

# SQLskills Immersion Event

IEAzure: Azure VMs and Azure SQL Database

## Module 2: Azure Virtual Machines

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# Overview

- What is Infrastructure as a Service?
- Compliance certifications
- Networking options
- Active Directory Integration from on-premises
- Deploying Azure VMs and installing SQL Server on Azure VMs
- Maintenance considerations for SQL Server
- HA/DR options and how you can extend on-premises to Azure
- Performance scaling compared to on-premises
- Billing and licensing considerations

# What is Infrastructure as a Service (IaaS)

- **Instant computing infrastructure, provisioned and managed over the internet**
  - Quickly scales up and down with demand
  - Helps avoid the complexity of buying and managing your own physical servers and other infrastructure
  - Azure manages the infrastructure, while you purchase, install, configure, and manage your own software, operating systems, middleware, and applications
  - Improved security, scalability, access to Azure 'fabric' benefits such as availability benefits, Azure Marketplace, and other benefits

# On-premises

- **Your organization has to purchase, configure, and install everything**
  - Hardware
  - Storage
  - Networking
  - Security devices
  - Meet regulatory requirements
  - Install everything

# Azure Marketplace

- The Azure Marketplace is located in the Azure Portal
- Over a dozen categories to choose from
  - Compute
  - Storage
  - Databases
  - Azure monitoring and management
  - Networking
  - Security + identity
  - Web + Mobile
  - Internet of things
  - and more

# Compute Options

- **Choose your OS version: Windows or Linux**
- **Select the size of the virtual machine, number of cores and memory**
  - Sizes matters for the number of disk you can have
  - Number of disk matter for amount of IO you can have
- **You can select a virtual machine that already has SQL Server installed**
  - I don't recommend that, yet
- **Other compute services**
  - Virtual machine scale set
  - Azure Container Service
  - Azure Container Registry
  - Function App
  - Batch Service

# Storage Options

- Storage account – blob, file, table, queue
- Azure File Sync
- Data Box Edge / Data Box Gateway (preview)
- Data Lake Storage Gen1
- Azure Data Box
- Backup and Site Recovery (OMS)
- AltaVault AVA-c4 version 4.4.1
- Cloudbian HyperCloud for Azure (preview)
- Veeam Cloud Connect for the Enterprise (preview)

# Database Options

- Azure SQL Managed Instance
- SQL Database (Elastic Pool, Hyperscale, Serverless)
- Synapse - SQL Data Warehouse
- Azure Database for MySQL
- Azure Database for PostgreSQL
- Azure Database for MariaDB
- SQL Server X on Windows Server X
- Azure Cosmos DB
- Database as a service for MongoDB
- Azure Cache for Redis



# Azure Monitoring and Management Options

- **Service Health**
- **Insights**
  - Applications
  - Virtual Machines
  - Containers
  - Network
- **Log Analytics**
- **Automation**
- **Backup and Site Recovery**
- **Intune App Protection – mobile device protection**
- **Traffic Manager profile**
- **Deeper dive into monitoring**
  - Alert rules, metrics, Resource Health, and diagnostics

# Demo

**A walk through the Azure Marketplace for Virtual Machines**

# IaaS Networking

- **Point-to-Site VPN – (P2S VPN)**
  - Single computer (point) to Azure network (site)
  - Uses certificates
  - Adds flexibility for roaming users
  - Consider Active Directory Certificate Services (AD CS)
- **Site-to-Site VPN – (S2S VPN)**
  - Persistent connection from on-premises to Azure network
  - Requires a static public IP address
- **ExpressRoute**
  - Fastest connection 50Mbps to 100Gbps
  - Limited availability

# Virtual Private Networking

- **Internal networks**

- VNets – Virtual Networks
  - Can create multiple VNets to isolate environments
  - Can subdivide using Subnets
  - Setup VPNs to allow VNets to communicate

- **Design and plan first**

- Before creating VMs or other services, setup your VNet

# Demo

**Network configuration options**

# Compliance

- **Many certifications**
  - DoD Provisional Authorizations at Impact Levels 5, 4, and 2
  - FedRAMP
  - FIPS 140-2 – US Federal Info Processing Standards
  - HIPPA/HITECH – Health Care
  - ISO 22301, 27001, 27017, 27018, 9001, and more
  - PCI DSS – Payment Card industry
  - CJIS – US Criminal Justice Information Services
  - EU Model Clauses
  - And so many more
- **Azure Trust Center** <http://bit.ly/2IKjwzK>

# Security

- **Network Security Groups (NSGs)**
  - Enforce and control network traffic rules
  - Similar to a firewall
- **Azure Active Directory**
  - Manage identity and access
  - Integrated for both cloud and on-premises
  - Single Sign-on
  - Support for iOS, Mac, OS X, Android, and Windows
  - Extend Active Directory with Azure AD Connect
  - Secure remote access to protect on-premises
  - Self-service capabilities
  - Enterprise scale and SLA at 99.9% uptime

# Demo

Show Azure AD Connect



# Virtual Machine Deployments

- **Azure Resource Manager**

- Resource – a manageable item (VM, VNet, etc)
- Resource group – container of resources
- Resource provider – a service, Microsoft.Compute, Microsoft.Storage, etc.
- Resource Manager template – JSON
- Declarative Syntax – syntax commands

- **Benefits**

- Manage resources for a solution in a group
- Repeatedly deploy a solution (dev/QA/testing)
- Granular billing, access controls, define dependencies, and more

# Virtual Machines

## ■ Creating the VM

- Huge inventory of images
  - OS based, solution templates, application infrastructure, and business applications
- Image with OS and SQL Server installed
  - Licensed or BYOL (Bring Your Own License)
  - Everything is installed
  - Lots of time spent cleaning, uninstalling
  - Images not currently optimized
- Image with OS, you install and license SQL Server
  - You specify what gets installed and where
  - Install Resource Provider to get auto-patching, auto-backup, and convert to PAYG license

# VM Storage

- **VM start with C: and D:**
  - C: registered as SATA, labeled /dev/sda by default
  - Max capacity of C: limited to 1023GB
  - D: is temporary, nothing important should be placed on it
  - D: is ideal for page or swap files, size varies on size of VM
- **VM size matters**
  - VM size determines number of disk and disk types
    - Standard – HDD
    - Premium – SSDs
    - NVMe SSDs on some models (H-series)

# VM Storage

- **Unmanaged disks**
  - Traditional disk
  - You manage
  - Don't allocate too many disks on the same account
- **Managed disks**
  - Creation and management handled for you
  - Specify size and performance tier (Standard/Premium)
  - Designed for 99.999% availability
  - Up to 50k VM disk in a subscription per region
- **Scale**
  - Add more disks and stripes (RAID)

# VM Storage

- **Standard Disk**

- HDD
- Cost effective for dev/test
- 1GB – 1TB
- Managed – 32GB, 64GB, 128GB, 512GB, and 1024GB
- 60 MB/s throughput and 500 IOPS per disk

- **Premium Disk**

- SSD – high performance
- 128GB, 512GB, and 1024 GB
- 200 MB/s throughput and 5000 IOPS per disk

- **Ultra Disk**

- SSD – higher performance
- 4GB up to 64TB
- 300 IOPS/GiB -160k IOPS per disk – 300MB/s – 2000MB/s throughput

# Virtual Machines

- **Sizing**
  - DS2 for SQL Standard and Web – minimum requirement
  - DS3 for SQL Enterprise edition – minimum requirement
- **Storage**
  - Use premium
  - Storage account and SQL VM in the same region
  - Multiple P30 disk – 1 for logs, 1 for data and tempdb
    - More disk striped if higher IO is needed
- **Follow performance best practices for SQL Server in Azure**
  - <http://bit.ly/2pKIDJ5>

# Demo

**Azure Market Place, resource groups, creating a VM with SQL installed, creating a VM with OS and install SQL, configure additional disk, Resource Provider, and more...**

# VM Creation Requirements

- What did we have to select?
  - Subscription
  - Resource group
  - Name
  - Region
  - Image
  - Username
  - Password
  - Inbound ports
  - Have a license?
  - Disk options
  - Virtual network
  - Subnet
  - Public IP
  - NSG
  - Public inbound ports
  - Accelerated networking
  - Load balancing
  - Management options



# SQL Server Configuration

- **Fine tune the instance**
  - ❑ Correctly size tempdb
  - ❑ Maxdop and cost threshold for parallelism
  - ❑ Trace flag – 1118 (2014 and below)
  - ❑ Trace flag - 3226
  - ❑ Min and max server memory
  - ❑ Optimize for ad hoc workloads
  - ❑ Instant File Initialization
  - ❑ SQL Agent alerts
  - ❑ Error log rollover
  - ❑ Backups

# Demo

Instance changes from defaults

# Maintenance Considerations

- Maintenance considerations for an Azure virtual machine are no different than any other virtual machine or instance of SQL Server
- Statistics will still need to be manually updated
- Index fragmentation is still a concern and should be addressed
- Corruption can occur anywhere, on-premises and in the cloud – DBCC CHECKDB shouldn't be overlooked
- Validating SQL Server backups and testing your HA/DR solutions are just as important in cloud based solutions as on-premises

# Azure VMs – How to Connect

## ■ External

- TCP ports in Windows firewall
- SQL Server must be listening on TCP ports
- Authentication type? Mixed or AD
- NSGs configured for proper port
- DNS need configuring?

## ■ Internal

- Specify server name and configure connection string if same VNet
- VPN configured between subnets

# High Availability and Disaster Recovery

- **HA/DR options**

- Always On Availability Groups
- Always On Failover Cluster Instances
- Log shipping
- Database mirroring
- SQL Server backup and restore with Azure Blob storage service

# High Availability and Disaster Recovery

- **Azure-only Availability Groups**

- Currently requires a WSFC
- Due to WSFC, must have a domain controller
- Servers will need to be in the same resource group
- Select your service name carefully

- **Hybrid**

- Easy to extend on-premises AG with a secondary in Azure
- Requires VPN, extend AD to Azure
- Inexpensive DR solution

# High Availability and Disaster Recovery

- **Failover Cluster Instances**

- Azure storage options
  - Windows Server 2016 Storage Spaces Direct (S2D)
  - Third party tool – SIOS Datakeeper
  - Remote iSCSI Target shared blocks storage via ExpressRoute
- Azure Shared Disk – GA July 2020
  - Industries first shared cloud block storage

# High Availability and Disaster Recovery

- **Log shipping**

- Just like on-premises
- Primary or secondary is in Azure
- Requires VPN
- Allows for load delay

- **Database mirroring**

- Cross-site disaster recovery using server certificates
  - Doesn't require same domain or VPN
- Cross-site with Active Directory would require VPN
- Deprecated in 2016



# High Availability and Disaster Recovery

- **SQL Server backup with Azure Blob Storage Service**
  - Backup on-premises to Azure Blob Storage
  - 2016 enhancements
    - Striping to multiple blobs for support up to 12.8TB
    - Snapshot backup – nearly instantaneous backups and rapid restores for DB files
    - Managed Backup Scheduling – custom schedules

# Performance Scaling

- **On Premises you add memory to a physical or virtual**
  - Azure VM – Change VM size
- **On Premises you can add more CPUs**
  - Azure VM – Change VM size
- **On Premises you can add additional network adapters**
  - Azure VM – add network adapters
- **On Premises you can migrate to different and faster storage**
  - Azure VM – increase the number of disk for additional storage and IOPS

# Performance Scaling

- **Migrate to a larger virtual machine**
  - Select a larger VM and migrate
  - Not a seamless migration
  - VM is migrated and started
  - Offline operation
  - Example: D1 V2 VM migrated to a D2 V2 VM took approximately 5 minutes

# Demo

Resizing an Azure virtual machine

# Billing Considerations and Licensing

- **Virtual machines are offered in a variety of sizes broken out by purpose**
  - General purpose – Balanced CPU-to-memory ratio – ideal for testing and dev, small to medium databases, and low to medium traffic web servers
  - Compute optimized – High CPU-to-memory ratio – good for medium traffic web servers, network appliance, and application servers
  - Memory optimized – High memory-to-core ratio – great for relational database servers, medium to large caches, and in-memory analytics
  - Storage optimized – High disk throughput and IO. Ideal for Big Data, SQL, and NoSQL databases
  - GPU – Specialized virtual machines targeted for heavy graphic rendering and video editing. Mining bitcoin too
  - High performance compute – The fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA)

# Billing Considerations and Licensing

- Each category of virtual machines have numerous options within that range, each one with a different price per hour depending on the number of cores, ram, and temporary storage
- Just like with on-premises, Developer edition is free, you pay to run the compute of the VM
- Customers with software assurance can bring their SQL Server licenses with one of the BYOL SQL Server images
- You incur billing while the server is up, for Dev and QA, migrate to a lower level VM or shutdown and deallocate the VM to avoid expense

# Key Takeaways

- Microsoft Azure is a cloud computing platform and infrastructure that you can use to start building, deploying, and managing applications in today
- Azure is compliant and secure
- You can extend your local Active Directory to Azure for seamless integration
- SQL Server can be run on Azure VMs by spinning up an OS with SQL Server already installed, or you can install SQL Server and BYOL
- Most common HA/DR options for on-premises SQL Server still apply to IaaS
- Scale Azure VMs much like you would on-premises
- Billing is very granular; you pay for what you use/provision

# Review

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# References

- **Azure Trust Center**
  - <http://bit.ly/2IKjwzK>
- **SQL Server in Azure best practices**
  - <http://bit.ly/2pKIDJ5>
- **Windows Virtual Machine Pricing**
  - <http://bit.ly/2iKC7iq>
- **Azure Active Directory**
  - <http://bit.ly/2meKK31>

# Questions?

