

SQL Server in Azure: Essentials for the Database Developer



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Reminder: Intersect with Speakers and Attendees

- Tweet tips and tricks that you learn and follow tweets posted by your peers!
 - Follow: #SQLintersection and/or #DEVintersection
- Join us – Thursday Evening – for SQLafterDark
 - Doors open at 7:30 pm
 - Trivia game starts at 8:00 pm
 - Winning team receives something fun!*
 - Raffle at the end of the night
 - Lots of great items to win including a seat in a SQLskills Immersion Event!*
 - The first round of drinks is sponsored by SQL Sentry and SQLskills



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Abstract

Your company is storing and using more data every day. And, every day, more of that is being stored using SQL Server and SQL Database in Azure. In this session, I'll help you understand what options are available for SQL in Azure and what you need to know to develop for them. I'll focus on the T-SQL that is (and isn't) supported, query tuning, and indexing. You'll leave this session with the right tools to write effective queries for SQL Server and SQL Database in Azure.



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Before we talk about SQL Server...

Secure cross-premises connectivity

- **Point-to-site VPN**
 - Configured on *each* client
 - Doesn't require a compatible VPN device
 - Doesn't require an internet-facing IPv4 IP address
- **Site-to-site VPN**
 - Configure compatible VPN device with Azure VPN Gateway
 - VPN device must have an Internet-facing IPv4 IP address
- **Express Route**
 - "More reliability, faster speeds, lower latencies and higher security"
 - More money
 - Limited locations and service providers
- **Channel 9: Azure Network Infrastructure** <https://channel9.msdn.com/Blogs/Azure-and-the-Modern-Data-Center/Azure-Network-Infrastructure>



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<https://azure.microsoft.com/en-us/documentation/articles/vpn-gateway-cross-premises-options/>

Express Route: <https://azure.microsoft.com/en-us/documentation/articles/expressroute-introduction/>

Networking Inside Azure

- **Virtual Networks (VNets)**
 - VNets are isolated from each other. Want them to talk? Set up a VPN.
 - VNet peering is in preview
 - ...but VMs in the same VNet can communicate on private IPs.
- **Can divide into subnets**
- **Can put behind load balancer**
- **Set up a VNet before any VMs or services**
- **MVA: Azure Networking Fundamentals for IT Pros**
https://mva.microsoft.com/en-US/training-courses/azure-networking-fundamentals-for-it-pros-8917?l=R70kv0B3_6104984382



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Demo

Go to Virtual networks (classic) and show TRAzureNet74 – gateway

Virtual Network Overview: <https://azure.microsoft.com/en-us/documentation/articles/virtual-networks-overview/>

What are you paying for?

- **Network (VPN Gateways, Public IP Address, Express Route)**
- **Compute (VMs)**
- **Licensing (SQL Server)**
- **Storage (disks)**
- **Throughput (SQL Database)**
- **Automation**
- **Data Out**



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Management

- **Portal**
 - Classic Portal (manage.windowsazure.com)
 - Portal (portal.azure.com)
 - You can't manage all features from either one: <https://azure.microsoft.com/en-us/features/azure-portal/availability/>
- **PowerShell**
 - Learn it and [love it](#)
 - Download and install <https://azure.microsoft.com/en-us/documentation/articles/powershell-install-configure/>
 - Cmdlet Reference <https://msdn.microsoft.com/en-us/library/azure/dn708514.aspx>



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All data-related services EXCEPT Machine Learning are available on the portal (as of 7/22/2016).

Open Portal to show

**What options are available for
SQL in Azure?**

The Azure Periodic Table

Explore the power and possibilities of Azure

<http://www.concurrency.com/landing/azure-periodic-table>

The Azure Periodic Table is a grid of 40 service icons. Annotations include:

- A yellow arrow points to the "VIRTUAL MACHINES" icon in the top row.
- A red arrow points to the "SQL DATABASE" icon in the bottom row.
- A red arrow points to the "DOCUMENTDB" icon in the bottom row.
- A red arrow points to the "DATA CATALOG" icon in the middle row.

SECURITY CENTER													AZURE IOT HUB
LINUX HUB	VIRTUAL MACHINES												EVENT HUBS
SCHEDULER	SERVICE FABRIC												POWERBI
AUTOMATION	BATCH	VPN GATEWAY	EXPRESSROUTE	AZURE DNS	APPLICATION GATEWAY	AZURE BACKUP	BIZTALK SERVICES	CDN	DATA CATALOG	DATA FACTORY	DATA LAKE ANALYTICS		MACHINE LEARNING
OPINSIGHTS	REMOTEAPP	RESERVED IP	VIRTUAL NETWORK	TRAFFIC MANAGER	LOAD BALANCER	SITE RECOVERY	SERVICE BUS	MEDIA SERVICES	HDINSIGHT	TABLE/BLOB STORAGE	DATA LAKE STORAGE		STREAM ANALYTICS
KEY VAULT	CLOUD SERVICES	PUBLIC IP	LOGIC APPS	API APPS	APP SERVICE	API MANAGEMENT	MOBILE APPS	MOBILE ENGAGEMENT	WEB APPS	CUSTOM DOMAIN	SSL CERTIFICATES		NOTIFICATION HUBS
DEVTEST LABS	VS APP INSIGHTS	VS ONLINE	SQL DATABASE	SQL DATA WAREHOUSE	DOCUMENTDB	CACHE	SEARCH	STORAGE	STORSIMPLE	IMPORT / EXPORT	PREMIUM STORAGE		SQL ELASTIC DB

So many, and we're only going to touch on a few.

IaaS – VMs

- **SQL Server licensing**
 - Bring your own licensing (BYOL)
 - Use a Windows VM image, install SQL Server with your license key, pay for compute costs
 - Image
 - Use a SQL Server VM image, pay compute & SQL Server costs
 - All features are installed – every last one!
 - SQL Server 2008R2, 2012, 2014, 2016
 - BYOL image
 - Enter your key within 10 days
 - All features are installed
- **No “development” or “test” tier**
 - Can use Express and Developer editions
 - Use Azure Dev Test Labs



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Compute costs

Tier/size	Cores	RAM	Disk Size	Price
Standard A2	2	3.5 GB	135 GB	\$0.18/hr
Standard A7	8	56 GB	605 GB	\$1.20/hr
Optimized D2	2	7 GB	100 GB	\$0.26/hr
Optimized D13	8	56 GB	400 GB	\$1.08/hr

SQL Server costs

Tier/size	Web	Standard	Enterprise
Standard A2	\$0.032/hr	\$0.40/hr	\$1.50/hr
Standard A7	\$0.064/hr	\$0.80/hr	\$3.00/hr
Optimized D2	\$0.032/hr	\$0.40/hr	\$1.50/hr
Optimized D13	\$0.064/hr	\$0.80/hr	\$3.00/hr

* Pricing current as of October 10, 2016; East US 2 region



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VMs – you pay for Windows + SQL Server

Note that no matter what tier of server you have, the pricing is essentially per core – same as SQL on-prem licensing

Basic and Standard (A*) – general purpose.

Optimized (D*) – 60% faster processors, local SSD

Optimized Premium Storage (DS*) – same hardware for vm but can connect to premium storage

Optimized V2 (D* v2) – Faster CPU. “Dv2-series instances are based on the latest generation 2.4 GHz Intel Xeon® E5-2673 v3 (Haswell) processor, and with Intel Turbo Boost Technology 2.0 can go to 3.2 GHz.”

G Series (G*) – only West and East 2. “G-series virtual machines feature latest [Intel® Xeon® processor E5 v3 family](#), two times more memory and four times more Solid State Drive storage (SSDs) than the D-series”

GS same hardware but can connect to premium storage

No, you're not getting as much memory on *any* of these. Tune, tune, tune!

PaaS – SQL Database

- **One or many**
 - Single database
 - Elastic pools
- **Database only – no Analysis Services, Integration Services, or Reporting Services**
 - SQL Data Warehouse (GA as of July 13, 2016)
 - Data Factory
 - Power BI
 - Analysis Services just announced yesterday!



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Single database

Tier/Size	DTUs	Max storage (per DB)	Price
Basic B	5	2 GB	\$5/mo
Standard S1	20	250 GB	\$30/mo
Premium P1	125	500 GB	\$465/mo
Premium P11	1,750	1 TB	\$7,001/mo

Elastic pool

Tier/DTUs	Max DBs (per pool)	Max storage (per pool)	Max eDTUs (per DB)	Price
Basic 100	200	10 GB	5	\$149/mo
Standard 100	200	100 GB	100	\$223/mo
Standard 1200	400	1.2 TB	100	\$2,701/mo
Premium 1500	50	750 GB	1,000	\$8,370/mo

* Pricing current as of October 10, 2016; East US 2 region



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Basic
Standard
Premium

IaaS – VMs

- Need to rapidly move existing database into Azure
- Databases larger than 1 TB
- Predictable, steady workloads
- DR for on-premises SQL Server instances

PaaS – SQL Database

- New cloud-designed apps
- Apps that need built-in HA and DR
- Variable workloads and usage patterns
- Scale-out
- SaaS / single-tenant databases



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IaaS: SQL Server on VM

Connectivity

- **Connect applications to the new server**
 - In the same Vnet? Specify server name and integrated security in the connection string.
 - Over the internet?
 - Open TCP ports in Windows Firewall
 - Configure SQL Server to listen on TCP
 - Configure mixed mode authentication
 - Configure a Network Security Group inbound rule for port 1433
 - Configure DNS name
 - Verify connectivity
- **Resource: Connect to a SQL Server Virtual Machine on Azure (Resource Manager)**
<https://azure.microsoft.com/en-us/documentation/articles/virtual-machines-sql-server-connectivity-resource-manager/>



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How can I demo this?

Moving data into the database

- **Back up to and restore from URL**
- **Deploy a SQL Server Database to a Microsoft Azure VM wizard**
 - Built into SSMS
- **SQL Server Database Migration wizard**
 - CodePlex download
- **Move data through an Availability Group failover, Database Mirroring failover, log shipping**



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Deploy a SQL Server DB to Azure VM wizard - <https://azure.microsoft.com/en-us/documentation/articles/virtual-machines-windows-migrate-sql/#azure-vm-deployment-wizard-tutorial>

SQL Server DB Migration wizard - <https://azure.microsoft.com/en-us/documentation/articles/machine-learning-data-science-move-sql-server-virtual-machine/#sql-migration>

Changing VM size

- Can upgrade or downgrade
- It IS an online operation!
- How long does it take? It depends.
- Done through Portal or PowerShell



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Stopping the VM - when do you get charged?

- “If the status says “**Stopped (Deallocated)**,” you’re not being billed. If it says “**Stopped Allocated**,” you’re still being billed for allocated virtual cores (not the software license itself).”
- <https://azure.microsoft.com/en-us/pricing/details/virtual-machines/>



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That is only for compute!

- You still pay for storage**
- You still pay for network**
- If you have multiple VMs in a cluster or an AG, and you don't shut all of them down, you pay for those still running**



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What features & T-SQL are supported?

- Everything



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Tools for development

- **Same as you've always used!**
 - You'll need a public IP address, a point-to-site VPN, or a site-to-site VPN to connect
- **SSMS**
 - I recommend the standalone, updated-monthly SSMS
 - <https://msdn.microsoft.com/en-us/library/mt238290.aspx>
- **Visual Studio**
 - I recommend Visual Studio Community 2015
 - <https://www.visualstudio.com/en-us/products/visual-studio-community-vs.aspx>



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Biggest pain points

- **Network**

- Is the pipe from users -> application -> database enough to provide adequate performance?

- **Performance**

- Is the virtual machine sized properly to handle load?

- **Security**

- Is everything set up correctly to allow the right users the right access?



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PaaS: SQL Database

Pricing & Performance



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Tiers

- **Based on DTUs - Database Throughput Units**
 - "How many transactions could be completed per second under fully loaded conditions"
 - Combo of CPU, memory, reads, writes
 - Benchmark: <https://azure.microsoft.com/en-us/documentation/articles/sql-database-benchmark-overview/>
- **How do I translate an existing SQL Server workload to a SQL Database?**
 - DTU calculator: <http://dtucalculator.azurewebsites.net/>



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Differences between SQL Server and SQL Database

Partially supported

- CREATE/ALTER DATABASE
- CREATE/ALTER USER
- CREATE/ALTER LOGIN
- CREATE/ALTER PROCEDURE
- CREATE/ALTER FUNCTION
- CREATE/ALTER TABLE
- CREATE/ALTER VIEW
- CREATE TYPE
- KILL

Not supported

- Cross-database queries (natively)
- Linked servers, OPENQUERY, OPENROWSET, etc
- Database Mail
- SQL Server Agent
- Replication (can be subscriber, but not publisher)
- Change Data Capture
- Data Collector
- FILESTREAM
- Resource Governor
- Service Broker
- Profiler/trace
- ..and more

<https://azure.microsoft.com/en-us/documentation/articles/sql-database-transact-sql-information/>



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Check <https://azure.microsoft.com/en-us/documentation/articles/sql-database-transact-sql-information/> for latest

Methods for migrating

- Deploy Database to Microsoft Azure Database Wizard
- BACPAC export & import
- Transactional replication
- Reference: SQL Server database migration to SQL Database in the cloud <https://azure.microsoft.com/en-us/documentation/articles/sql-database-cloud-migrate/>



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Tools for development

- **SSMS**
 - I recommend the standalone, updated-monthly SSMS
 - <https://msdn.microsoft.com/en-us/library/mt238290.aspx>
- **Visual Studio**
 - I recommend Visual Studio Community 2015
 - <https://www.visualstudio.com/en-us/products/visual-studio-community-vs.aspx>



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Designing for resiliency

- SLAs are on connectivity, not uptime
- Your databases can and will be moved at any time
- Design your applications for resiliency!
- Using the Transient Fault Handling Application Block with SQL Azure (C#)
[https://msdn.microsoft.com/en-us/library/hh680899\(v=pandp.50\).aspx](https://msdn.microsoft.com/en-us/library/hh680899(v=pandp.50).aspx)
- Design an application for cloud disaster recovery using Active Geo-Replication in SQL Database <https://github.com/Azure/azure-content/blob/master/articles/sql-database/sql-database-designing-cloud-solutions-for-disaster-recovery.md>



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Tools for tuning

- **Wait statistics**
- **Extended Events**
- **Plan cache**
- **Query Store**
- **Query Performance Insight**
- **SQL Database Advisor**



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Wait statistics

- “What resource(s) is my database waiting on?”
- `sys.dm_os_wait_stats` is valid, but won’t return helpful information
- Use `sys.dm_db_wait_stats` instead
- Current since database was created, moved, or taken offline
- Capture on a regular basis and store in a table for later querying



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Extended Events

- **Capture detailed information about events in real-time**
 - 125 events exposed
 - Database-level only, not server-level
- **Memory- and disk-based targets to view and store data**
- **View the sessions using SSMS (not VS)**



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Plan cache and Query Store

- Use the same DMVs to access plan cache data as you would in SQL Server instances
- View and save the execution plan XML
- Enable Query Store to save historical information about query execution
- Use Query Performance Insight to view the information and make decisions about it



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Query Performance Insight

- **Requires Query Store be enabled**
- **Review top resource-consuming queries**
 - CPU
 - Duration
 - Number of executions
- **Select a query to view its details**
- **Check recommendations in SQL Database Advisor (on the Portal)**



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Pull up portal

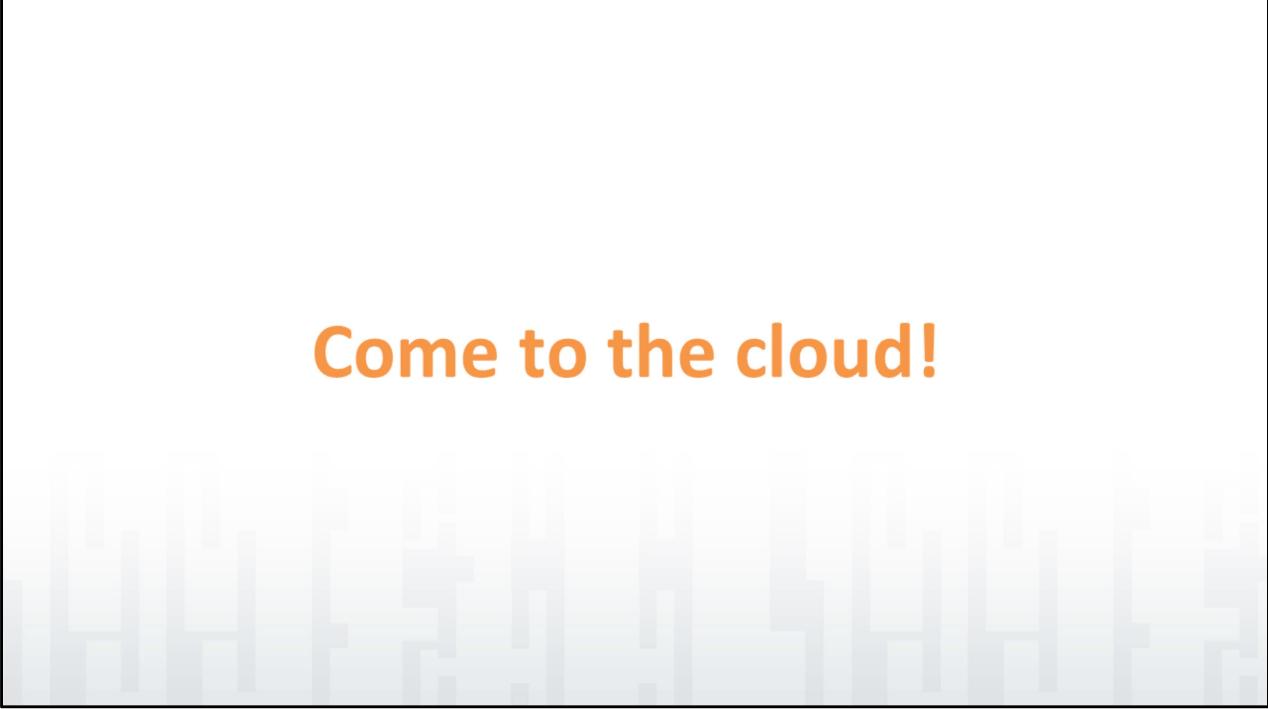
SQL Database Advisor

- **Create Index recommendations**
 - Non-clustered only
- **Drop Index recommendations**
 - Detects duplicates
- **Schema issues**
 - Invalid column name, invalid object name, couldn't find stored procedure, etc
- **When queries can benefit from parameterization**
 - Enables forced parameterization



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View from Portal



Come to the cloud!

IaaS

- Need to rapidly move existing database into Azure
- Databases larger than 1 TB
- Predictable, steady workloads
- DR for on-premises SQL Server instances

PaaS

- New cloud-designed apps
- Apps that need built-in HA and DR
- Variable workloads and usage patterns
- Scale-out
- SaaS / single-tenant databases



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Questions?

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blogs.lessthandot.com

concurrency.com/blog

Links: <http://tinyurl.com/azurefordbdev>

Slides & demos: github.com/grrlgeek/azure-sql-server



Don't forget to complete an online evaluation!

**SQL Server in Azure:
Essentials for the Database Developer**

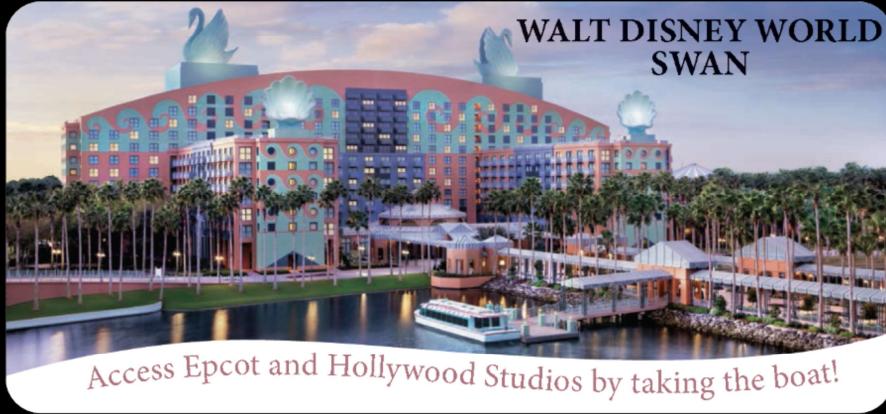
Your evaluation helps organizers build better conferences
and helps speakers improve their sessions.



Thank you!

Save the Date!

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2017

May 21-24

We're back in Orlando!



Leave the every day behind and enter a world of wonder and enchantment at the Walt Disney World® Resort. Located in the heart of the most magical place on earth, the Walt Disney World Swan and Dolphin Resort provides a truly extraordinary backdrop for our event! Beautiful tropical landscaping, tranquil waterways and classic art and architecture work together to create a stunning landmark!