



# Migrating On-Prem VM to Microsoft Azure Cloud

## HIGH LEVEL STEP INVOLVED

- Access
- Design
- Migrate
- Go-Live
- Decommission

Migrating  
On-Prem  
VM to  
Microsoft  
Azure  
Cloud

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Azure VMs

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Migrate Data

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Scaling VMs

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SQL Server VM feature

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VM Storage

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HA/DR architecture

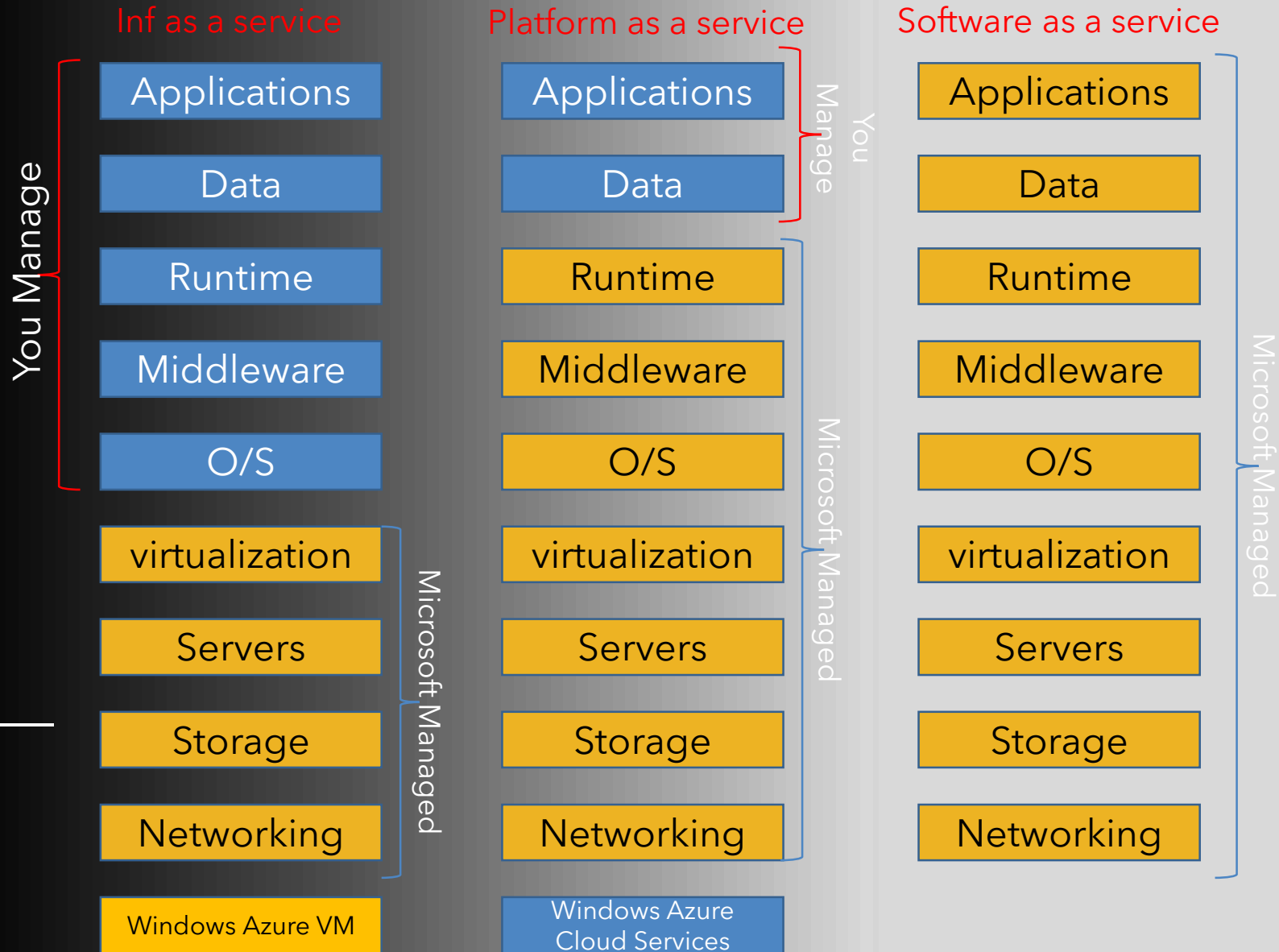
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Best practice

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# Migrating On-Prem VM to Microsoft Azure Cloud

Management



# Azure VM

## VM hosted on Microsoft Azure infrastructure

- Your image or from Microsoft image gallery.
  - SQL 2008R2 / 2012 / 2014 / 2016 Web / Standard / Enterprise
  - Images are refreshed with latest version, SP CU
  - Provisioned in under 10 mins
  - Accessible via PowerShell and RDP
  - Full SQL server compatibility
- Pay per use
  - Cost will depend on the licensing and size. EA customers can use existing License
  - Network: Only outgoing (not incoming) - charges
  - Storage: Only used (Does not charge allocated)
- Elasticity
  - 1 core / 2 GB mem / 1 TB ← → 32 cores / 448 GB mem / 64 TB

# Sizes for Windows virtual machines in Azure

(as of JAN 2020)

Type	Sizes	Description
General purpose	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC	Balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute optimized	Fsv2	High CPU-to-memory ratio. Good for medium traffic web servers, network appliances, batch processes, and application servers.
Memory optimized	Esv3, Ev3, Easv4, Eav4, Mv2, M, DSv2, Dv2	High memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage optimized	Lsv2	High disk throughput and IO ideal for Big Data, SQL, NoSQL databases, data warehousing and large transactional databases.
GPU	NC, NCv2, NCv3, ND, NDv2 (Preview), NV, NVv3, NVv4 (Preview)	Specialized virtual machines targeted for heavy graphic rendering and video editing, as well as model training and inferencing (ND) with deep learning. Available with single or multiple GPUs.
High performance compute	HB, HC, H	Our fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA).

# Compute optimized virtual machine sizes

Size	vCPUs	Memory: GiB	Temp storage (SSD) GiB	Max data disks	Max cached and temp storage throughput: IOPS / MBps (cache size in GiB)	Max uncached disk throughput: IOPS / MBps	Max NICs / Expected network bandwidth (Mbps)
Standard_F2s_v2	2	4	16	4	4000 / 31 (32)	3200 / 47	2 / 875
Standard_F4s_v2	4	8	32	8	8000 / 63 (64)	6400 / 95	2 / 1750
Standard_F8s_v2	8	16	64	16	16000 / 127 (128)	12800 / 190	4 / 3500
Standard_F16s_v2	16	32	128	32	32000 / 255 (256)	25600 / 380	4 / 7000
Standard_F32s_v2	32	64	256	32	64000 / 512 (512)	51200 / 750	8 / 14000
Standard_F48s_v2	48	96	384	32	96000 / 768 (768)	76800 / 1100	8 / 21000
Standard_F64s_v2	64	128	512	32	128000 / 1024 (1024)	80000 / 1100	8 / 28000
Standard_F72s_v2 <sup>2, 3</sup>	72	144	576	32	144000 / 1152 (1520)	80000 / 1100	8 / 30000

# Storage Configuration

Automatically creates one windows storage space (virtual drive) across all disks

The screenshot displays three panels from the Azure portal:

- Create virtual machine:** A progress bar with five steps: 1. Basics (Done), 2. Size (Done), 3. Settings (Done), 4. SQL Server settings (Active), and 5. Summary (SQL Server 2014 Enterprise on...).
- SQL Server settings:** Includes sections for SQL connectivity (Private (within Virtual Network)), Port (1433), SQL Authentication (Disable/Enable), Storage configuration (General), Automated patching (Sunday at 2:00), Automated backup (Disabled), and Azure Key Vault integration (Disabled).
- Storage configuration:** Features sliders for IOPS (15000), Throughput (MBps) (256), and Storage size (TB) (3). A note states: "3 data disks will be added to the virtual machine. This value was computed based on the value of IOPS, throughput, and storage size." A Storage optimization dropdown is set to General.

# Azure Service by Region (North America)

<https://azure.microsoft.com/en-us/global-infrastructure/services/?products=all>

TABLE KEY: Generally Available In Preview In Preview (hover to view expected timeframe) Future availability (hover to view expected timeframe)

Products	CANADA		UNITED STATES							
	Non-regional	Canada Central	Canada East	Central US	East US	East US 2	North Central US	South Central US	West Central US	West US
Managed Disks										
Storage Accounts										
Archive Storage										
Disk Storage										
Hot/Cool Blob Storage Tiers										
Import/Export										
Azure Data Lake Storage Gen2										
Premium Blob Storage										
Premium Files Storage										
Azure Backup										
Azure Database Migration Service										



# Azure VM – Management

## Automated Patching

- Predictable solution for patching (Windows & SQL)
- Simple: just specify a time window
- Uses *SQL Agent Extension* and *MS Update*
- Portal and Powershell
- It relies on the Windows Update and the Microsoft Update infrastructure and installs any update that matches the 'Important' category for the machine.

The image shows two side-by-side screenshots from the Azure portal. The left screenshot is titled "SQL Server settings" and displays various configuration options: "SQL connectivity" is set to "Private (within Virtual Network)", "Port" is 1433, "SQL Authentication" is set to "Disable", and "Storage configuration" is "Not available". The "Automated patching" option is highlighted in blue, showing a schedule of "Sunday at 2:00". Other options like "Automated backup" and "Azure Key Vault integration" are also visible. The right screenshot is titled "SQL Automated Patching" and provides a detailed view of the patching configuration. It includes a description: "Set a patching window during which all Windows and SQL patches will be applied." The "Automated patching" toggle is set to "Enable". The "Maintenance schedule" is set to "Sunday", the "Maintenance start hour (local time)" is "02:00", and the "Maintenance window duration (minutes)" is set to 60. Both screenshots have an "OK" button at the bottom.

# Azure VM - Management Automated Backups

- For all DBs in the SQL instance
- Simple: just specify a retention period
- Supports Compression and Encryption
- Portal and Powershell
- Full database and transaction log backups
- Configure at database level or SQL Server instance level

## In SQL Server 2016:

- Full, bulk-logged and simple recovery models are all supported
- System databases can be configured for backups
- Backup striping can be used to support backup sizes of up to 12 TB
- Customer backup schedules can be specified to ensure your backups are created when it is best for your workload

The image shows two side-by-side screenshots from the Azure portal. The left screenshot, titled "SQL Server settings", displays various configuration options for a SQL Server instance. The "SQL connectivity" is set to "Private (within Virtual Network)". The "Port" is set to 1433. "SQL Authentication" is currently set to "Disable". "Storage configuration" is "Not available". "Automated patching" is set to "Sunday at 2:00". "Automated backup" is currently "Disabled" and is highlighted with a blue selection bar. "Azure Key Vault integration" is also "Disabled". An "OK" button is visible at the bottom. The right screenshot, titled "SQL Automated Backup", provides a detailed view of the backup configuration. It includes a "Disable" button and an "Enable" button. The "Retention period (days)" is set to 30, shown on a slider. The "Storage account" is "sqlserver3058". The "Encryption" is currently set to "Disable". An "OK" button is visible at the bottom.

# Licensing / Bring your own license

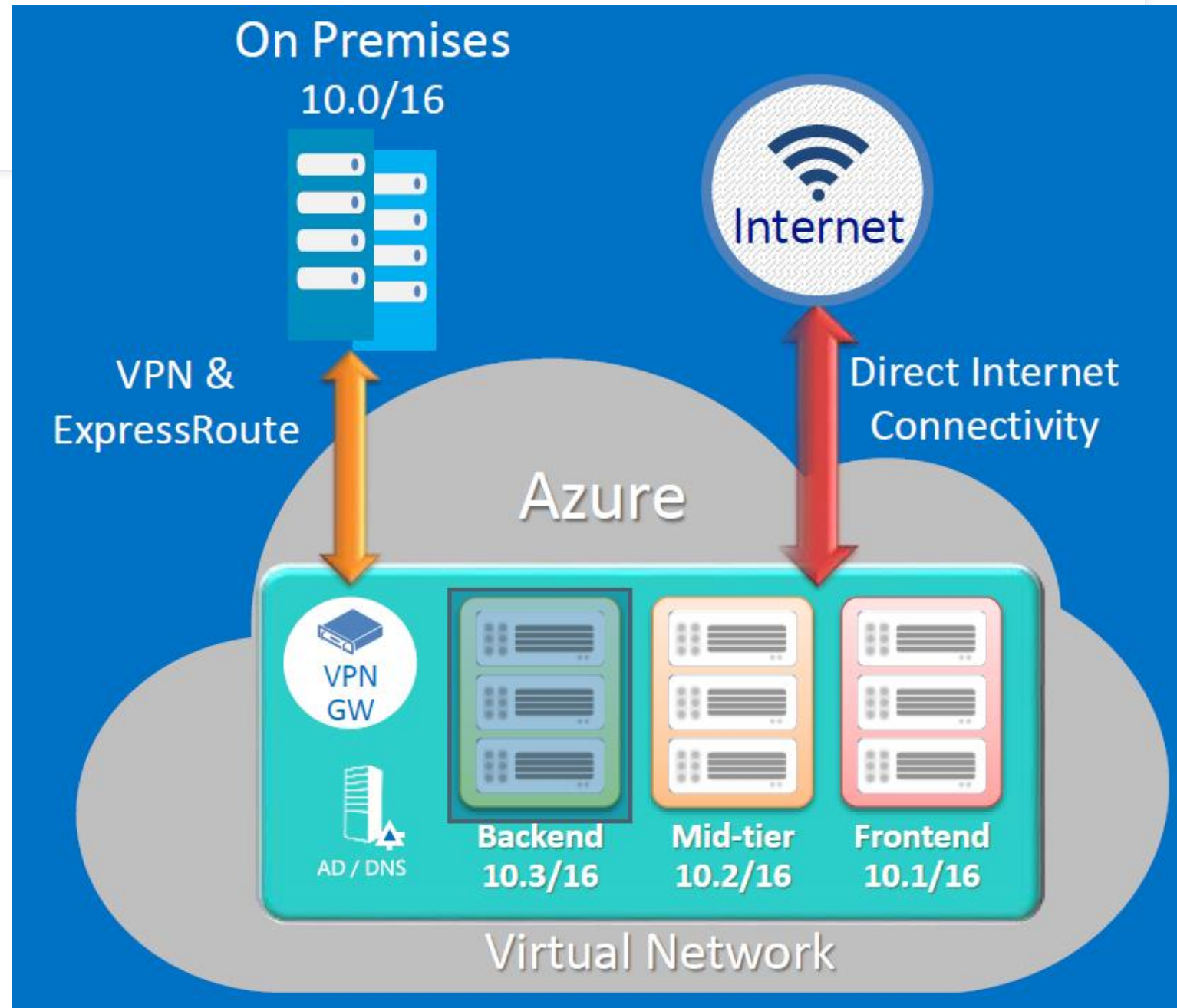
**Obtain SQL  
image from  
Azure VM gallery  
Pay per use**

**Install or upload  
your own SQL  
Server image**









PRODUCTS	AVAILABLE IN THE IMAGE GALLERY AND CHARGED PER MINUTE	LICENSE MOBILITY THROUGH SOFTWARE ASSURANCE	SPLA SAL LICENSE
Windows Server Datacenter Edition	✔ (per-minute charge includes use of hardware resource, server license and client access rights)		
Windows Server Standard Edition			
SQL Server Enterprise Edition	✔	✔	
SQL Server Standard Edition	✔	✔	✔
SQL Server Web Edition	✔		
BizTalk Server Enterprise Edition	✔	✔	
BizTalk Server Standard Edition	✔	✔	
SharePoint Server		✔	✔
System Center Datacenter		✔	
System Center Standard		✔	
Team Foundation Server		✔	✔
Project Server		✔	✔
Microsoft Dynamics NAV			✔
Microsoft Dynamics GP			✔

# Virtual Machine networking

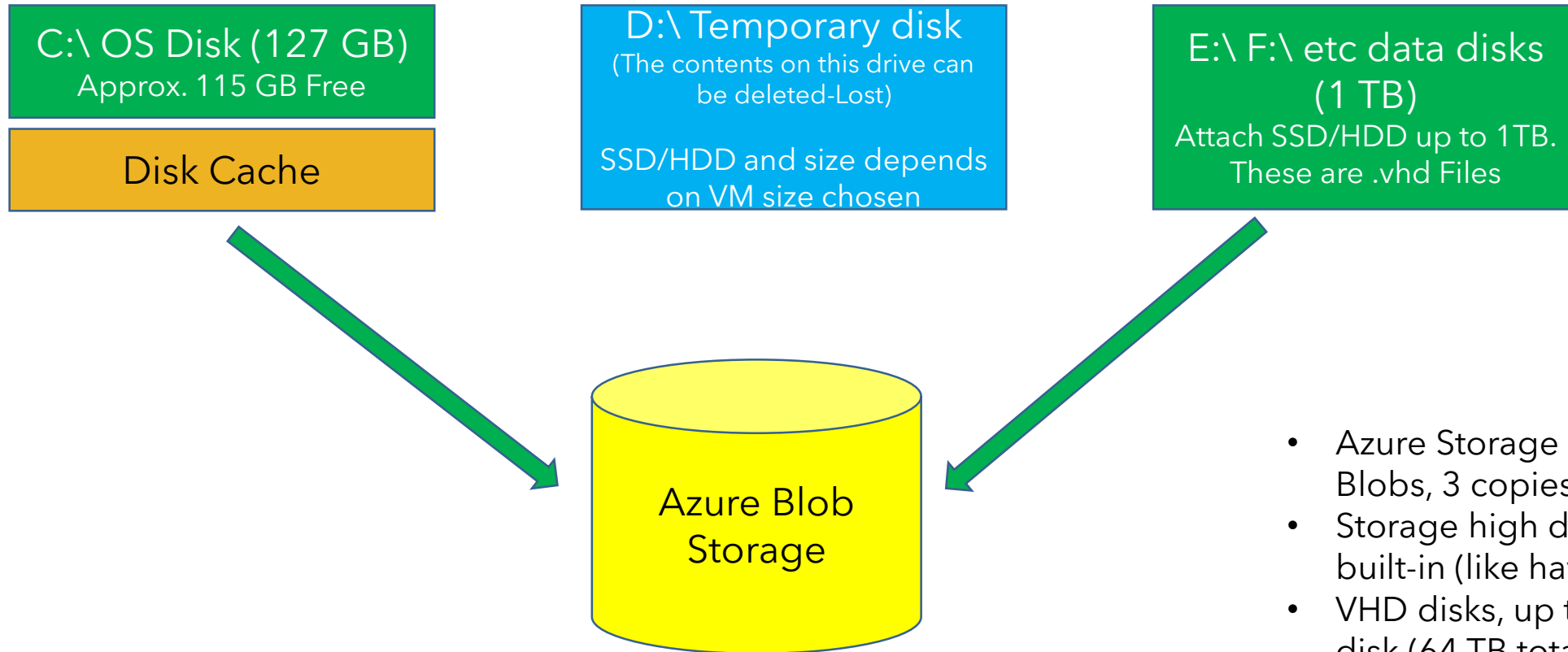
- Create subnets with private or public IP addresses
- Bring your own DNS or use Azure-provided DNS
- Secure with Network Security Groups ACLs
- Control traffic with user-defined routes



# Azure connectivity Options

Cloud		Customer	Segment and workloads
	Internet connectivity		<ul style="list-style-type: none"><li>• <b>Consumers</b></li><li>• Access over public IP</li><li>• DNS resolution</li><li>• Connect from anywhere</li></ul>
	Secure point-to-site connectivity		<ul style="list-style-type: none"><li>• <b>Developers</b></li><li>• POC Efforts</li><li>• Small scale deployments</li><li>• Connect from anywhere</li></ul>
	Secure site-to-site VPN connectivity		<ul style="list-style-type: none"><li>• <b>SMB, Enterprises</b></li><li>• Connect to Azure compute</li></ul>
	ExpressRoute private connectivity		<ul style="list-style-type: none"><li>• <b>SMB, Enterprises</b></li><li>• Mission critical workloads</li><li>• Backup/DR, media, HPC</li><li>• Connect to Microsoft services</li></ul>

# Azure Virtual Machine Storage

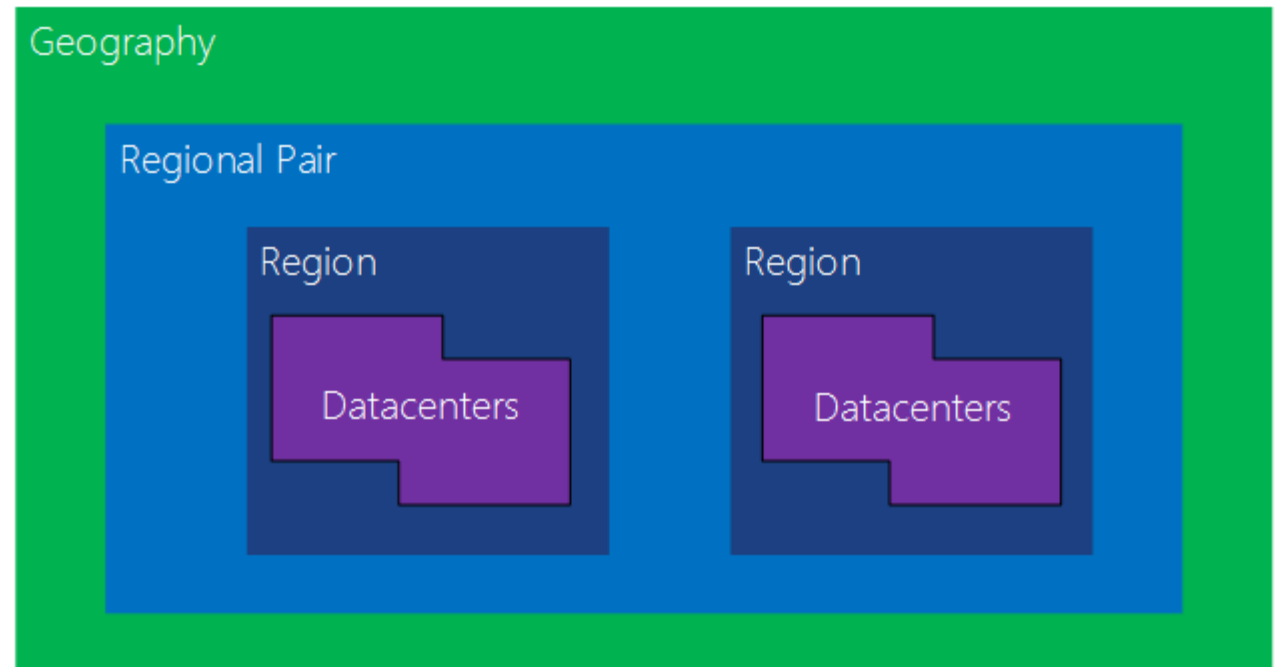


- Azure Storage Page Blobs, 3 copies
- Storage high durability built-in (like have RAID)
- VHD disks, up to 1 TB per disk (64 TB total)

# Geo-Replication - Storage

Azure Storage copies your data so that it is protected from planned and unplanned events, including transient hardware failures, network or power outages, and massive natural disasters. You can choose to replicate your data within the same data center, across zonal data centers within the same region, or across geographically separated regions.

- Locally redundant storage (LRS)
- Zone-redundant storage (ZRS)
- Geo-redundant storage (GRS)
- Read-access geo-redundant storage (RA-GRS)
- Geo-zone-redundant storage (GZRS)
- Read-access geo-zone-redundant storage (RA-GZRS)



# HA/DR - SQL Server architecture

SQL Server HADR technologies that are supported in Azure include:

- Always On Availability Groups
- Always On Failover Cluster Instances
- Log Shipping
- SQL Server Backup and Restore with Azure Blob Storage Service
- Database Mirroring - Deprecated in SQL Server 2016



# HA/DR - SQL Server architecture

## AlwaysOn Availability Groups

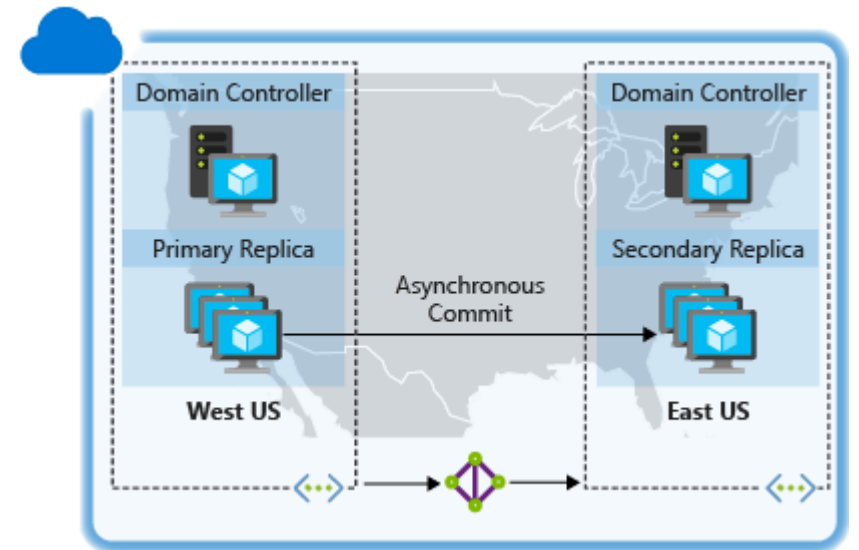
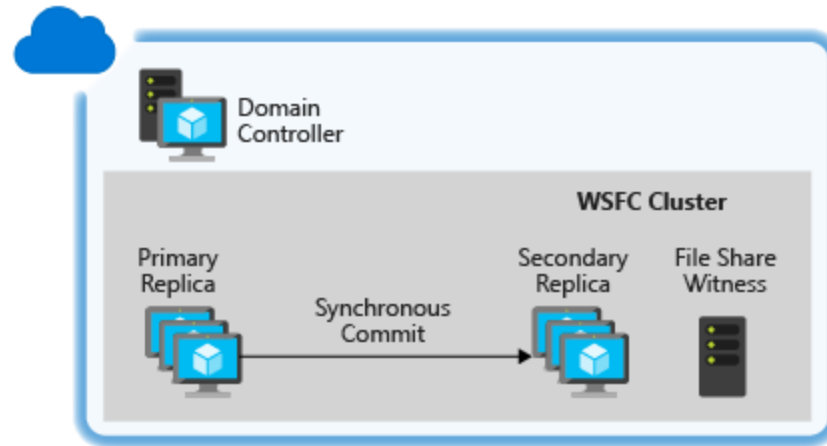
### Azure Only

Availability replicas running across multiple datacenters in Azure VMs for disaster recovery.

Cross-region solution protects against complete site outage.

### Hybrid

Some availability replicas running in Azure VMs and other replicas running on-premises for cross-site disaster recovery.



# HA/DR - SQL Server architecture

## AlwaysOn Failover Cluster Instances (FCI)

### **HA only, not DR**

FCI on a two-node WSFC running in Azure VMs with storage supported by a third-party clustering solution.

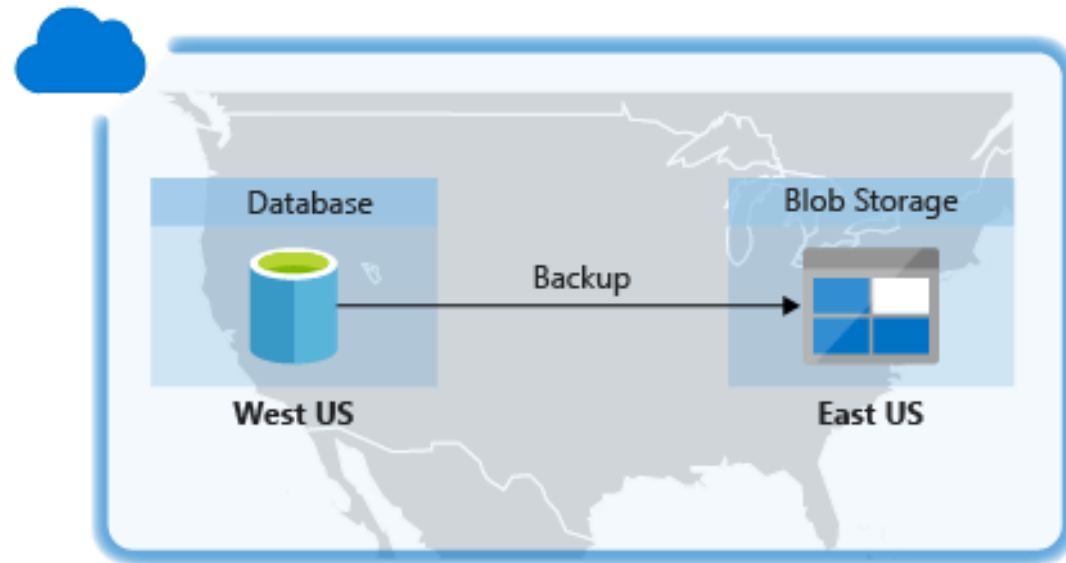
FCI on a two-node WSFC running in Azure VMs with remote iSCSI Target shared block storage via ExpressRoute.

Failover Cluster Instances (FCI), which require shared storage, can be created in 4 different ways.

1. A two-node failover cluster running in Azure VMs with attached storage using Windows Server 2016 Storage Spaces Direct (S2D) to provide a software-based virtual SAN.
2. A two-node failover cluster running in Azure VMs using Premium File Share. Premium file shares are SSD-backed consistently-low-latency file shares that are fully supported for use with Failover Cluster Instance.
3. A two-node failover cluster running in Azure VMs with storage supported by a third-party clustering solution. For a specific example that uses SIOS DataKeeper, see High availability for a file share using failover clustering and third party software SIOS DataKeeper.
4. 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.

# HA/DR - SQL Server architecture

## Backup and Restore with Azure Blob Storage Service

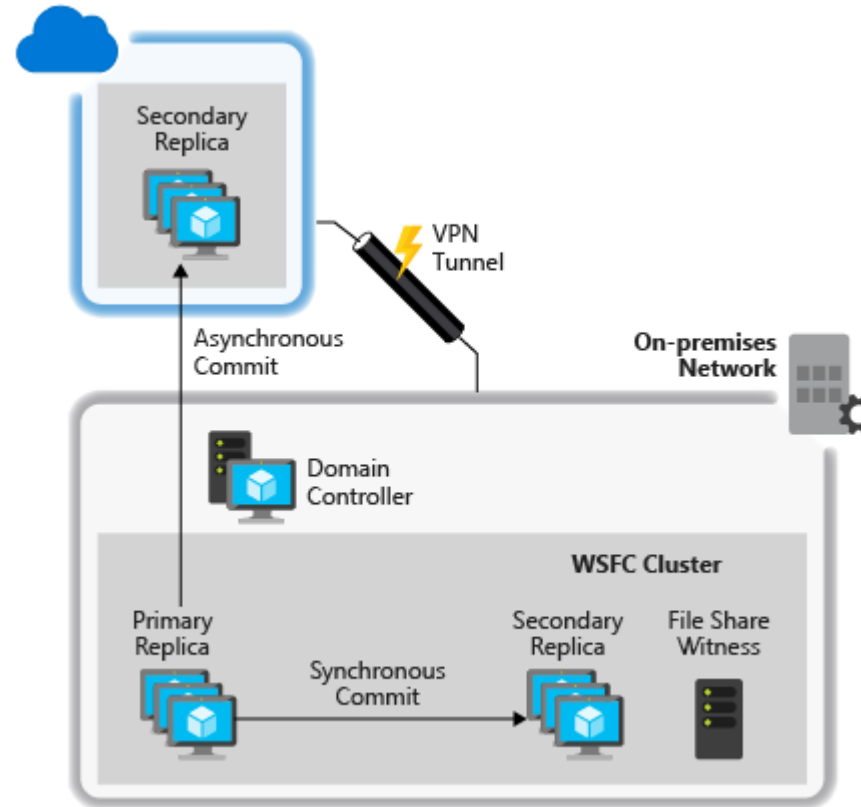


# HA/DR - SQL Server architecture

## Hybrid IT: Disaster recovery solutions

You can have a disaster recovery solution for your SQL Server databases in a hybrid-IT environment using availability groups, database mirroring, log shipping, and backup and restore with Azure blob storage.

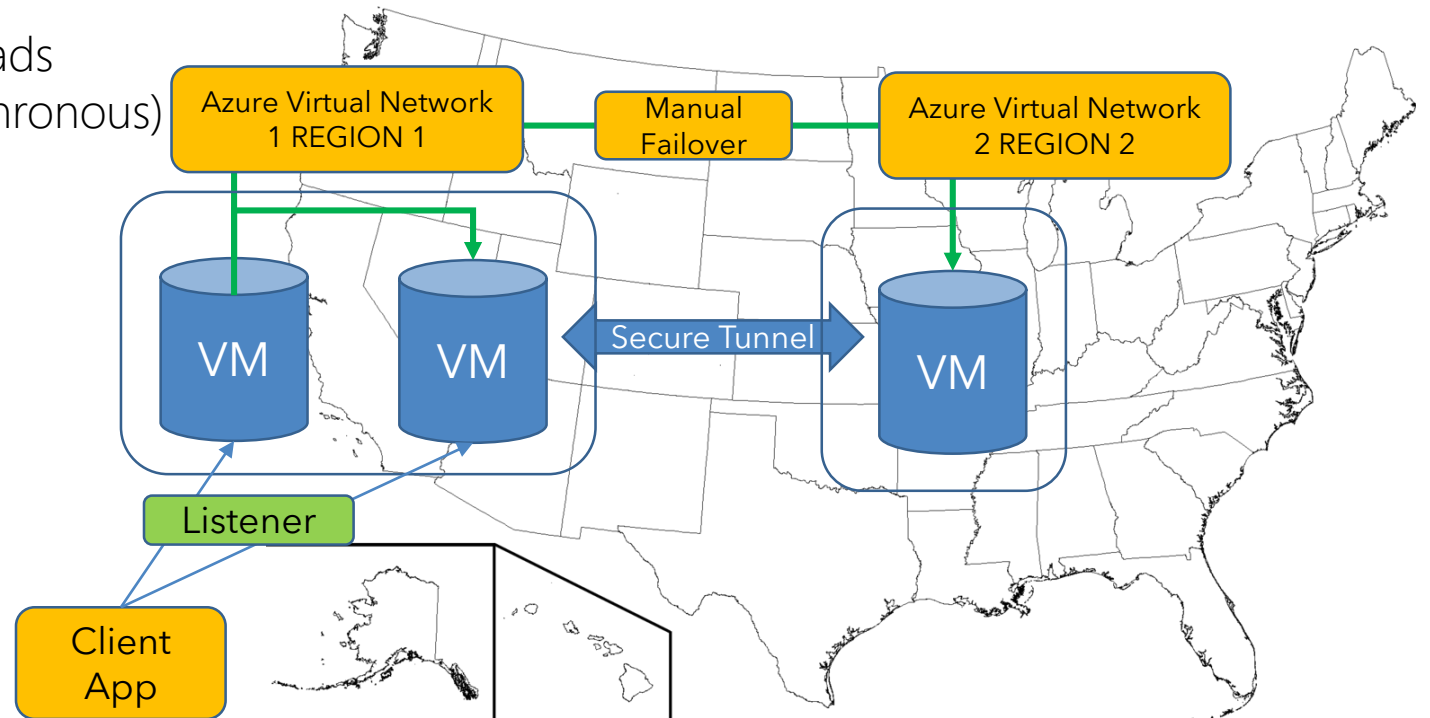
Some availability replicas running in Azure VMs and other replicas running on-premises for cross-site disaster recovery. The production site can be either on-premises or in an Azure datacenter.



# HA/DR - Azure VMs

## AlwaysOn between Azure Regions

- Configure AlwaysOn between VMs in different geographic regions (asynchronous)
  - Over secure tunnel
- Manual Failover (~15 seconds) in case of a regional failure
  - Test it at any time
- Use closest secondary for read workloads
- Region 1: AG used instead of FCI (synchronous)



# RTO/RPO


RTO – Recover Time Objective. How much time after a failure until we have to be up and running again?

RPO – **Recover** Point Objective. How much data can we lose?

- HA – High Availability
  - RTO: seconds to minutes
  - RPO: Zero to seconds
  - Automatic failover
  - Well tested (maybe with each patch or release)
- DR – Disaster Recovery
  - RTO: minutes to hours
  - RPO: seconds to minutes
  - Manual failover into prepared environment
  - Tested from time to time

How long does it take to fail over:

- Backup-Restore: Hours
- Log Shipping: Minutes
- AlwaysOn FCI: Seconds to minutes
- AlwaysOn AG/Mirroring: Seconds



# AlwaysOn FCI vs AlwaysOn AG

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	FCI	AG
Configuration/Install	Setup	Post-Setup
Protects	Instance	Database
“Shared” Storage Requirement	Yes	No
Can Be Used for Reporting	No*	Yes
Data Loss	Consistent to the point of failure	It depends
Edition of SQL Server	Standard (2 node) or Enterprise	Enterprise
Number of nodes or replicas	Up to OS max for nodes	4 secondary replicas (2012); 9 (2014)

# SQL Server in Azure VM Best Practices

<https://docs.microsoft.com/en-us/azure/virtual-machines/windows/sql/virtual-machines-windows-sql-performance>  
Performance guidelines for SQL Server in Azure Virtual Machines

## VM Size

- Use VM sizes with 4 or more vCPU like [E4S v3](#) or higher, or [DS12 v2](#) or higher.
- [Es, Eas, Ds and Das Series](#) offers the optimum memory to vCPU ratio required for OLTP workload performance.
- [M Series](#) offers the highest memory to vCPU ratio required for mission critical performance and is ideal for data warehouse workloads.

## Storage

- Use premium storage
- Keep the storage account and SQL Server in same region
- Disable Azure geo-redundant storage (geo-replication) on the storage account

## Disks

- Use [premium SSDs](#) for the best price/performance advantages. Configure [ReadOnly cache](#) for data files and no cache for the log file.
- Use [Ultra Disks](#) if less than 1 ms storage latencies are required by the workload.
- Avoid using the OS or Temp Disk for Logging or Data Storage
- Enable read caching on the disks hosting the data files and tempdb
- Don't enable caching on tlog disks
- Strip multiple azure disks to get increased IO throughput
- Format the disks with documented allocation size

## I/O

- Enable DB Compression
- Enable Instant File initialization for Data Files
- Limit Autogrow on the databases
- Disable Autoshrink
- Move all system and user databases to data disks
- Move SQL Log files to data Disks
- Enabled locked pages
- Apply SQL patches

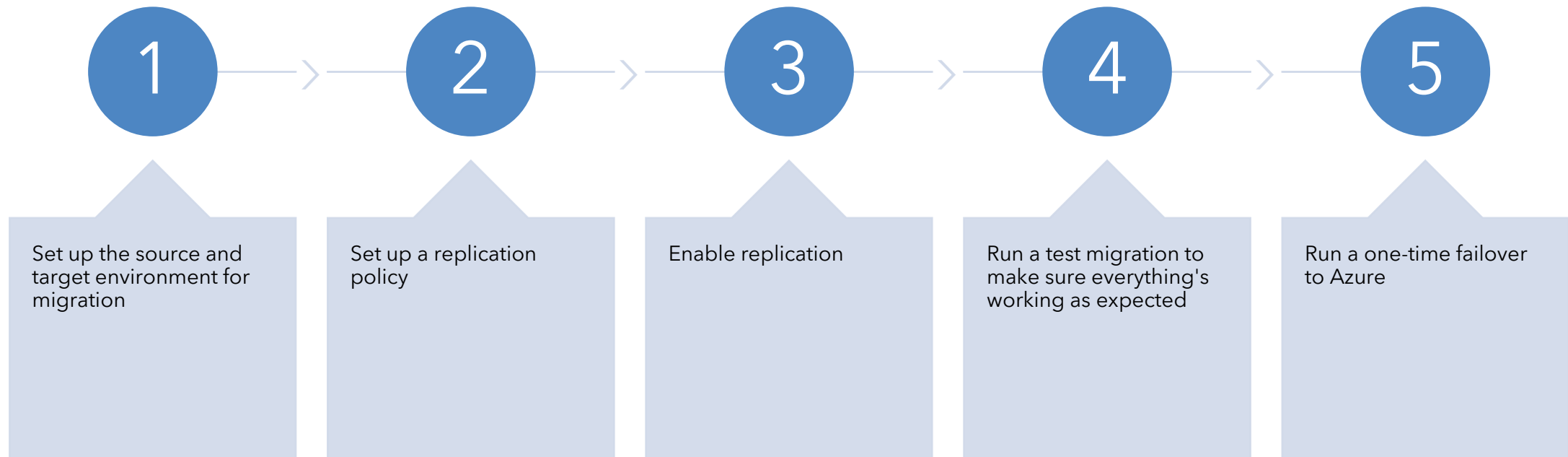




# MIGRATION

# Migrate on-premises machines to Azure

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# Prepare Azure for on- premises disaster recovery to Azure

- Verify that the Azure account has replication permissions.
- Create a Recovery Services vault. A vault holds metadata and configuration information for VMs, and other replication components.
- Set up an Azure virtual network (VNet). When Azure VMs are created after failover, they're joined to this network.

Site Recovery can manage replication for:

- Azure VMs replicating between Azure regions.
- On-premises VMs, Azure Stack VMs and physical servers.

# Enable replication to Azure for VMware VMs

## Resolve common issues

- Each disk should be smaller than 4 TB.
- The OS disk should be a basic disk, not a dynamic disk.
- For generation 2/UEFI-enabled virtual machines, the operating system family should be Windows, and the boot disk should be smaller than 300 GB.

## Before you Start

- When you're replicating VMware virtual machines, keep this information in mind:
- Your Azure user account needs to have certain [permissions](#) to enable replication of a new virtual machine to Azure.
- VMware VMs are discovered every 15 minutes. It can take 15 minutes or longer for VMs to appear in the Azure portal after discovery. Likewise, discovery can take 15 minutes or longer when you add a new vCenter server or vSphere host.
- It can take 15 minutes or longer for environment changes on the virtual machine (such as VMware tools installation) to be updated in the portal.
- You can check the last-discovered time for VMware VMs: See the **Last Contact At** field on the **Configuration Servers** page for the vCenter server/vSphere host.
- To add virtual machines for replication without waiting for the scheduled discovery, highlight the configuration server (but don't click it), and select **Refresh**.
- When you enable replication, if the virtual machine is prepared, the process server automatically installs the Azure Site Recovery Mobility service on it.

# How do we Replicate - Azure Site Recovery

## Pricing details

Azure Site Recovery is billed based on number of instances protected. Every instance that is protected with Azure Site Recovery is free for the first 31 days, as noted below.

	PRICE FOR FIRST 31 DAYS	PRICE AFTER 31 DAYS
Azure Site Recovery to customer owned sites	Free	\$16/month per instance protected
Azure Site Recovery to Azure	Free	\$25/month per instance protected

Azure Site Recovery between Azure regions is charged at the same rate as Azure Site Recovery to Azure.

Azure Site Recovery is billed in units of the average daily number of instances you are protecting over a monthly period. For example, if you consistently protected 20 instances for the first half of the month, and none for the second half of the month, the average daily number of protected instances would be 10 for that month.

# How do we Replicate - Azure Site Recovery

## Simple to deploy and manage

Set up Azure Site Recovery simply by replicating an Azure VM to a different Azure region directly from the Azure portal. As a fully integrated offering, Site Recovery is automatically updated with new Azure features as they're released. Minimize recovery issues by sequencing the order of multi-tier applications running on multiple virtual machines. Ensure compliance by testing your disaster recovery plan without impacting production workloads or end users. And keep applications available during outages with automatic recovery from on-premises to Azure or Azure to another Azure region.

