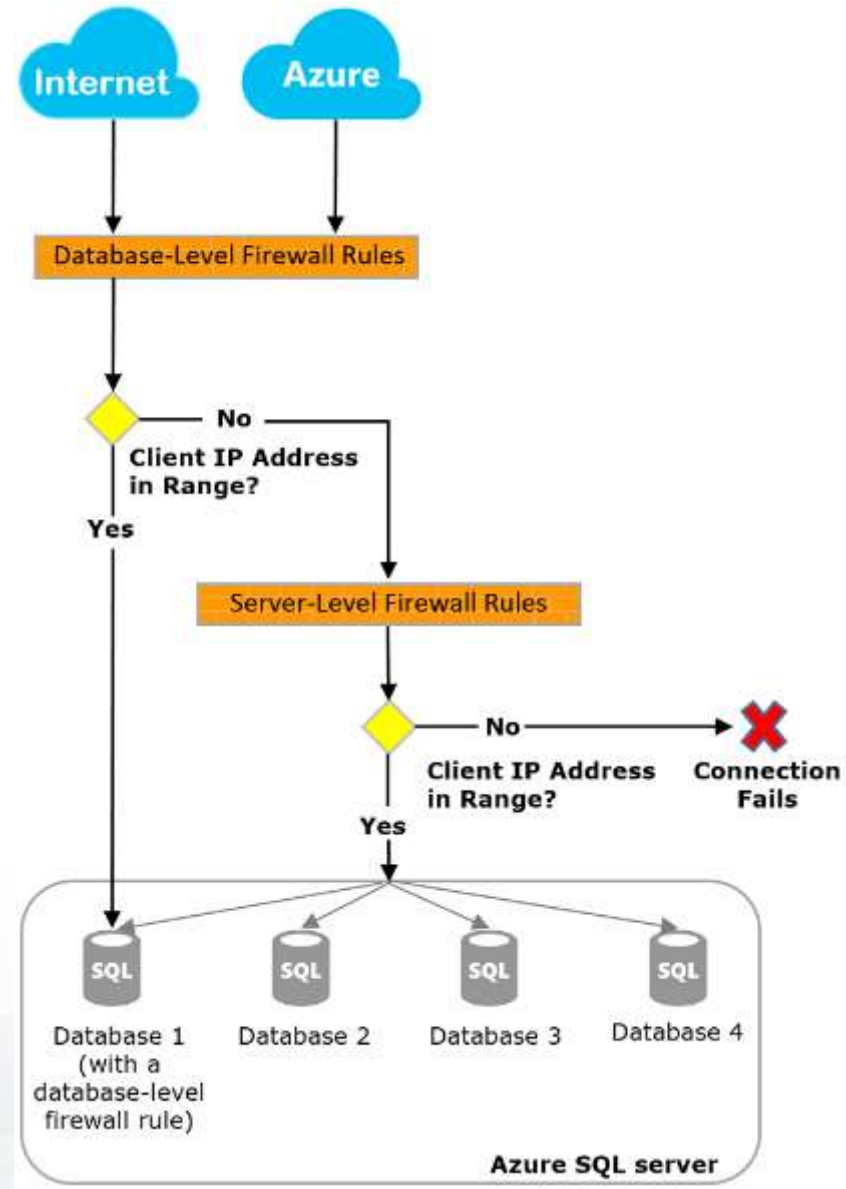
Roles

- **Server-level admin roles**
 - dbmanager - create new databases
 - loginmanager - create new logins in master database
- **Server-level non-admin users can be created**
- **Database users can be tied to a server-level login, or contained.**
- **Database-level roles**
 - db_accessadmin, db_backupoperator, db_datareader, db_datawriter, db_ddladmin, db_denydatareader, db_denydatawriter, db_owner, db_securityadmin
 - Can also GRANT and REVOKE permissions on objects

Firewall

- **Each SQL server has a firewall, which controls access to the databases created on it.**
 - Create firewall rules to allow access.
 - IP address or range.
 - Azure services.
- **SQL Databases can have database-level rules set.**
 - Only configurable with T-SQL.





Data

- **Column encryption is supported**
- **Transparent Data Encryption**
 - On by default for databases created after May 2017
 - Uses built-in server certificate, rotated every 90 days
 - That certificate protects the database encryption key
 - Enable using Portal, T-SQL, or PowerShell
- **Always Encrypted**
 - Fully supported in SQL Database

Auditing

- **Events are written to an Azure storage account for review**
- **Levels**
 - Server-level
 - Server-level policies are applied to all databases on the server
 - Database-level
 - If using both
 - Make sure they use different storage accounts
 - Audit different event types
- **View logs**
 - Portal
 - T-SQL - `sys.fn_get_audit_file`
 - SSMS - Merge Audit Files
 - Power BI

Threat Detection

- **Based on machine learning algorithms**
- **Requires Auditing be enabled**
- **Checks for**
 - SQL injection
 - SQL injection vulnerability
 - Anomalous client login
- **If events are triggered, an email is sent**
- **Additional cost per month**

Tools for planning and performing data migration

Data Migration Assistant (DMA)

- **Downloadable tool**

- **Scenarios**

- SQL Server database to SQL Database - finds blockers, unsupported features
- SQL Server database to on-premises or Azure VM SQL Server database - schema, data, users, server roles, logins
- SQL Server database upgrade - breaking changes, behavior changes, deprecated features, new features to benefit from

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Data Migration Assistant

← Test1

1 Options

2 Select sources

3 Review results

☑ SQL Server feature parity

⊖ Compatibility issues

SQL2016D

Target Platform

Azure SQL Database V12

SQL2016D / SQL Server 2016

Feature parity (7)

Recommendation

Databa...

▼ Unsupported features (5)

File groups not supported in Azure SQ...1

FILESTREAM not supported in Azure S...1

Windows authentication not supported...N/A

Azure SQL Database doesn't support A...N/A

SQL Server Reporting Services is not su...N/A

▼ Partially-supported features (2)

In-memory tables only supported in pr...1

Table partitioning considerations in Az...1

File groups not supported in Azure SQL Database

Details

Impact

Recommendation

Databases

Database details

Export report

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Restart Assessment

🗑

Delete Assessment

☑ SQL Server feature parity

⊖ Compatibility issues

SQL2016D

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Details

Impact

Recommendation

Databases

Database details

Export report

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Restart Assessment

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Delete Assessment

BACPAC

- **Create a BACPAC to migrate from SQL Server to SQL Database**
- **T-SQL files for schema**
- **bcp files for data**

Transactional replication

- **SQL Server 2012+**
- **Run DMA first to resolve any incompatibilities**
- **Ensure your SQL Database tier is high enough to support the initial writes for synchronization**
- **Set up your distributor and publisher locally, make SQL Database the subscriber**
- **When ready to migrate, stop application updates, ensure all transactions are replicated, then point application to SQL Database**

Performance Tuning Tools

"A bad query is always worth tuning"

- Using SQL Database, you are paying for every bit of CPU, memory, read, and write
- Tune your queries to be as efficient as possible

Query Performance Insight

- **A real-time view of how queries are affecting your database**
- **Requires Query Store be enabled**
- **View top resource-consuming queries**
 - CPU, data IO, log IO, duration, execution count
- **View long-running queries**
- **Get Performance Recommendations for a query**

Performance Recommendations

- **Create index**
 - High, Medium, Low
 - If index is implemented and doesn't offer a benefit, will be reverted
- **Drop index**
 - Duplicate indexes - same key and index columns, filters, and partition schema
 - Unused for a long period of time (93 days)
- **Parameterize queries**
 - Will be recommended if queries are constantly recompiled but have the same execution plan
 - Enables forced parameterization on the database
- **Fix schema issues**
 - Procedure or function " expects parameter ", which was not supplied.
 - Invalid column name '*'.
 - Invalid object name '*'.
 - Column name or number of supplied values does not match table definition.
 - Could not find stored procedure '*'.
 - Procedure or function * has too many arguments specified.

Automatic Tuning

- **Executed queries are monitored for improvements; improvements are applied and measured**
- **Automatic index management**
 - Creates useful indexes
 - Drops duplicate or unused indexes
 - If improvement isn't significant, actions are reverted
- **Automatic plan choice correction**
 - Coming soon!
 - If plan regression is detected, the database will switch to the last known good plan for that query

Monitoring Tools

Dynamic Management Views

- **Querying DMVs requires VIEW DATABASE STATE.**
- **A subset of DMVs is available for querying in SQL Database.**
- **Other DMVs have been created to address SQL Database specifically.**
 - Wait statistics - sys.dm_db_wait_stats
 - Resources statistics - sys.dm_db_resource_stats
 - Geo-replication - sys.geo_replication_links

Demo

Azure SQL DB DMVs.sql

Extended Events

- Using XE requires Control permission to create sessions.
- A subset of events is available for use in SQL Database.
- T-SQL differences
 - [CREATE | ALTER | DROP] EVENT SESSION <name> ON DATABASE
 - DMVs referencing XE are sys.dm_xe_database_...
- Targets
 - Ring buffer - in memory, not persisted
 - Event counter - in memory, not persisted
 - Event File - write to an Azure Storage container, persisted
- No GUI available in SSMS

Alert rules

- **Monitor your databases - when set conditions are met, an email will be sent**
 - Can tie into a webhook so that when the alert is raised, an Automation Runbook fires
- **Portal**
 - Choose a metric
 - Set a condition - less than, equal to, greater than
 - Set a threshold
 - Pick a period of time
- **PowerShell**
 - <http://www.mikefal.net/2016/08/23/creating-alerts-for-azure-sql-database-with-powershell/>

Blocked by Firewall
Failed Connections
Successful Connections
CPU percentage
Deadlocks
DTU percentage
DTU limit
DTU used
Log IO percentage
Data IO percentage
Sessions percentage
Total database size
Database size percentage
Workers percentage
In-Memory OLTP storage percent

Software suites

- **System Center Management Pack for Microsoft Azure SQL Database -**
<https://www.microsoft.com/en-us/download/details.aspx?id=38829>
- **SentryOne SQL Sentry**
- **Solarwinds Database Performance Analyzer**

Managed Instances

The benefits of SQL Database

- Automatic management of patches, updates, and backups
- Easy scalability
- Cloud-first feature development



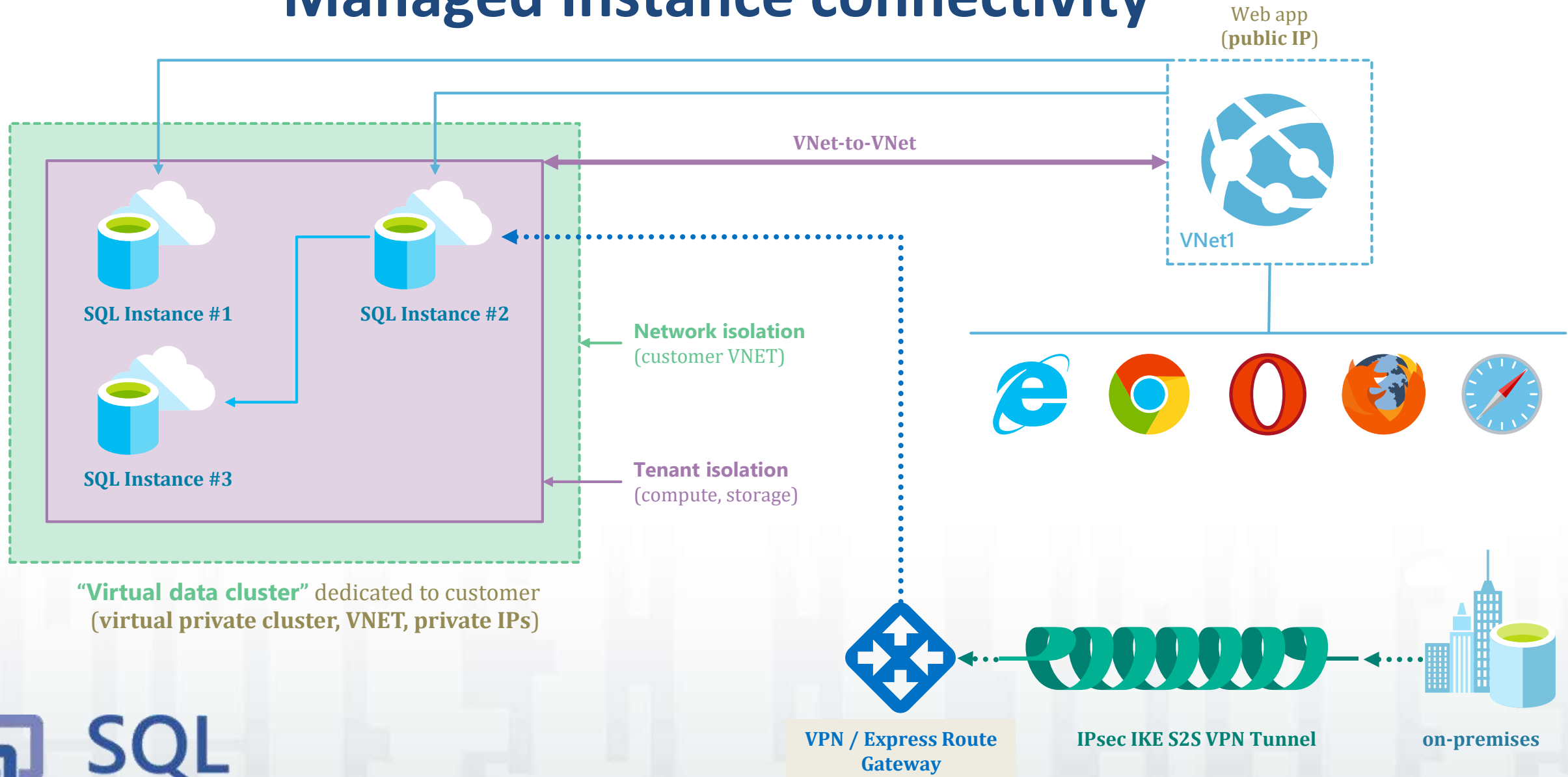
The drawbacks of SQL Database

- **Limited surface area - major features missing**
- **No way to tie to a virtual network**
- **Lack of cross-database communication**

Solving the problem

- **Managed Instances: a PaaS offering combining the managed services of SQL Database with the compatibility and server-level options of SQL Server**

Managed Instance connectivity



Compatibility being introduced

- Cross-database queries
- Cross-instance queries
- Global temp tables
- CLR
- R services
- SQL Audit
- SQL Agent
- Database mail
- Change Data Capture
- Service Broker
- Transactional Replication
- Log Shipping
- Resource Governor

Scaling

- **Managed Instances will offer the same ability to scale up/down as SQL Database does**

High Availability & Disaster Recovery

- **Matches SQL Database features**

- Automatic backups
- Point-in-time restore
- Geo-replication

Security

- **Connecting to Managed Instances**

- Windows Authentication isn't supported
- Azure Active Directory will be
- Active Directory Integrated Authentication will be

- **Data**

- Fully compatible with column encryption, TDE, Always Encrypted

Migrating data to Managed Instances

- Full native restore
- Log ship
- DMS (Database Migration Service)
- Export and import a bacpac
- Move data with SSIS
- Set as transactional replication subscriber

What can be migrated?

- **Data**
- **Logins**
- **Credentials**
- **Jobs**

Performance tuning tools

- **Matches SQL Database options**

- Query Performance Insight
- Automatic Tuning
- Threat Detection

Where can I learn more?!

- Modernize your on-premises applications with SQL Database Managed Instances (video) <https://myignite.microsoft.com/videos/53442>

Summary



Compute



Networking



Storage



Web + Mobile



Containers



Data + Analytics



Databases



AI + Cognitive
Services



IoT



Security + Identity



Developer Tools



Monitoring +
Management

Data Services in Azure

- **Transactional**

- IaaS VMs
- SQL Database



- **Analytical**

- SQL Data Warehouse
- Cosmos DB
- HD Insight
- Data Lakes
- Machine Learning



SQL Server VMs

- **Great for lift-and-shift of current applications and databases**
- **Full SQL Server functionality**
- **Built-in scaling capabilities**



SQL Database

- **Great for new applications and databases**
- **Eliminate administrative tasks such as setting up High Availability and taking backups**
- **Easily scale up and down**
- **Isolate resources with single databases; share resources with elastic pools**
- **Take advantage of new tools like Threat Detection, Query Performance Insight, and Automatic Tuning**



Managed Instances

- **Nearly full feature parity with SQL Server**
- **Same managed capabilities with SQL Database**
 - Backups
 - High Availability
 - Scaling
- **Coming to public preview soon!**

Questions?

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<https://github.com/grrlgeek/azure-sql-server>