



# SAP on Azure Enablement

Tuesday, Oct 13, 2020

Leon Davis  
Ravi Gangampalli  
APAC, Singapore

Module Two – Week One

Day 2 – Tuesday, Oct 13, 2020

**IMPT NOTICE:**

- If you choose to participate in this session using Microsoft Teams, your name, email address, phone number, and/or title may be viewable by other session participants.
- **Please note that the training will not and cannot be recorded in alignment with Microsoft's policies**



# SAP on Azure Partner Enablement

Module Two – Week One

Day 2 – Architecting Netweaver on AnyDb on  
Azure



**Leon Davis**

Cloud Solution Architect – SAP on Azure  
Partner Success Team



**Ravi Gangampalli**

Cloud Solution Architect– SAP on Azure  
One Commercial Partner

# Check-in

We are happy to host you 😊

<https://aka.ms/apac-enablement-check-in>

<https://aka.ms/apac-sap-enablement>



# Agenda

1. SAP Certification for Azure (Any DB)

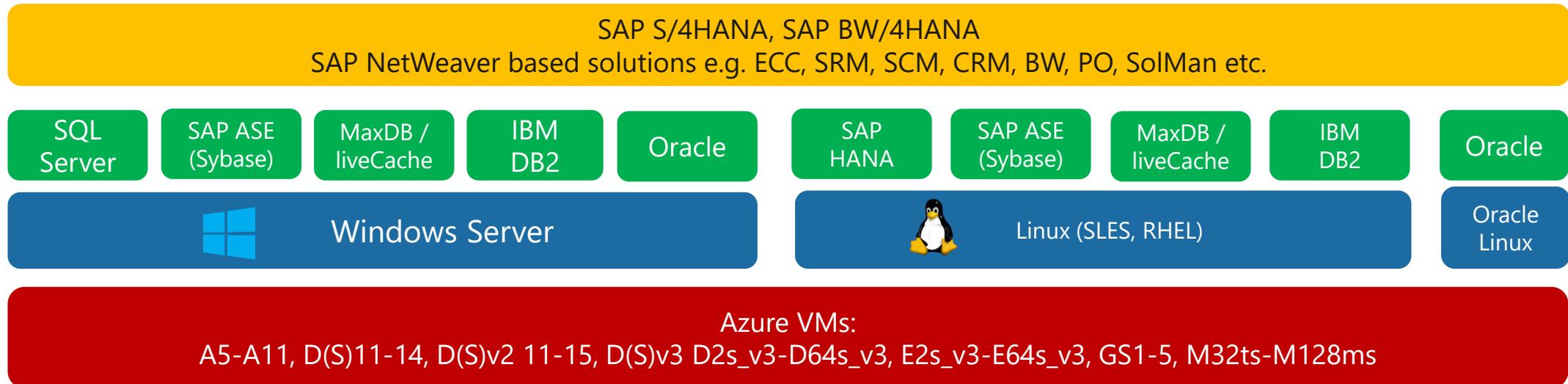
2. Key Design Aspects

3. Reference Architecture

4. Backups

5. Migration to Azure

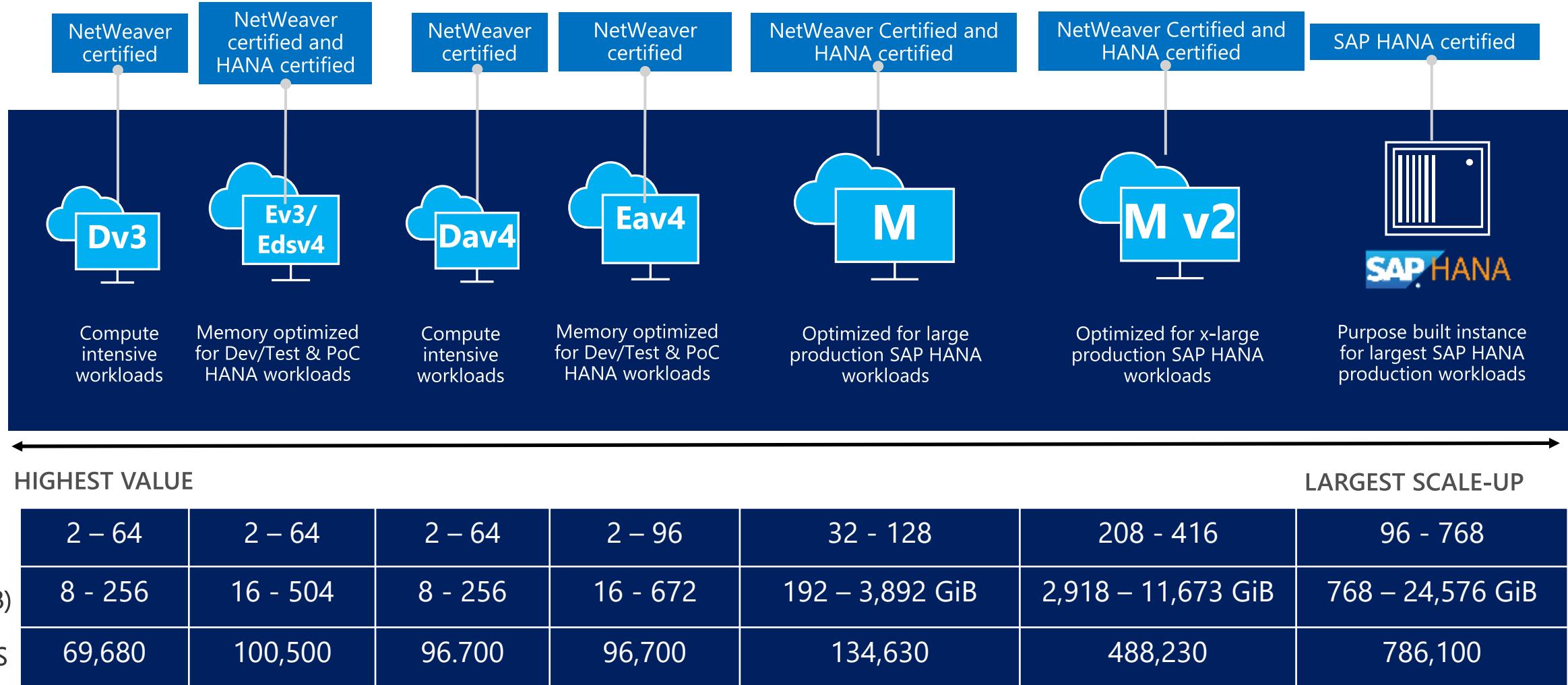
# Certified SAP Solutions on Azure



Additional certified SAP solutions:

- SAP Business One
- SAP Business Objects
- TREX
- SAP Content Server
- SAP Financial Consolidation
- SAP Hybris Commerce

# SAP on Azure— Large Variety on Compute Instances



# Agenda

1. SAP Certification for Azure (Any DB)

2. Key Design Aspects

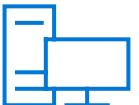
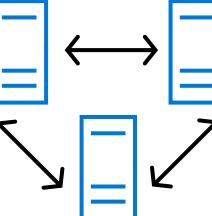
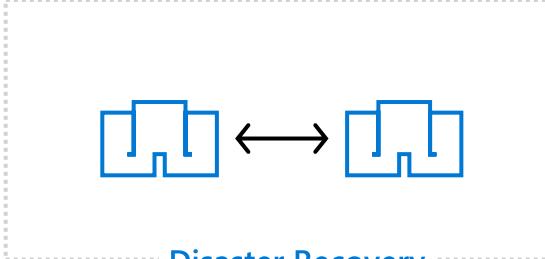
3. Reference Architecture

4. Backups

5. Migration to Azure

# Azure Virtual Machine Resilience

Industry-leading high availability SLA

Power/facility	Region Pairs, Availability Zones, Availability Set		
Industry-only	• Industry-leading high availability SLA	• Industry-leading Disaster Recovery	•
VM SLA 99.9%	VM SLA 99.95%	VM SLA 99.99%	Regions 54
			
Single VM Protection with Premium Storage	Availability Sets Protection against failures within datacenters	Availability Zones Protection from entire datacenter failures	Region Pairs Protection from disaster with Data Residency compliance

# Architecting to Protect Single Points of Failure



## SAP's Single Points of Failures

SPOF's	HA Protection Mechanisms	DR Protection Mechanisms
Application Servers	Multiple App Servers + Availability Sets / Zones	Azure Site Replication (ASR)
ABAP SAP Central Services	SAP HA + Clustering + Availability Sets / Zones	Azure Site Replication (ASR)
Database Instance	Clustering + Availability Sets / Zones	DB Replication or Storage Replication

## SLA'S, RPO, RTO dictate the architecture

- Design to cover the customers Service Level Agreement 99.9%, 99.95% or 99.99%?
- How fast to recover the landscape in a DR scenario and how much data can they afford to lose dictates the DR design.

# Architecting to Protect Single Points of Failure



## High Availability (HA)

Service Level Agreement	HA Protection Mechanisms
99.9%	Single VM's with Premium Storage
99.95%	SAP HA + Clustering + Availability Sets
99.99%	SAP HA+ Clustering + Availability Zones



## Disaster Recovery (DR)

Recovery Point Objective	DR Protection Mechanisms
0 mins	Availability Zones with DB Replication Synchronous Mode
0>30 mins	Azure Region Pair with DB Replication Asynchronous
Recovery Time Objective	DR Protection Mechanisms
4 Hours	This is procedure based and vary depending on disaster recovery and business continuity plans in place and automation.

# Architecting to Protect Single Points of Failure



## Azure Site Recovery (ASR)

ASR is a protection mechanism for replicating the VM's from one location to another.

Couple of things to consider:

- Some limitations on VM's Types, OS versions, Regions Availability. All details: <https://docs.microsoft.com/en-us/azure/site-recovery/azure-to-azure-support-matrix>
- Suitable for App and ASCS servers. Not suitable for DB nodes. (Churn rate limitations)



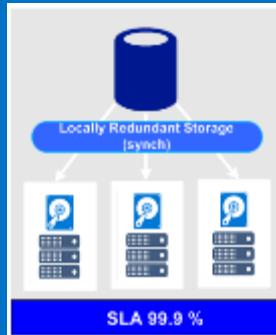
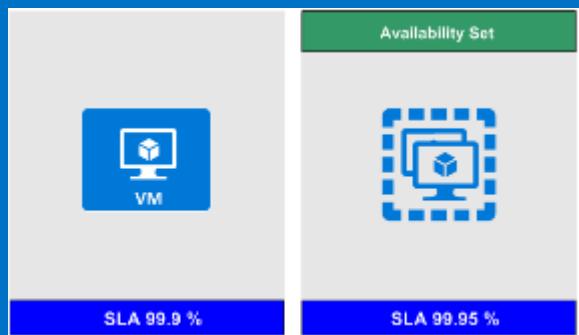
## Database Replication Options (DR)

There are multiple options for replicating the DB. Specifically:

Replication Type	Example
DBMS Replication	HANA System Replication or SQL Always On
Storage Replication	Available on SAP Hana Large Instances
Azure NetApp Files Replication	Cloud Sync Replication using ANF

# SAP VM & Storage Sizing Principles

1. Know # of SAPS for SAP application and database tiers
2. Know system activity period, use snoozing, Azure automation to shutdown (i.e. sandbox 10x5, not 24x7)
3. For SAP APPL servers, use a few smaller VM vs one large VM (redundant nodes).
4. Ensure the selected VM supports the IOPS & throughput requirements of the database server.
5. Choose standard or premium storage Managed Disks based on IOPS and disk throughput requirements.
6. Use premium storage for SAP databases (both database files and log file(s)).
7. For database servers use Windows storage spaces or LINUX-LVM to stripe (glue) disks and aggregate IOPS, throughput and storage capacity
8. SAP application servers can be deployed on small premium storage (P4, P6) if using a single server in order to benefit from single instance SLA.



# Choose Azure VM types to meet sizing requirements

VM Series	VM Type	VM Size	Temp SSD	SAPS	# of v-disks	Max IOPS (cached)	Max Disk Bandwidth (cached)	Max Network Bandwidth	Compute (No OS) hourly on demand, USE2	Supported HANA scenarios	Remark	SAP certification
DS v3	D2s_v3	2 vCPU, 8 GiB	16 GiB	2,178	4	4,000	32 MB/sec	moderate	\$ 0.110		Xeon E5-2673 v4 (Broadwell) 3.5Ghz TB	Certified (Any DB, App)
	D4s_v3	4 vCPU, 16 GiB	32 GiB	4,355	8	8,000	64 MB/sec	moderate	\$ 0.220			
	D8s_v3	8 vCPU, 32 GiB	64 GiB	8,710	16	16,000	128 MB/sec	high	\$ 0.440			
	D16s_v3	16 vCPU, 64 GiB	128 GiB	17,420	32	32,000	256 MB/sec	high	\$ 0.880			
	D32s_v3	32 vCPU, 128 GiB	256 GiB	34,840	32	64,000	512 MB/sec	extremely high	\$ 1.760			
	D64s_v3	64 vCPU, 256 GiB	512 GiB	69,680	32	128,000	1024 MB/sec	extremely high	\$ 3.520			
ES v3	E2s_v3	2 vCPU, 16 GiB	32 GiB	2,178	4	4,000	32 MB/sec	1 Gbps	\$ 0.146		Xeon E5-2673 v4 (Broadwell) 3.5Ghz TB	Certified (Any DB, App)
	E4s_v3	4 vCPU, 32 GiB	64 GiB	4,355	8	8,000	64 MB/sec	2 Gbps	\$ 0.293			
	E8s_v3	8 vCPU, 64 GiB	128 GiB	8,710	16	16,000	128 MB/sec	4 Gbps	\$ 0.585			
	E16s_v3	16 vCPU, 128 GiB	256 GiB	17,420	32	32,000	256 MB/sec	8 Gbps	\$ 1.170			HANA certification in roadmap App, Any DB certified
	E32s_v3	32 vCPU, 256 GiB	512 GiB	34,840	32	64,000	512 MB/sec	16 Gbps	\$ 2.341	OLTP/OLAP		
	E64s_v3	64 vCPU, 432 GiB	864 GiB	70,050	32	128,000	1024 MB/sec	30 Gbps	\$ 4.412	OLTP/OLAP		
M	M32ts	32 vCPU, 192 GiB	1,000 GiB	33,670	16	40,000	400 MB/sec	8 Gbps	\$ 2.707	OLTP	Intel® Xeon® E7-8890 v3 (Haswell)	HANA, App, Any DB certified
	M32ls	32 vCPU, 256 GiB	1,000 GiB	33,300	16	40,000	400 MB/sec	8 Gbps	\$ 2.873	OLTP		
	M64ls	64 vCPU, 512 GiB	2,000 GiB	66,600	32	80,000	800 MB/sec	16 Gbps	\$ 5.415	OLTP		
	M64s	64 vCPU, 1,024 GiB	2,000 GiB	67,315	32	80,000	800 MB/sec	16 Gbps	\$ 6.669	OLTP/OLAP		
	M64ms	64 vCPU, 1,792 GiB	2,000 GiB	68,930	32	80,000	800 MB/sec	16 Gbps	\$ 10.337	OLTP		
	M128s	128 vCPU, 2,048 GiB	4,000 GiB	134,630	64	160,000	1,600 MB/sec	30 Gbps	\$ 13.338	OLTP/OLAP		
	M128ms	128 vCPU, 3,800 GiB	4,000 GiB	134,630	64	160,000	1,600 MB/sec	30 Gbps	\$ 26.688	OLTP		
M v2	M208s v2	208 vCPU, 2,850 GiB	7,040 GiB	259,950	64	80,000	1,000 MB/sec	16 Gbps	\$ 22.31	OLTP/OLAP	Intel® Xeon® Platinum 8180M 2.5GHz (Skylake)	HANA, App, Any DB certified
	M208ms v2	208 vCPU, 5,700 GiB	7,040 GiB	259,950	64	80,000	1,000 MB/sec	16 Gbps	\$ 44.62	OLTP/OLAP		

SAP Note 1928533 and <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/sizes-memory>

MICROSOFT CONFIDENTIAL—INTERNAL USE ONLY

# Agenda

1. SAP Certification for Azure (Any DB)

2. Key Design Aspects

3. Reference Architecture

- Storage

4. Backups

5. Migration to Azure

# Why is Storage Performance important for SAP?

SAP applications rely on Databases.

Databases need to adhere to the ACID Properties:

Atomicity:

A

Transactions  
are all or  
nothing!

Consistency:

C

Only valid  
data is saved

Isolation:

I

Transactions  
do not affect  
each other

Durability:

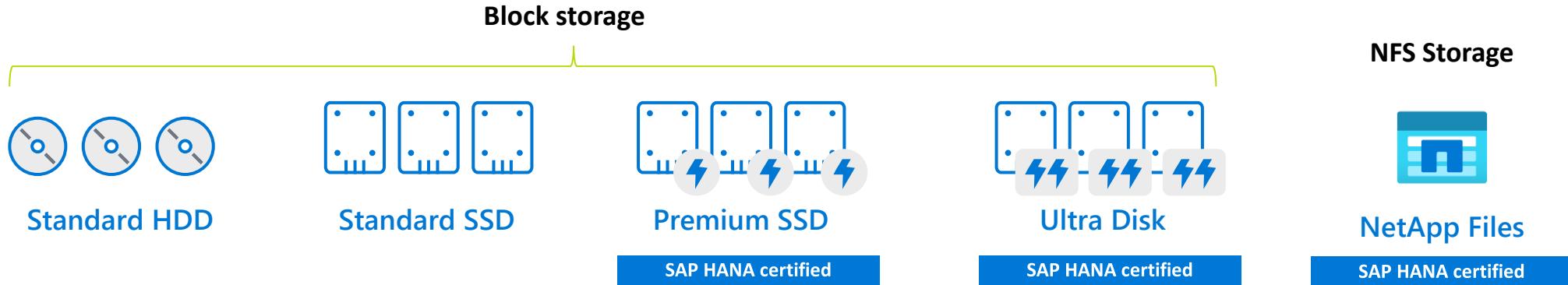
D

Written data  
will not be  
lost

DB keeps a change log that is persisted on storage when transactions are committed.

Independent of if you have an in-memory database or 'traditional' database, having poor storage performance will greatly impact SAP performance.

# Scalable storage to meet demanding SAP workload needs



Workload	Backups	SAP APP or Non-Prod DBMS	SAP Production	SAP Production	SAP Scale out with Standby
Volume Sizes	32GB-32TB	4GB-32TB	4GB-32TB	4GB-64TB	100GB-100TB
IOPS	500-2,000	120-6,000	120-20,000	100-160,000	4,000/TB
Disk Snapshots	Yes	Yes	Yes	No	Yes
Throughput/IOPS SLA	No	No	Yes	Yes	Yes
Latency Reads	High	Medium to High	Low	Sub-millisecond	Sub-millisecond
Latency Writes	High	Medium to High	Low to Sub-millisecond	Sub-millisecond	Sub-millisecond
VM SLA	95% *new*	99.5% *new*	99.9%	99.9%	99.9%

# Azure Premium Storage

Bread and butter block storage for DBMS under SAP workload

- Smaller I/Os in the 2-3ms latency range
- Throughput and IOPS SLAs bound to capacity of the disk
- Cache type of Write Accelerator improves write performance of smaller I/Os into the .3-.4ms range
- I/O latency in conjunction with Write Accelerator meets SAP HANA KPIs for read and write
- Write Accelerator used for Log/redo log volumes of different DBMS
- Increase IOPS of volumes by combining multiple disks and create a stripe set across it
- Use for:
  - Volumes that host database data and log files or volumes that need performance
  - OS disks for VMs that require single VM SLA of 99.9%
  - SAP application layer VMs with 99.9% SLA

# What is Azure Write Accelerator?

Azure Write Accelerator is a distributed cache that speeds up smaller Write I/Os

- Only works with Mv1 and Mv2 VM family in Azure
- Does not work with any other VM family in Azure
- Reduces write I/Os of sizes up to 512KB
- Makes sure that data gets persisted
- Is recommended for DBMS log/redo log files
- Limit to # of IOPS lower than VM limit → Don't use for DBMS data files
- <https://docs.microsoft.com/en-us/azure/virtual-machines/windows/how-to-enable-write-accelerator>

# Azure Premium Storage Bursting

Premium Storage introduced bursting of up to 3500 IOPS for disks up to 512GB

- Burst Account for each disk that comes preloaded when disk is created
- Is good for IOPS burst of 30min – account loaded with  $(3500 - \text{nominal IOPS}) * 1800$  IOPS
- Every burst IOPS (IOPS larger than provisioned IOPS) gets subtracted from account
- Account recharges when running I/O workload below provisions IOPS of disk
- For example:
- Premium storage disk with 128GB has 500 provisioned IOPS and can burst up to 3500 IOPS → burst account loaded with  $(3500 - 500) * 1800$  IOPS = 5.4 million IOPS
- Burst at max burst rate for 15min → account half empty
- Now system is running for 15min with an average of 250 IOPS against disk
- Recharging burst account with  $900 * 250 = 225K$  IOPS
- <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/disk-bursting>

# Azure NetApp Files (ANF) Introduction



## What is ANF?

- Bare-metal cloud file storage and data management.
- Running on NetApp Industry Leading ONTAP Technology.
- Joint Microsoft and NetApp Partnership lead solution.
- Not a 3<sup>rd</sup> Party marketplace offering but a fully hosted and supported Microsoft solution using NetApp technology.

## Why use ANF?

- Storage Simplification and centralized management.
- Provides a serverless replacement to provide NFS/SMB file shares.
- Leverage NetApp ONTAP Technology to provide fast Snapshots and Cloud Sync Replication.
- On Demand Capacity Management and Scalability.
- Perfect technology for hosting distributed SAP Solutions for shared files systems for High Availability clustering.

# Azure NetApp Files (ANF) for SAP workloads

## Simple to Manage

Native Azure experience for easy deployment & scale



## Highly Performant

On-prem like performance  
On-demand scalability

## Enterprise Data Management

Space/Time efficient snapshot and cloning

## Hybrid

Cloud Sync integration for hybrid cloud deployments

### SAP Application Server

SAP Certified

### SAP AnyDB

Planned

### SAP HANA

SAP Certified

### Compute layer

Azure IaaS VMs



### Compute layer

Azure IaaS VMs



/sapmnt

/usr/sap/trans

/usr/sap/SID

binaries

data

log

/hana/shared

data

log

### Storage layer

Azure NetApp Files



SAP on Azure w/ Azure NetApp Files <http://aka.ms/tr-4746>

Performance Requirement

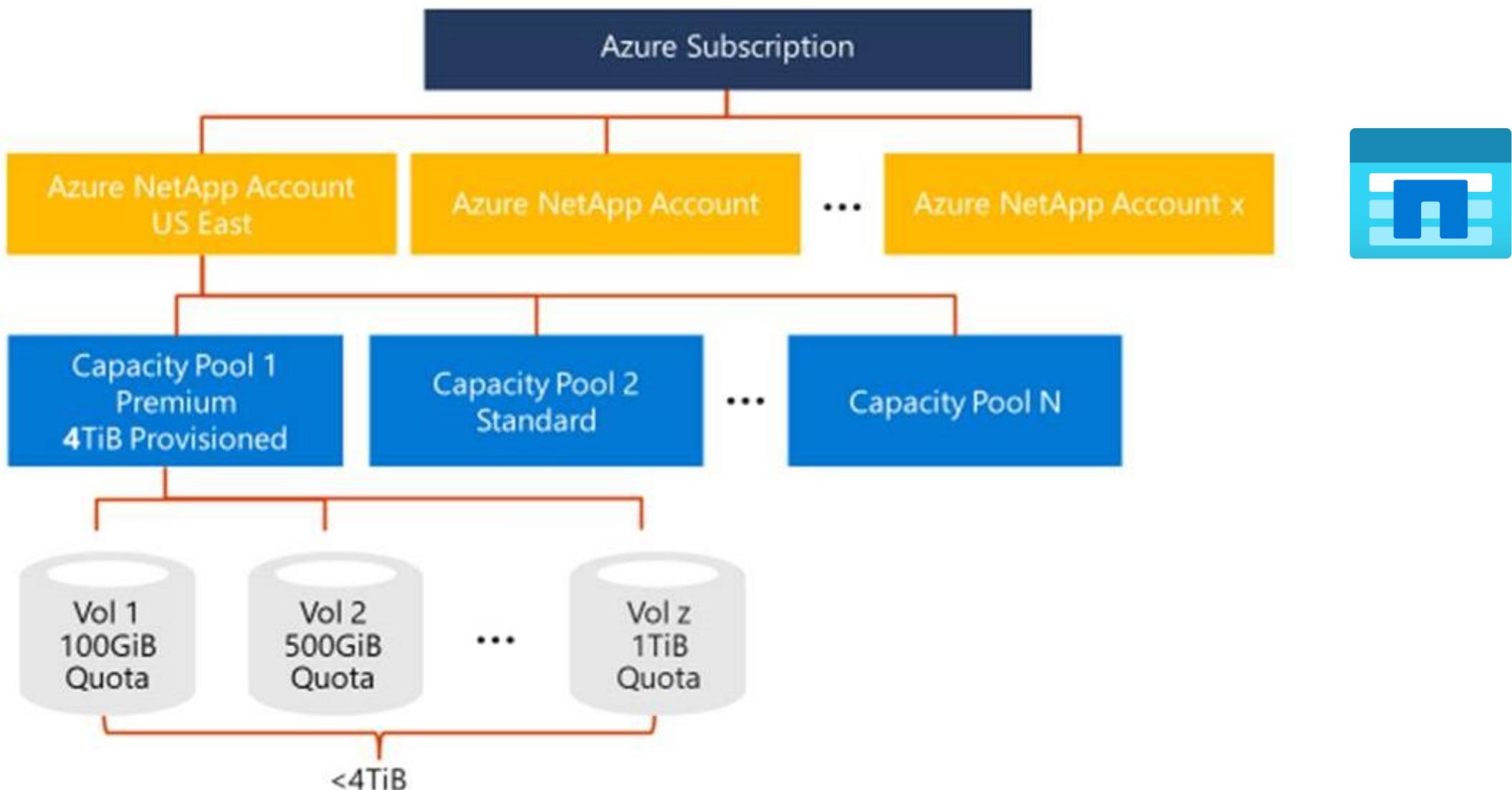
Low

Medium

Med-High

High

# Storage Hierarchy

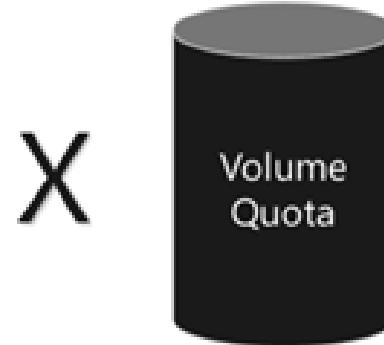


# ANF Storage Performance Tiers



Service Level	Throughput
Ultra	128MiB/s per 1TiB quota
Premium	64MiB/s per 1TiB quota
Standard	16MiB/s per 1TiB quota

E.g. 1      Premium Tier  
(64MiB/s per 1TiB quota)



2TiB  
Volume  
Quota

Up to 128MiB/s gross  
throughput

E.g. 2      Premium Tier  
(64MiB/s per 1TiB quota)

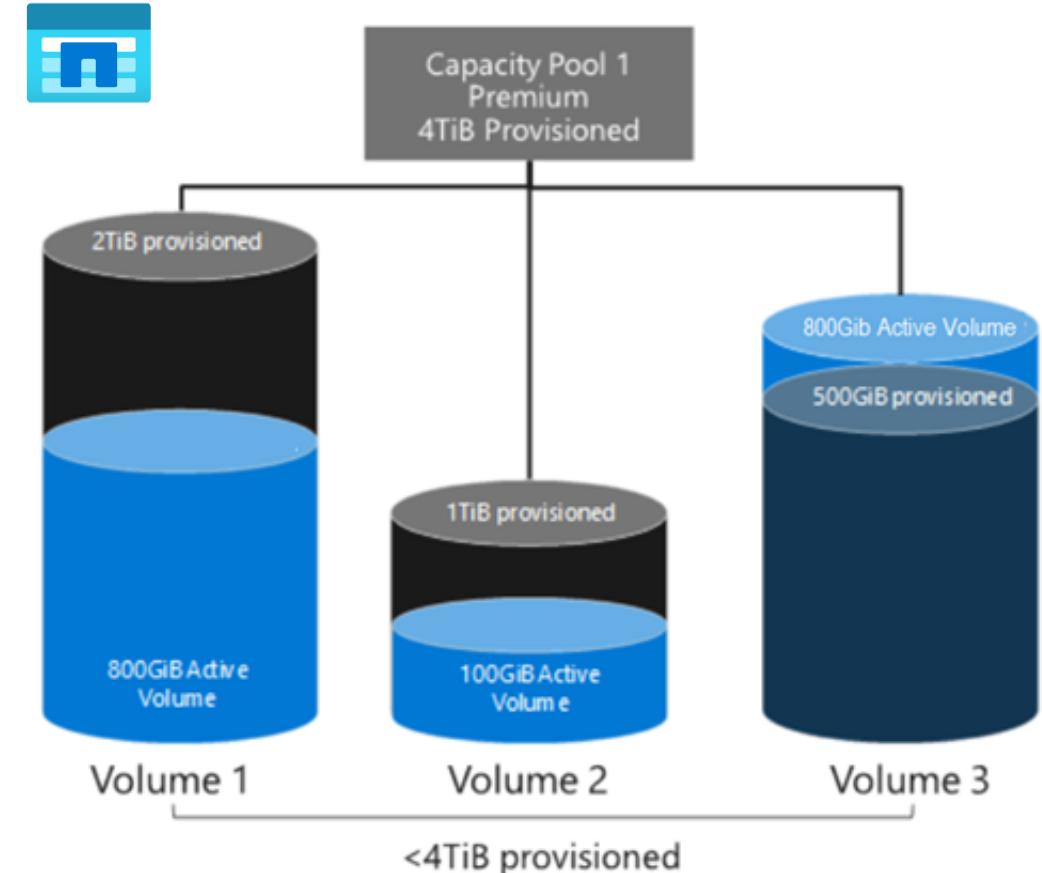
100 GiB  
Volume  
Quota

Up to 6.25MiB/s gross  
throughput

# Storage Example Azure NetApp Files

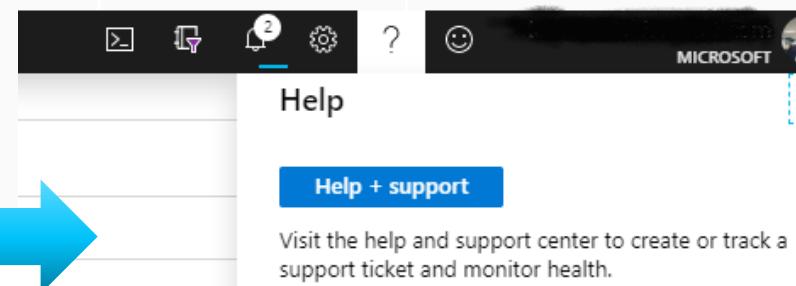
## How ANF is \$ invoiced:

- Invoicing is based on the capacity pool provisioned.
- \$/provisioned-GiB/month Hourly increments
- 4TiB is the minimum capacity pool.
- Snapshots come under the same capacity pool quota.
- In this example, 1.7TiB has been consumed and the storage cost will be for the entire 4TiB.



# Some Resource Limits to Note

Resource	Default	Adjustable via Support?
Number of NetApp accounts per Azure region	10	Yes
Number of capacity pools per NetApp Account	25	Yes
Number of Volumes per capacity pool	500	Yes
Number of snapshots per volume	255	No
Minimum Size of a capacity pool	4TiB	No
Maximum Size of a capacity pool	500TiB	No
Minimum Size of a Single Volume	100GiB	No
Maximum Size of a Single Volume	100TiB	No
Request a default resource limit value increase via an Azure Portal Help + Support request		



<https://docs.microsoft.com/en-us/azure/azure-netapp-files/azure-netapp-files-resource-limits>

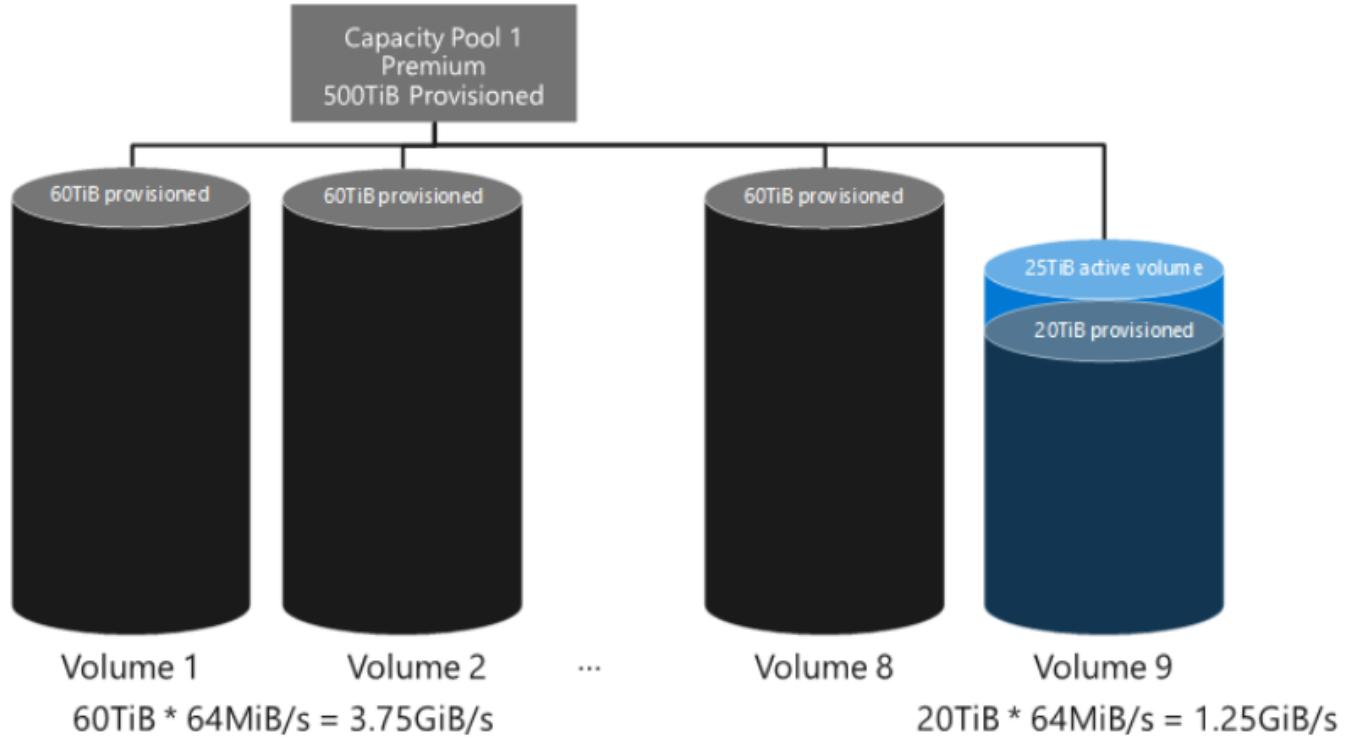
# Auto Scaling and Overage

## Auto Scale

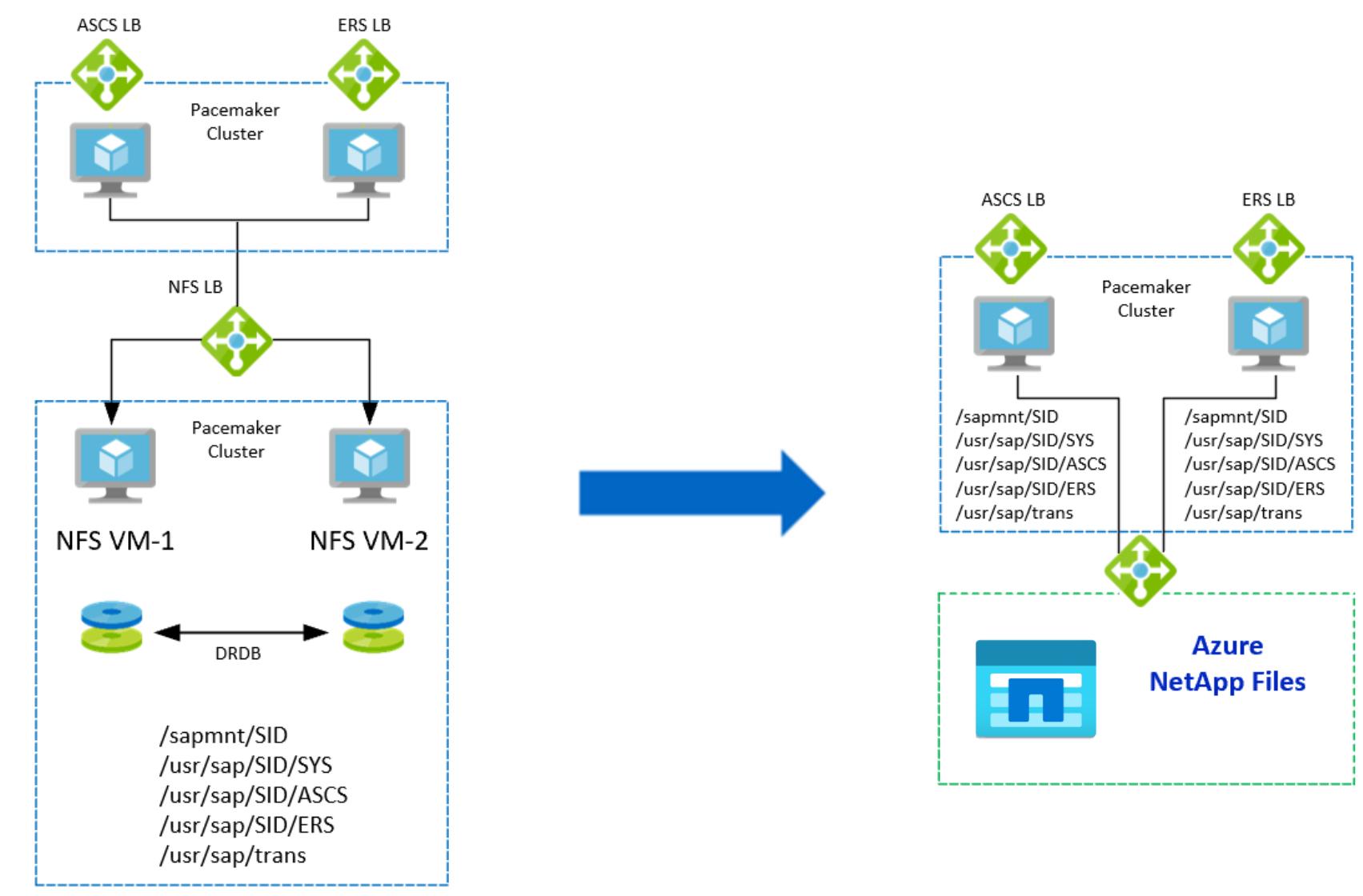
- If Capacity Pool or Volumes go over their defined size value, they are not restricted. If they are still over their defined limit the capacity after one hour, the volume and/or capacity pool will be uplifted.

## Overage

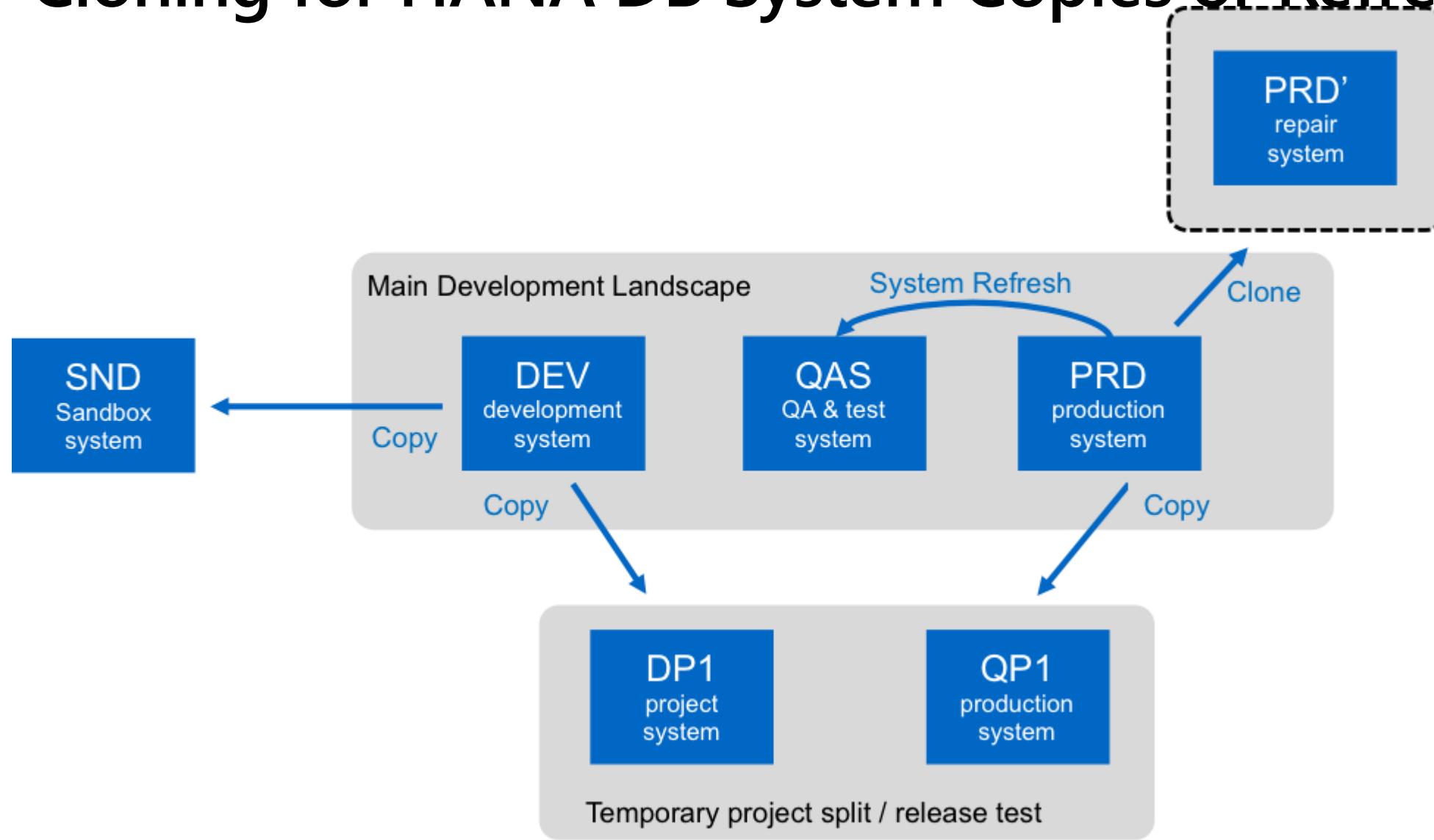
- If you grow beyond the capacity pool limit, this is still permitted but performance will be locked at the defined volume limit.
- In the example it has grown to 505TiB. Invoicing will be for 505TiB but Volume 9 is locked to 1.25GiB/s.



# Simplification for SAP Shared Files | Old vs New

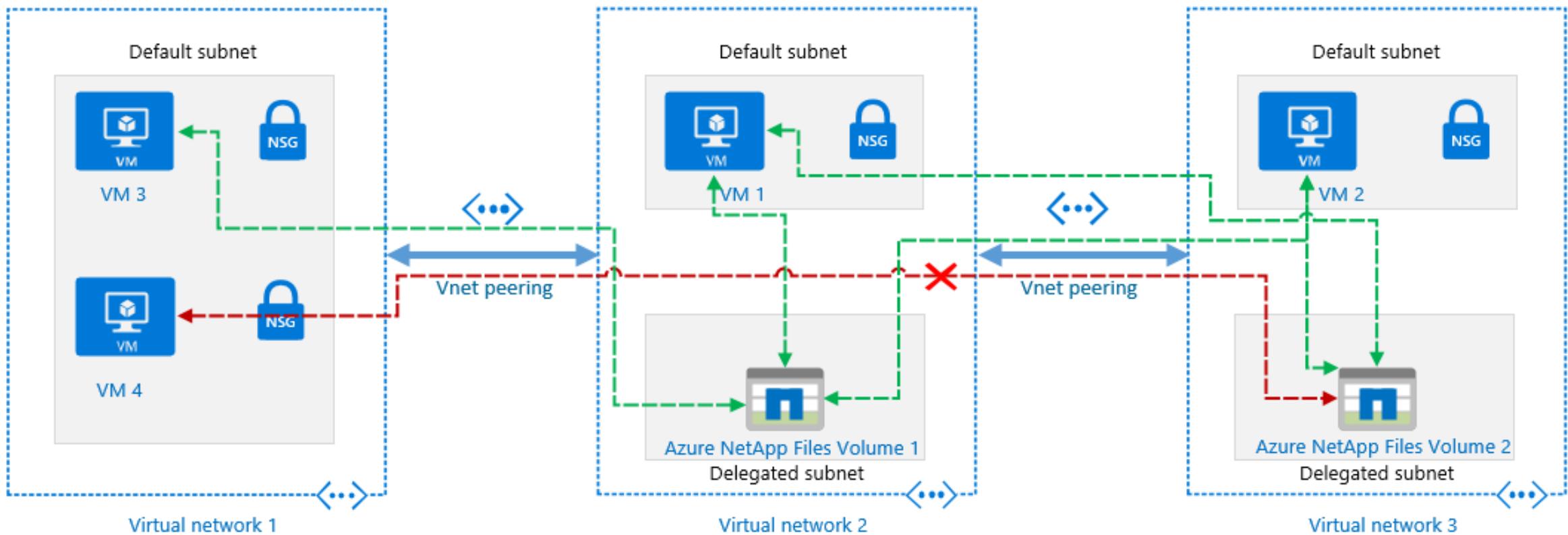


# ANF Cloning for HANA DB System Copies or Refresh



# ANF Network Design

- ANF volumes will be contained in a special purpose subnet (delegated subnet)
- You can only access volumes directly from your Vnet or peered Vnets in the same region.
- You can connect to volumes from On Premise via Express Route.



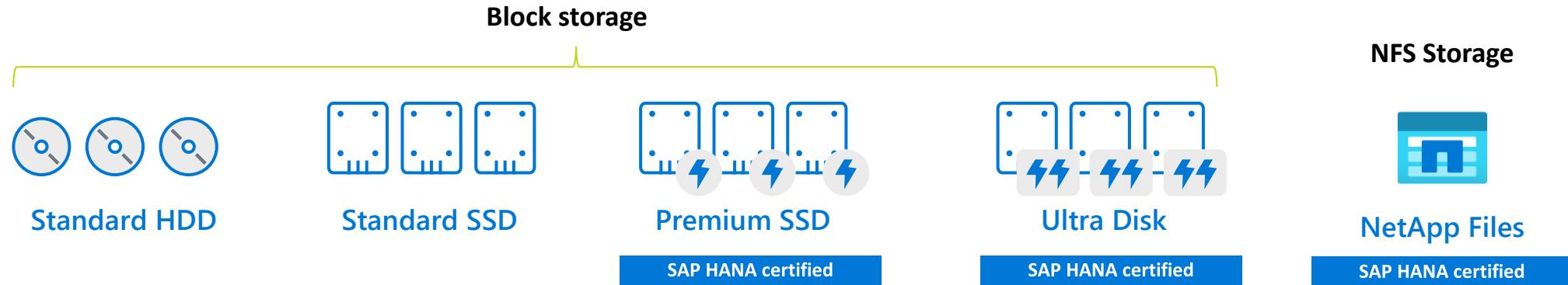
# Azure NetApp Files Recommendations



## Recommendations:

- You still follow SAP's storage recommendations for HANA Performance and just apply them to ANF by either increasing the volume quota or increase the Tier Level.
- Keep Capacity Pools low to reduce cost. They will auto grow if required.
- Like any volume make sure you make the mount persistent. (/etc/fstab file to mount the ANF Volumes on linux reboot)
- NFS V4.1 for Data and Log Volumes Only.
- NetApp Files are encrypted by default to FIPS 140-2 standard. All keys are managed by the ANF service. You don't need to manage encryption.
- Continue to backup using traditional backup methods until snapshots replication is confirmed.
- Watch the Network Limitations and design your network accordingly.
- Try and avoid vNet Peering to reduce peering costs.

# High Level Guidance choosing the right Storage for SAP



<b>Suitable for OS</b>	No	Non-Prod Only	Yes	Yes	Yes
<b>Global Trans Dir</b>	No	No	Yes	Yes	Yes
<b>SAPMNT</b>	No	Non-Prod Only	Yes	Yes	Yes
<b>HANA DBMS Data Volume</b>	No	No	Yes	Yes	Yes
<b>HANA DBMS Log Volume</b>	No	No	Yes	Yes	Yes
<b>Non-HANA DBMS Data Volume</b>	No	Non-Prod Only	Yes	Yes	Yes
<b>Non-HANA DBMS Log Volume</b>	No	Non-Prod Only	Yes	Yes	Yes

For more details: <https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/planning-guide-storage>

# Guidance depending on VM type

Architecting in the cloud uses the same methodology as On-Premise.

Use these recommendations as a baseline. Always try to validate your IOPS and Throughput requirements and adjust accordingly.

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/hana-vm-operations-storage>



Premium SSD



Ultra SSD



NetApp Files

VM SKU	RAM	Max. VM I/O			/root volume	/usr/sap	hana/backup
		Throughput	/hana/data	/hana/log			
M32ts	192 GiB	500 MB/s	3 x P20	2 x P20	1 x P20	1 x P6	1 x P6
M32ls	256 GiB	500 MB/s	3 x P20	2 x P20	1 x P20	1 x P6	1 x P6
M64ls	512 GiB	1000 MB/s	3 x P20	2 x P20	1 x P20	1 x P6	1 x P6
M64s	1000 GiB	1000 MB/s	4 x P20	2 x P20	1 x P30	1 x P6	1 x P6
M64ms	1750 GiB	1000 MB/s	3 x P30	2 x P20	1 x P30	1 x P6	1 x P6
M128s	2000 GiB	2000 MB/s	3 x P30	2 x P20	1 x P30	1 x P10	1 x P6
M128ms	3800 GiB	2000 MB/s	5 x P30	2 x P20	1 x P30	1 x P10	1 x P6
M208s_v2	2850 GiB	1000 MB/s	4 x P30	2 x P20	1 x P30	1 x P10	1 x P6
M208ms_v2	5700 GiB	1000 MB/s	4 x P40	2 x P20	1 x P30	1 x P10	1 x P6
M416s_v2	5700 GiB	2000 MB/s	4 x P40	2 x P20	1 x P30	1 x P10	1 x P6
M416ms_v2	11400 GiB	2000 MB/s	8 x P40	2 x P20	1 x P30	1 x P10	1 x P6

# Storage recommendations

**Premium storage in combination with logical volume managers, like LVM, MDADM, Storage Spaces delivers best price/performance ratio:**

- Read latencies dependent on read size 2.5 to 10ms
- Write latencies with Write Accelerator less than 0.5ms

Ultra disk is a storage that delivers consistent sub-millisecond latency

**ANF is native NFS service with sub-millisecond latency:**

- Ideal for n+m scale-out
- Use as NFS share for SAP application layer

**SAP application layer:**

- `usr\sapmnt` should show reasonable latency
- Global transdir storage latency can impact support package application and transport import majorly and can contribute severely to the downtime phase

# Agenda

1. SAP Certification for Azure (Any DB)

2. Key Design Aspects

3. Reference Architecture

- Network

4. Backups

5. Migration to Azure

# Microsoft Beats Amazon & Google for Network Reliability – Research



NEWS ANALYSIS  
MITCH WAGNER,  
Executive Editor,  
Light Reading

11/8/2018

COMMENT (1)

Login



50% 50%

Like 7

Tweet

Share

G+

Microsoft Azure provides more predictable network performance than Google Cloud and Amazon Web Services, according to research released Thursday by network monitoring company ThousandEyes.

Google Cloud Platform and Amazon Web Services Inc. fluctuate more unpredictably than Microsoft Azure in terms of latency, packet loss and jitter, according to the study.

That means developers deploying software on Azure can more reliably predict application performance, Archana Kesavan, ThousandEyes senior product marketing manager and report author, tells Light Reading.

The reason for Microsoft's predictability: Microsoft uses its own backbone to move data between users and services. "Their network is fast and highly reliable," Kesavan says.



**"Microsoft Azure provides more predictable network performance than Google Cloud and Amazon Web Services, according to research released Thursday by network monitoring company ThousandEyes." [link](#)**

# Microsoft Global Network

Which Azure Region is Best Suited to my needs?

Datacenter

Edge

Network

60+ AZURE REGIONS

130K+ MILES OF FIBER AND SUBSEA CABLES

170+ EDGE SITES

200+ EXPRESSROUTE PARTNERS

# Defining the Azure Region Strategy



## Inputs

Data Residency and Security Policies

Business Continuity Requirements

Connectivity

SAP Certified Building Blocks

Business Model

Cost of Ownership

## Considerations

Country and or Geo Restrictions; Customer specific policies

Regional DR, Metro DR

Network performance, throughput, latency, security

M-Series, ANF, Azure Backup for HANA, Ultra Disk, AZones

Centralized / De-centralized

Pricing variations across Azure Regions

# Guiding Principles – User to System Latency



## MSFT and SAP Latency Guidance:

<https://wiki scn.sap.com/wiki/display/VIRTUALIZATION/Frequently+Asked+Questions%3A+Microsoft+Azure>

### How can I test the latency between my home location and the next Azure datacenter?

To be able to reach valuable performance in your SAP application, sufficient performance of the underlying connection to the Azure datacenter is essential. Therefore, check your Internet connection using one of the Azure speed test tools which are available at <http://www.azurespeed.com> and <http://azurespeedtest.azurewebsites.net>.

As VPN routes over Internet connections and the routing itself can change from time to time, it is important to check the speed test tool(s) on a regular base. If you observe very poor performance using Azure speed test, contact your Internet Service Provider to fix your connection. In that case, Microsoft or SAP support cannot help.

The response time you measure using Azure speed test, should remain below 220 msec, as indicated in the table below:

Quality of response time	Measured response time
Good	200 up to 220 msec
Better	150 msec
Best	less than 80 msec
Too low	more than 220 msec

# Azure Networking Services

**Virtual Network**

**Virtual WAN**

**ExpressRoute**

**VPN**

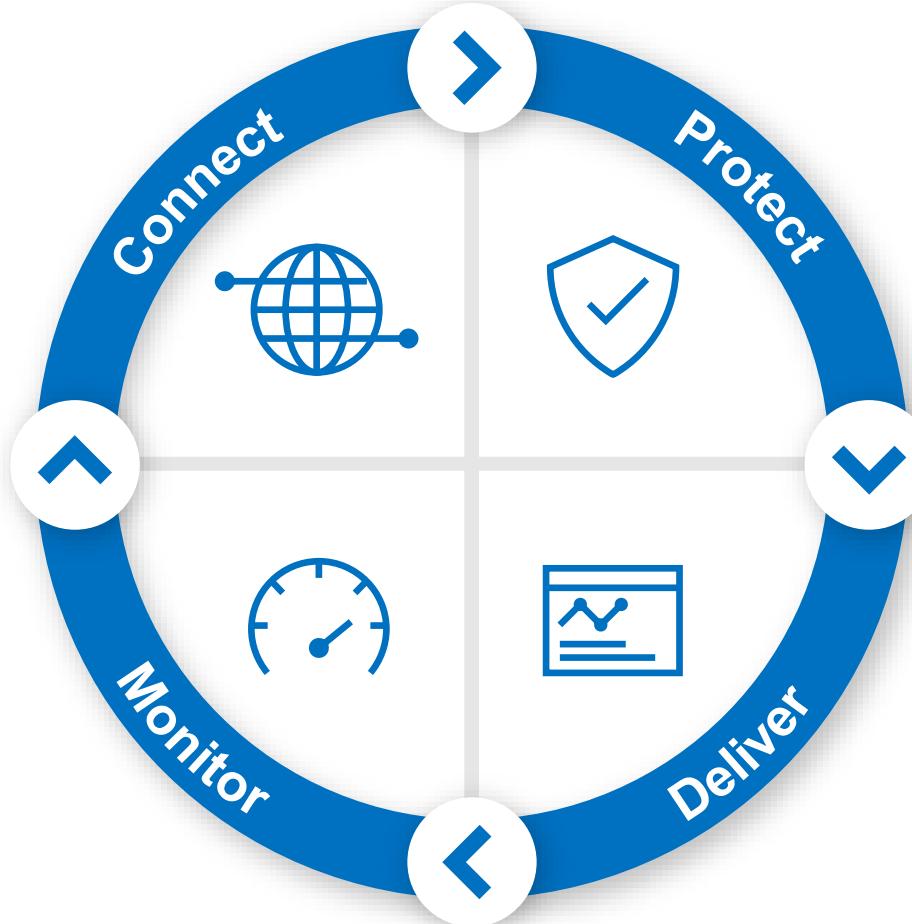
**DNS**

**Network Watcher**

**ExpressRoute Monitor**

**Azure Monitor**

**Virtual Network TAP**



**DDoS Protection**

**Firewall**

**NSG**

**Web Application Firewall**

**Virtual Network Endpoints**

**CDN**

**Front Door**

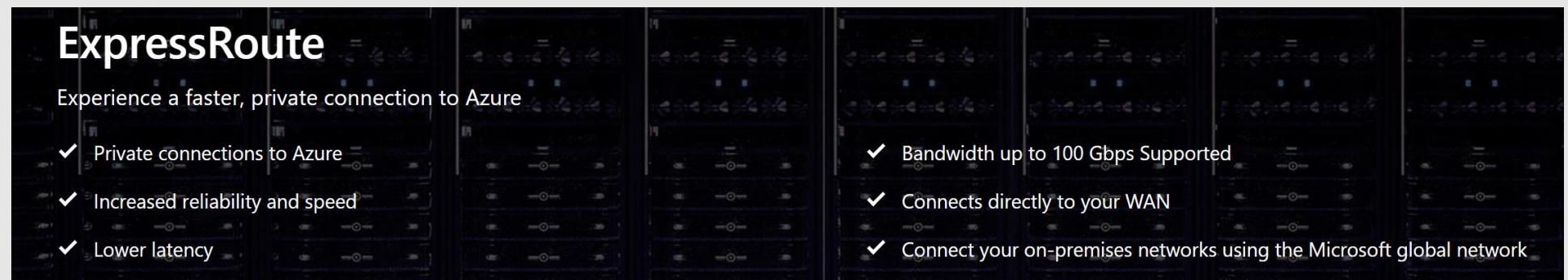
**Traffic Manager**

**Application Gateway**

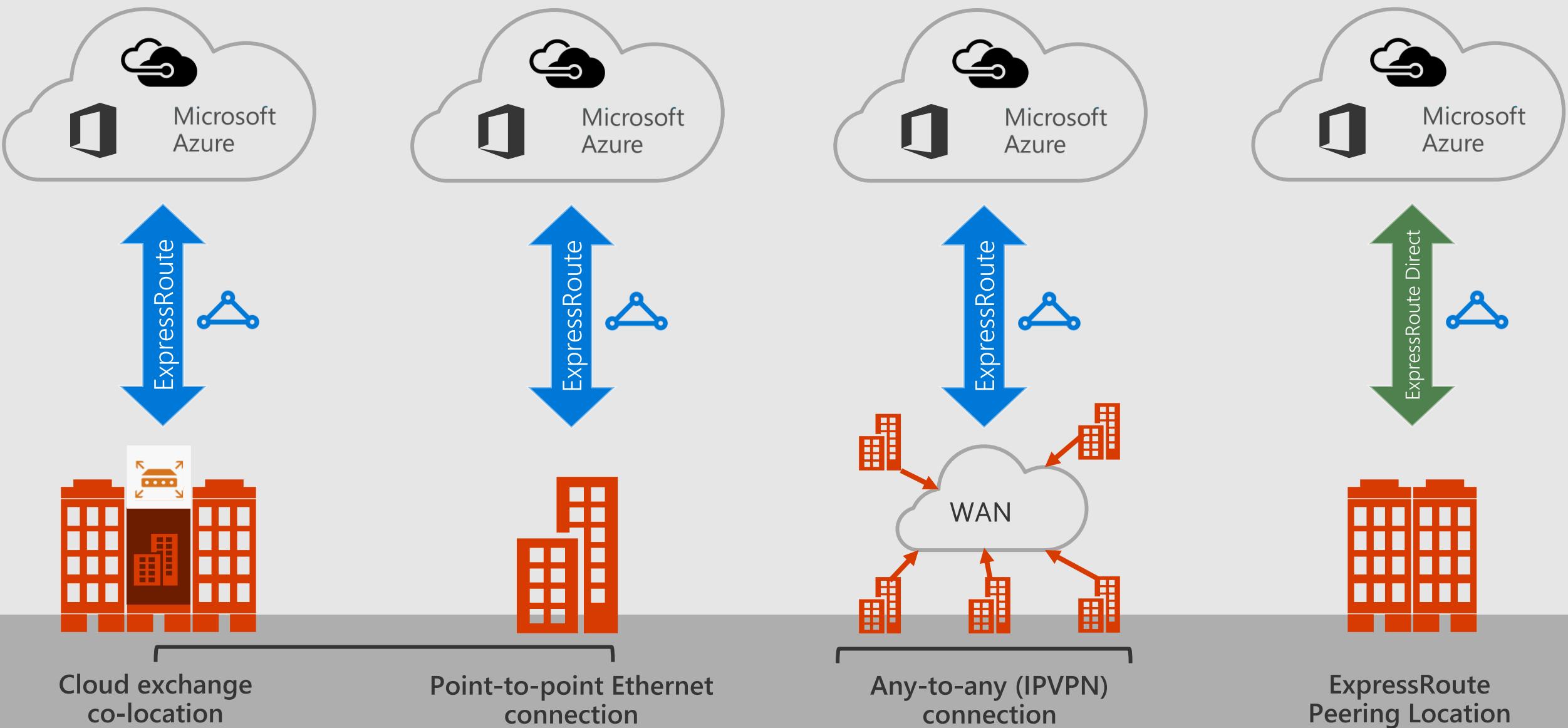
**Load Balancer**

# (SAP) Why ExpressRoute/VNET design is important for SAP

1. Stability and high availability of networking impact SAP application SLAs
2. Predictable network performance is critical for SAP user experience and productivity
3. VNET needs to be designed to be flexible for future changes and growth

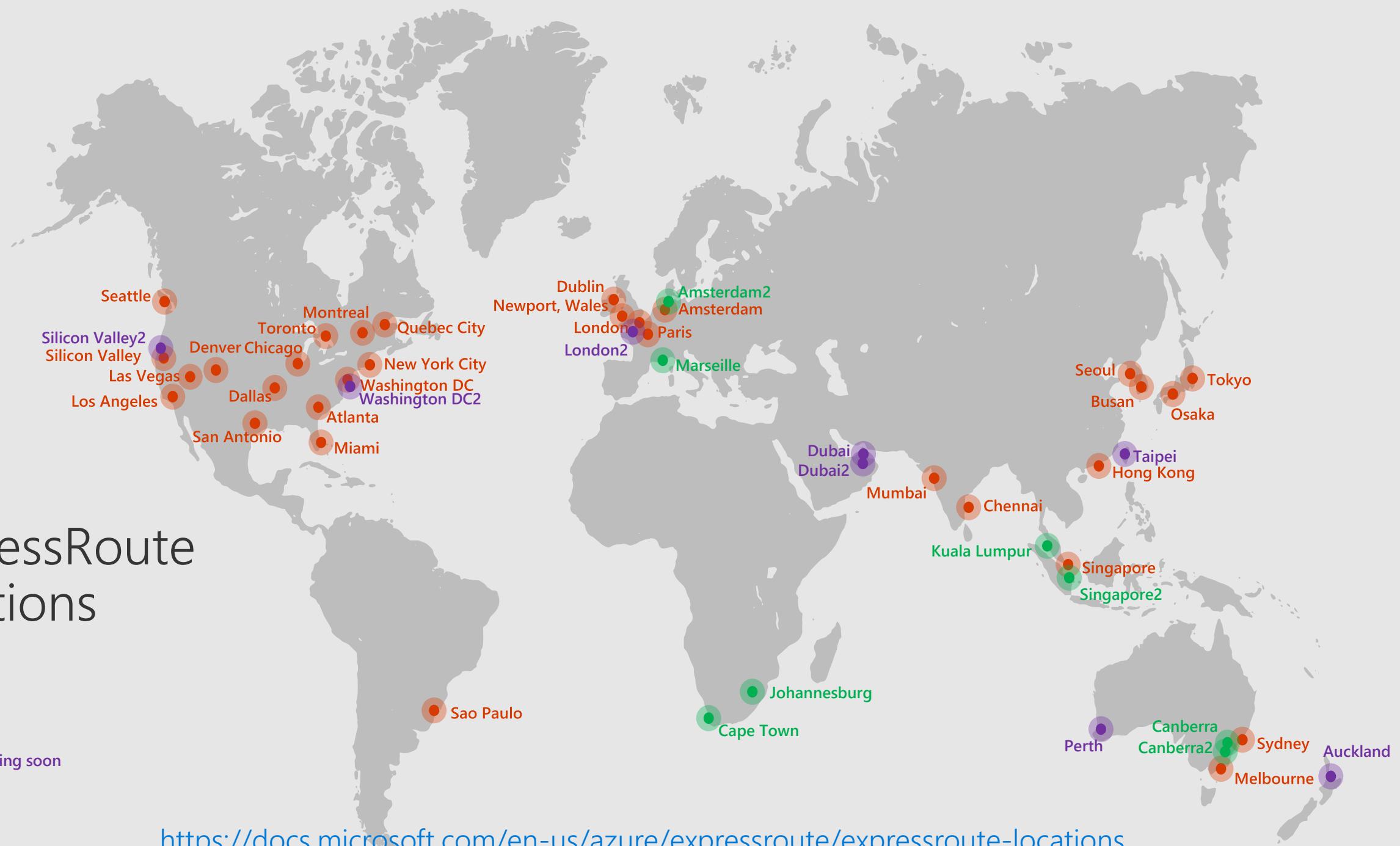


# ExpressRoute connectivity models



# ExpressRoute locations

- New
- Coming soon



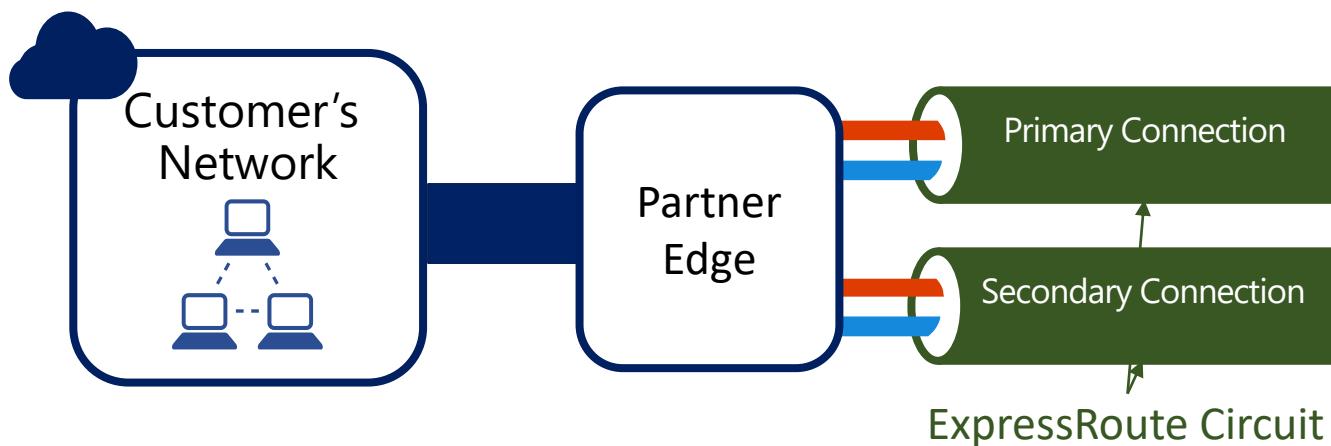
<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-locations>



200+ ExpressRoute Partners

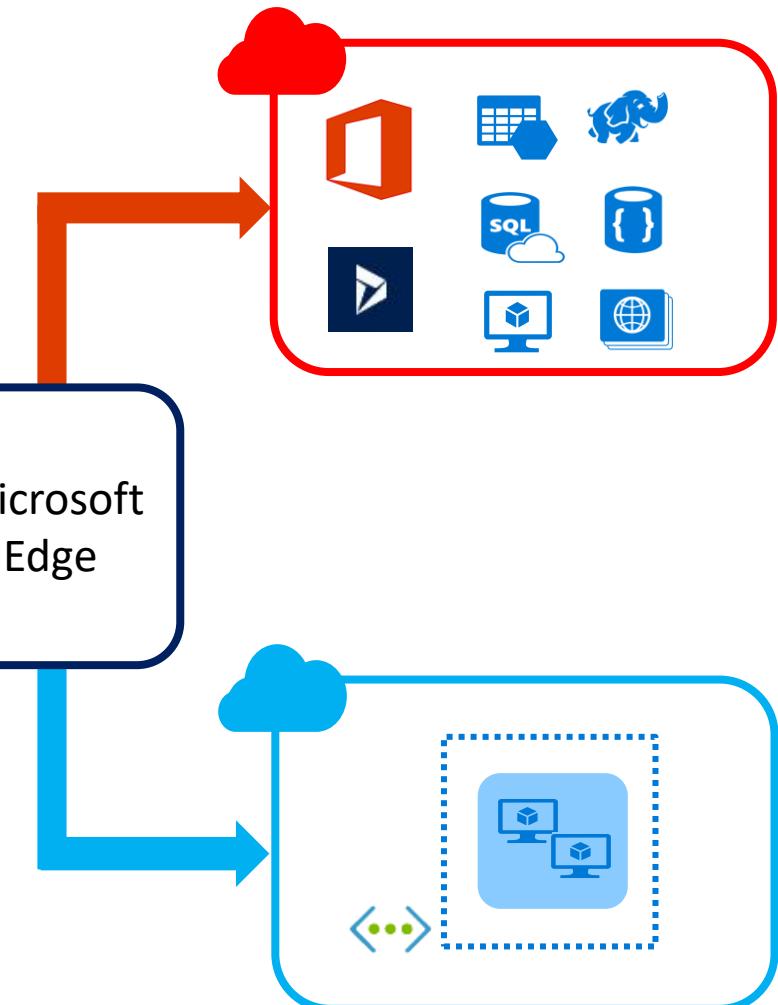
# ExpressRoute

- ✓ Unified connectivity to Microsoft Cloud Services
- ✓ Predictable performance
- ✓ Enterprise-grade resiliency and with SLA for availability
- ✓ Large and growing ExpressRoute partner ecosystem



Microsoft Peering for Office 365, Dynamics 365, Azure public services (public IPs)

Azure Private Peering for Virtual Networks



# ExpressRoute and ExpressRoute Direct

## ExpressRoute

Utilizes service provider to enable fast onboarding and connectivity into existing infrastructure

Integrates with hundreds of providers including Ethernet and MPLS

Circuits from 50Mbps-10Gbps

Optimized for single tenant

## ExpressRoute Direct

Requires 100Gbps infrastructure and full management of all layers

Direct/Dedicated capacity for regulated industries and massive data ingestion

Circuits from 1Gbps to 100Gbps

Optimized for single tenant/Cloud Service providers/multiple business units

# ExpressRoute Global Reach

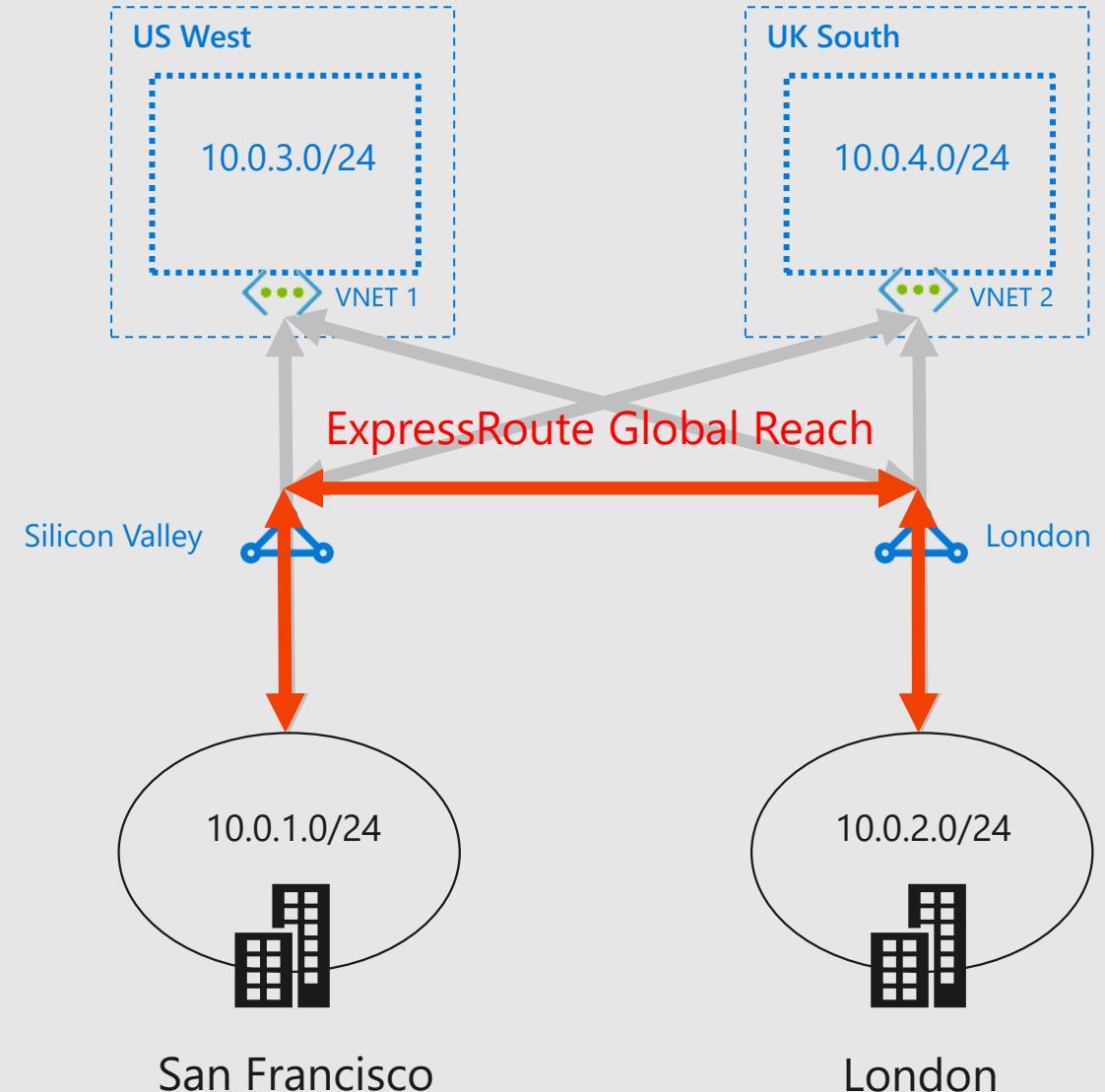
ExpressRoute enables you to connect to Azure

ExpressRoute Global Reach enables you to connect **your sites**

On-demand connectivity using your existing ExpressRoute circuits

Traffic staying on Microsoft's global network

Complement your service provider's WAN solution



# Azure regions to ExpressRoute locations within a geopolitical region.

The following table provides a map of Azure regions to ExpressRoute locations within a geopolitical region.

<b>Geopolitical region</b>	<b>Azure regions</b>	<b>ExpressRoute locations</b>
<b>Australia Government</b>	Australia Central, Australia Central 2	Canberra, Canberra2
<b>Europe</b>	France Central, France South, North Europe, West Europe, UK West, UK South	Amsterdam, Amsterdam2, Copenhagen, Dublin, Frankfurt, London, London2, Marseille, Newport(Wales), Paris, Stockholm, Zurich
<b>North America</b>	East US, West US, East US 2, West US 2, Central US, South Central US, North Central US, West Central US, Canada Central, Canada East	Atlanta, Chicago, Dallas, Denver, Las Vegas, Los Angeles, Miami, New York, San Antonio, Seattle, Silicon Valley, Silicon Valley2, Washington DC, Washington DC2, Montreal, Quebec City, Toronto
<b>Asia</b>	East Asia, Southeast Asia	Hong Kong SAR, Kuala Lumpur, Singapore, Singapore2, Taipei
<b>India</b>	India West, India Central, India South	Chennai, Chennai2, Mumbai, Mumbai2
<b>Japan</b>	Japan West, Japan East	Osaka, Tokyo
<b>Oceania</b>	Australia Southeast, Australia East	Auckland, Melbourne, Perth, Sydney
<b>South Korea</b>	Korea Central, Korea South	Busan, Seoul
<b>UAE</b>	UAE Central, UAE North	Dubai, Dubai2
<b>South Africa</b>	South Africa West, South Africa North	Cape Town, Johannesburg
<b>South America</b>	Brazil South	Sao Paulo

## What connection speeds are supported by ExpressRoute?

Supported bandwidth offers:

50 Mbps, 100 Mbps, 200 Mbps, 500 Mbps, 1 Gbps, 2 Gbps, 5 Gbps, 10 Gbps

<https://docs.microsoft.com/en-us/azure/expressroute/expressroute-faqs>

## What is ExpressRoute premium?

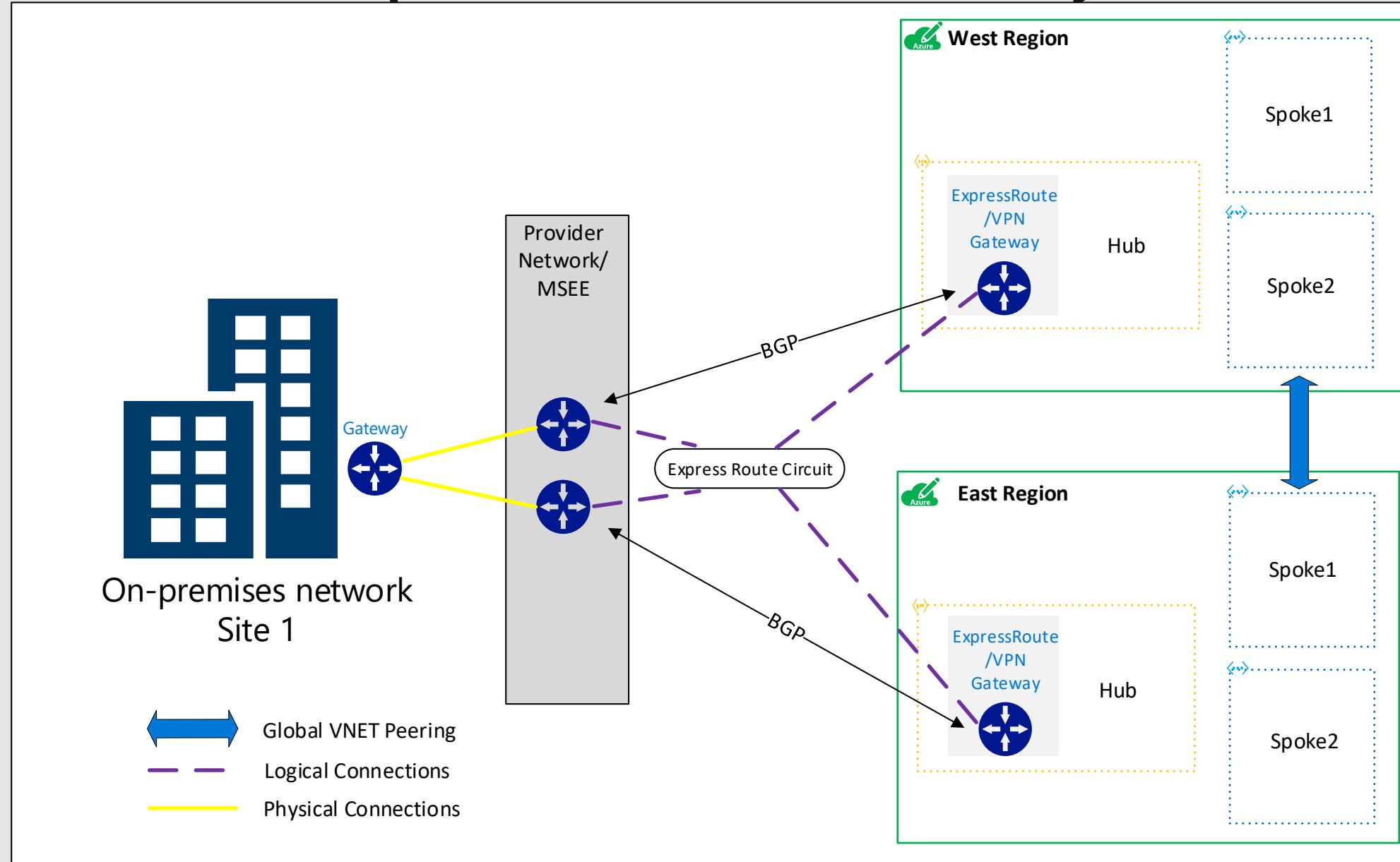
ExpressRoute premium is a collection of the following features:

- Increased routing table limit from 4000 routes to 10,000 routes for private peering.
- Increased number of VNets and ExpressRoute Global Reach connections that can be enabled on an ExpressRoute circuit (default is 10). For more information, see the [ExpressRoute Limits](#) table.
- Connectivity to Office 365
- Global connectivity over the Microsoft core network. You can now link a VNet in one geopolitical region with an ExpressRoute circuit in another region.

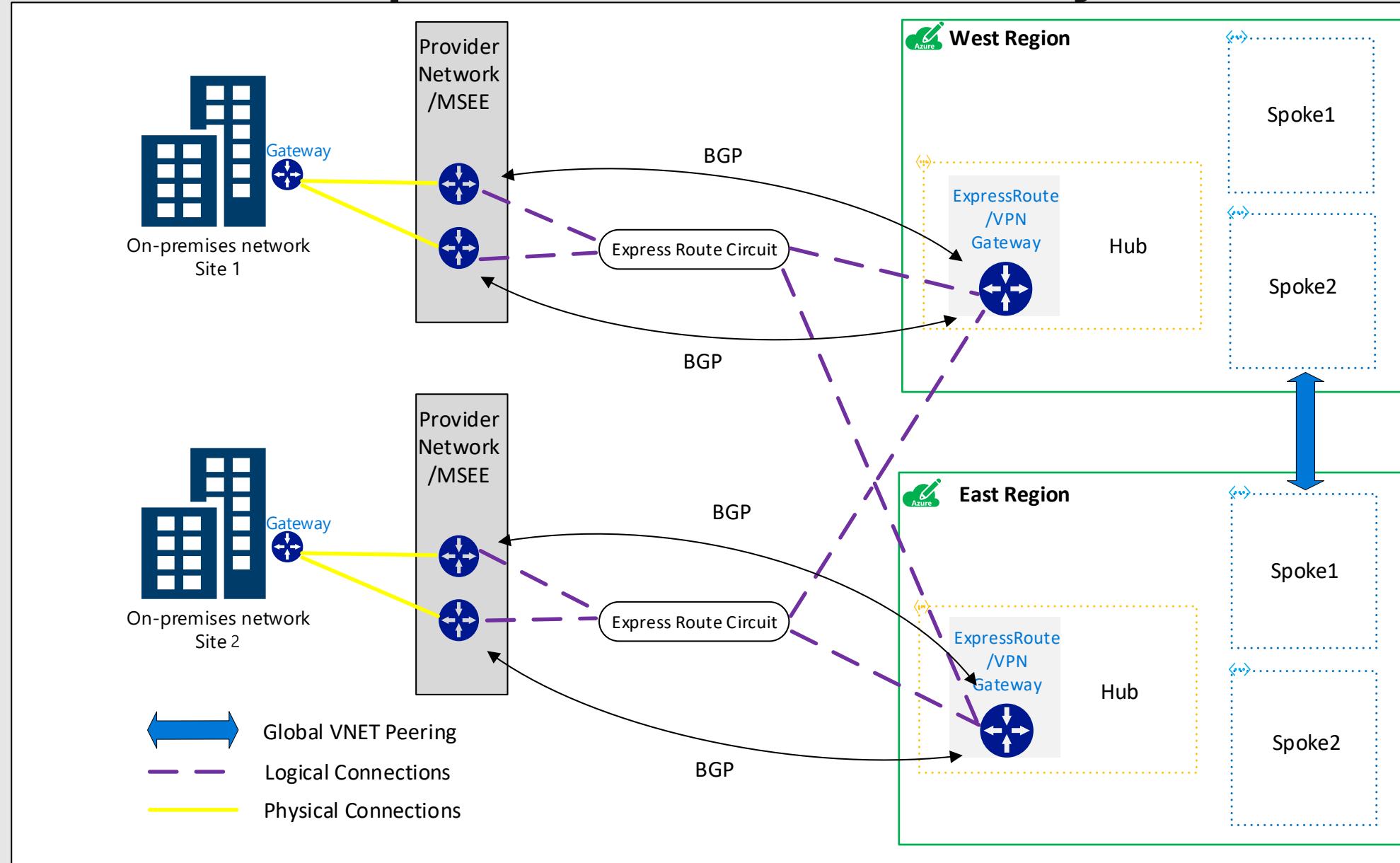
### Examples:

- You can link a VNet created in Europe West to an ExpressRoute circuit created in Silicon Valley.
- On the Microsoft peering, prefixes from other geopolitical regions are advertised such that you can connect to, for example, SQL Azure in Europe West from a circuit in Silicon Valley.

# ExpressRoute Connectivity



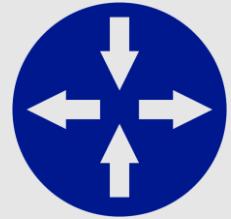
# ExpressRoute Connectivity



# ExpressRoute Gateway

The Gateway provides the Azure endpoint for customer ExpressRoute connections.

Multiple ExpressRoute SKU's with varying throughput, packets and connections per second.



Note AZ means these SKU's are Availability Zone redundant.

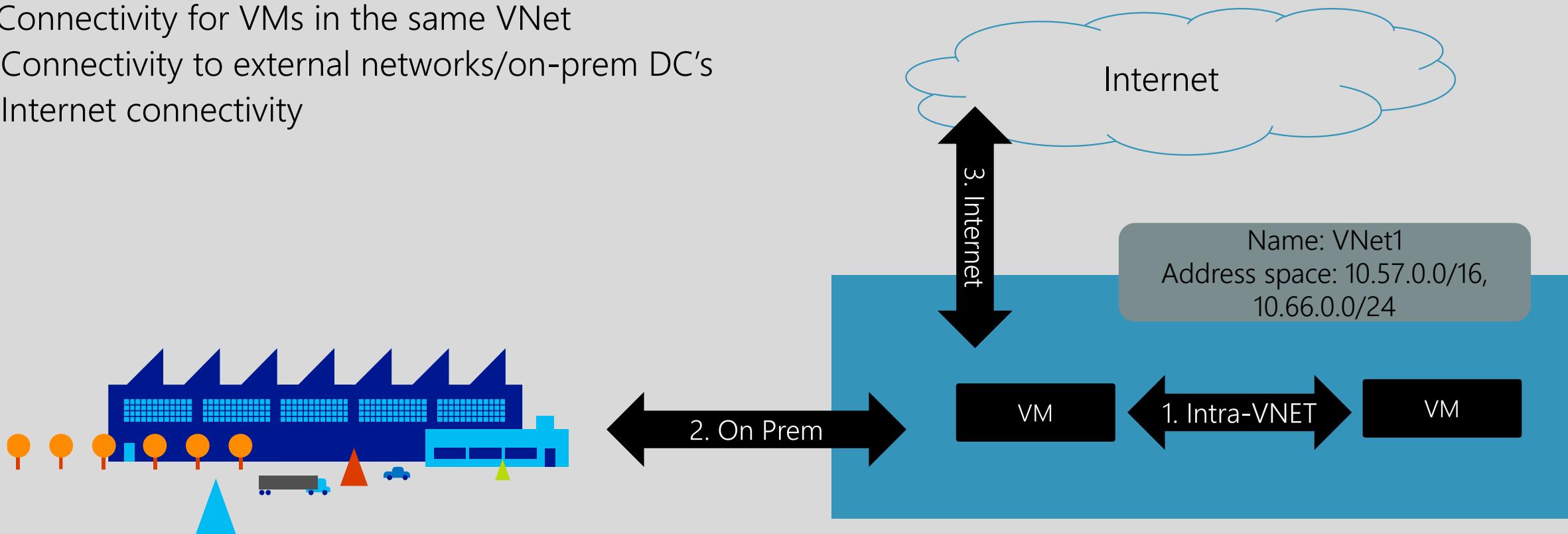
	<b>Megabits per second</b>	<b>Packets per second</b>	<b>Connections per second</b>	<b>VPN Gateway and ExpressRoute coexist</b>	<b>FastPath</b>
<b>Basic SKU (deprecated)</b>	500	Unknown	Unknown	No	No
<b>Standard SKU/ErGw1AZ</b>	1,000	100,000	7,000	Yes	No
<b>High Performance SKU/ErGw2AZ</b>	2,000	250,000	14,000	Yes	No
<b>Ultra Performance SKU/ErGw3AZ</b>	10,000	1,000,000	28,000	Yes	Yes

# Virtual Network (think of a VRF)

Isolated, logical network providing connectivity for Azure Virtual Machines

User-defined address space (can be one or more IP ranges, not necessarily RFC1918)

1. Connectivity for VMs in the same VNet
2. Connectivity to external networks/on-prem DC's
3. Internet connectivity



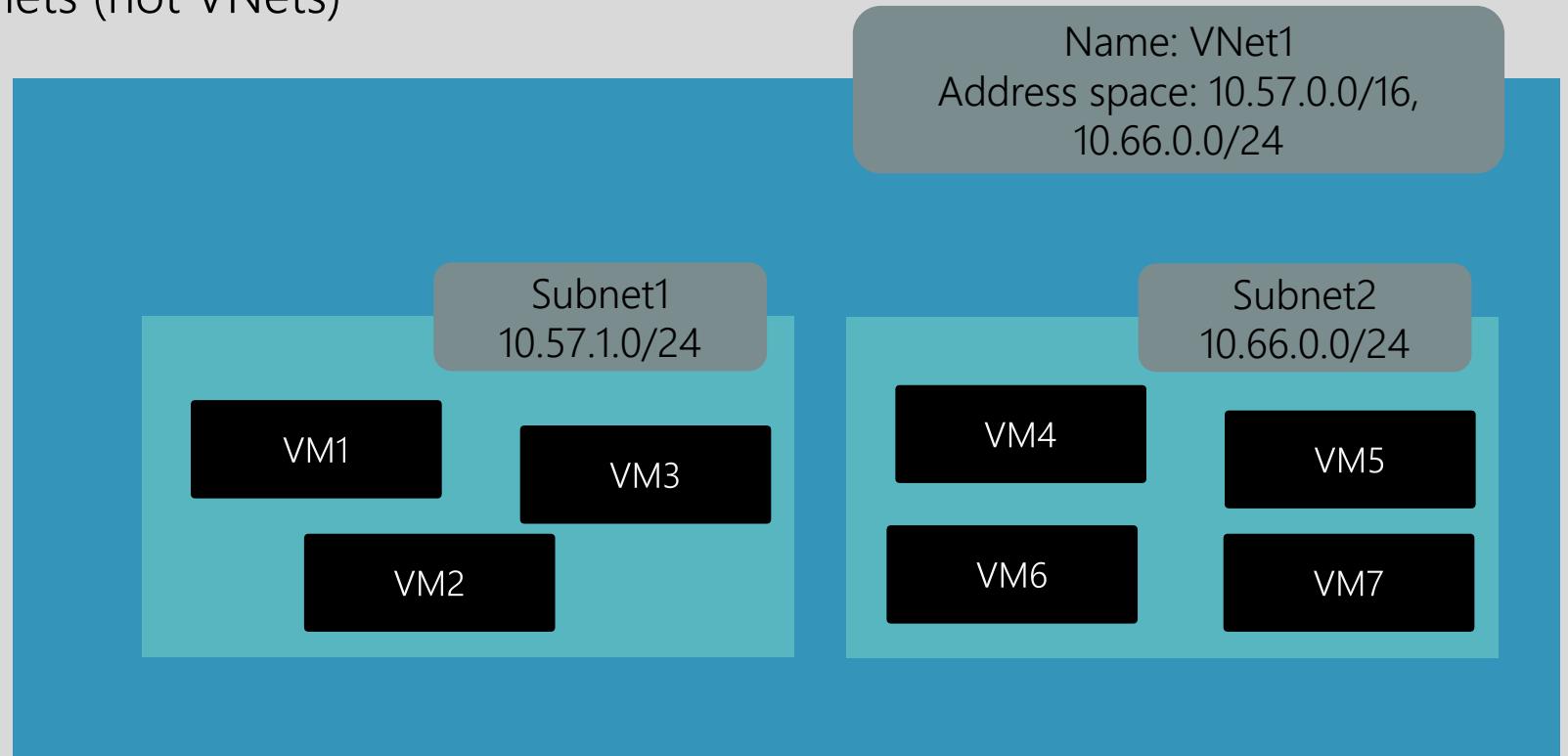
# Subnet (think of a VLAN)

## IP Subnet

Provides full layer-3 semantics and partial layer-2 semantics (DHCP, ARP, no broadcast/multicast)

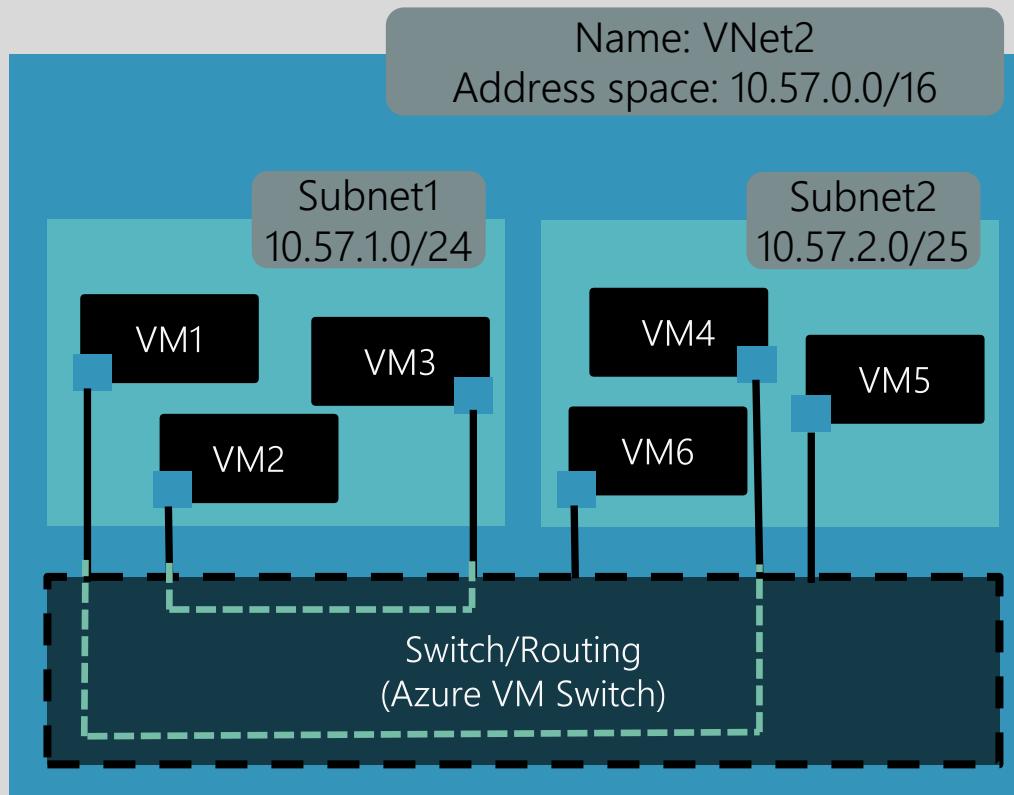
Subnets must include one range of contiguous IP addresses

VMs can be deployed only to subnets (not VNets)



# Switching/Routing in Azure VNs

A VNet provides a switching/routing functionality that allows VMs to talk to each other

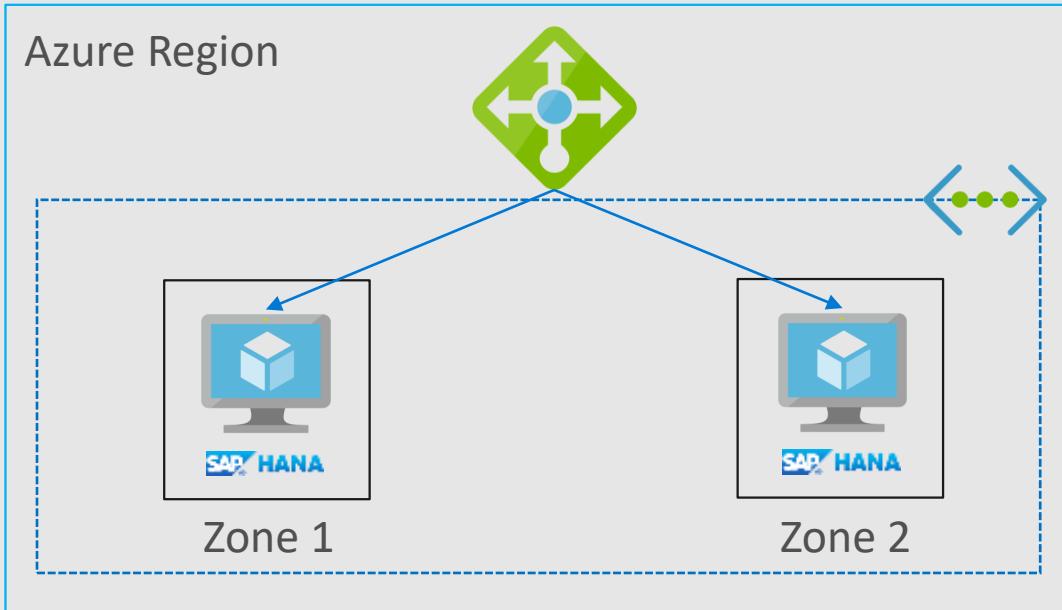


Please note that, in an Azure VNet, packets can flow between two different subnets without explicitly traversing any layer-3 device. Azure's network virtualization stack effectively works as a layer-3 switch

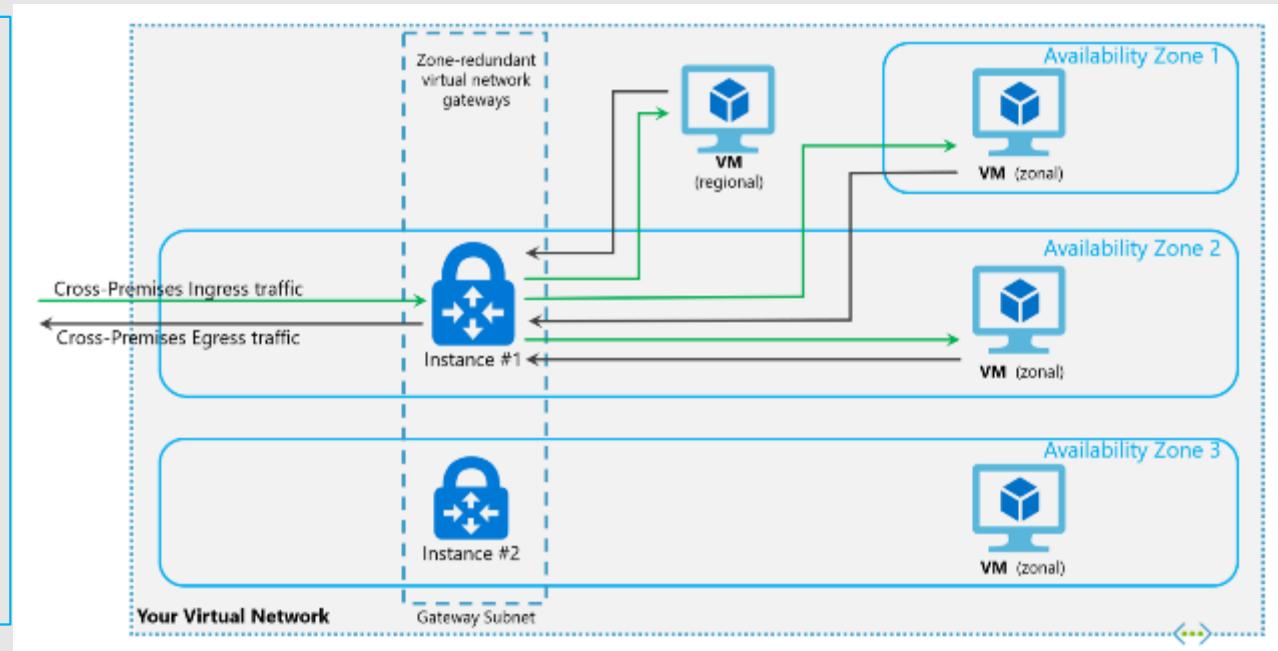


# Standard Load Balancer & Zone Redundant Gateway

Standard Load Balancer



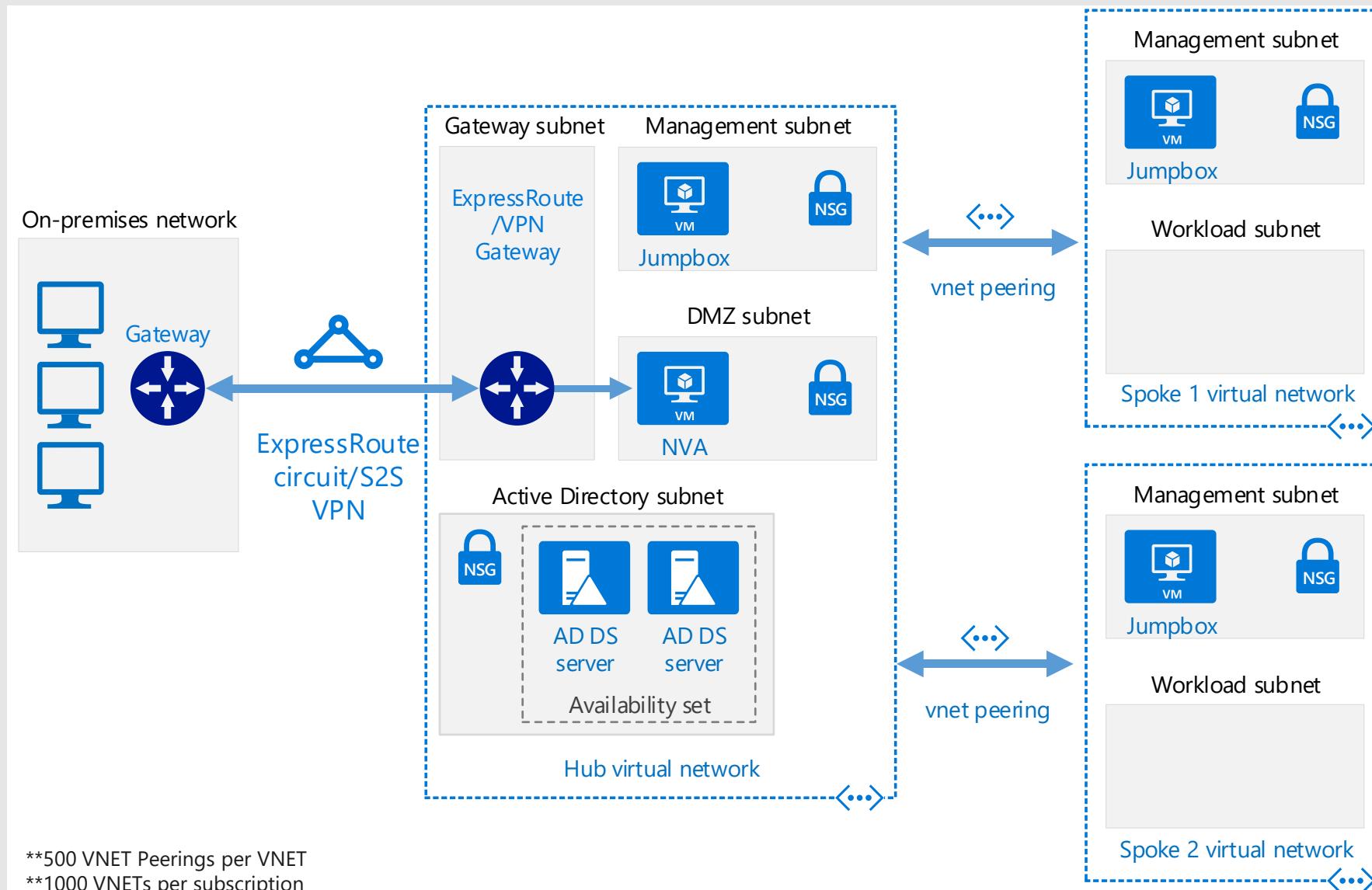
Zone Redundant Gateway



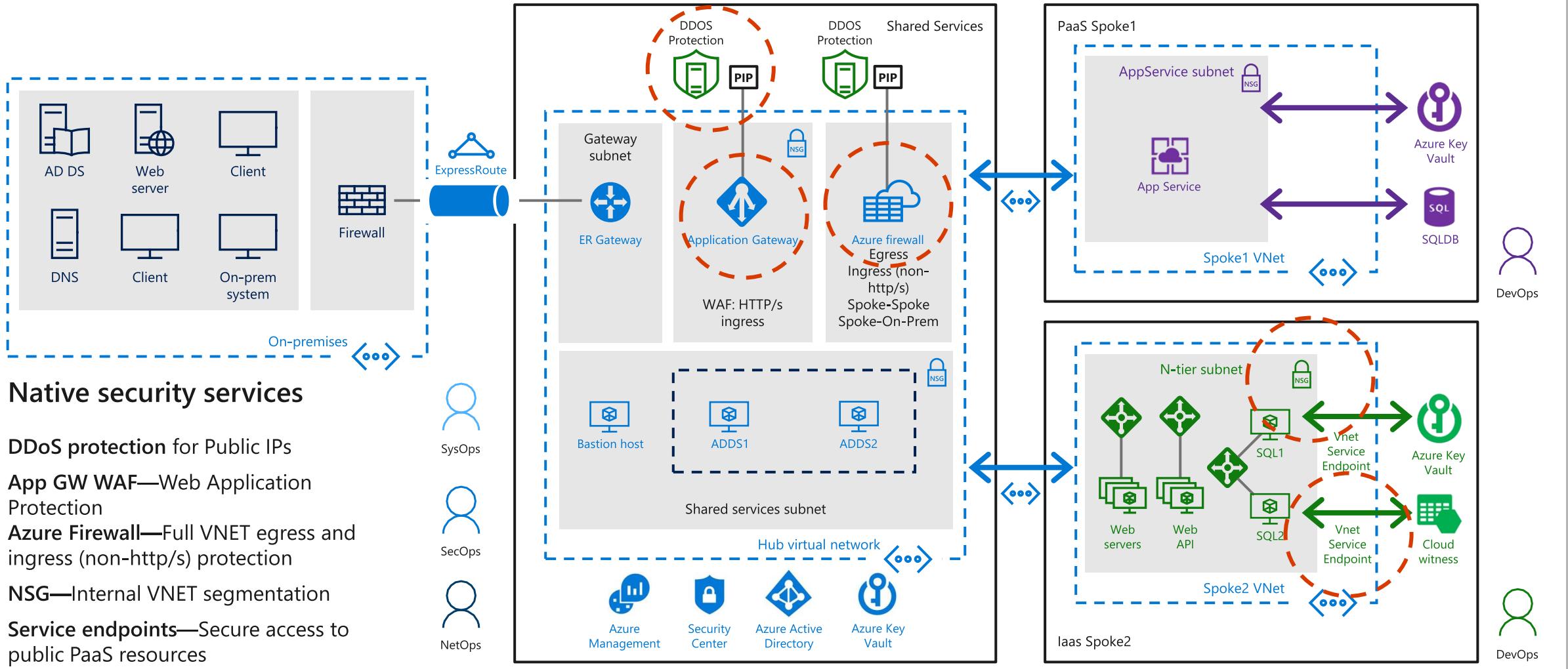
- In a region with Availability Zones, a Standard Load Balancer (frontend) is zone-redundant by default.
- A single frontend IP address can handle zone failure and can be used to reach all backend pool members (VMs) irrespective of the zone.

- Deploy VPN/ER GW in Azure Availability Zones.
- Resiliency/higher availability for VNet GW.
- Physically and logically separates GW's within a region
- Protects on-prem network connectivity to Azure from zone-level failures.

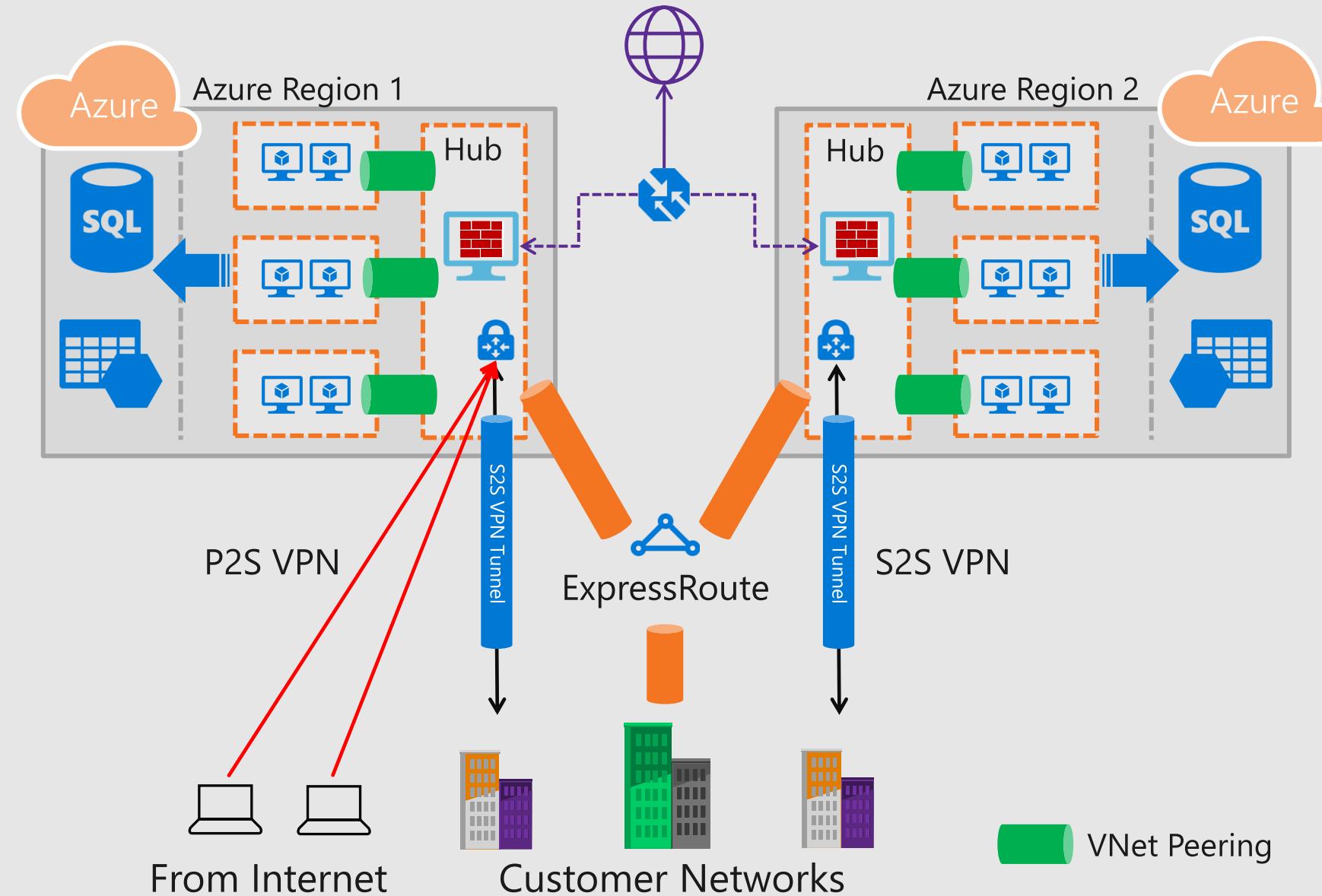
# Hub & Spoke High Level Design



# Hub & spoke architecture—native security services



# Putting everything together



## Hub-and-Spoke

- Hub-and-spoke in each region with VNet peering and Service Endpoints

## Global VNet peering

- Connecting Azure regions together
- Direct VM-to-VM over Azure backbone

## ExpressRoute

- Private connectivity into Microsoft Clouds
- High-throughput with carrier QoS

## S2S VPN

- Cross-premises connectivity over the Internet
- Secure connectivity over Internet

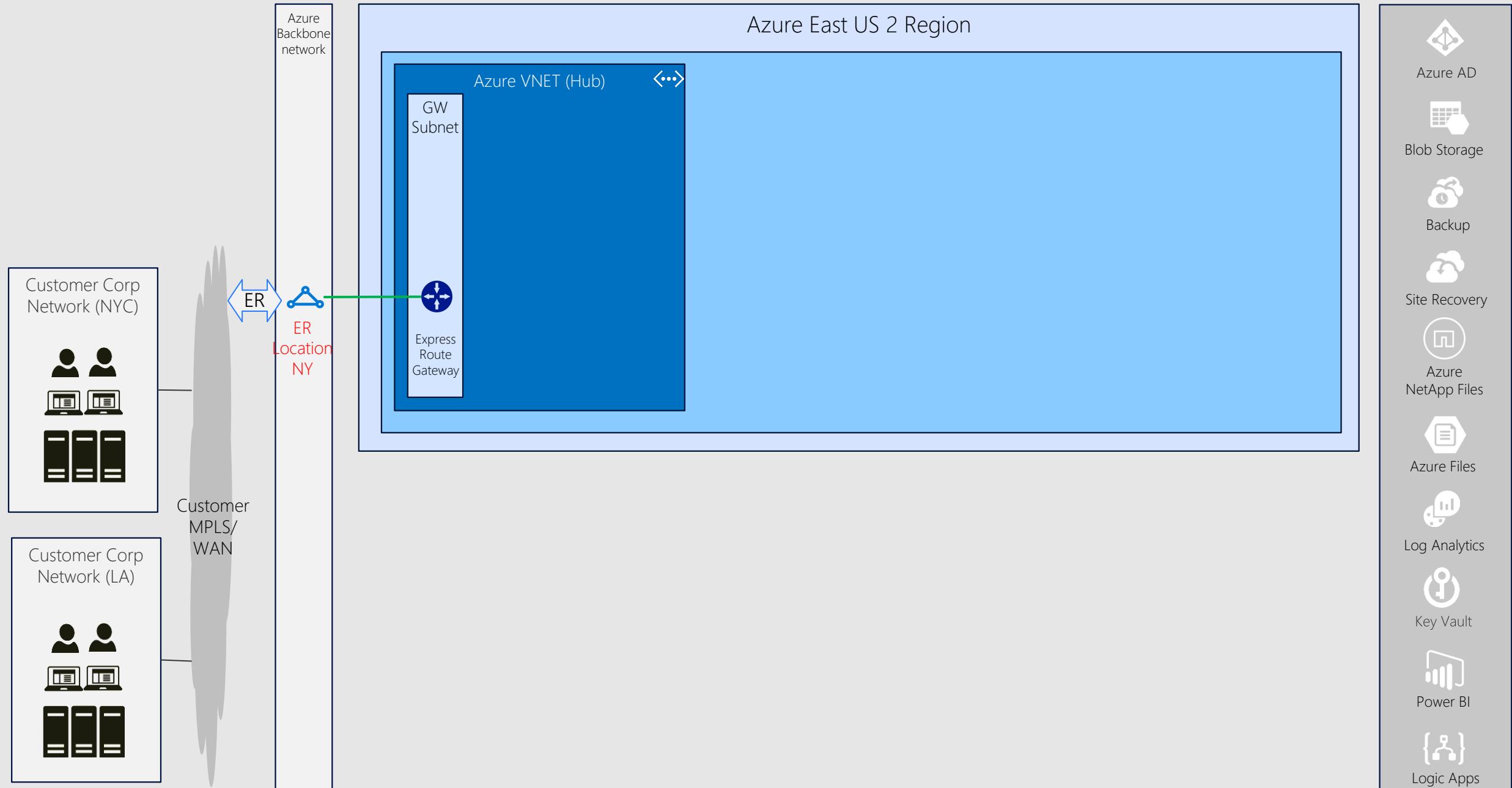
## P2S VPN

- Connect to Azure VNet securely from ANYWHERE
- Apple Mac, Windows with AD authentication

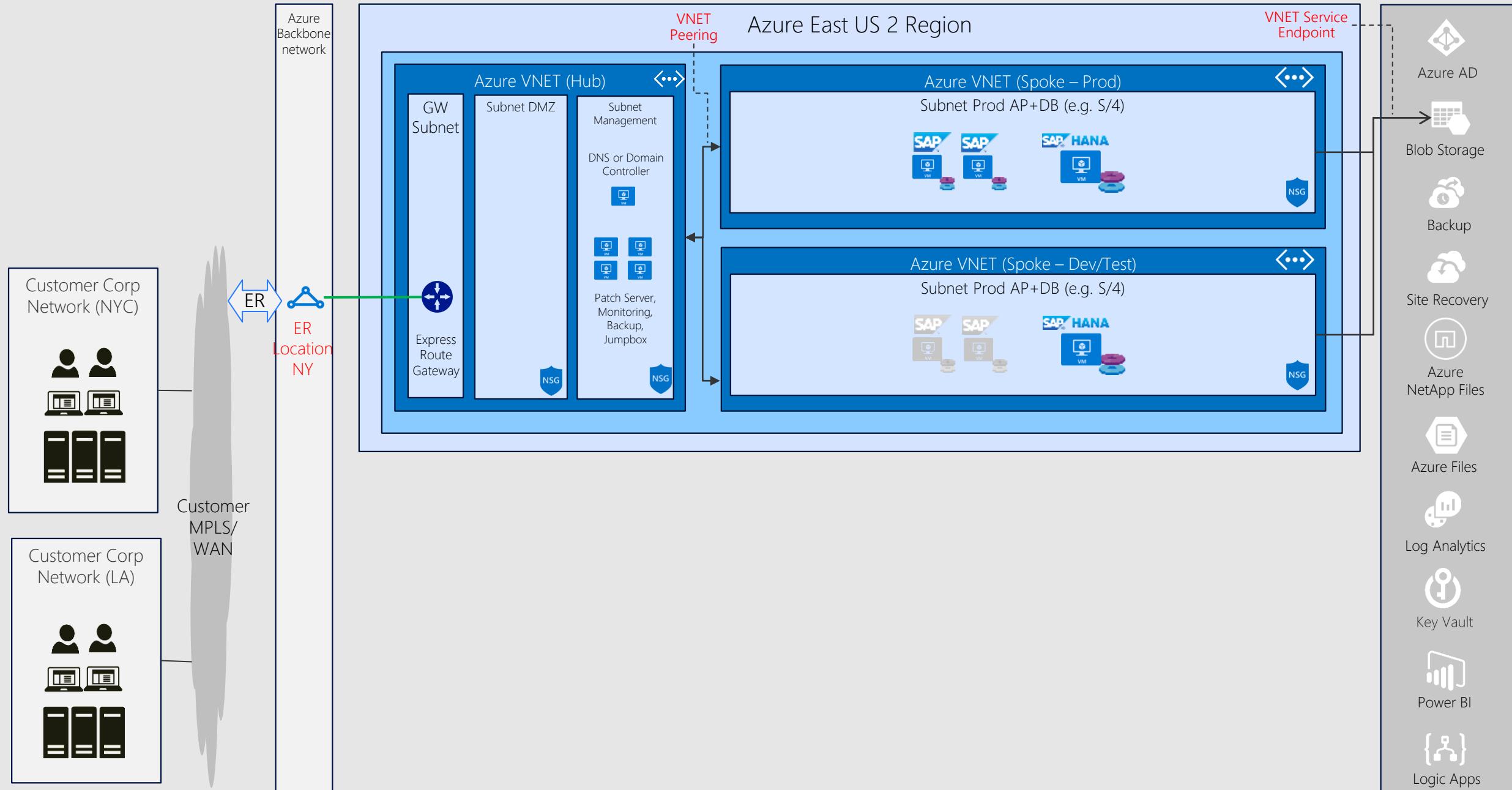
# (SAP) SAP and Azure Networking

1. Initial Setup of ExpressRoute and Hub VNET
2. Deployment of SAP Prod/Non-Prod Landscape in Spoke VNETs in Primary region
3. Addition of S2SVPN and SAP Router for Administration
4. Addition of SAP DR/QA Landscape in DR region

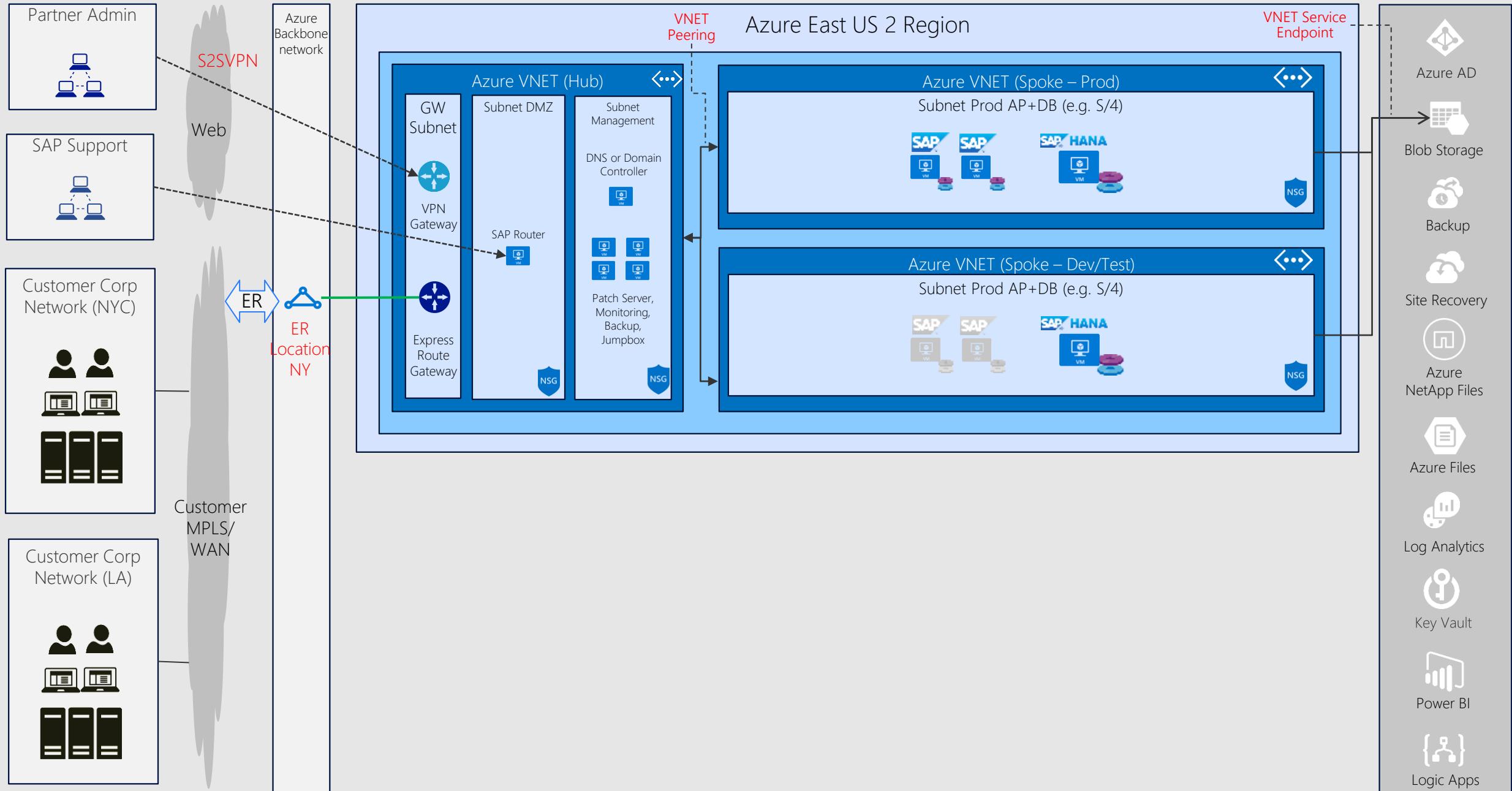
# (SAP) Initial Setup of ExpressRoute and Hub VNET



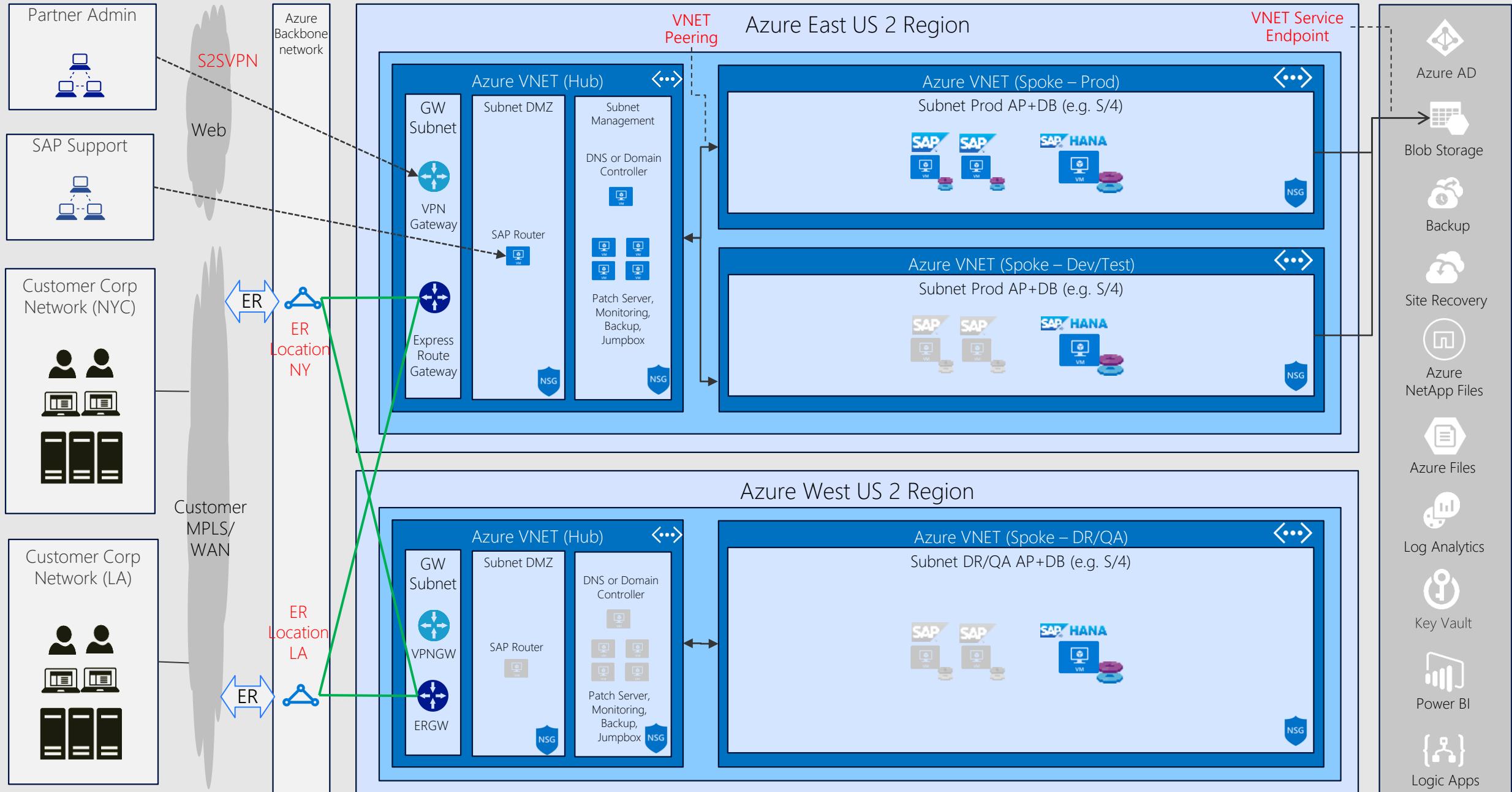
# (SAP) Deployment of SAP Prod/Non-Prod Landscape in Spoke VNets in Primary region



# (SAP) Addition of S2SVPN and SAP Router for Administration



# (SAP) Addition of SAP DR/QA Landscape in DR region



# (SAP) Why security solutions are important for SAP

1. Increasing number of SAP customers are now utilizing SAP Fiori user experience and Odata application programming interfaces over public internet
2. User/system access over internet needs to be secure, robust and performant
3. Security boundary is required when VNET connections span across different subscriptions / AAD tenants



# Network and application security groups

## Network security for your VNet traffic

### Network Security Groups

- Protects your workloads with distributed ACLs
- Simplified configuration with augmented security rules
- Enforced at every host, applied on multiple subnets

### Application Security Groups

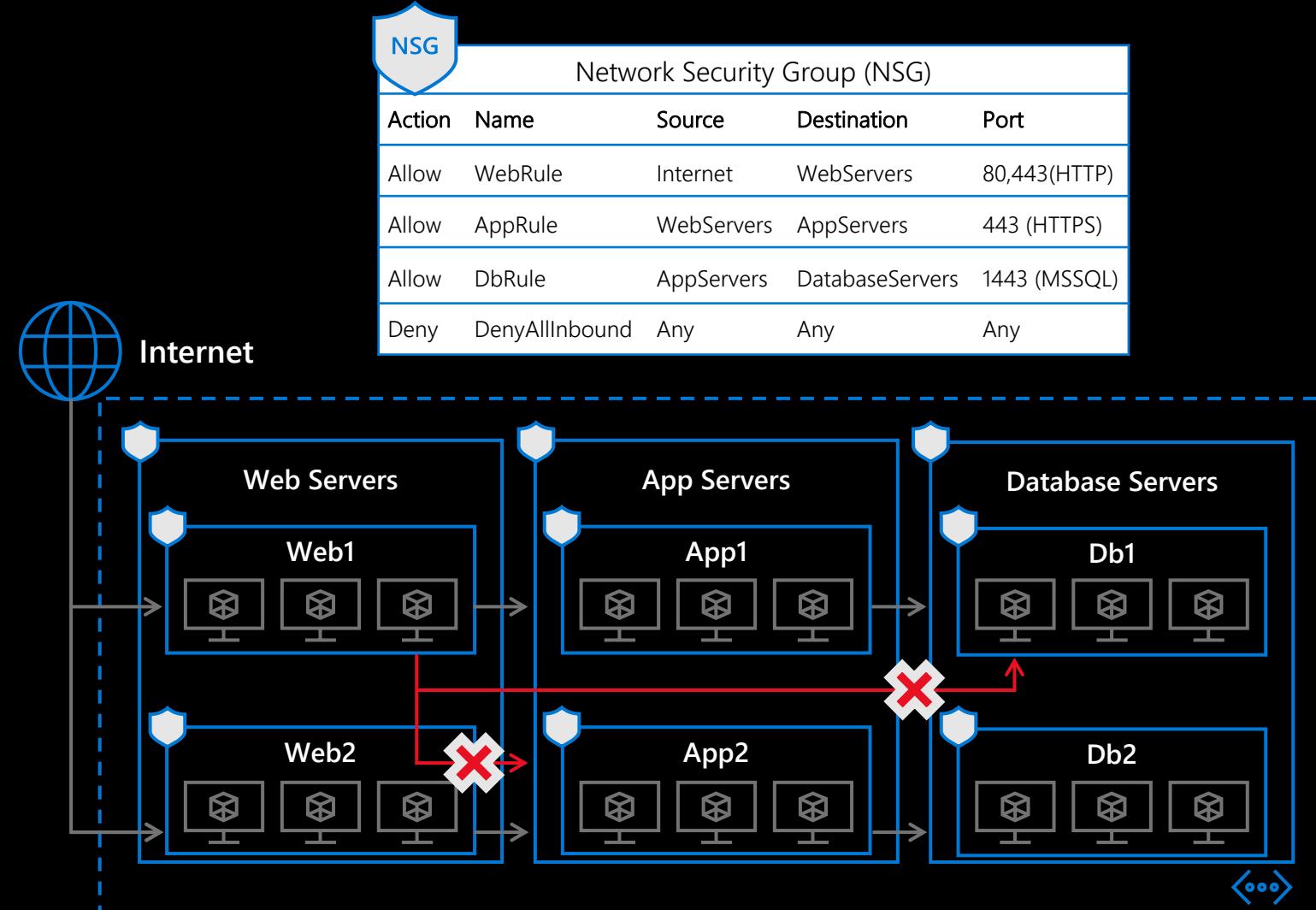
- Micro-segmentation for dynamic workloads
- Named monikers for groups of VMs
- Removes management of IP addresses

### Service Tags

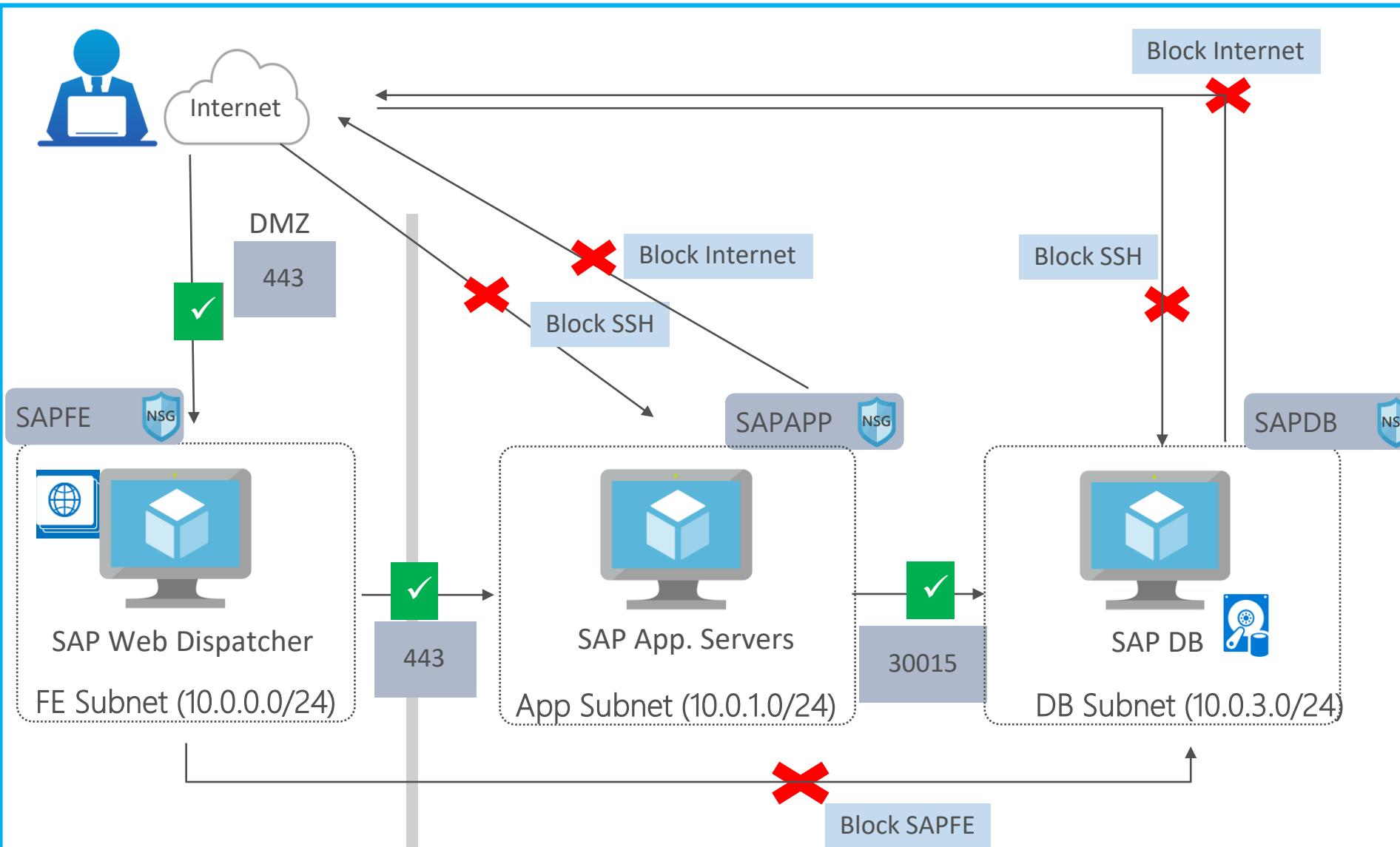
- Named monikers for Azure service IPs
- Many Services tagged including AzureCloud

### Logging and troubleshooting

- NSG flow logs for traffic monitoring
- Integrated with Network Watcher
- JIT access policies with Azure Security Center



# Network Security Groups (NSGs)



A NSG contains a list of security rules that allow or deny network traffic to resources connected to Azure Virtual Networks (VNet).

- Subnet or VM/NIC
- Network Filter
- Protocol
- Source/Dest Port Range
- Direction (In or Out)
- **ACL - Allow or Deny**

# Azure Firewall

Cloud native stateful Firewall as a service

A first among public cloud providers

Central governance of all traffic flows

Built-in high availability and auto scale

Network and application traffic filtering

Centralized policy across VNets and subscriptions

Complete VNET protection

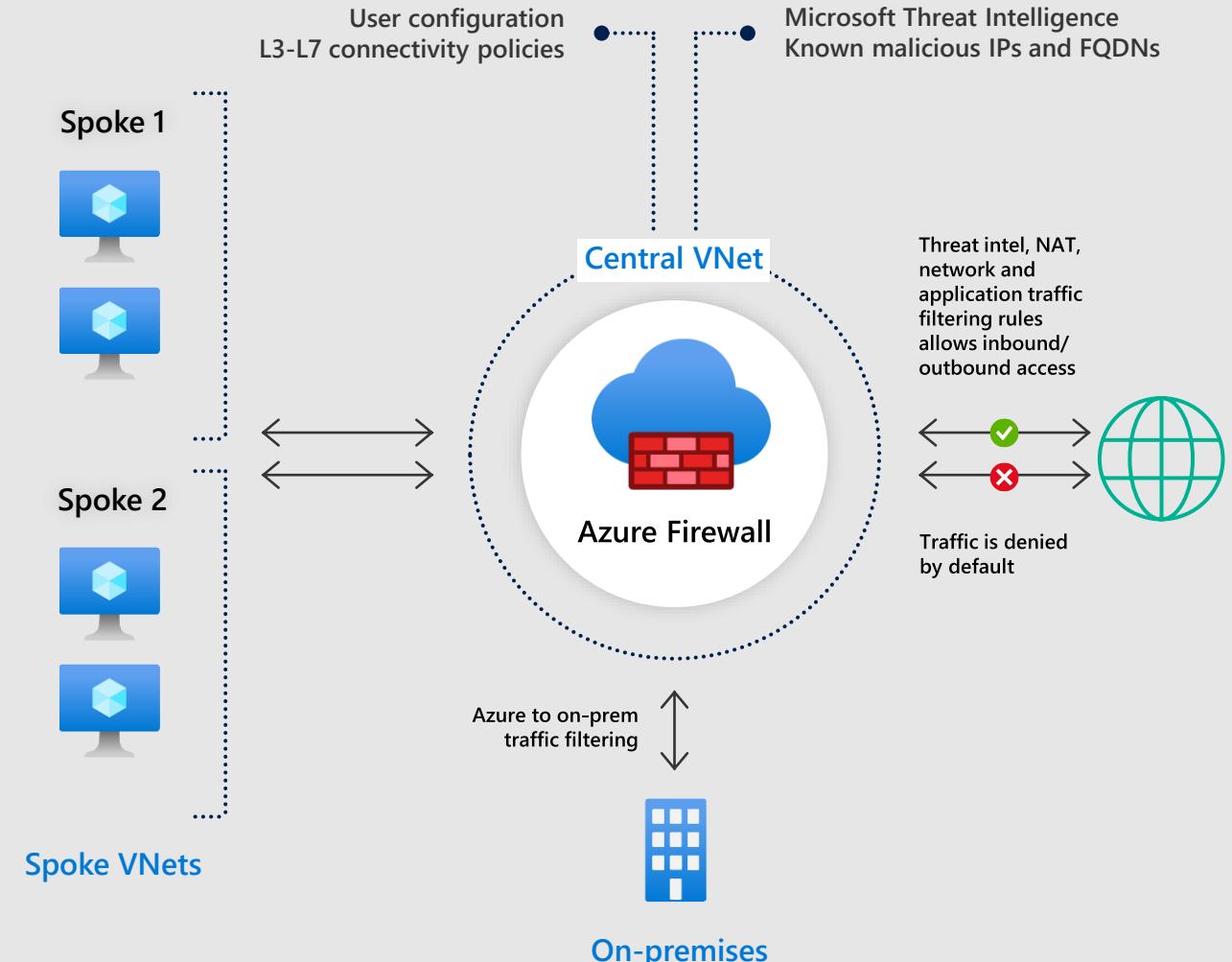
Filter Outbound, Inbound, Spoke-Spoke and Hybrid Connections traffic (VPN and ExpressRoute)

Centralized logging

Archive logs to a storage account, stream events to your Event Hub, or send them to Log Analytics or Security Integration and Event Management (SIEM) system of choice

Best for Azure

DevOps integration, FQDN Tags, Service Tags, Integration with ASE, Backup and other Azure services



# Network Virtual Appliances

## Overview

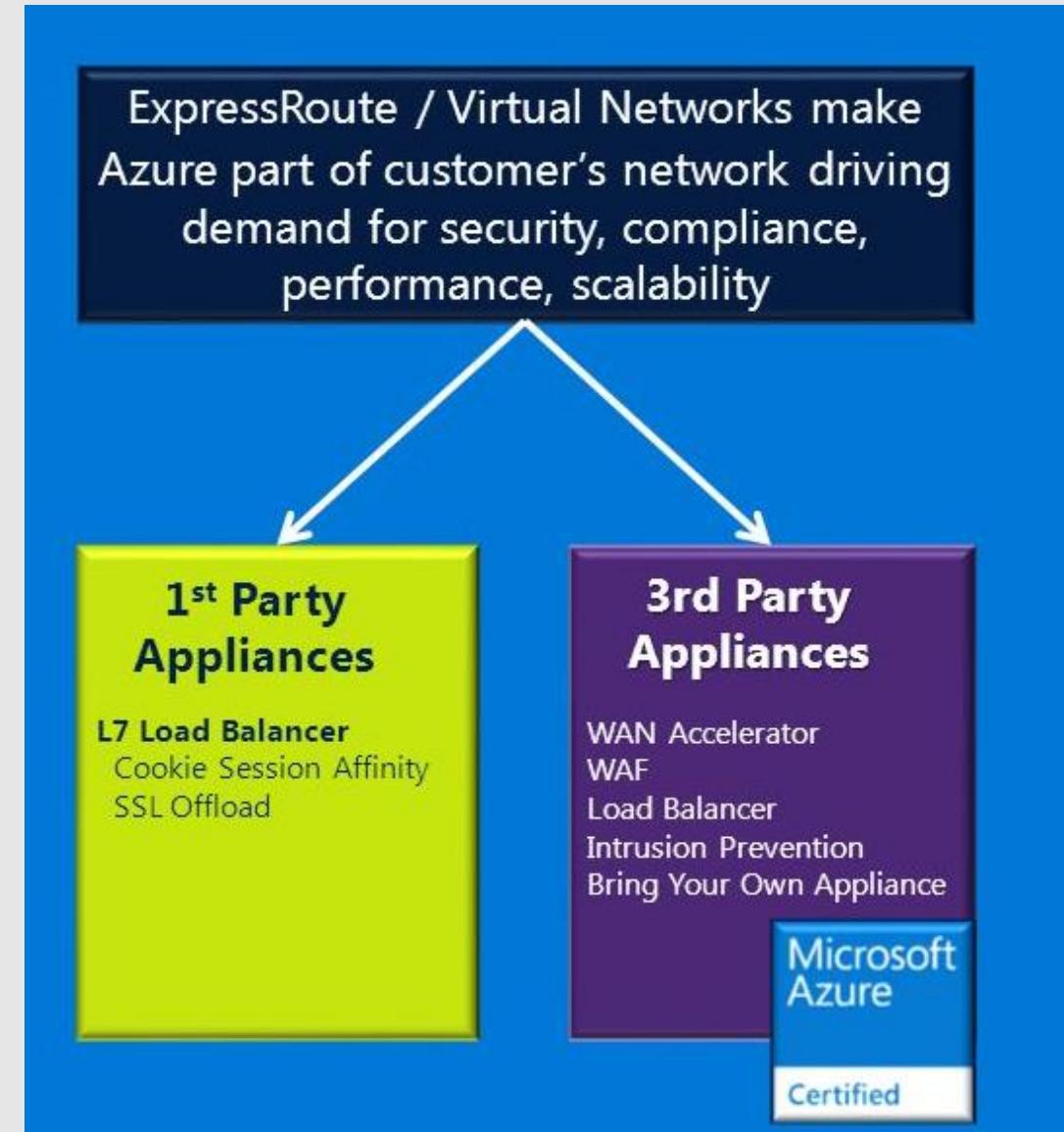
- VMs that perform specific network functions
- Focus: Security (Firewall, IDS, IPS), Router/VPN, ADC (Application Delivery Controller), WAN Optimization
- First and third-party appliances

## Scenarios

- IT policy and compliance—consistency between on-premises and Azure
- Supplement/complement Azure capabilities

## Azure Marketplace

- Available through Azure Certified program to ensure quality and simplify deployment
- You can also bring your own appliance and license



Feature	Azure Firewall	NVAs
FQDN filtering (no SSL termination)	✓	✓
Inbound/Outbound traffic filtering rules by IP address (source and destination), port, and protocol (5-tuple rules)	✓	✓
Network Address Translation (SNAT+DNAT)	✓	✓
Traffic filtering based on threat intelligence feed to identify high risk sources/destinations (e.g., C&C, botnet, etc.)	✓	✓
Full logging including SIEM integration	✓	✓
Built-in HA with unrestricted cloud scalability (auto scale as traffic grows)	✓	VMSS (vendor dependent)
Azure Service Tags and FQDN Tags for easy policy management	✓	
Integrated monitoring and management, zero maintenance—cloud service model	✓	
Easy DevOps integration using Azure REST/PS/CLI/Templates	✓	Templates
SSL termination with Deep Packet Inspection (IDPS) to identify known threats (e.g., viruses, spyware)	Roadmap	✓
Traffic filtering rules by target URI (full path - incl. SSL termination)	Roadmap	✓
Central management	Using partners (in preview)	✓
Application and user aware traffic filtering rules	Roadmap	✓
IPSEC and SSL VPN gateway	Azure VPN GW	✓
Advanced Next Generation Firewall features (e.g. Sandboxing)		Vendor Dependent

<https://azure.microsoft.com/en-us/blog/azure-firewall-and-network-virtual-appliances/>

# Azure Application Gateway (V2)

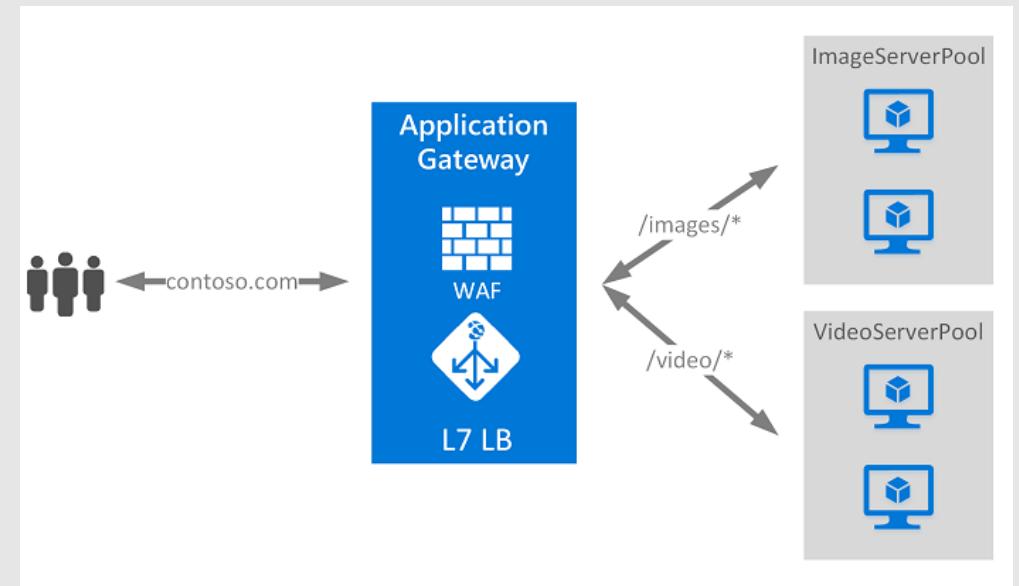
Azure Application Gateway is a **web traffic load balancer** that enables you to manage traffic to your web applications

Scalable

Web Application Firewall

SSL Offload

Integrated with Other Azure services



# Azure Web Application Firewall

Protect web sites from common application vulnerabilities

## Platform managed

Built in scalability and high availability

## Protection for web applications

Protect your app from XSS, SQL Injection, session hijack & others

Support for CRS 3.0 and 2.2.9

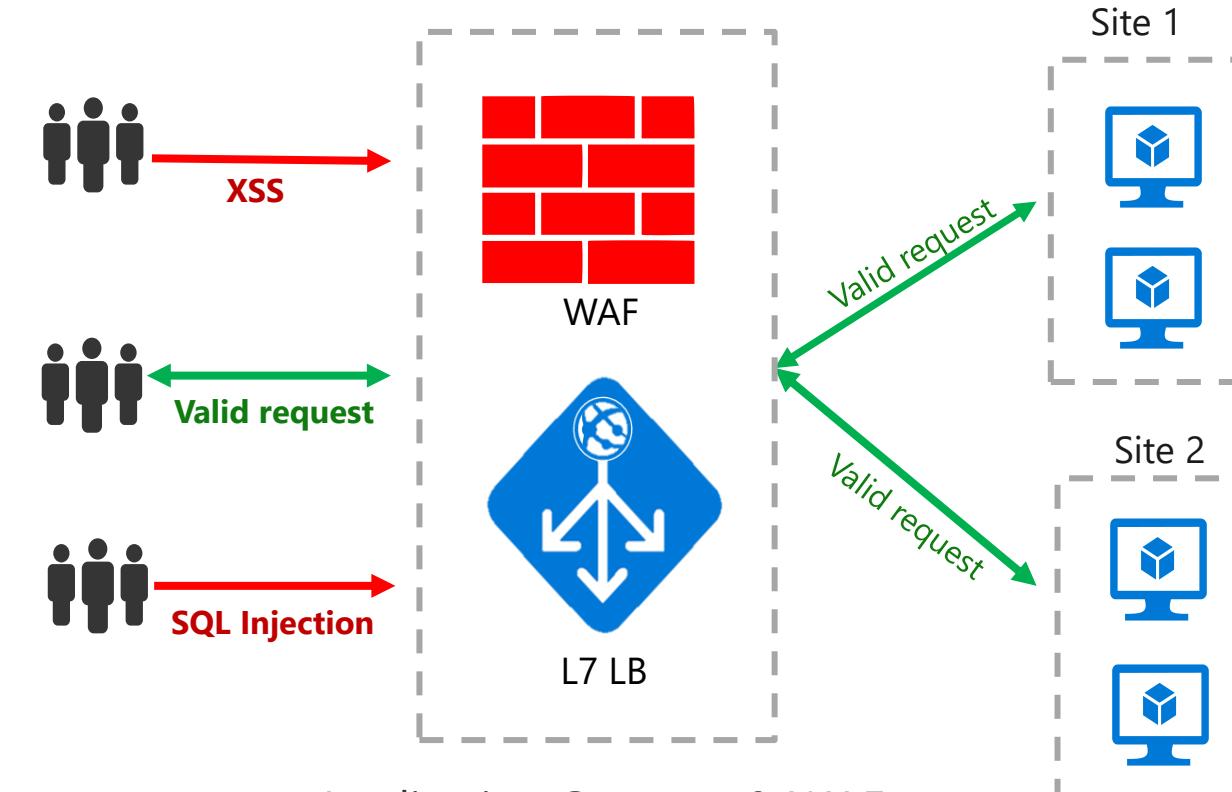
ModSecurity compatible rules engine

WAF modes and rule selection

## Diagnostics

Near real-time logging with Azure Monitor, Log Analytics

Integrated with Azure Security Center for alerts, health and SIEM



Application Gateway & WAF

# Azure Firewall synergies and recommendations



## Application Gateway WAF

- Provides inbound protection for web applications (L7)
- Azure Firewall provides network level protection(L3) for all ports and protocols and application level protection (L7) for outbound HTTP/S. Azure Firewall should be deployed alongside Azure WAF
- Azure Firewall can be combined with 3<sup>rd</sup> party WAF/DDoS solutions



## Network Security Groups (NSG)

- NSG and Azure Firewall are complementary, with both you have defense and in-depth
- NSGs provides host based, distributed network layer traffic filtering to limit traffic to resources within virtual networks
- Azure Firewall is a fully stateful centralized network firewall as-a-service, providing network and application level protection across virtual networks and subscriptions

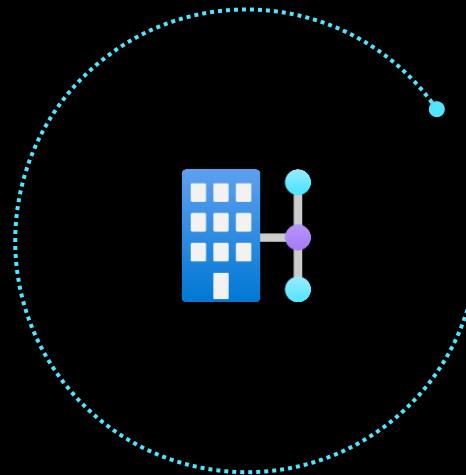


## Service endpoints

- Recommended for secure access to Azure PaaS services
- Can be leveraged with Azure Firewall for central logging for all traffic by enabling service endpoints in the Azure Firewall subnet and disabling it on the connected spoke VNETs

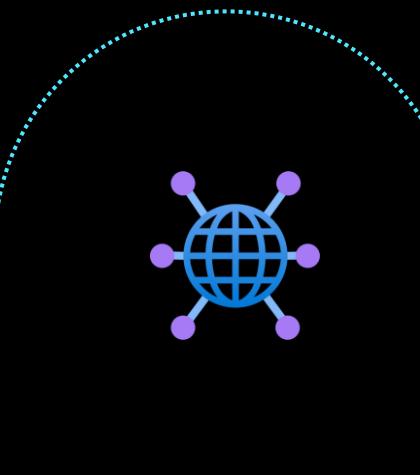
# Azure Virtual WAN Overview

## Connectivity Automation



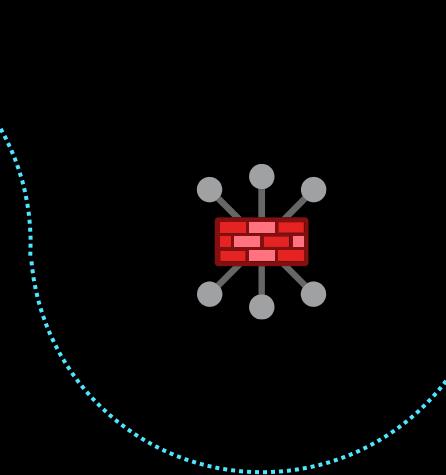
- IPSec automation
- 3<sup>rd</sup> party integration
- VPN & SD-WAN

## Global Transit Architecture



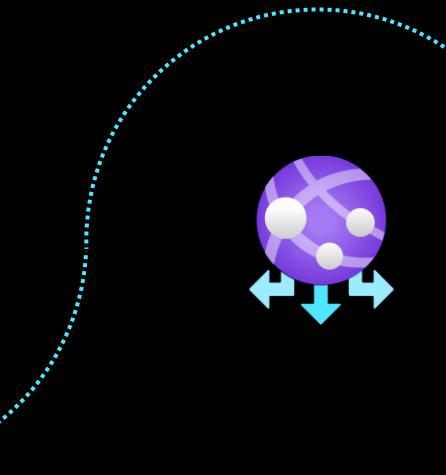
- Branch to Azure
- Remote User
- Private connectivity
- Transit VPN<->ER
- Transit VNET<->VNET
- Zero touch fully meshed hubs

## Secure Virtual Hub



- Create and enforce Azure Firewall connectivity policies
- Manage policies with Azure Firewall Manager

## Routing



- Virtual Hub Route Tables
- Associate & learn routes
- Propagate to share routes
- Custom Routing

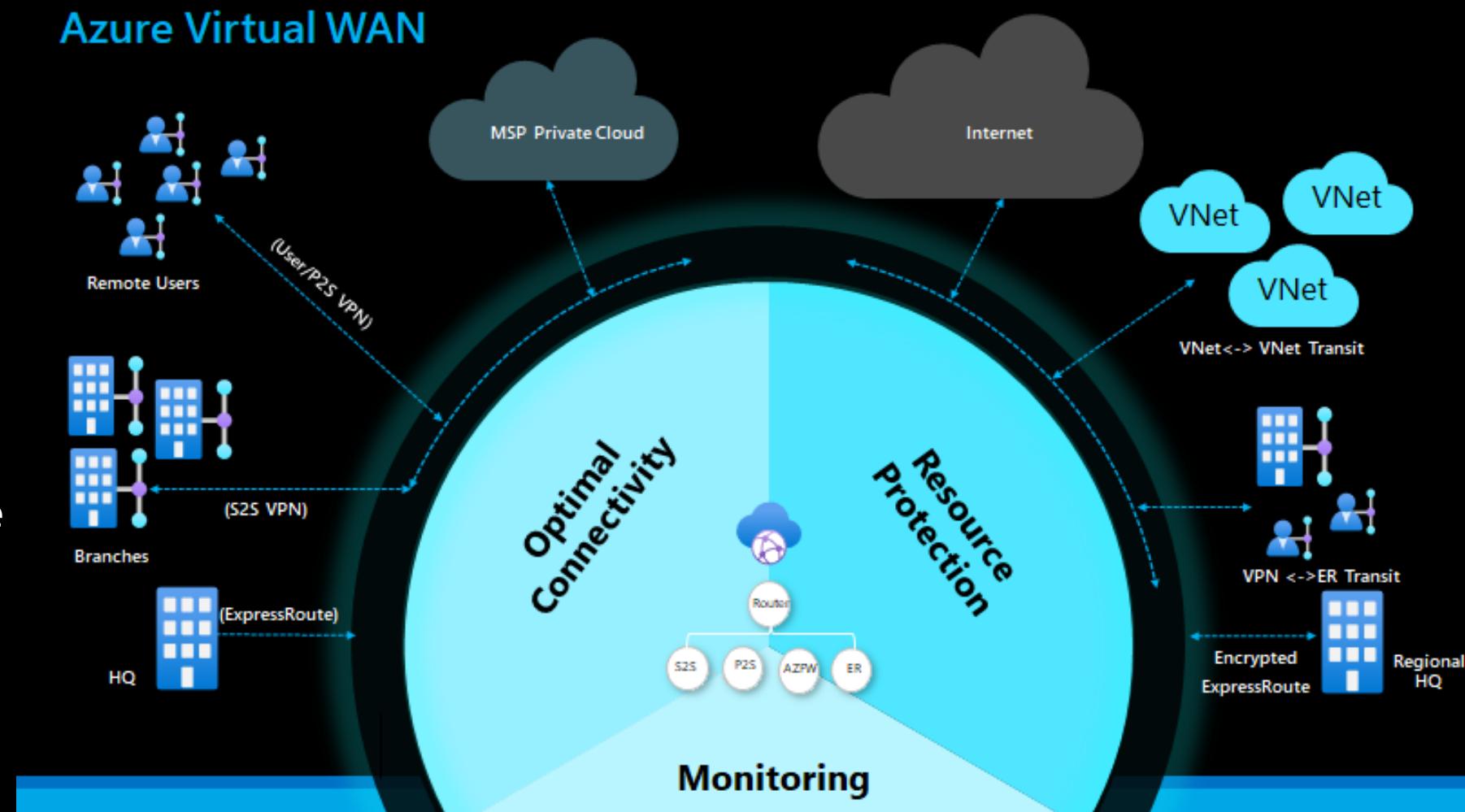
## Integrated Network Virtual Appliance



- End-to-end NVA enabled functionality
- Barracuda Cloud Gen SD\_WAN (*Preview*)

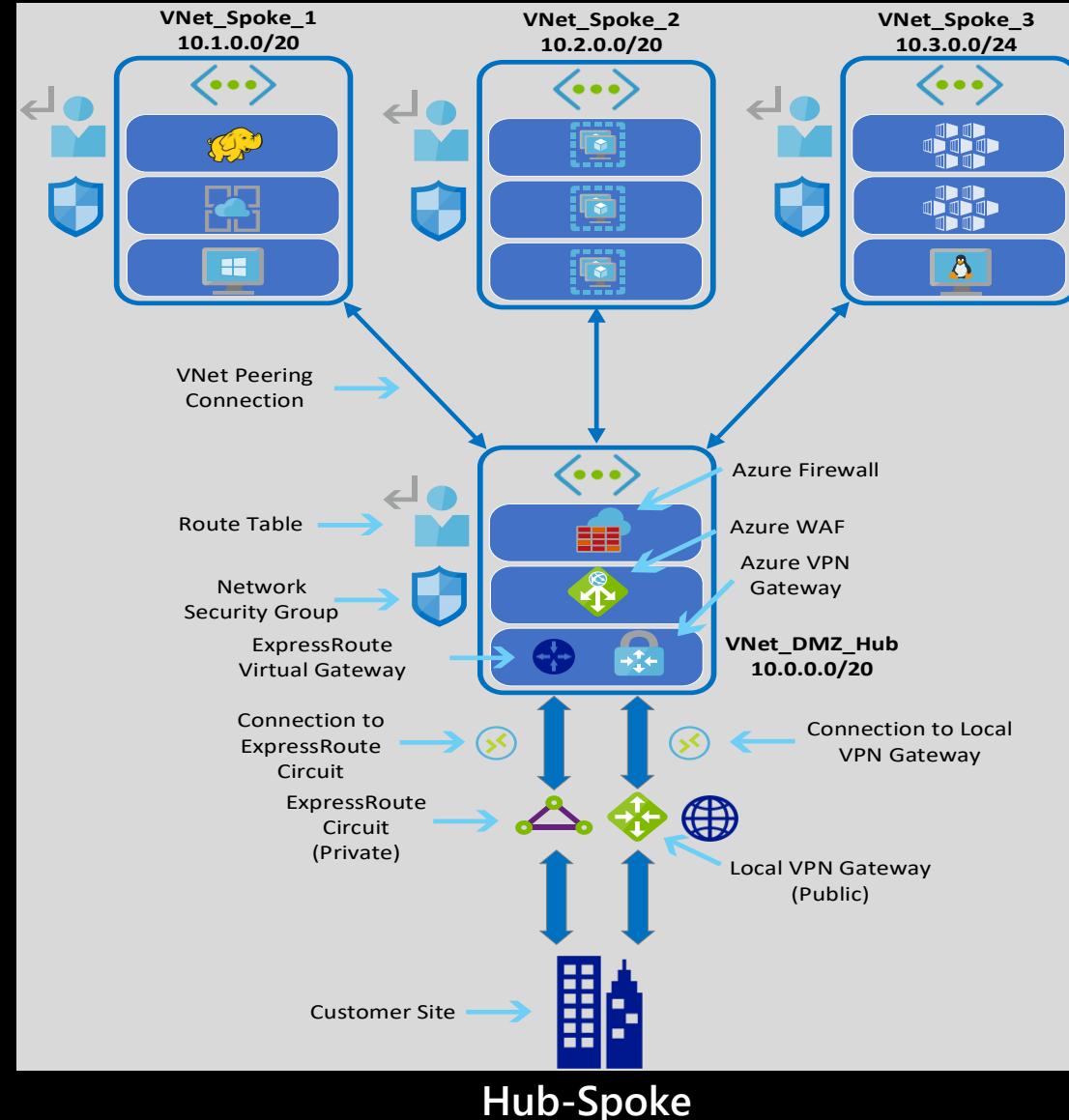
# Global Transit Architecture

- Fully meshed hub
- Any-to-any connectivity
  - Branch to Azure
  - Branch to Branch
  - Users <-> Branch
  - VNet<->VNet transit
  - VPN<-> ExpressRoute transit
  - Encrypted ExpressRoute

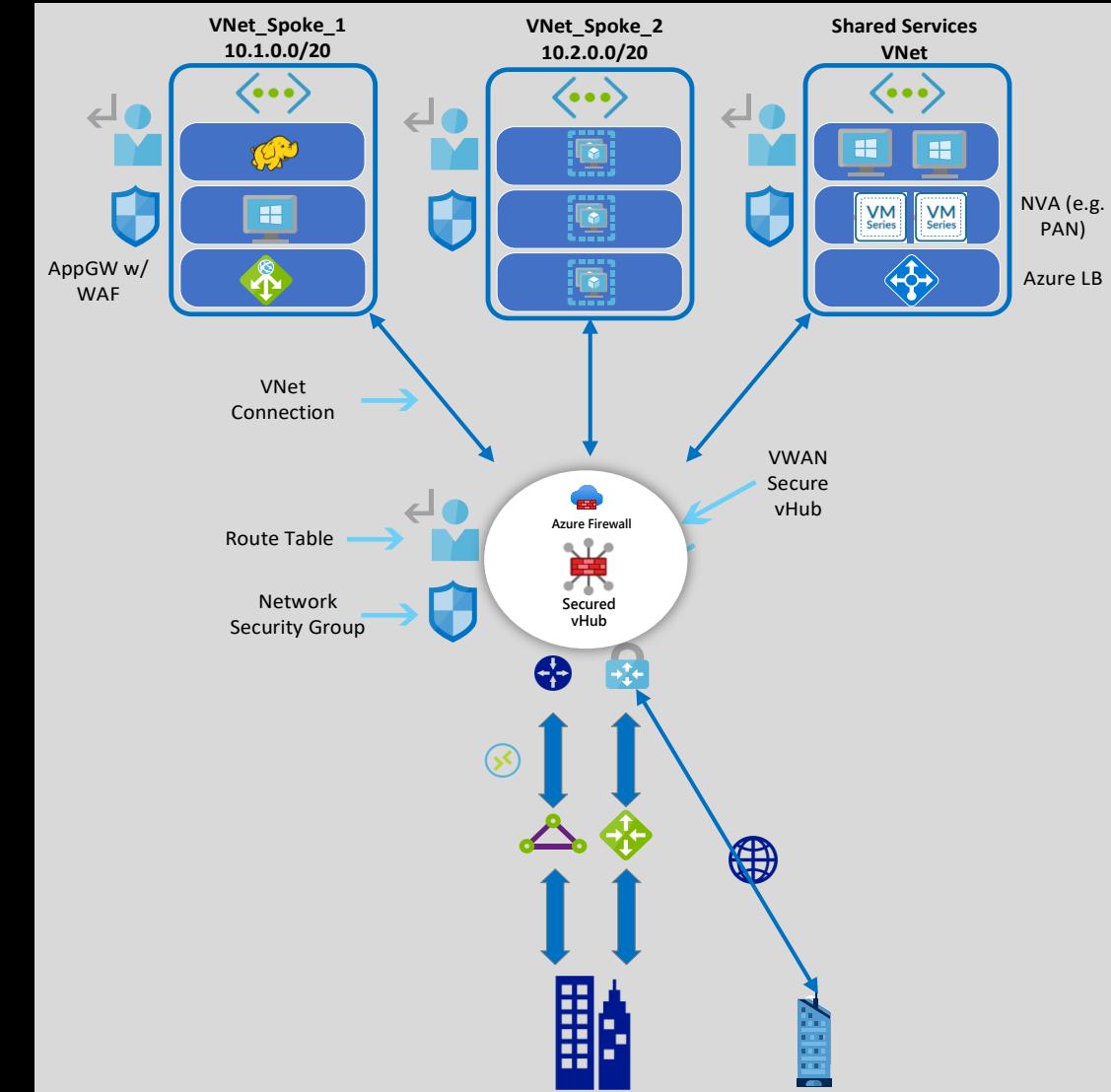


[aka.ms/virtualwan-docs](https://aka.ms/virtualwan-docs)

# Traditional vs Virtual WAN



Hub-Spoke



Virtual WAN

NVA (e.g.  
PAN)  
Azure LB



# Azure Front Door

Global entry point for high performance, high availability web applications

GA

## Single or multi-region app and API acceleration

- Improve HTTP performance and reduce page load times

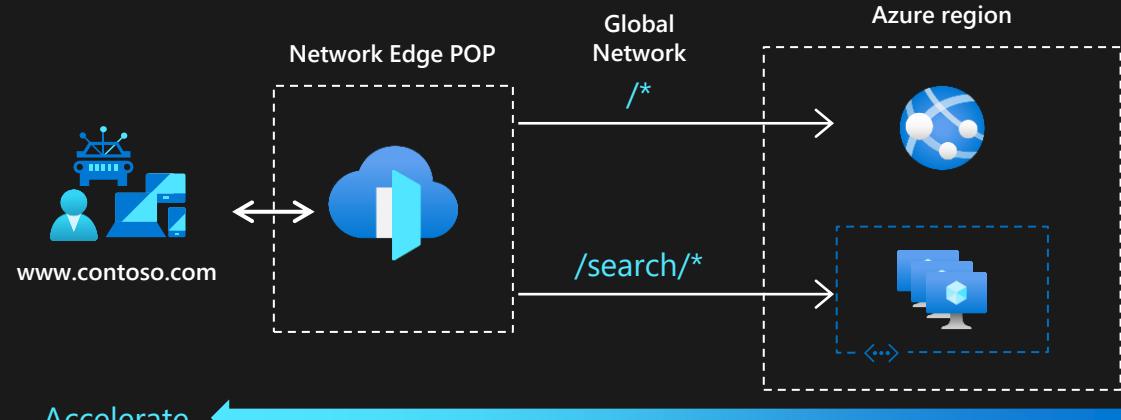
## Load balancing at the Edge and fast-failover

- Build always-on application experiences that fail-fast (safely)

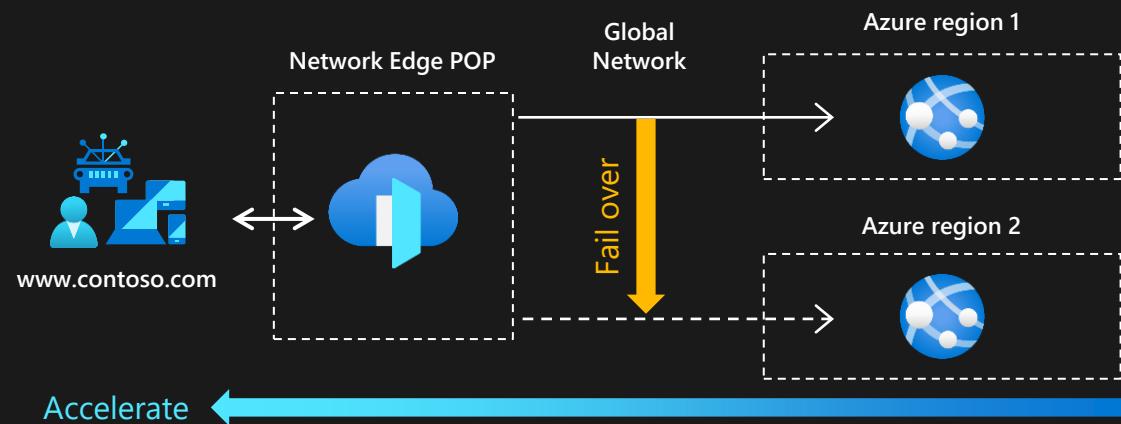
## Integrated SSL, WAF and DDoS

- Protect and scale your application to global users, devices, traffic and attacks

## Single region apps



## Multi-region apps





# Azure CDN

Cost efficient, reliable global content distribution

GA

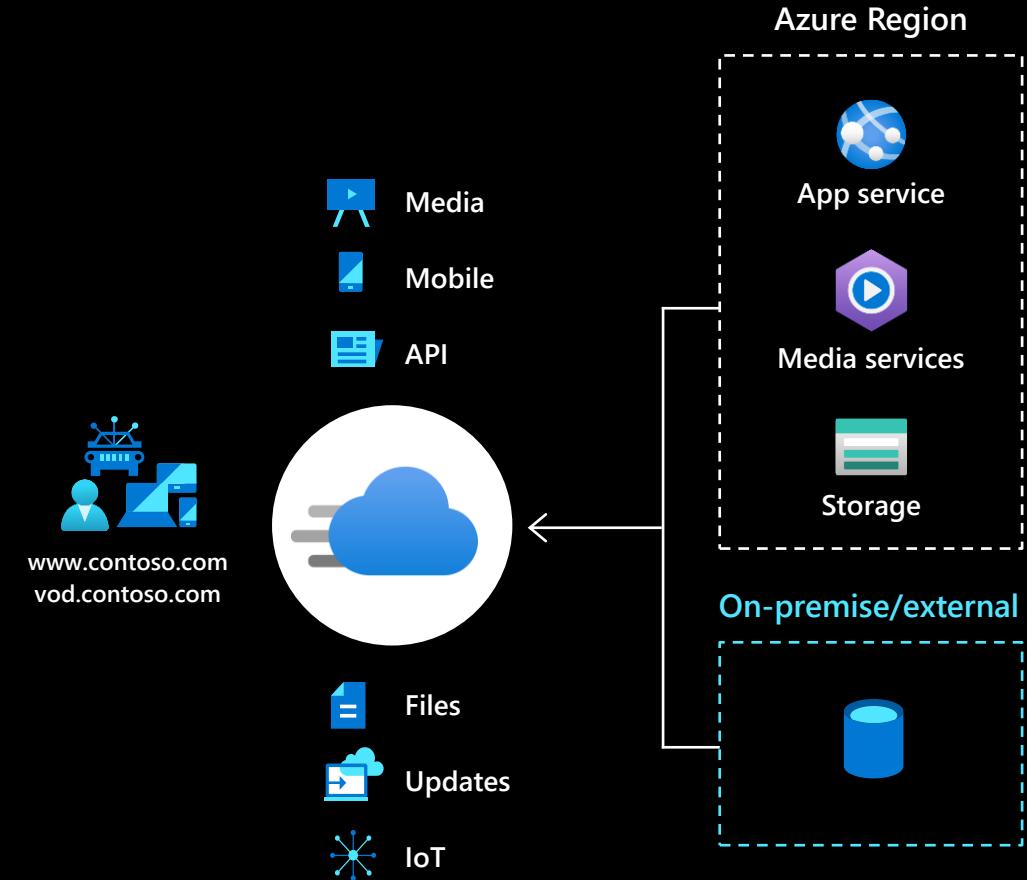
## Reduced Azure egress pricing

- Egress is free from Storage, Compute, Media Services to Azure CDN from Microsoft

PREVIEW

## Easy to use and highly customizable rules engine

- Few click onboard and common-api-driven everything
- Use Rules Engine to customize CDN



## Edge delivery partners

verizon<sup>✓</sup>

Akamai



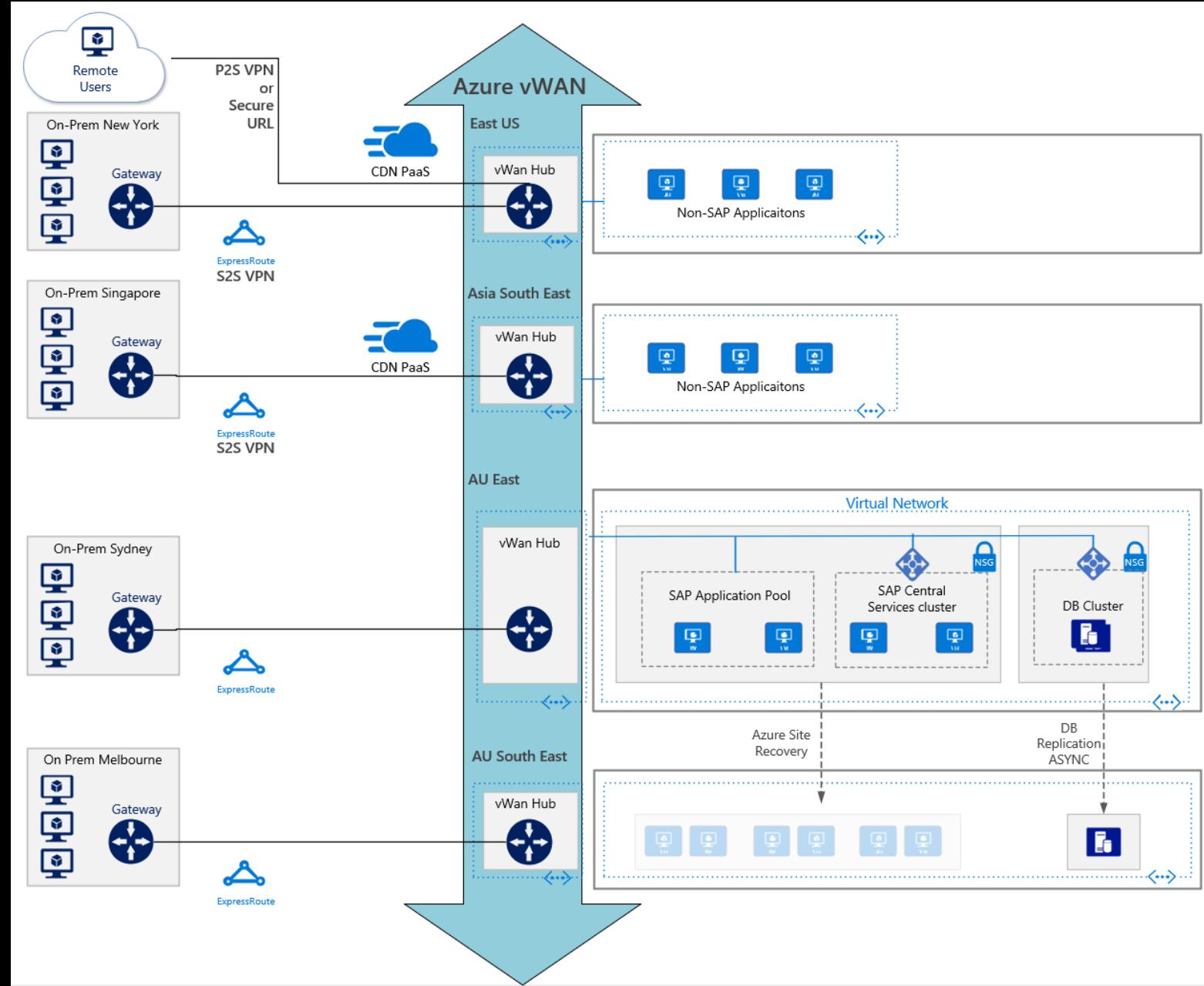
# Global SAP Instance on Azure Virtual Wan Example

Example Network diagram indicating Global User Connectivity via Azure Virtual Wan.

Branches can use either S2S VPN (Up to 4 for redundancy) or Express Routes. Remote staff can use a Client to Site VPN or direct URL. Inter Branch Communication also available.

Fiori Performance is increased via the use of the Content Delivery Network.

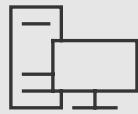
Ability to host additional services in each region. E.g. Azure PaaS or Non-SAP applications.



# Azure VM Availability Overview

## VM SLA

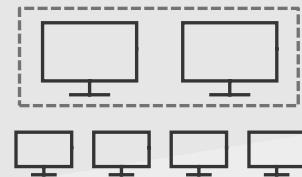
99.9%  
with Premium Storage



## SINGLE VM

Easier lift and shift

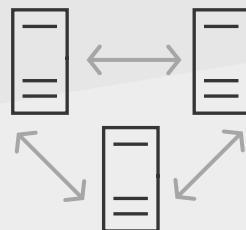
VM SLA  
99.95%



## AVAILABILITY SETS

Protecting against  
failures within  
datacenters

VM SLA  
99.99%

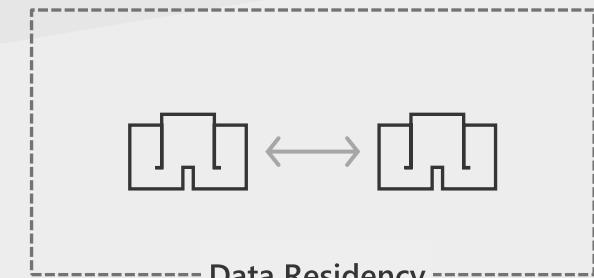


## AVAILABILITY ZONES

Protection from  
entire datacenter  
failures

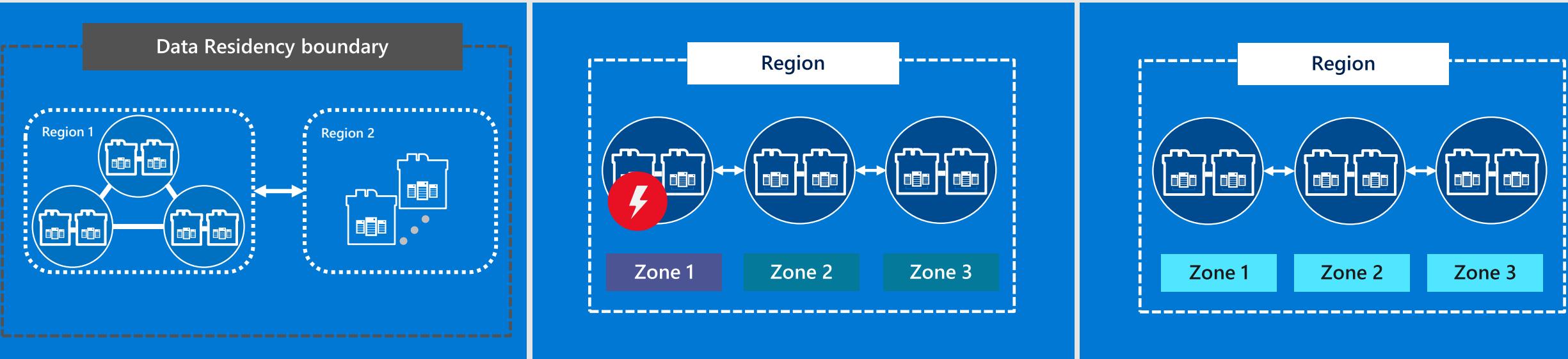
## REGION PAIRS

Regional protection  
within Data Residency  
Boundaries



# Azure Availability Zones

Part of Azure's native HA/DR solutions, providing protection from datacenter failure



## Comprehensive resiliency with Data Residency

Availability Zones and a paired region within the same data residency boundary provides high availability, disaster recovery, and backup.

## Protect against entire datacenter loss

Each zone is physically separated and consists of one or more datacenters with independent power, network, and cooling. Applications and data are replicated through zone-redundant services.

## Run mission-critical applications with 99.99% SLA

High Availability supported with industry best SLA when two or more VMs are running in separate Availability Zones within a region.

# SAP Deployments on Azure Availability Zones



1. Availability zones provide **High-Availability** with the addition of resiliency to data-centre (zone) failures within an Azure region.
2. Availability Zones are **physically separate zones** within an Azure region each with its own power, network, cooling. This protects against unexpected downtime due to a hardware or infrastructure failure within a given zone.
3. An Availability Zone in an Azure region is a combination of a fault domain and an update domain providing **data center isolation**.
4. Azure recognizes this distribution across update domains to ensure that **VMs in different zones are not updated in unison** in the case of Azure Planned Maintenance Events.
5. By architecting the SAP deployment to leverage **replication across zones** e.g. DBMS replication SAP Enqueue Replication Server and distributing the SAP application servers (for redundancy) across zones you can protect the SAP system from the loss of a complete datacenter. If one zone is compromised, the SAP System will be available in another zone.
6. **There is no guarantee of a certain distance between the building structures hosting different Availability Zones – therefore, this may not constitute a viable DR solution for a customer.** Different regions have varying distances between physical buildings which can result in variable network latencies i.e. RTT between SAP Application servers in alternative zone to the Database.
7. Availability Zones are **not a DR solution**. Natural disasters in a given region can cause widespread damage.

# SAP on Availability Zones | Customer Motivation



## Metro-DR

Customers have on-premises data centers within the same metropolitan area i.e. <10KM apart.  
Due to the proximity of the data centers, customers build combined HA/DR solutions (RPO=0)

## Lack of interest in Regional DR

For example, a customer based in the Netherlands with an on-premises/metro-DR is not motivated to replicate their SAP data from West Europe (Amsterdam) to North Europe (Dublin)

## SLA requirements Drive Availability Zone Deployment

Composite SLA with Availability Zones:

$$0.9999 \text{ (ASCS)} \times 0.9999 \text{ (APP)} \times 0.9999 \text{ (DB)} \times 0.9999 \text{ (NFS)} = 99.96\%$$

### Unavailability Hours

99.96% = Yearly: 3h 30m 22.8s

99.80% = Yearly: 17h 31m 53.9s

Composite SLA with Availability Sets:

$$0.9995 \text{ (ASCS)} \times 0.9995 \text{ (APP)} \times 0.9995 \text{ (DB)} \times 0.9995 \text{ (NFS)} = 99.80\%$$

## Cost

Within the Availability Zone deployment model, customers pay for 2 x Azure infrastructure.

When a customer opts for HA via Availability Sets +GeoDR, the cost includes 3 x Azure Infrastructure

## Experience with other Cloud providers

Customers have experience with our competitors and are familiar with Availability Zones principles.

# Availability Zones | Roadmap

30 Availability Zones enabled across 10 regions

Additional 33 zones across 11 more regions planned by the end of 2021

Documentation for SAP deployments on Availability Zones is released:

<https://docs.microsoft.com/en-us/azure/virtualmachines/workloads/sap/sap-ha-availability-zones>

	NDA	GA New Regions ETA Q1 2020
	Regions	GA
Americas	Central US	✓
	East US	✓
	East US 2	✓
	West US 2	✓
	Canada Central	Q1 CY20
	South Central US	Q2 CY20
	US Gov Virginia	H2 CY20
	Brazil South	H2 CY20
EMEA	West US	H2 CY20
	France Central	✓
	North Europe	✓
	UK South	✓
	West Europe	✓
	Germany West Central	H2 CY20
	Switzerland North	H1 CY21
APAC	Japan East	✓
	Southeast Asia	✓
	Australia East	Q1 CY20
	India Central	H2 CY20
	East Asia	H1 CY21
	Korea Central	H1 CY21

This chart does not include zone launch dates for regions that are currently in planning or for regions that have not yet launched.

# SAP Performance KPIs | Rules of Thumb

ST03N: Database time (Av. DB time) includes network transfer time.

**Av. DB Time = 40% of Total RT (or 200-600ms).**

ST03N: Enqueue time (Av. Lock Time) is increased by 2 x the network latency i.e. write entry on REPL ENQ table and respond.

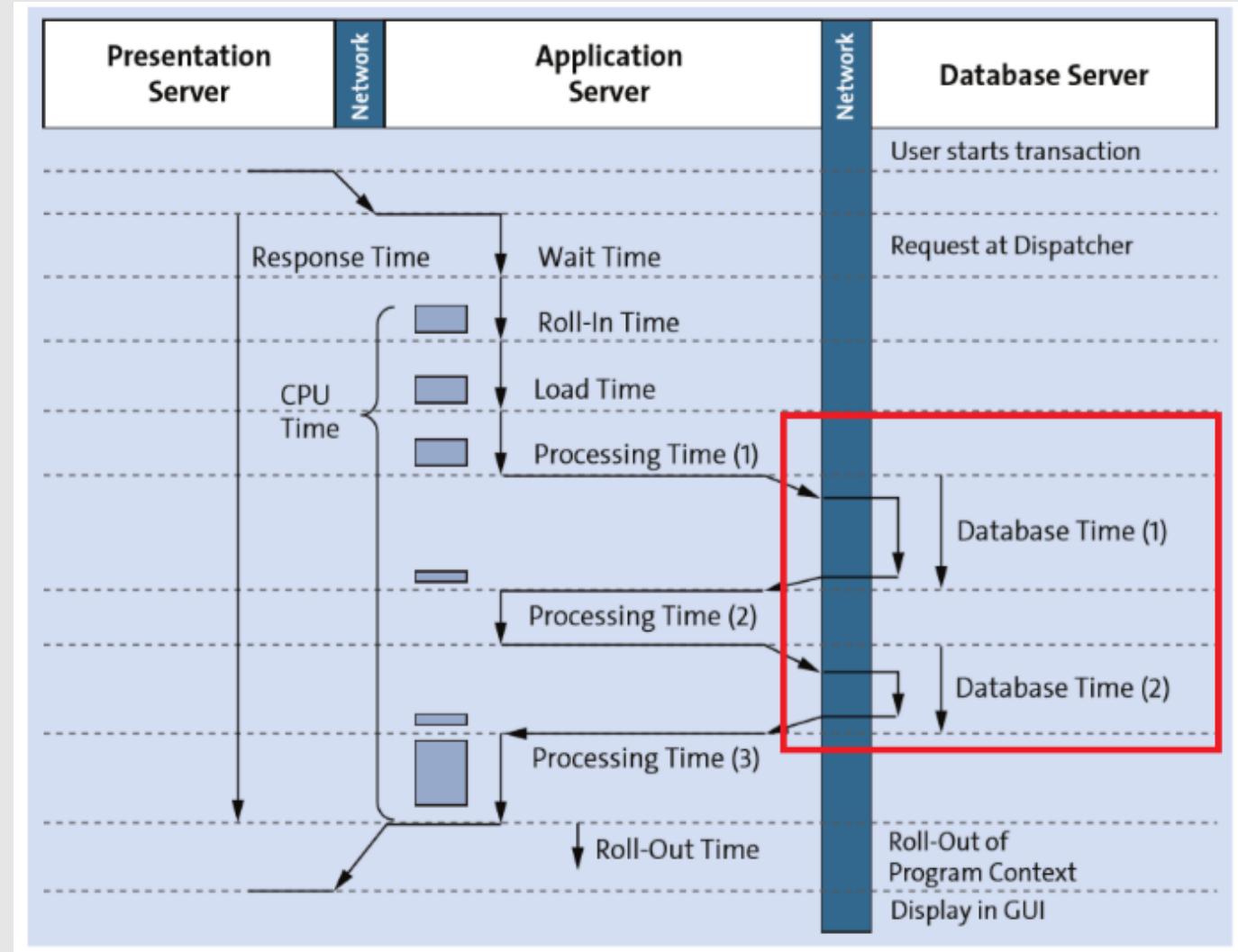
**Av. Lock Time = region of < 5ms**

SAP Note 1100926 - FAQ: Network Perf.

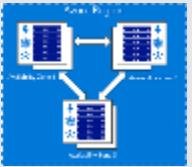
**Good value, RTT       $\leq 0.3 \text{ ms}$**

**Moderate value RTT     $0.3 \text{ ms} \rightarrow 0.7 \text{ ms}$**

**Below avg value RTT     $> 0.7 \text{ ms}$**



# SAP on AvZones | Deployment Considerations



**50% of SAP APP will show higher RT (ST03) – those in opposite zone to DBMS/SAP CS**

## Mitigation:

- Execute perf./load test in run up-to go-live (ensure not problematic)
- Run heavy, 'chatty' batch (SM61) on SAP Application servers in same zone as DBMS and SAP Central Services

**No AvSet within a Zone - UD/FD hedging cannot be leveraged. Possible all APP in a zone could experience outage**

## Mitigation

- Leverage PPG with AvSet in Zones
- Platform updates not executed in unison across all zones; always one zone available.

**Zone failure results in loss of 50% APP capacity (50% still active in secondary zone)**

## Mitigation

- Start *dormant* SAP APP in the Zone 2. Customize SMLG, SM61, RZ12, etc) to reach 100% horse-power and optimize load distribution.

**DBMS/SAP CS could failover resulting in unpredictable RT and variations In UX**

## Mitigation

- Monitoring tools should detect the failover and alert admins. Adjust SAP workload transactions post failover(SMLG, etc).

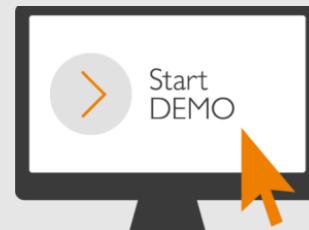
# GitHub Repo | SAP-on-Azure-Scripts-and-Utilities

## [AvZone-Latency-Test](#)



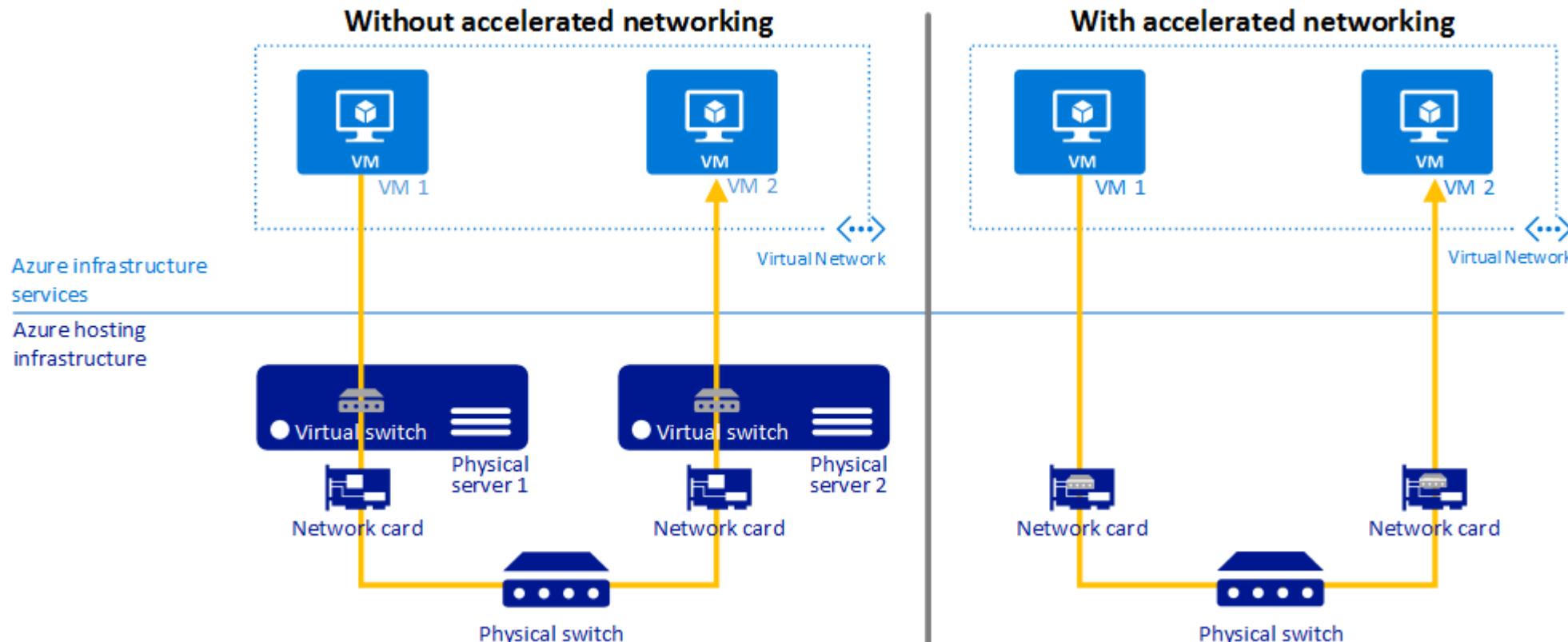
<https://github.com/Azure/SAP-on-Azure-Scripts-and-Utilities>

Installing qperf on all VMs																
Running bandwidth and latency tests																
Region: westeurope																
VM Type: Standard_D8s_v3																
Latency:																
<table><thead><tr><th></th><th>zone 1</th><th>zone 2</th><th>zone 3</th></tr></thead><tbody><tr><td>zone 1</td><td></td><td></td><td>55.9 us</td></tr><tr><td>zone 2</td><td>619 us</td><td></td><td>608 us</td></tr><tr><td>zone 3</td><td>66.8 us</td><td>610 us</td><td></td></tr></tbody></table>		zone 1	zone 2	zone 3	zone 1			55.9 us	zone 2	619 us		608 us	zone 3	66.8 us	610 us	
	zone 1	zone 2	zone 3													
zone 1			55.9 us													
zone 2	619 us		608 us													
zone 3	66.8 us	610 us														
Bandwidth:																
<table><thead><tr><th></th><th>zone 1</th><th>zone 2</th><th>zone 3</th></tr></thead><tbody><tr><td>zone 1</td><td></td><td>400 MB/sec</td><td>468 MB/sec</td></tr><tr><td>zone 2</td><td>225 MB/sec</td><td></td><td>400 MB/sec</td></tr><tr><td>zone 3</td><td>466 MB/sec</td><td>389 MB/sec</td><td></td></tr></tbody></table>		zone 1	zone 2	zone 3	zone 1		400 MB/sec	468 MB/sec	zone 2	225 MB/sec		400 MB/sec	zone 3	466 MB/sec	389 MB/sec	
	zone 1	zone 2	zone 3													
zone 1		400 MB/sec	468 MB/sec													
zone 2	225 MB/sec		400 MB/sec													
zone 3	466 MB/sec	389 MB/sec														

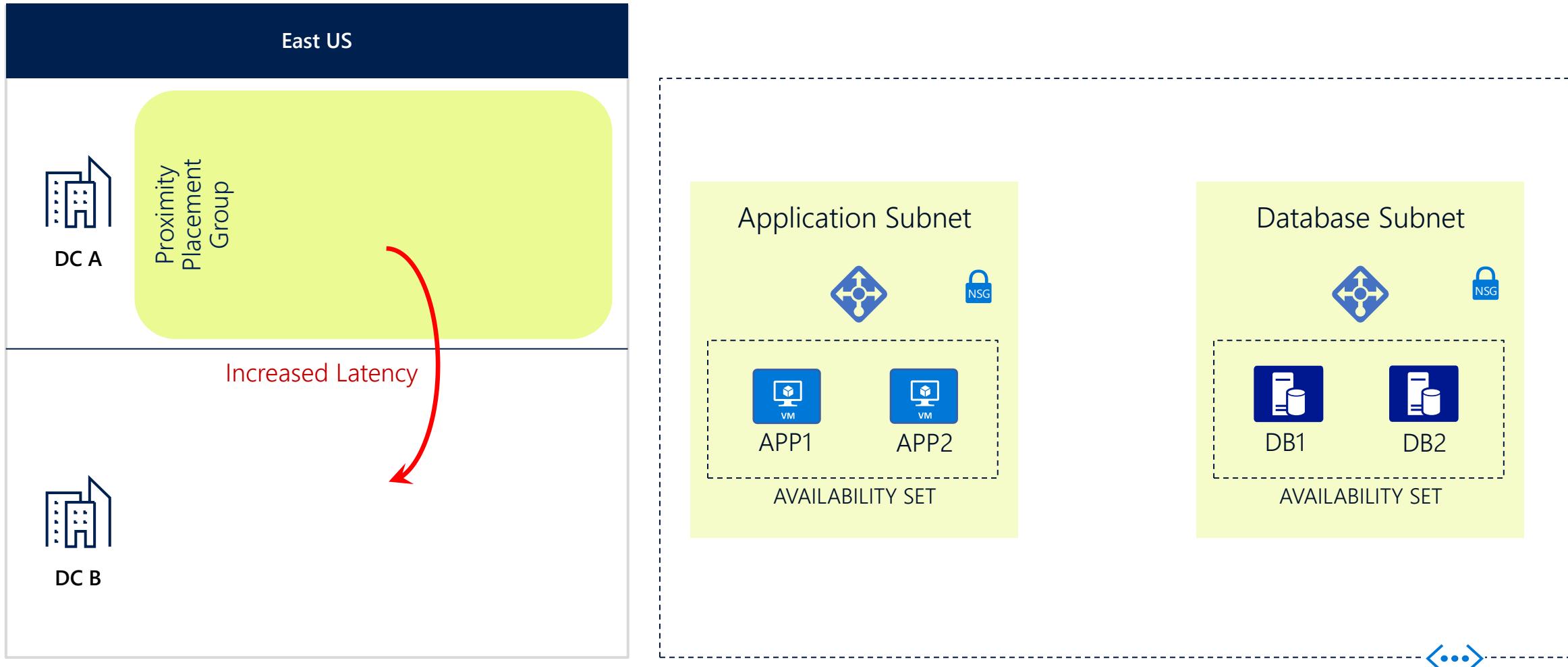


# Accelerated Networking

- Essentially a number of VM's have the ability to have Accelerated Networking enabled. It is recommended for SAP to enable Accelerated networking. Especially between App and DB servers.
- Essentially Accelerated Networking bypasses the Virtual Switch.
- <https://docs.microsoft.com/en-us/azure/virtual-network/create-vm-accelerated-networking-cli>



# Proximity Placement Groups Introduction



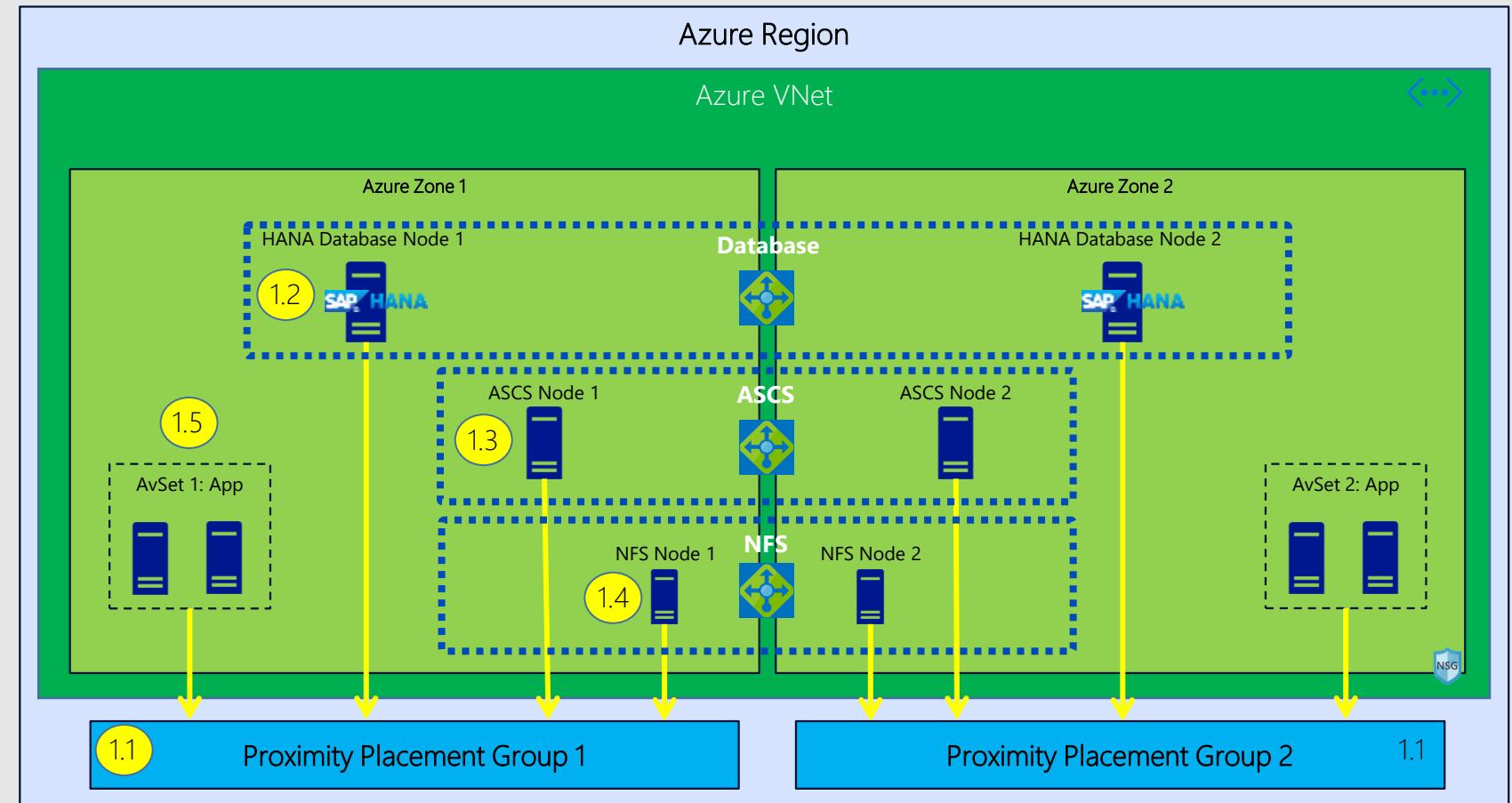
# Proximity Placement Groups with Availability Zones

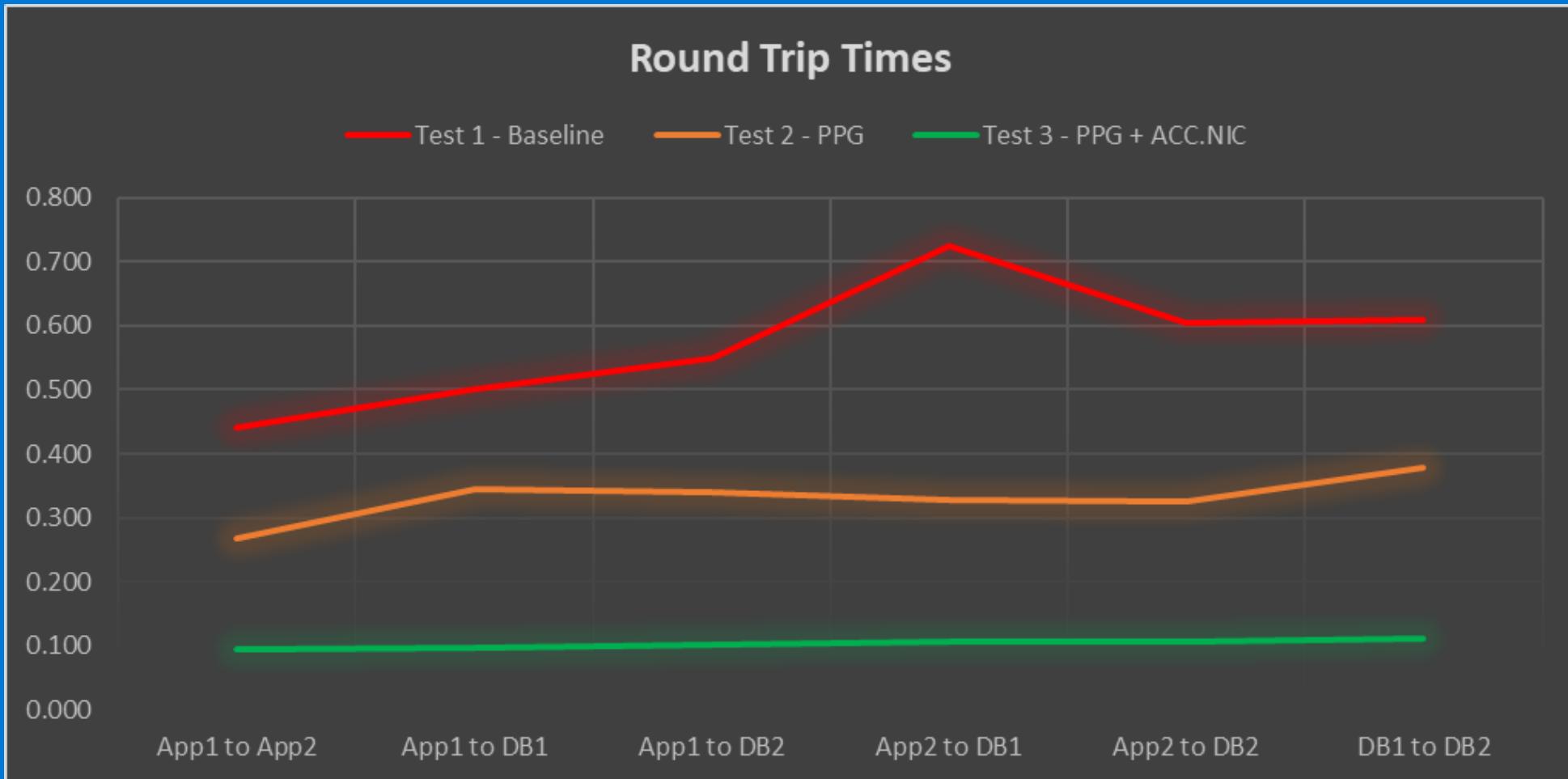
Create two Proximity Placement Groups (PPG) – one PPG in each AvZone

Create DB VM and associate with PPG1-Zone1

Create ASCS and NFS VMs and associate with PPG1-Zone1

Create App AvSet incl. VMs and associate associate with PPG1-Zone1





# ANF Network Considerations

## Constraints

- You cannot use Network Security Groups, Loadbalancers, User Defined Routes or Azure polices to control the ANF Subnet.
- The number of IPs in use in a VNet with ANF (including peered VNets) cannot exceed 1000 at this time.
- Only one subnet can be delegated to ANF in each VNet.
- You cannot do cross region or global peering.
- Transitive Routing across VNet peering relationships is not supported.

# Agenda

1. SAP Certification for Azure (Any DB)

2. Key Design Aspects

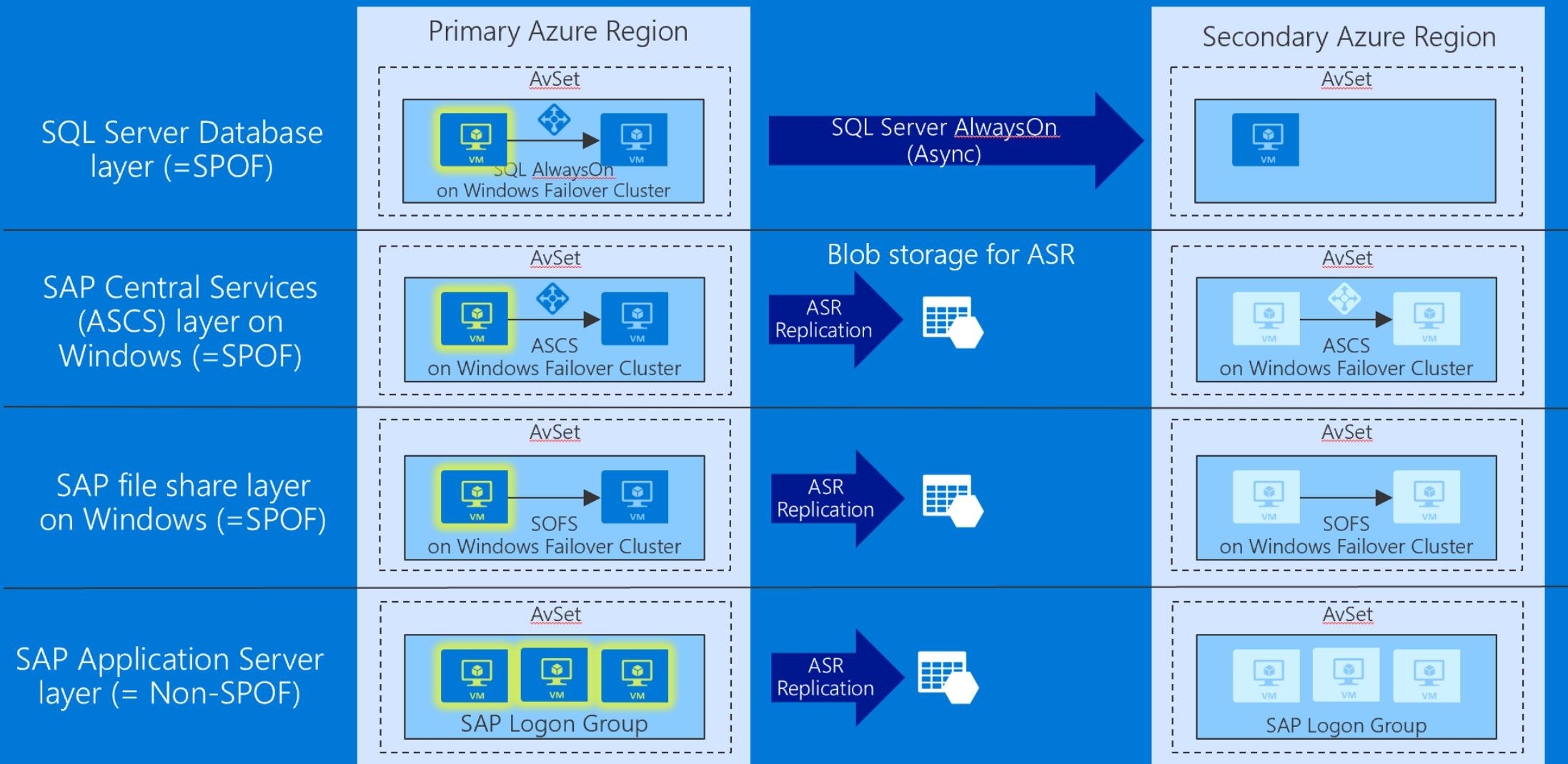
3. Reference Architecture

- Example Ref Architecture

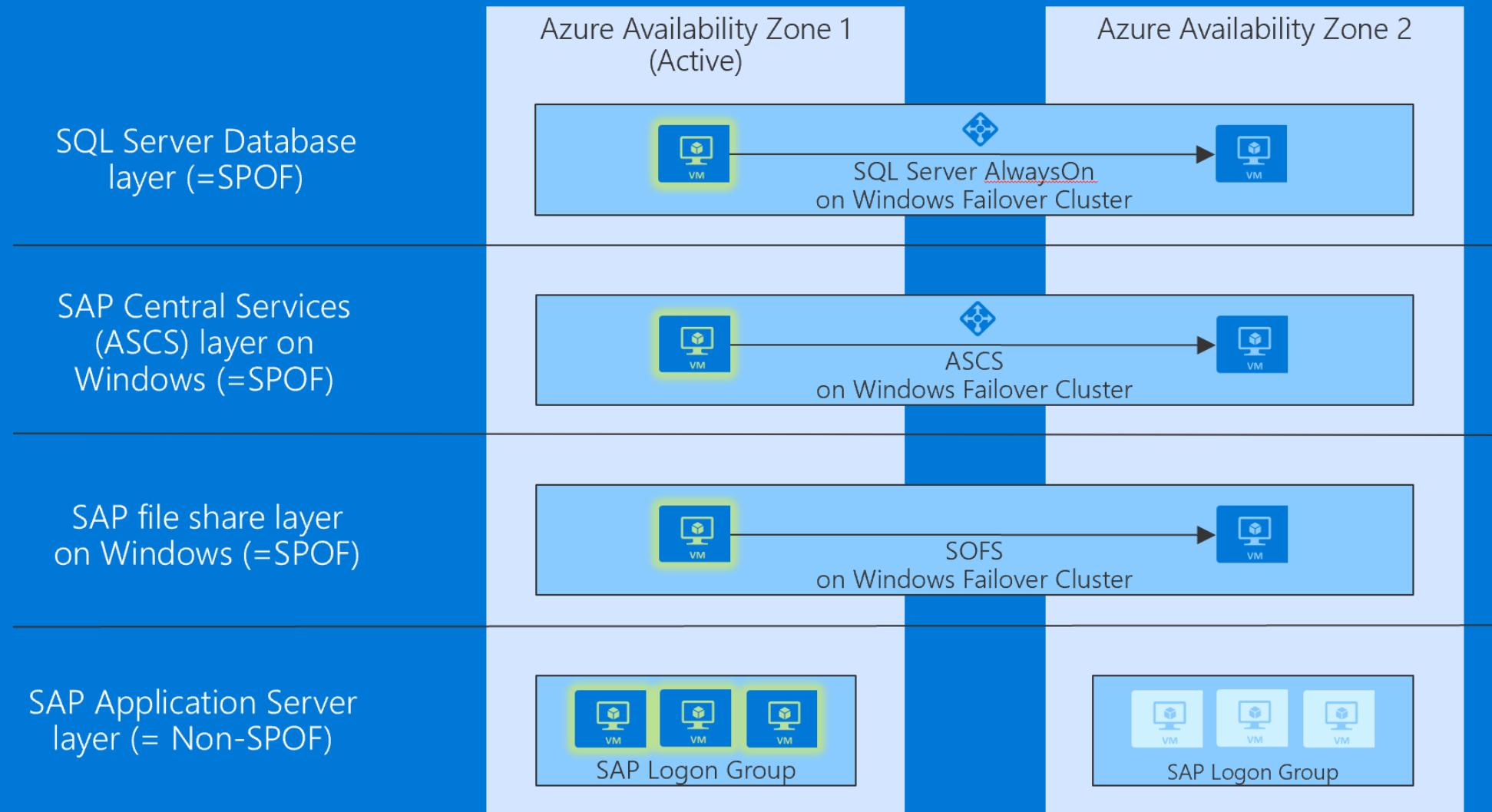
4. Backups

5. Migration to Azure

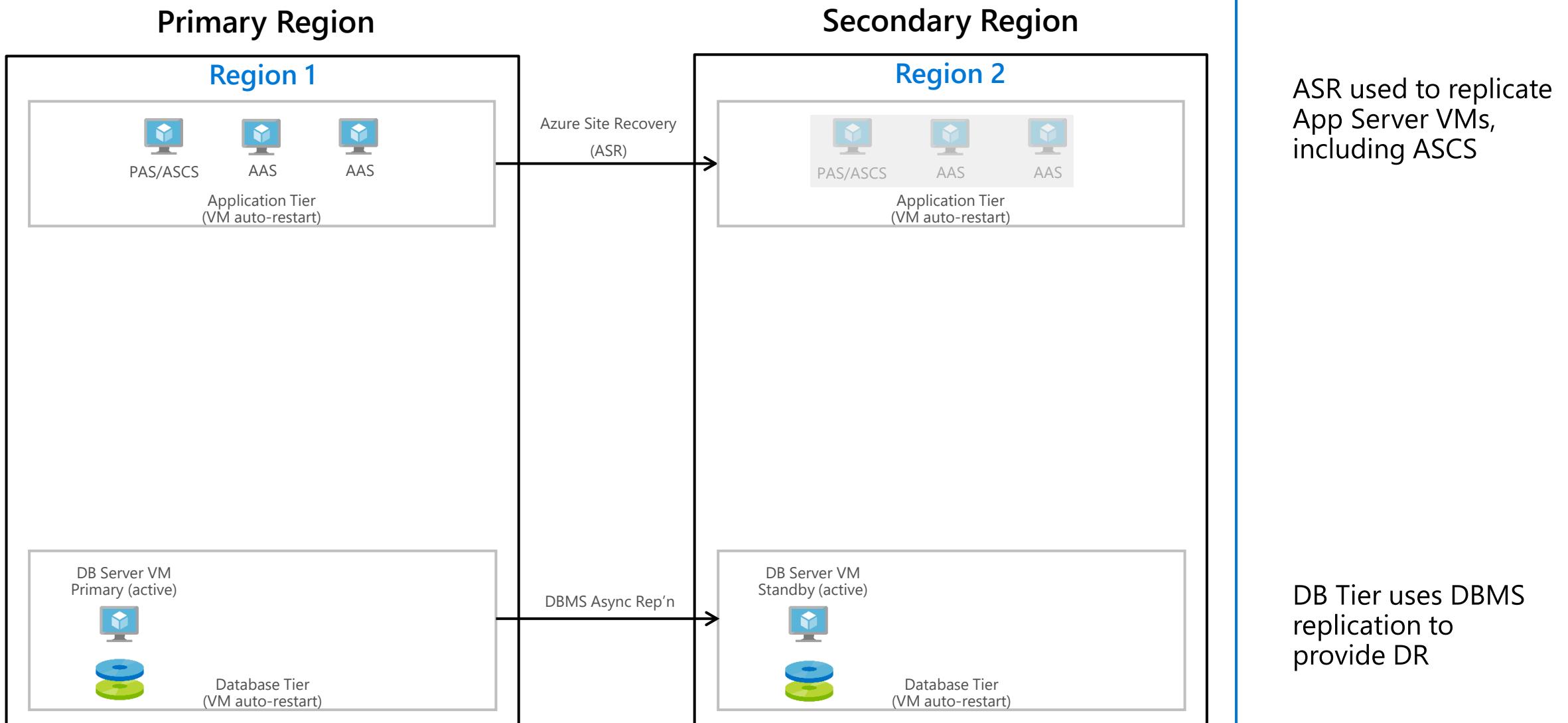
# SAP HA in Availability Set and DR across Regions



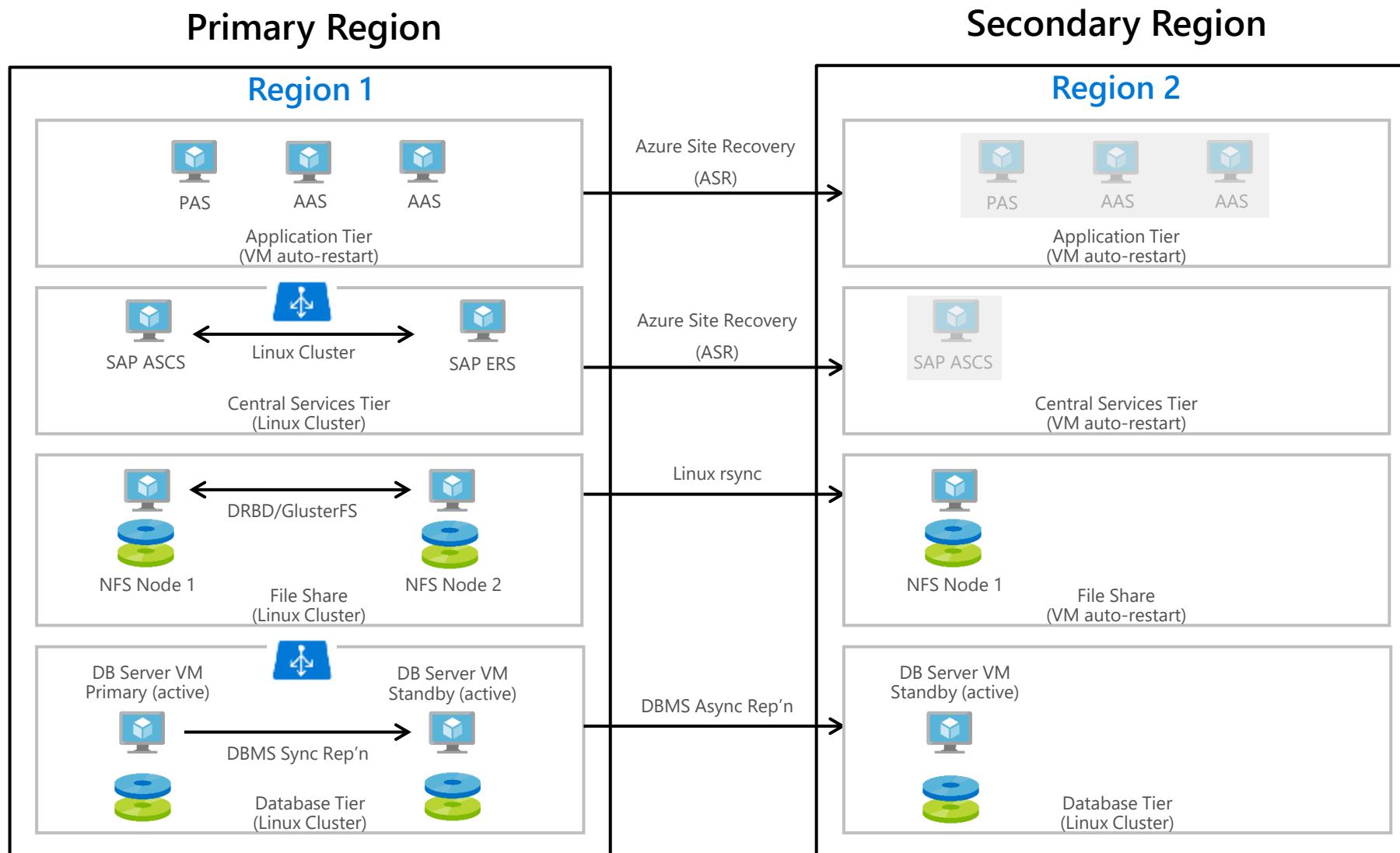
# S/4HANA HA and DR across Availability Zones



# SAP VM HA (99.9%) & DR – Linux



# SAP App HA Availability Sets (99.95%) & DR – Linux



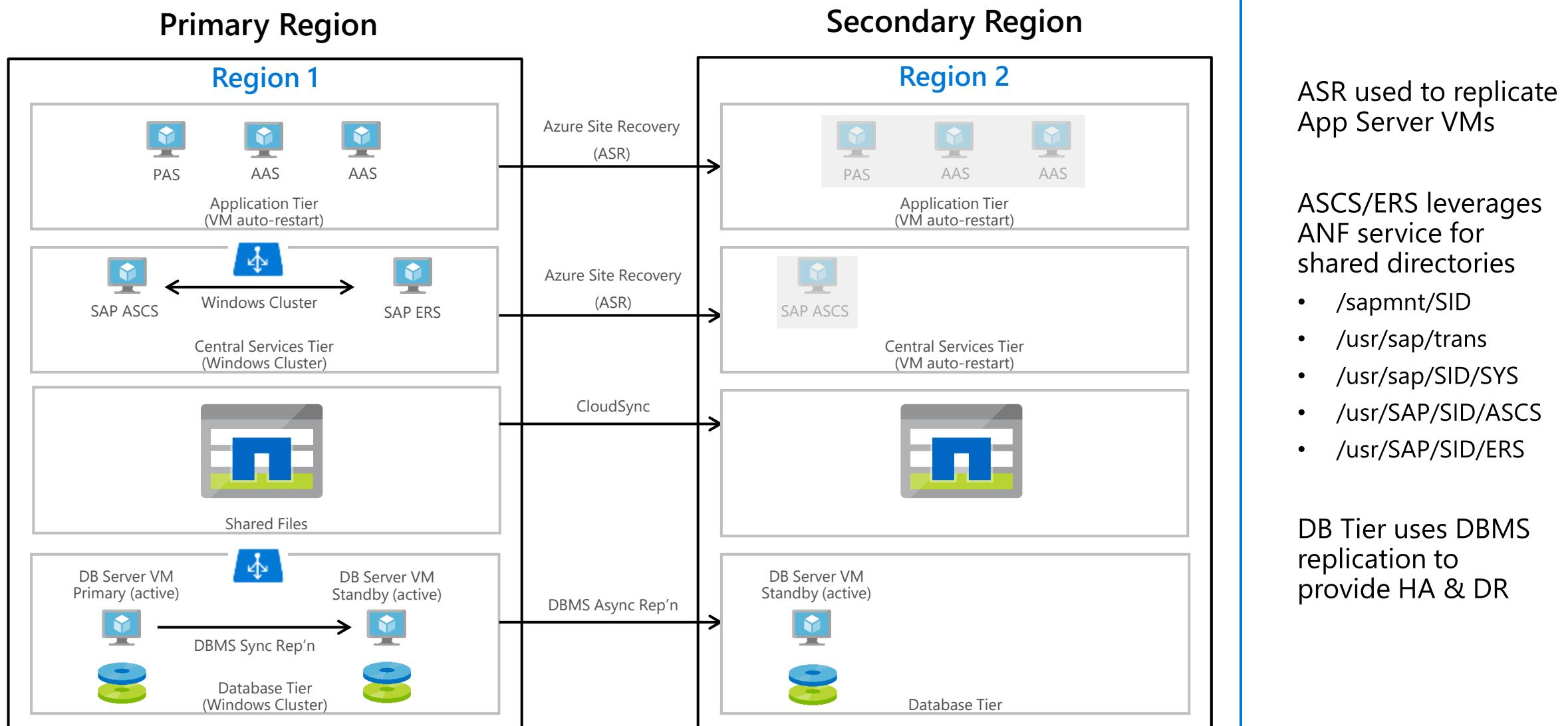
ASR used to replicate App Server VMs

ASCS/ERS cluster requires an NFS server for shared directories

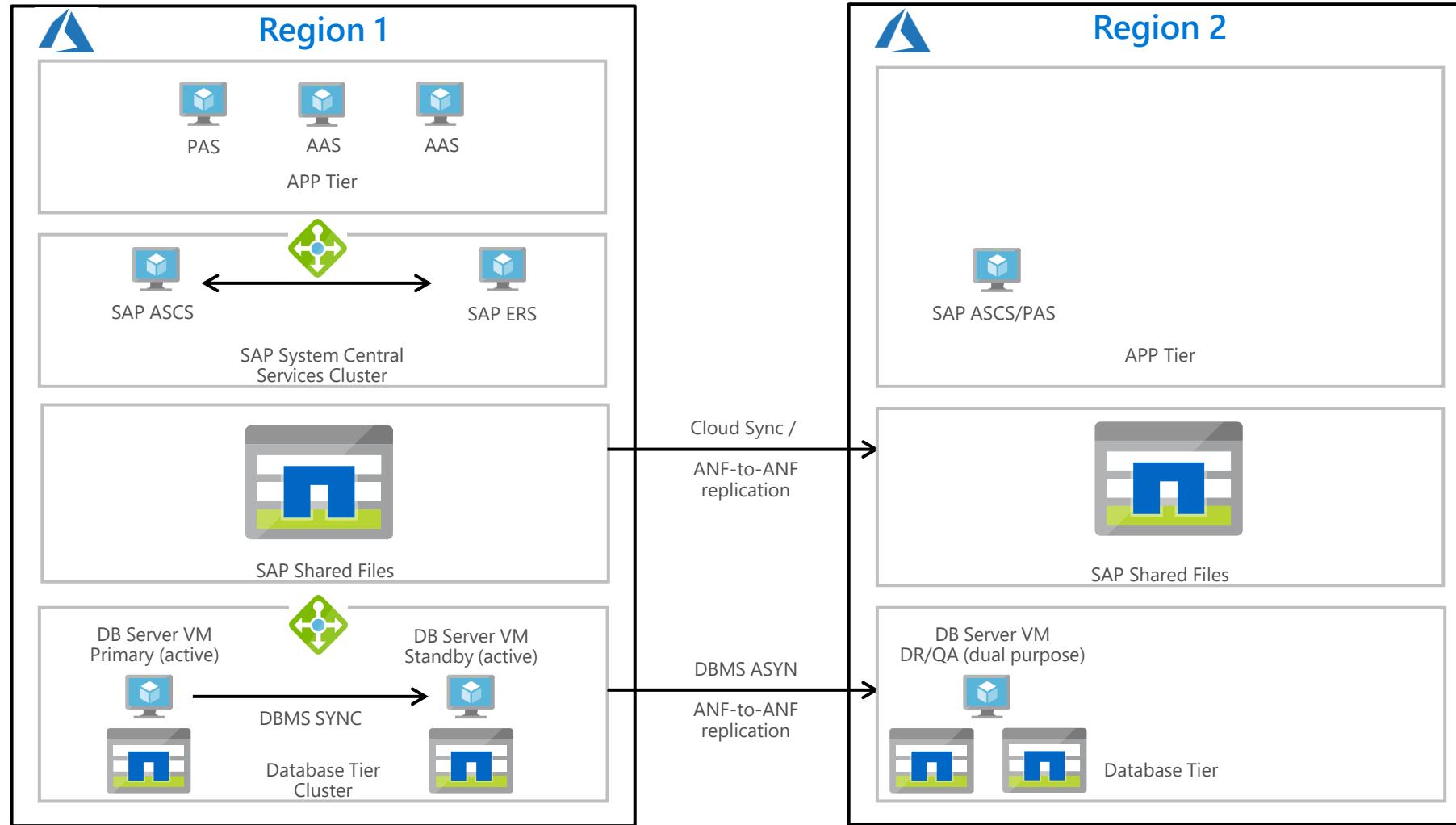
- /sapmnt/SID
- /usr/sap/trans
- /usr/sap/SID/SYS
- /usr/SAP/SID/ASCS
- /usr/SAP/SID/ERS

DB Tier uses DBMS replication to provide HA & DR

# SAP App HA Availability Sets (99.95%) & using ANF



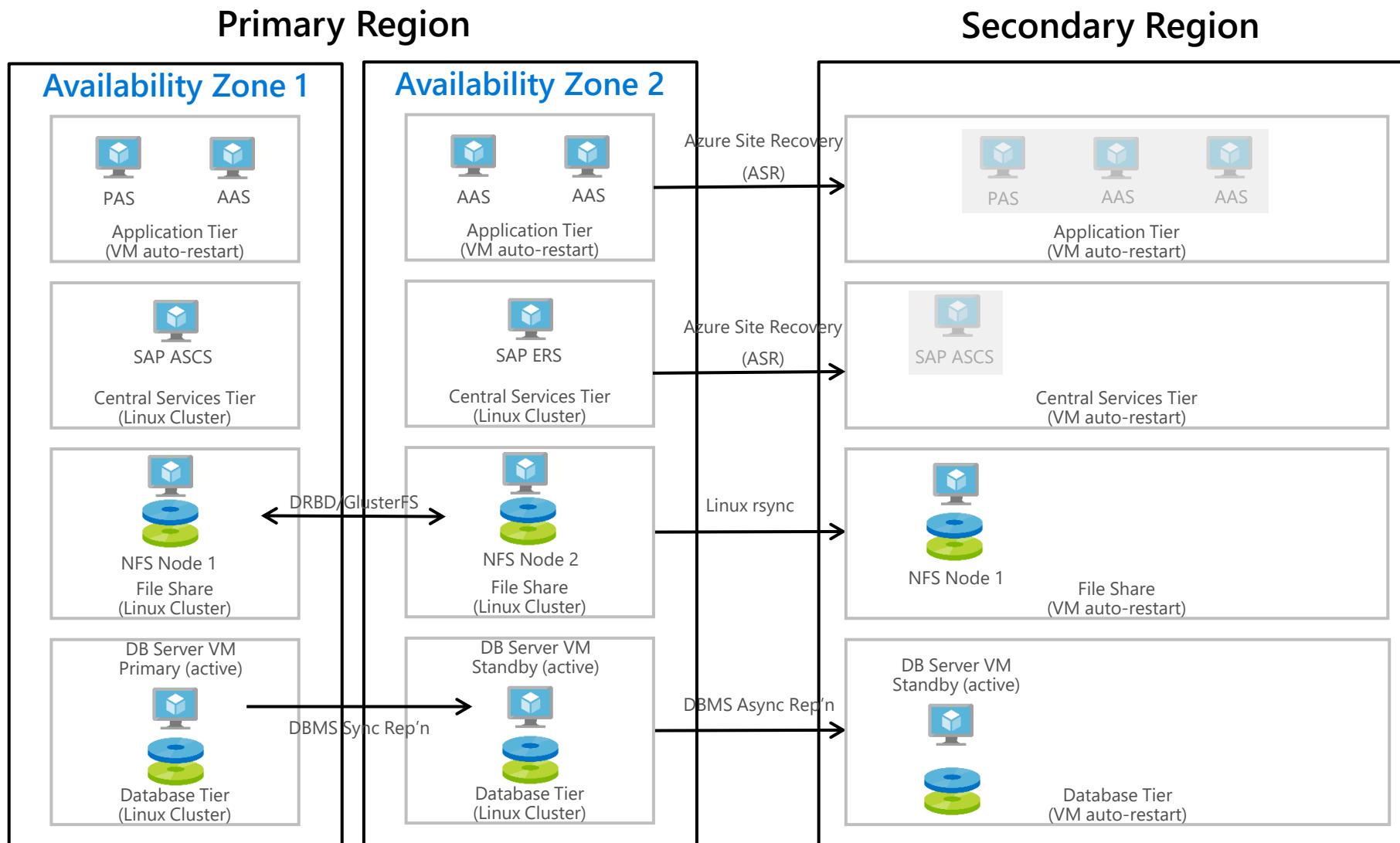
# SAP App HA Availability Sets (99.95%) & using ANF with DB



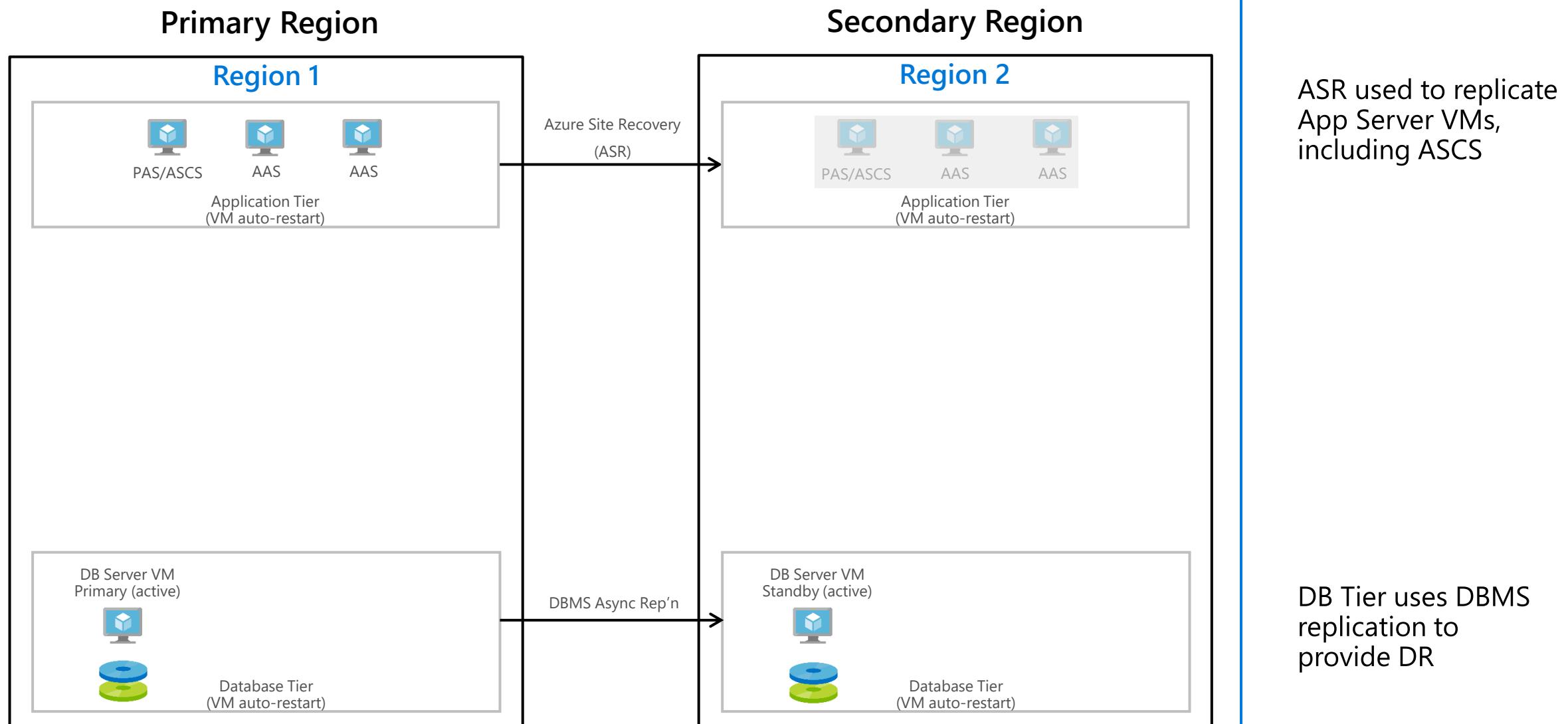
ASCS/ERS leverages ANF for SAP shared files

DB Tier uses DBMS replication (HA) and DBMS replication or ANF-to-ANF replication for DR coming soon.

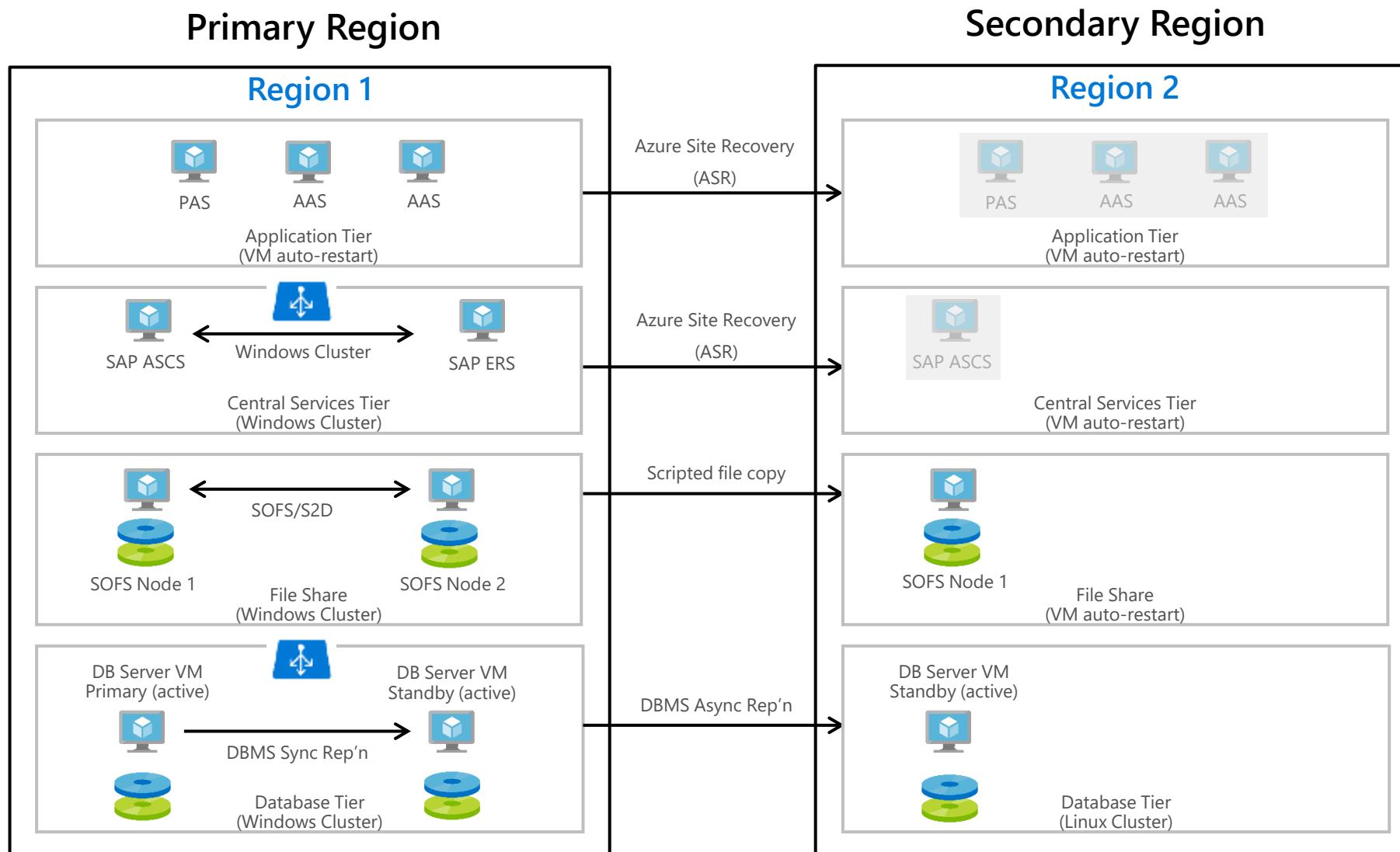
# SAP App HA Availability Zones (99.99%) & DR – Linux



# SAP VM HA (99.9%) & DR – Windows



# SAP App HA Availability Sets (99.95%) & DR – Windows



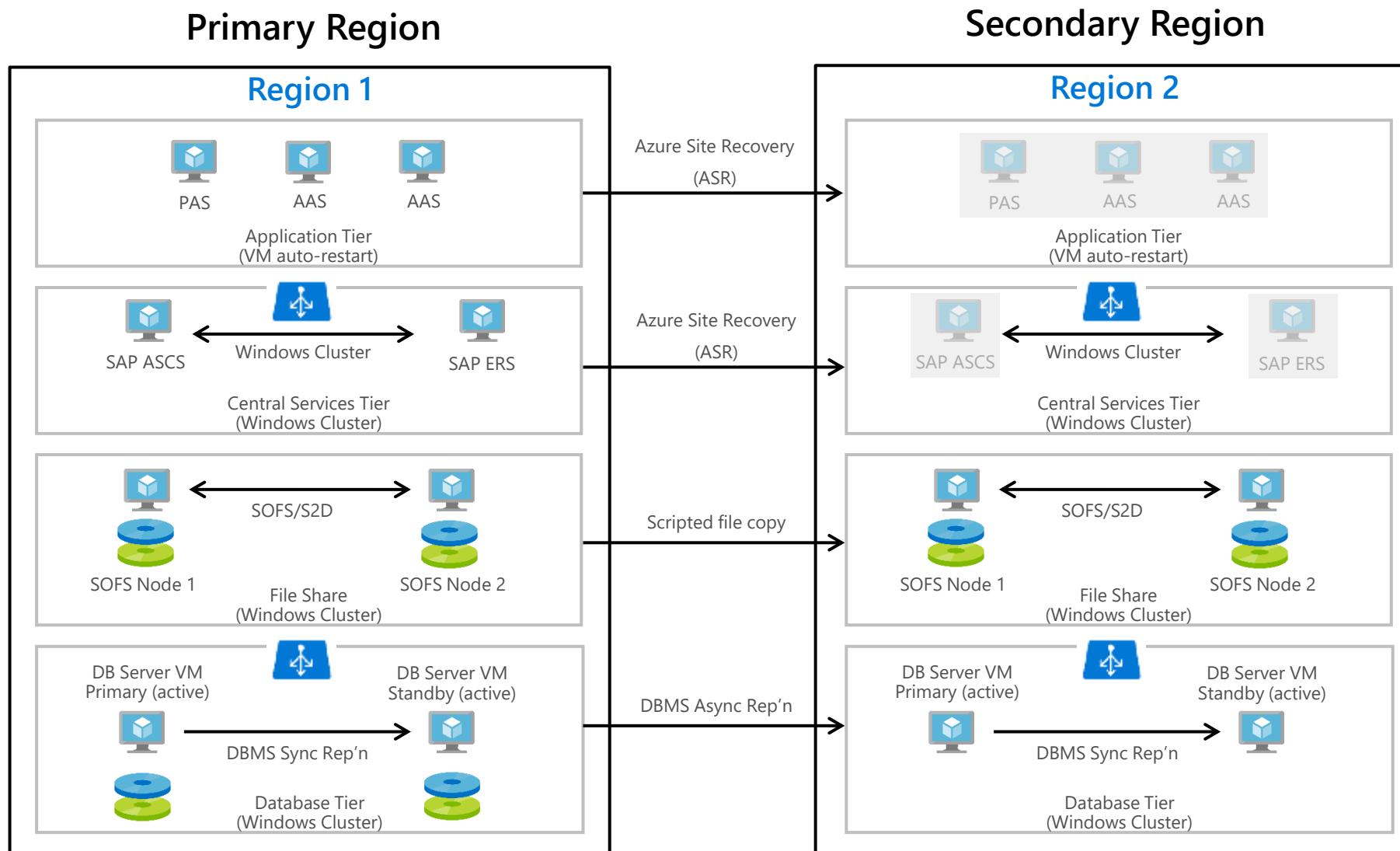
ASR used to replicate App Server VMs

ASCS/ERS cluster requires a SOFS server for shared directories

- \sapmnt\SID
- \usr\sap\trans
- \usr\sap\SID\SYS
- \usr\SAP\SID\ASCS
- \usr\SAP\SID\ERS

DB Tier uses DBMS replication to provide HA & DR

# SAP App HA Availability Sets (99.95%) & DR – Windows



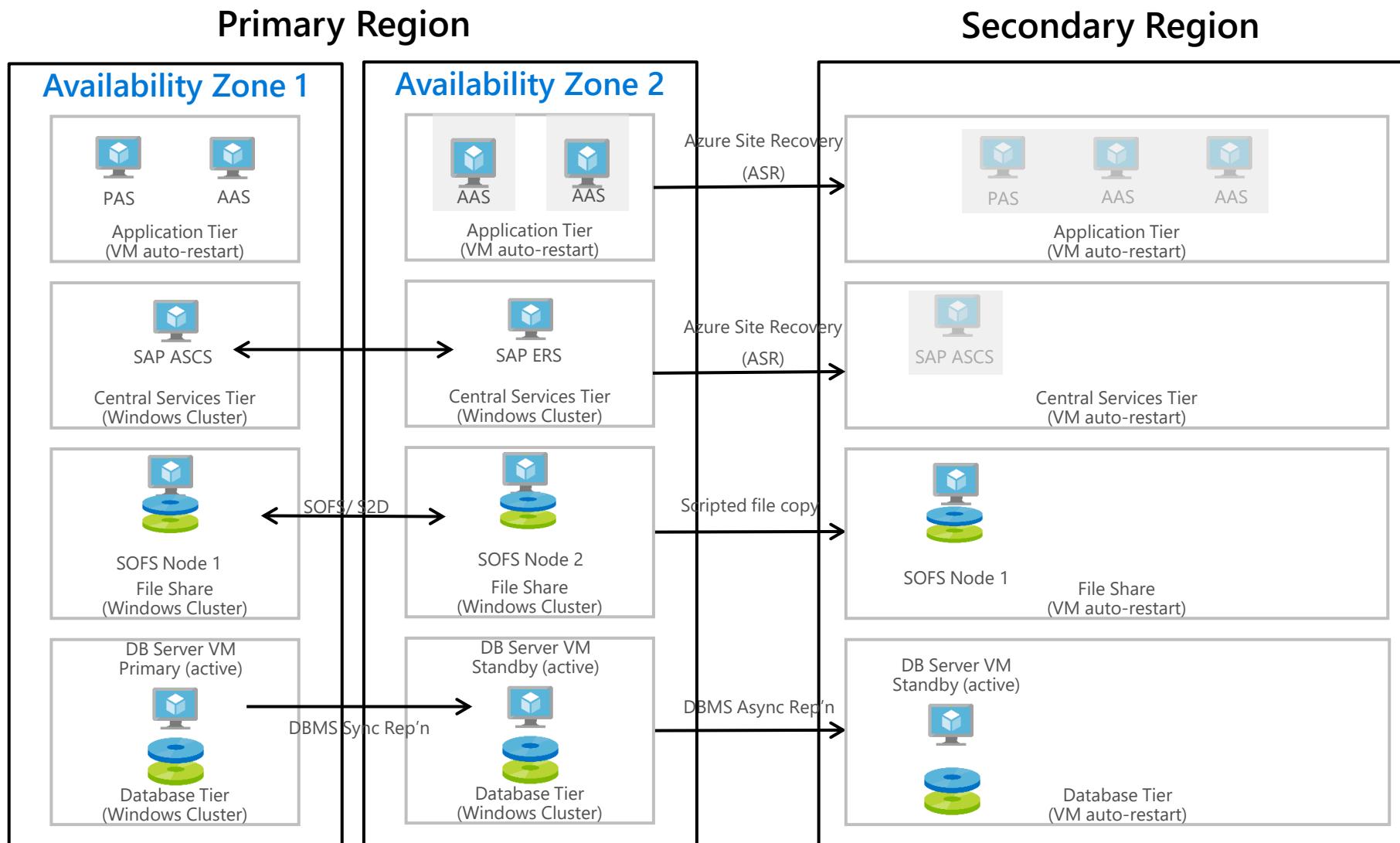
ASR used to replicate App Server VMs

ASCS/ERS cluster requires a SOFS server for shared directories

- \sapmnt\SID
- \usr\sap\trans
- \usr\sap\SID\SYS
- \usr\SAP\SID\ASCS
- \usr\SAP\SID\ERS

DB Tier uses DBMS replication to provide HA & DR

# SAP App HA Availability Zones (99.99%) & DR – Windows



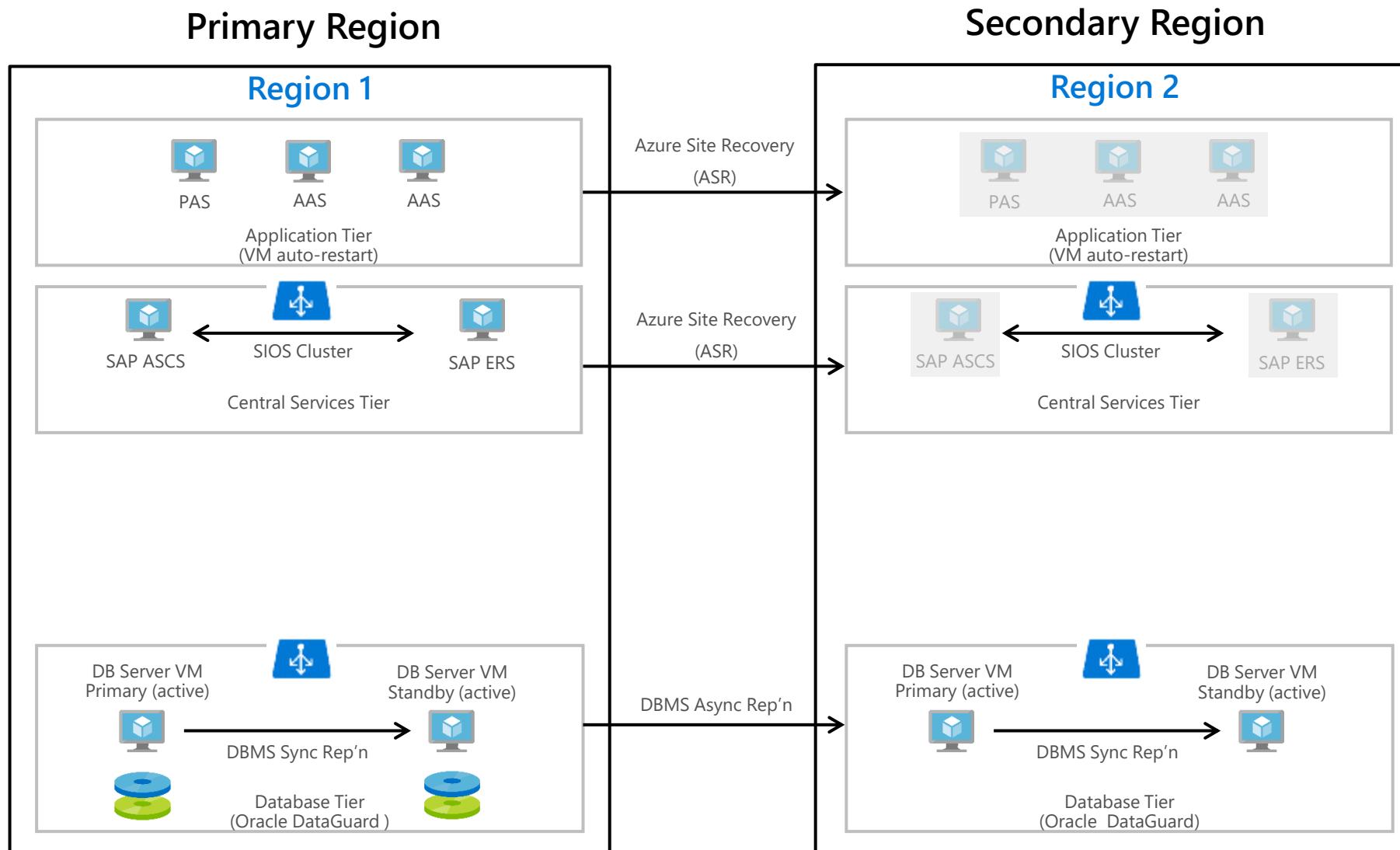
App Server VMs in AZ2 shut down until needed

ASCS/ERS cluster requires an SOFS server for shared directories

- /sapmnt/SID
- /usr/sap/trans
- /usr/sap/SID/SYS
- /usr/SAP/SID/ASCSS
- /usr/SAP/SID/ERS

DB Tier uses DBMS replication to provide HA & DR

# SAP App HA Availability Sets (99.95%) & DR – Oracle Linux



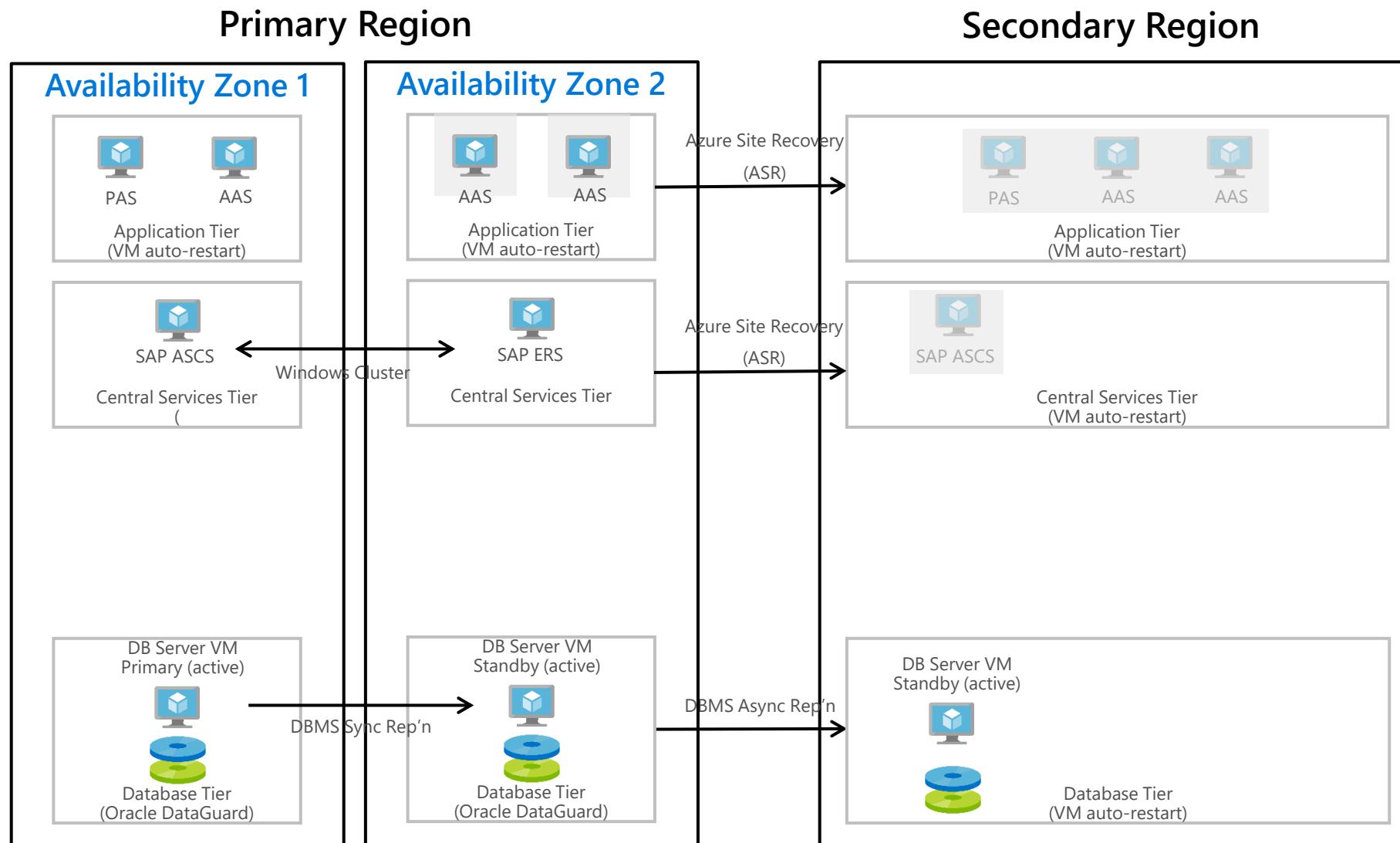
ASR used to replicate App Server VMs

ASCS/ERS cluster requires an SIOS replicated disk/s server for shared directories

- \sapmnt\SID
- \usr\sap\trans
- \usr\sap\SID\SYS
- \usr\SAP\SID\ASCS
- \usr\SAP\SID\ERS

DB Tier uses DBMS replication to provide HA & DR

# SAP App HA Availability Zones (99.99%) & DR – Oracle Linux



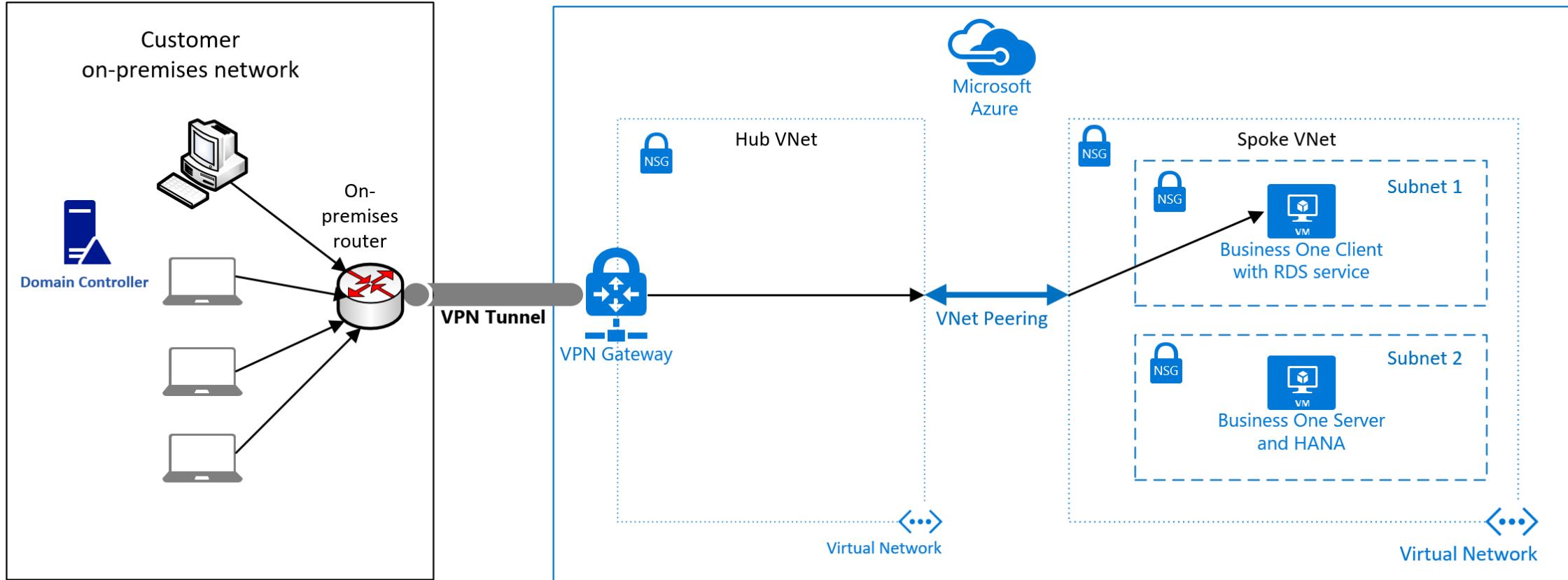
App Server VMs in AZ2 shut down until needed

ASCS/ERS cluster requires an SIOS replicated disk/s server for shared directories

- /sapmnt/SID
- /usr/sap/trans
- /usr/sap/SID/SYS
- /usr/SAP/SID/ASCS
- /usr/SAP/SID/ERS

DB Tier uses DBMS replication to provide HA & DR

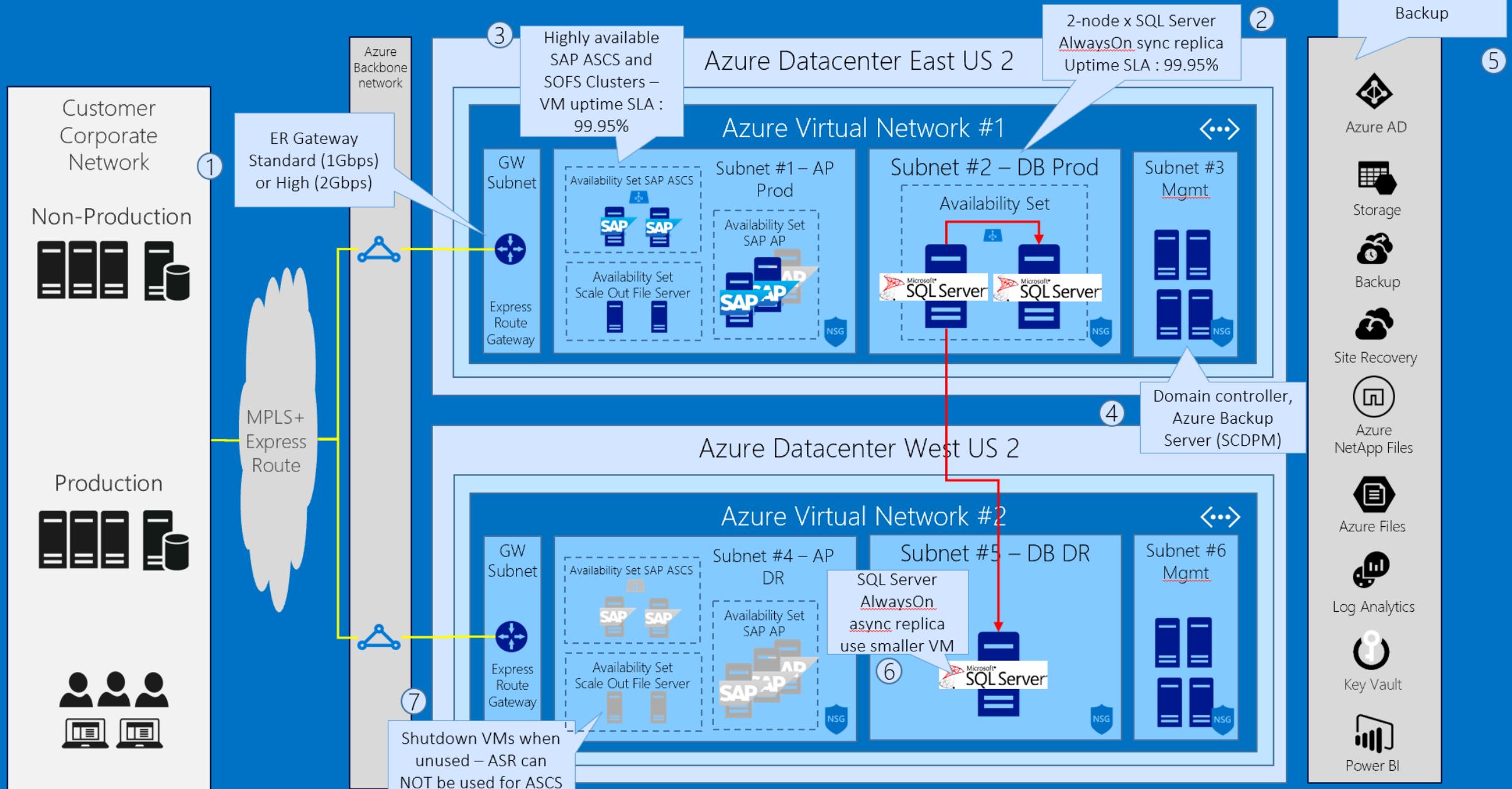
# Reference Architecture – SAP Business One



Online B1 Documentation and architecture available:

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/business-one-azure#deploying-infrastructure-in-azure-for-sap-business-one>

# SAP Business Suite, NetWeaver – Azure VM with HA and DR (continued)



# Baseline knowledge for SAP as a service on Azure

Icon	Name	Description
	Region	An area within a geo that does not cross national borders and contains one or more datacenters.
	Subscription	A customer's agreement with Microsoft that enables them to obtain Azure services.
	Azure Active Directory (Tenant)	Azure Active Directory helps you manage user identities and create intelligence-driven access policies to secure your resources.
	ExpressRoute	Direct Connectivity from customer network to Microsoft Enterprise Edge (MSEE)
	MSEE (Enterprise Edge)	Each ExpressRoute circuit consists of two connections to two Microsoft Enterprise edge routers (MSEEs) from the connectivity provider/your network edge.
	Virtual Network	A network that provides connectivity between your Azure resources that is isolated from all other Azure tenants.
	Subnet	A subnetwork or subnet is a logical subdivision of an IP network.
	Network Security Group	NSG contains a list of security rules that allow or deny network traffic to resources connected to Azure Virtual Networks ( <a href="#">VNet</a> )
	VPN Gateway	A specific type of virtual network gateway that is used to send encrypted traffic between an Azure virtual network and an on-premises location over internet.
	ExpressRoute Gateway	A specific type of virtual network gateway that is used to send traffic between an Azure virtual network and an on-premises location over ExpressRoute/Direct Peering.
	Virtual Machines	The software implementation of a physical computer that runs an operating system.
	Azure Premium Storage and Managed Disks	Azure Storage offers a massively scalable object store for data objects, a file system service for the cloud
	Availability Set	A collection of virtual machines that are managed together to provide application redundancy and reliability.
	Internal Load Balancer	ILB directs traffic only to resources that are inside a virtual network or that use a VPN to access Azure infrastructure. (Layer 4)
	HANA on Azure Large Instances	HANA tailored data center integration (TDI) certified server hardware infrastructure
	NFS Storage	HANA tailored data center integration (TDI) certified storage infrastructure
	High Availability Pair	two or more identical HANA large instances deployed in the same region and configured by the customer for system replication
	Backend ExpressRoute	Backend network to connect Azure Virtual Network and HANA Large Instances stamp
	Azure Backbone Network	Microsoft owned global fiber network linking all Azure datacenters
	Regional Pairs	Regional protection within data residency boundaries

# Online Azure pricing calculator

The screenshot shows the Microsoft Azure Pricing calculator page. At the top, there's a navigation bar with links like 'Why Azure', 'Solutions', 'Products', 'Documentation', 'Pricing' (which is highlighted in yellow), 'Training', 'Marketplace', 'Partners', 'Support', 'Blog', and 'More'. A 'FREE ACCOUNT' button is also visible. Below the navigation, the title 'Pricing calculator' is displayed, followed by the sub-instruction 'Configure and estimate the costs for Azure products'. To the right of the title is a graphic featuring a digital clock showing '01134' and several interlocking gears. A 'Login' link is located in the top right corner of the main content area. The main content area has a blue header bar with the text 'Select a product to include it in your estimate.' Below this, there's a search bar labeled 'Search products' and a sidebar on the left containing a 'Featured' section and a list of service categories: Compute, Networking, Storage, Web + Mobile, Containers, Databases, Data + Analytics, AI + Cognitive Services, Internet of Things, Enterprise Integration, Security + Identity, Developer Tools, and Monitoring + Management. The 'Compute' category is currently selected, indicated by a blue background. To the right of the sidebar, there are eight product cards arranged in two columns of four:

- Virtual Machines**: Provision Windows and Linux virtual machines in seconds.
- Storage**: Durable, highly-available, and massively-scalable cloud storage.
- SQL Database**: Managed relational SQL Database as a service.
- App Service**: Quickly create powerful cloud apps for web and mobile.
- Azure Cosmos DB**: Globally distributed, multi-model database for any scale.
- Machine Learning Studio**: Easily build, deploy, and manage predictive analytics solutions.
- Azure Container Service (AKS)**: Simplify the deployment, management, and operations of Kubernetes.
- Functions**: Process events with serverless code.
- Cognitive Services**: Add smart API capabilities to enable contextual interactions.

<https://azure.microsoft.com/en-us/pricing/calculator/>

# Azure VM Design Tips

1

Use certified VM types

2

Use Premium Storage for database

3

Consider backup and data retention

4

Set up HA + DR as needed

5

Guide customer to use ExpressRoute

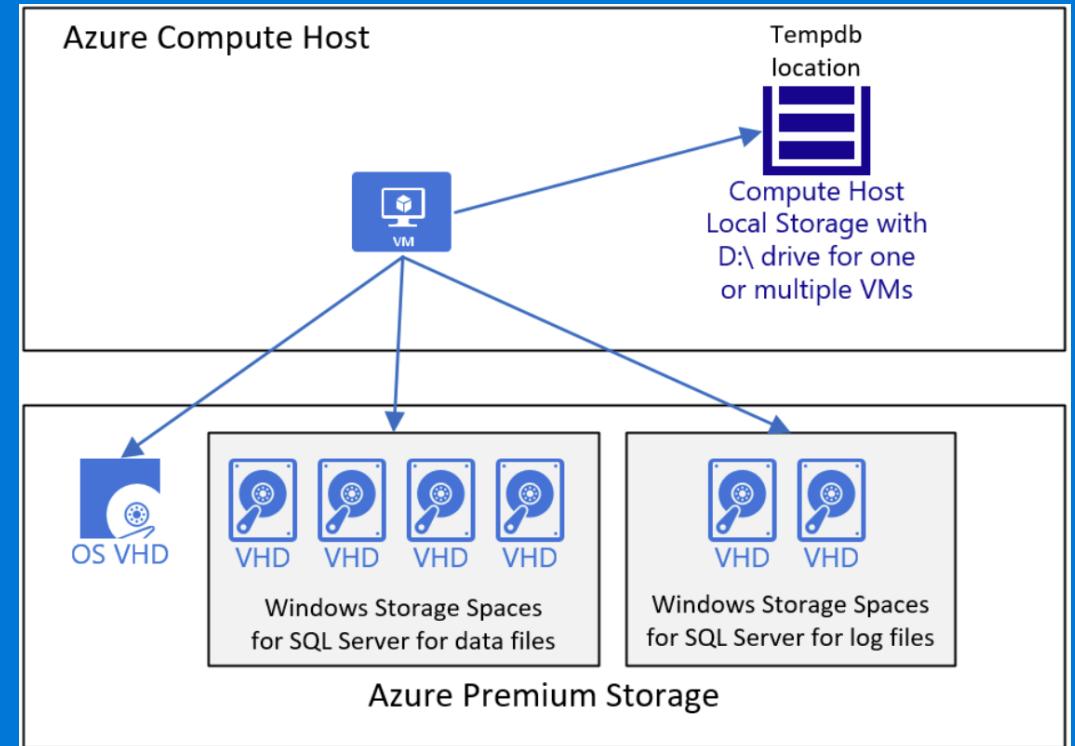


# General Recommendations

- Always read SAP's Master and Installation Guides as well our [Azure VM Planning and Implementation Guide for SAP](#).
- Read [SAP Note 2015553](#) to understand the support pre-requisites for SAP on Azure.
- Read the related OS and DB SAP Notes for your OS/DB combination.
- Always separate OS, DB and SAP executables into separate Azure disk.
- Ensure you find the best balance between:
  - The number of data files.
  - The number of disks that contain the files.
  - The IOPS quotas of a single disk or NFS share.
  - The data throughput per disk or NFS share.
  - The number of additional data disks possible per VM size.
  - The overall storage or network throughput a VM can provide.
  - The latency different Azure Storage types can provide.
  - VM SLAs
- For DB Data and Log use Premium, Ultra or Azure Netapp Files for Storage.
- For Networking ensure the Vnets don't have access to the internet.
- DB VM's run in the same Vnet as the APP layer but separated into different subnets.
- VM's have Static IP's
- For DB VM's use Network Security Groups to restrict traffic instead of OS VM's

# SAP on MSSQL General Recommendations

- Confirm SQL version support. (don't use SQL 2008 anymore) Use latest release. (check PAM)
- SQL performance typically faster on Azure than other Hyperscalers, but check Best Practices Guide.
- If deploying SQL from Azure Marketplace images check the extra steps required here to change the Collation.
- SQL System DB's (Master, MSDB and Model) can be installed together with the SQL Server directories.
- TEMPDB should be located on either D:\ (NonPersistant) or on separate disk.
- For M Series VM's makes sure Write Accelerator is enabled for the Log Volume.
- Use Accelerated Networking on SAP VM's.
- Disk should be formatted with NTFS block size 64kb.
- Recommended to enable database Page compression and improves IOPS.
- [https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms\\_guide\\_sqlserver](https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms_guide_sqlserver)



# SAP on Oracle General Recommendations

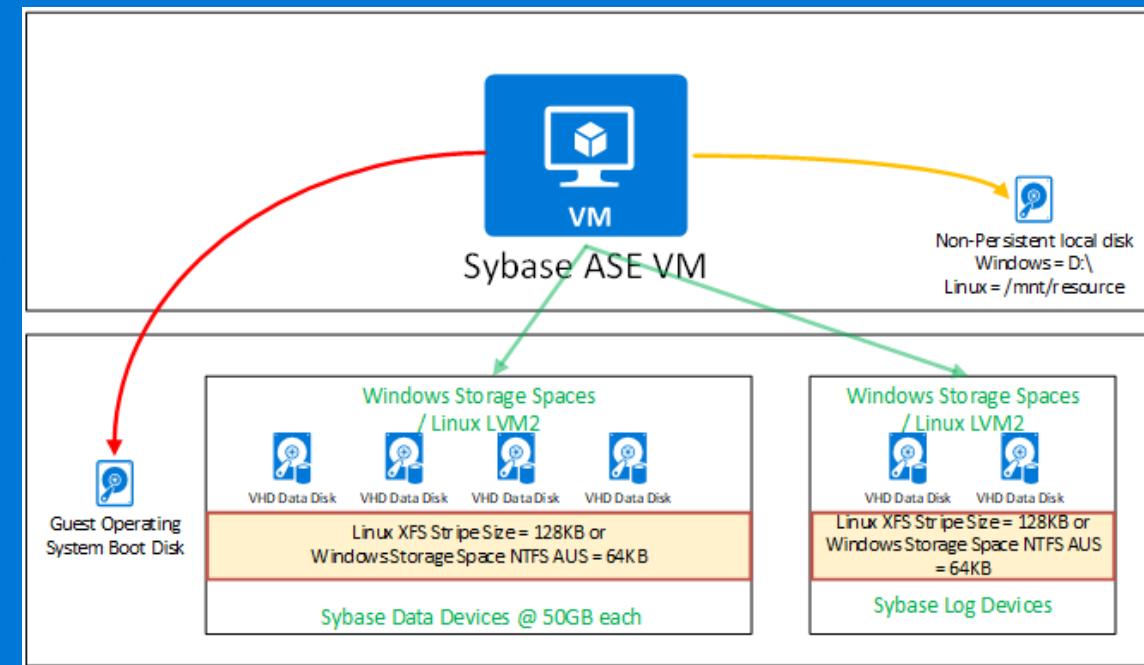
- See Note [2039619](#) for Oracle Version Support.
- Oracle only supported on Windows or Oracle Linux OS on Azure.
- Separate OS from Oracle related files.
- Separate Data and Redo Logs onto separate Disks.
- Oracle Tempfiles can be created on D:/ (NonPersistent)
- Recommend Managed Disk with Premium or Ultra for Oracle on Azure.
- For M Series VM's makes sure Write Accelerator is enabled for the Redo Log Volume.
- Backups can use BR\*Tools or RMAN (or 3<sup>rd</sup> Party)
- You can use Oracle Dataguard for High Availability
- Use Accelerated Networking on SAP VM's
- [https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms\\_guide\\_oracle](https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms_guide_oracle)

# SAP on DB2 General Recommendations

- DB2 Supported from Version 10.5 or higher.
- Recommended to use Managed Disk Premium Storage.
- You can store all DB files on the one disk if IOPS and throughput is sufficient for the workload. You can stripe volumes to achieve Sufficient IOPS if required.
- For disks containing DB2 Storage path for SAPDATA and SAPTMP directories, define a physical sector size of 512kb.
- For M Series VM's makes sure Write Accelerator is enabled for the DB2 Transaction Logs.
- High Availability delivered by DB2 HA with Pacemaker on SUSE and REDHAT are supported. Please read the necessary guides. [SUSE](#) [REDHAT](#)
- Microsoft Cluster Server is not supported.
- Use Accelerated Networking on SAP VM's
- [https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms\\_guide\\_ibm](https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms_guide_ibm)

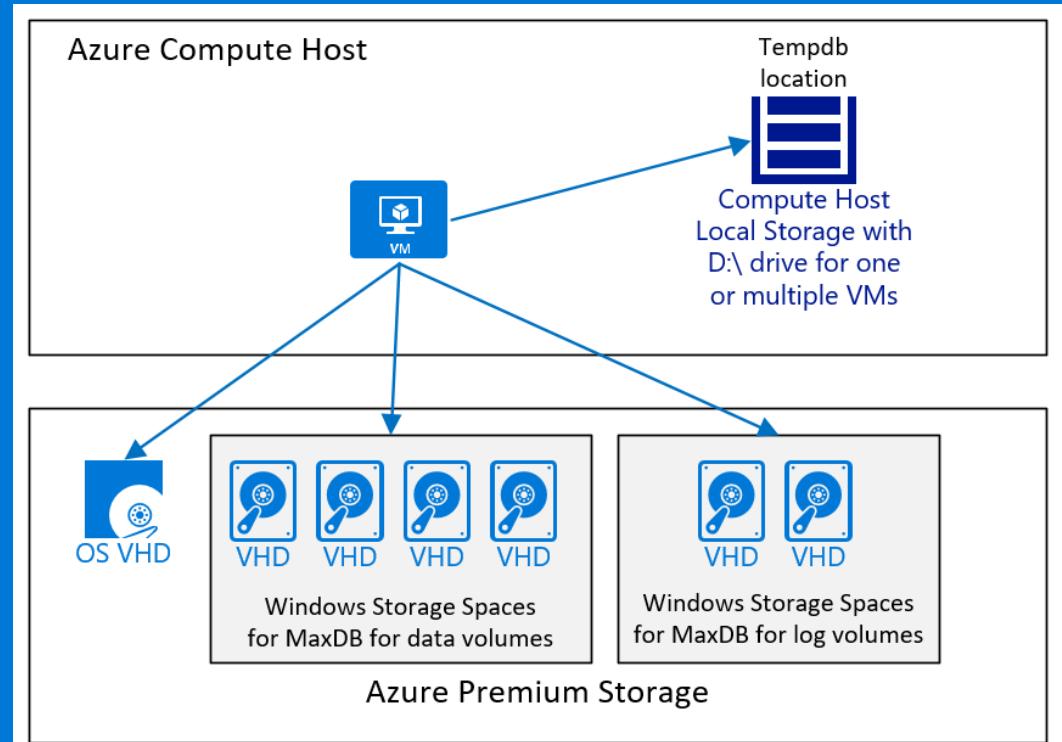
# SAP on ASE General Recommendations

- Minimum version SAP ASE 16.0.0.2.
- OS Support on Suse 12, 15 and RedHat 7. Windows 2016, 2019 Supported. Oracle Linux not supported.
- Run saptune on Linux and confirm Huge Pages should be enabled for 2048KB. [More Info](#)
- Recommend to separate Data and Log Volumes.
- ASE writes to first data file first until full, so best to stripe disk for maximum performance. See pic>
- Stripe Backup Disk as well for best performance.
- Apply Compression for best IOPS.
- For M Series VM's makes sure Write Accelerator is enabled for the ASE Transaction Log Disk.
- DB HA Supported but do not use Floating IP.
- Use Accelerated Networking on SAP VM's
- [https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms\\_guide\\_sapase](https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms_guide_sapase)



# SAP on MaxDB General Recommendations

- Minimum version SAP MaxDB 7.9 or higher.
- OS Support on Windows, SLES and RedHat. Not Oracle Linux.
- Recommend to separate Data and Log Volumes.
- Recommended to stripe disk for maximum performance.  
See pic>
- Stripe Backup Disk as well for best performance.
- Read dedicated Azure guides for SAP LiveCache and SAP Content Server.
- [https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms\\_guide\\_maxdb](https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/dbms_guide_maxdb)



# Agenda

1. SAP Certification for Azure (Any DB)
2. Key Design Aspects
3. Reference Architecture
4. Backups
5. Migration to Azure

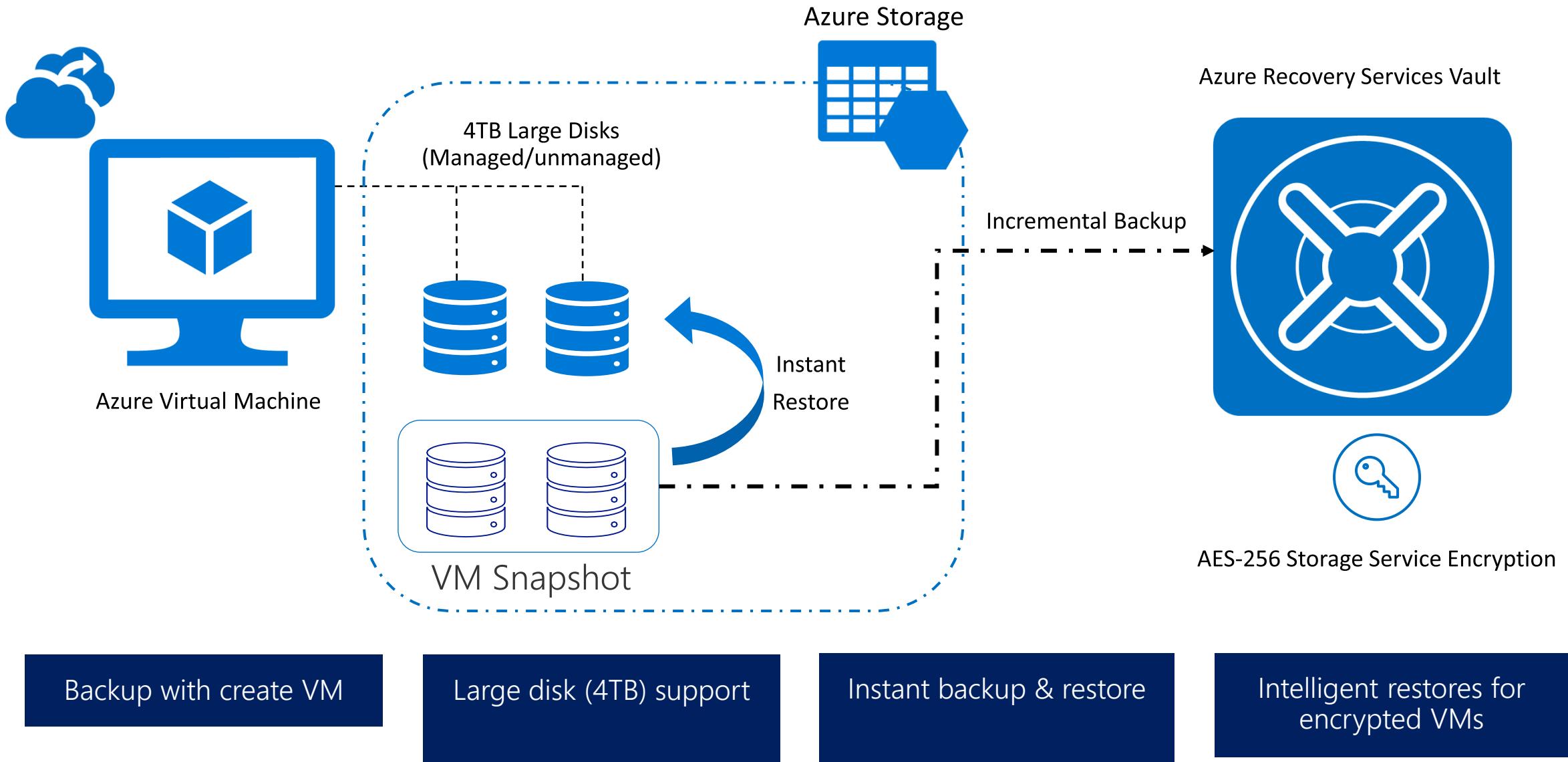
# SAP on Azure Backup solutions Overview

Solution	Description
Azure IaaS VM Backup	Azure backup ( VM snapshot backups)
Standard Database backup	SQL Server, Oracle, HANA, Sybase, DB2, MaxDB etc. native backup.
Azure Backup Server (SCDPM)	DPM running on an Azure VM, Azure Backup allows offload storage from the Azure disk. Storing older data in a Backup vault allows to storing new data to disk.
3 <sup>rd</sup> party solutions	Commvault, NetBackup, advanced features like data depduplication, remote replication etc.
HANA Backup using BackInt	Azure Backup integration with backint for HANA database backup(in Preview)
HANA on Azure Large Instances	HANA backup, storage snapshots and third party (Commvault) backup

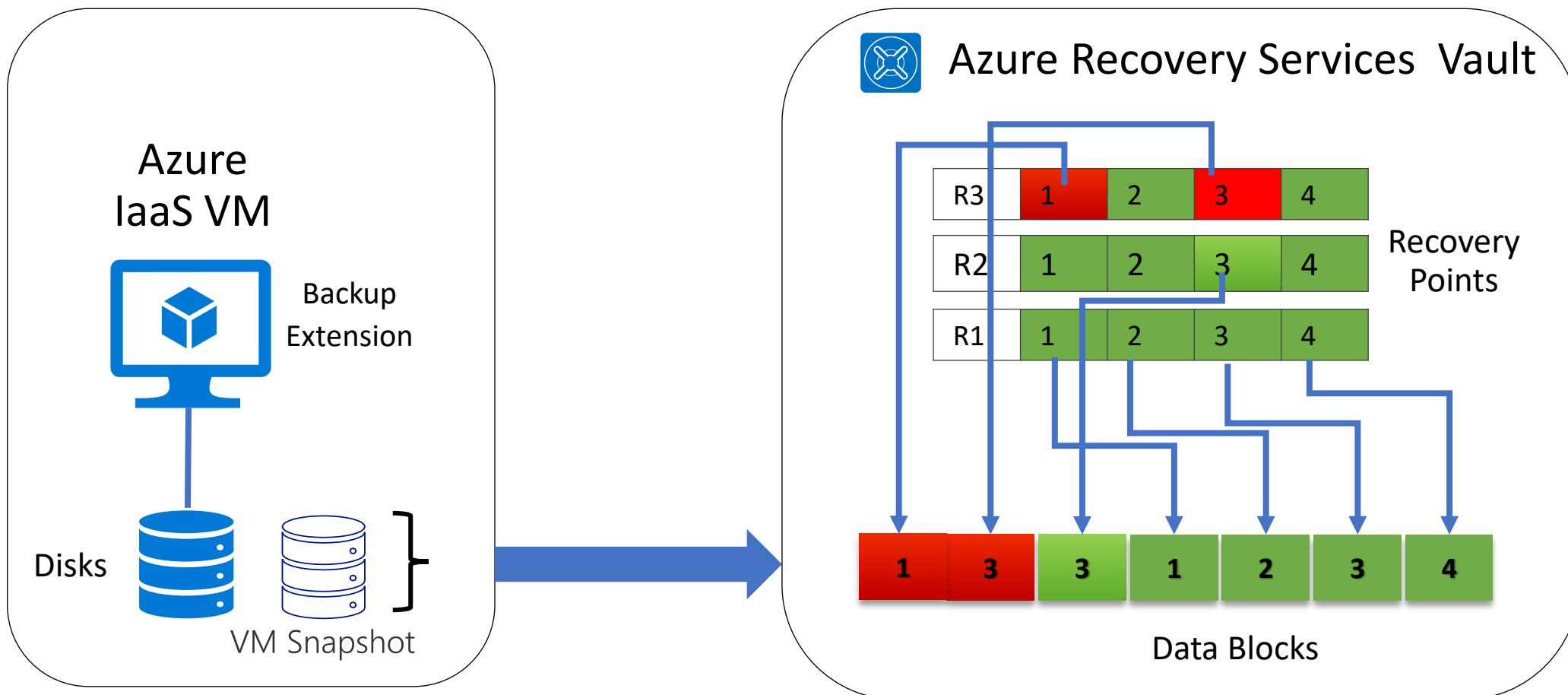
# Best Practices for Design

- Understand business requirements especially RTO and RPO, performance, encryption and backup retention requirements.
- Identify the scope of backup : What need to be backed up.
- Review tools and technology available and supported: Native (OS and Database), platform specific and Third-party
- Design solution meeting requirements but consider ease of use and less complexity.
- Test the solution especially a recovery test to verify backup integrity.
- Estimate the space requirement based on the backup solution.
- Consider complete system recoverability not alone the database.
- Backup tool compatibility and future product support roadmap

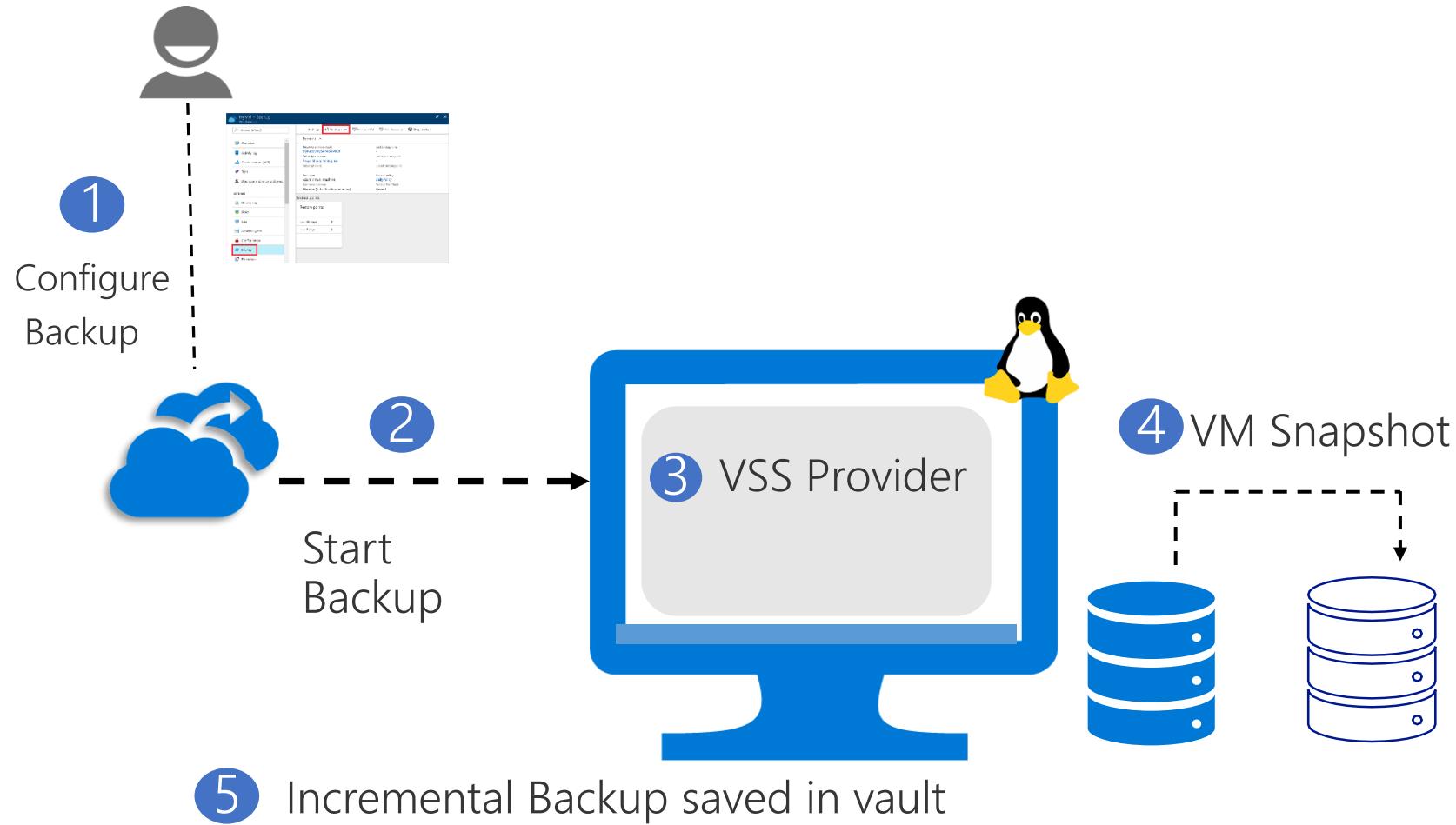
# Azure VM Backup



# Azure IaaS VM Backup – Recovery Points



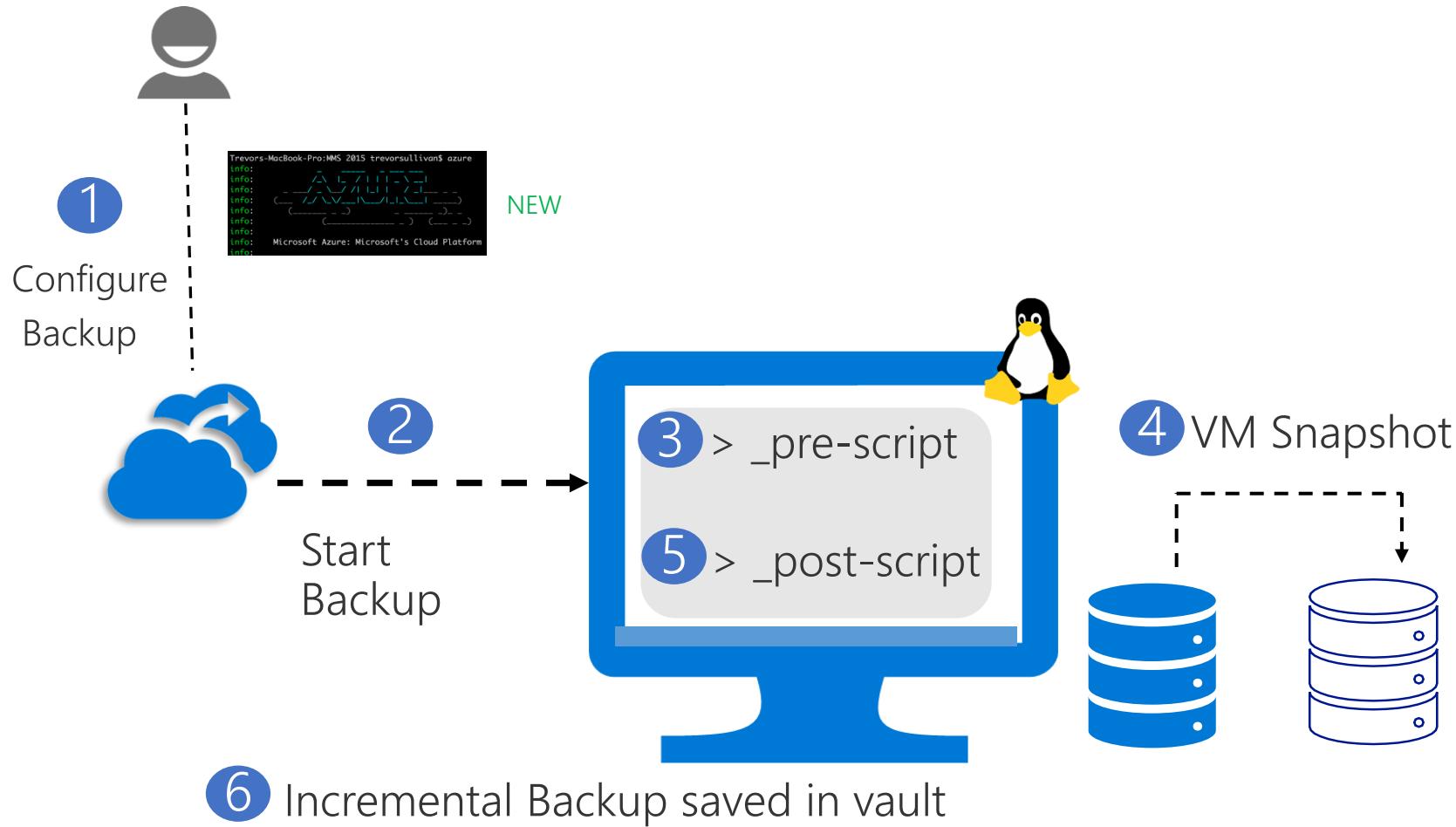
# Windows application-consistent backup



App consistent backup

Open support platform

# Linux application-consistent backup



App consistent backup

Open support platform

# Azure IaaS VM backups workflow

1. Azure Backup starts a as per backup schedule
2. During the first backup, a backup extension is installed on the VM if the VM is running.
3. For Windows VMs, the VMSnapshot extension is installed.
4. For Linux VMs, the VMSnapshotLinux extension is installed.
5. For Windows, Backup coordinates with Volume Shadow Copy Service (VSS)
6. Otherwise it takes a file-consistent snapshot of the underlying
7. For Linux VMs, Backup takes a file-consistent backup.
8. After Backup takes the snapshot, it transfers the data to the vault.
9. The backup is optimized by backing up each VM disk in parallel.
10. For each disk that's being backed up, Azure Backup reads the blocks on the disk and identifies and transfers only the data blocks that changed (the delta) since the previous backup.
11. Snapshot data might not be immediately copied to the vault. It might take some hours at peak times. Total backup time for a VM will be less than 24 hours for daily backup policies.
12. When the data transfer is complete, the snapshot is removed, and a recovery point is created.

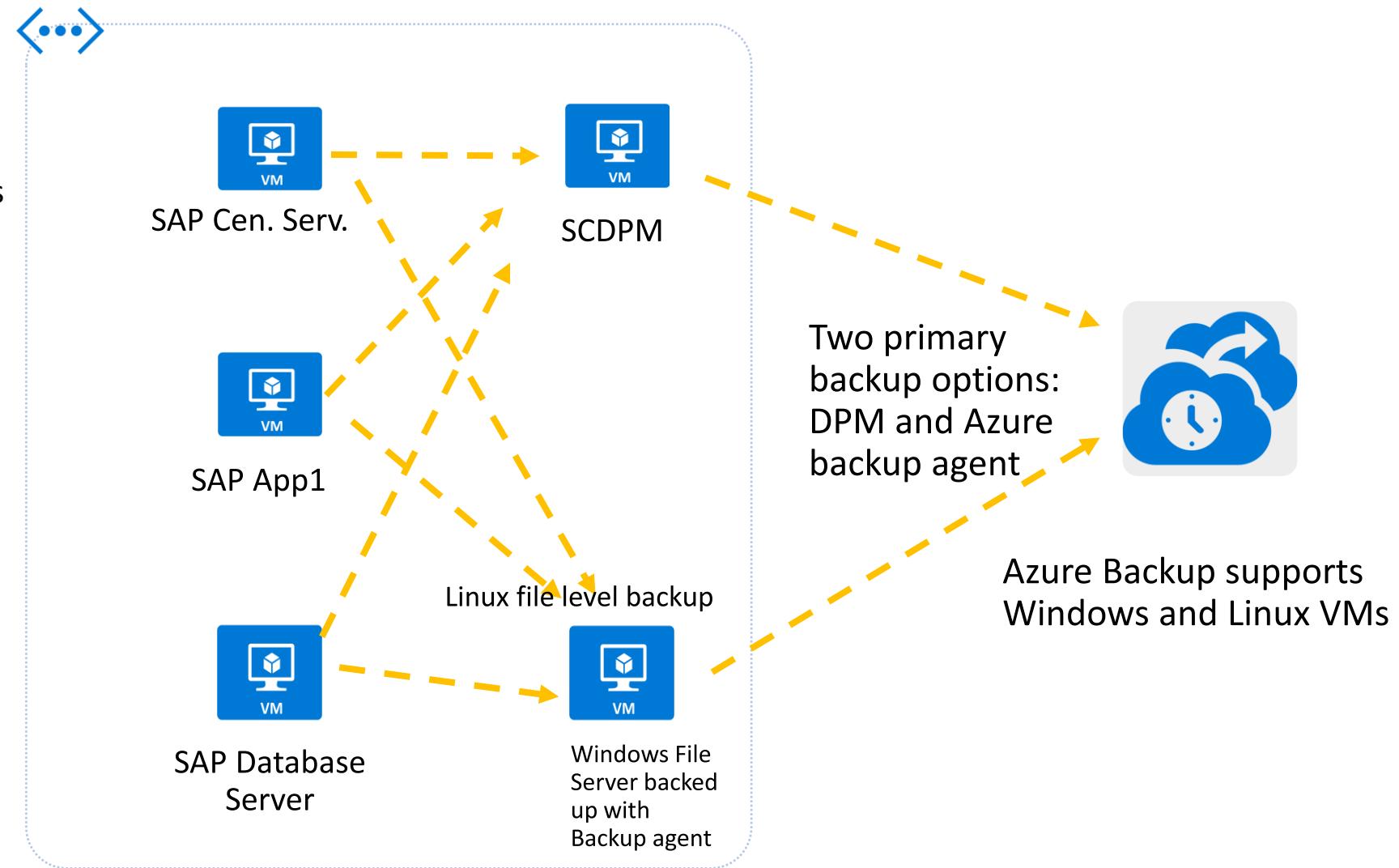
# SAP System backups: two options

## Windows Servers

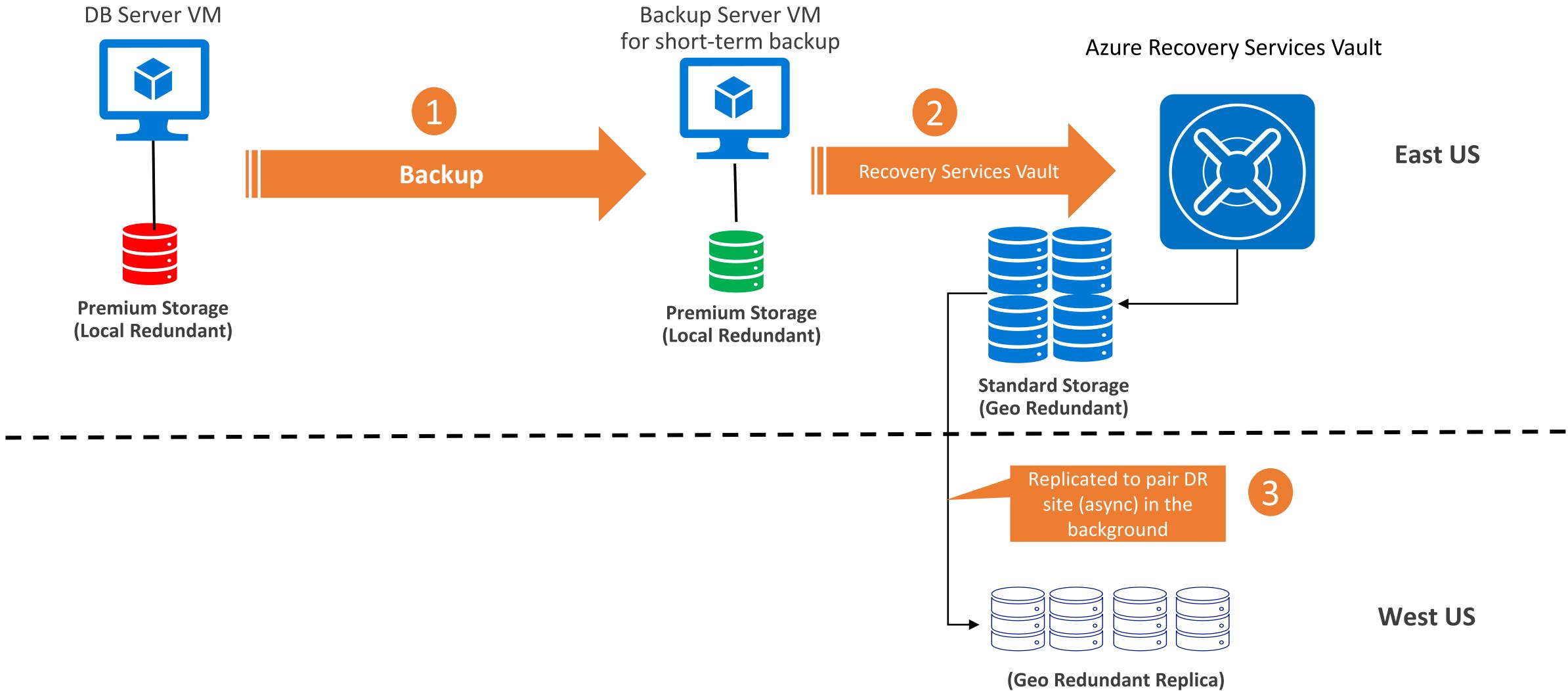
- Files/Dir level backup
- Azure Storage Blob snapshots
- Application level consistency for Windows OSes

## Linux Servers

- VM level backup
- Storage blob snapshot
- No file level backup integration yet. Need to leverage a Windows File Server which has the backup agent installed
- File level copy direct to Azure storage via open source tools
- File system level consistency for Linux OSes



# Two-step DB Backup – Premium and Geo Redundant Storage

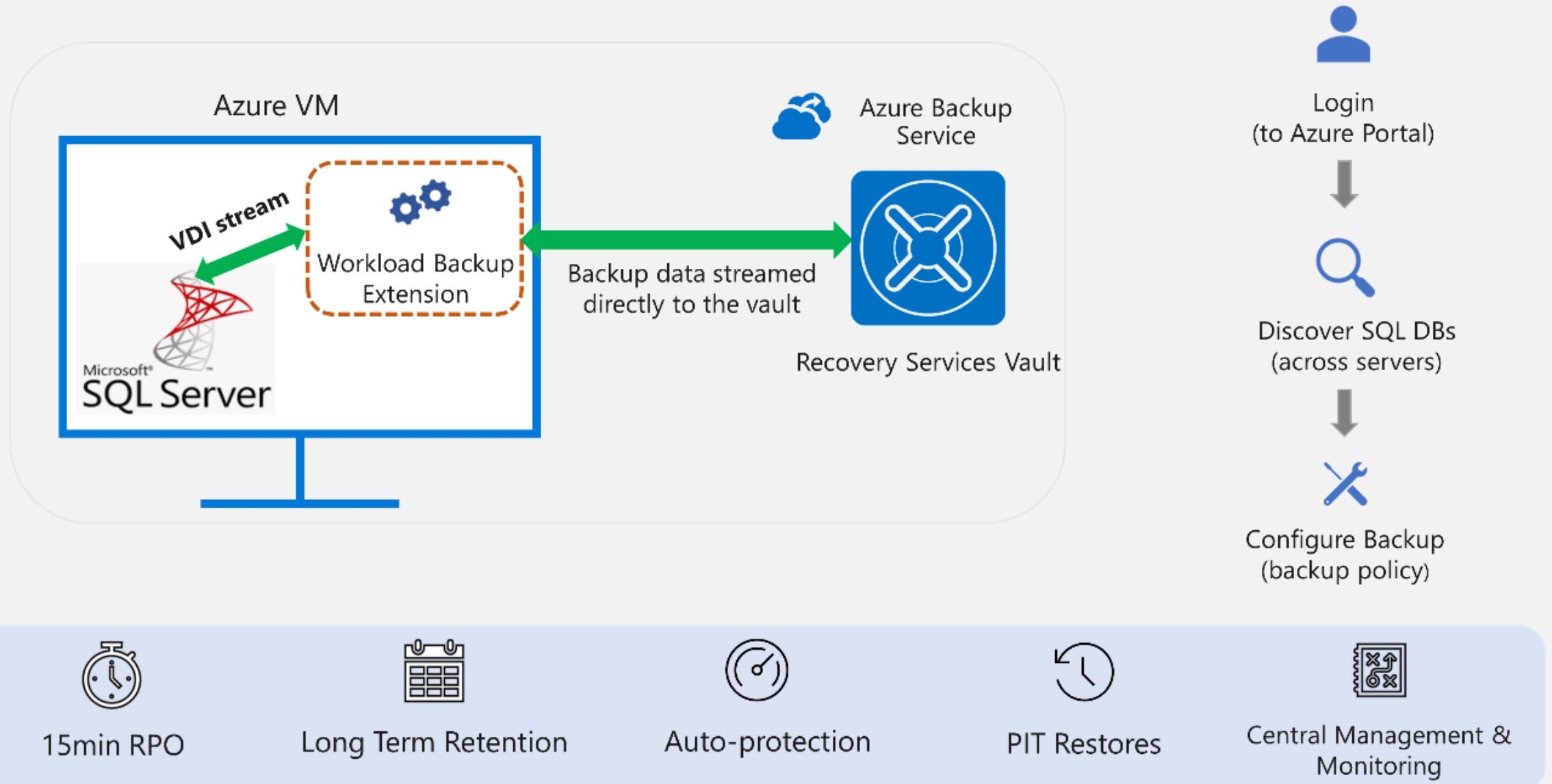


# Backups of SQL Server VM on Azure

## Backup Options for SQL Server

- **Manual Backups** – Perform conventional backups to attached Azure Disk. Good for the build process to take manual backups during a critical milestone or complex configuration task. Can be swiftly retrieved for restore.
- **Automatic Backups** – Service provided using the SQL Server IaaS Agent Extension. Can be setup via the Azure Portal by looking at the VM properties. Simplified solution to achieve automated backups.
- **3<sup>rd</sup> Party Backup Solutions** – May be the customers current preference for backups. Example Commvault.
- **Azure Backup for SQL Server VMs** – Latest service where the SQL server is backed up to Azure Recovery Service Vault. Low recovery point objective and long term retention options. Centralized solution that can be used to manage all backups and simplify monitoring and administration. SQL Always On introduces the option of using the secondary node for backups with some limitations.
- A good comprehensive guide on the different backup types and a decision matrix on which solution to use can be found [here](#).

# Backing up SQL Server running on Azure VM



# SQL Server Backup with file snapshots

- Available to users whose database files are located in Azure Storage
- Copies database using a virtual snapshot within Azure Storage
- Database data does *not* move between storage system and server instance, removing IO bottleneck
- Uses only a fraction of the space that a traditional backup would consume
- Very fast

# Azure Backup for SQL Server VM's

## Key Limitations of Azure Backup for SQL

- VMs need to have public internet access for Azure public IP's.
- Using more than one backup solution may lead to backup failure.
- 2000 SQL Server DB's in a vault. If you need more can create multiple vaults.
- Possible performance issues for DB's greater than 2TB and should be monitored.
- Recovery Services Vault needs to be in the same region as the VM's hosting SQL.
- Avoid using DB naming with spaces, "!", "]", ";" , "/"
- Backing up the secondary node can only be done for Log backups. For DB Full Backup it will only backup using Copy-Only Full (which means the backup cannot be part of a differential base).
- More information on limitations can be found [here](#).

# Note on DB2 backup recovery on Azure

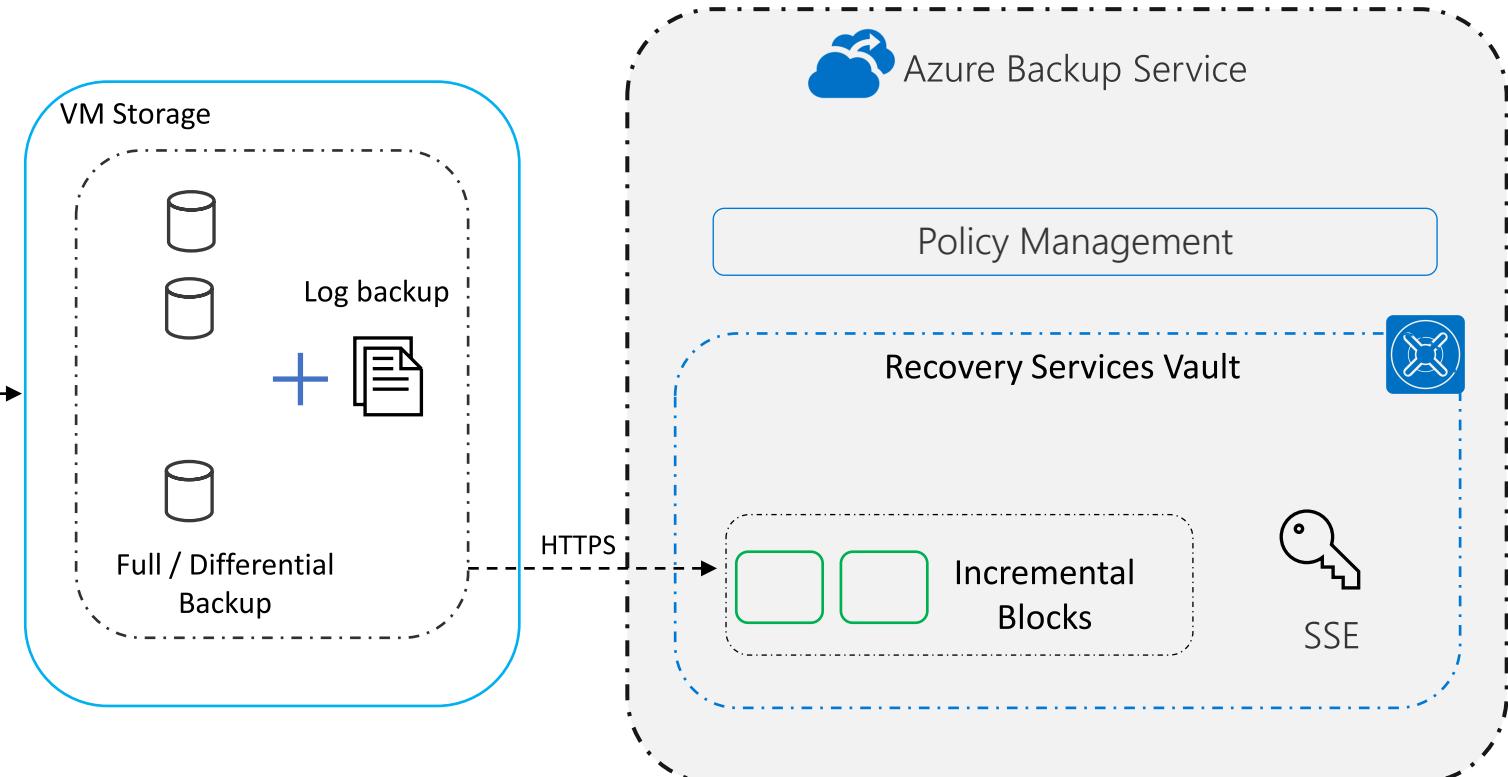
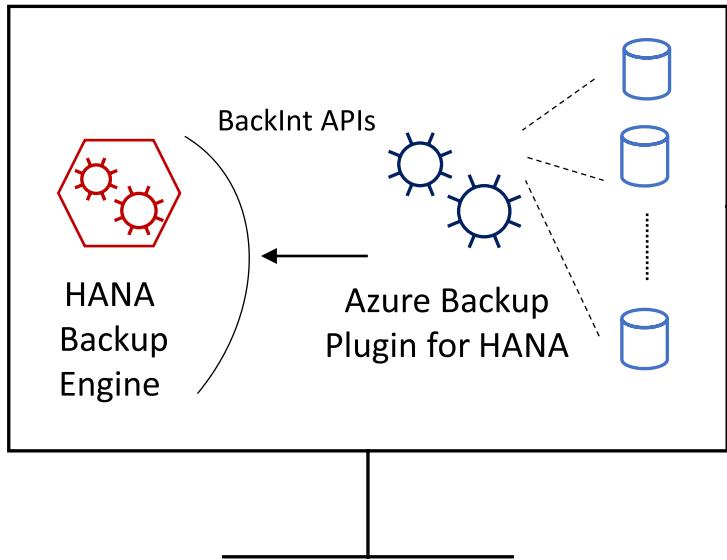
- IBM DB2 for LUW Backup supported same way as standard Windows Server/Linux Operating Systems
  - Native database backup to disks ( As discussed earlier)
  - Third party backup solutions
- Backup/restore performance depends on how many volumes can be read in parallel and volume throughput
- CPU consumption used by backup compression may play a significant role on VM
- Db2 on Windows does not support the Windows VSS technology, application consistent VM backup of Azure Backup Service cannot be leveraged.

## **Best Practices for DB2 Backups on Azure**

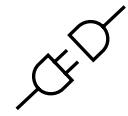
- Stripe the backup target volume over multiple disks in order to improve the IOPS throughput on that striped volume
- Using more than one target directory to write the backup
- Design solutions around the RPO/RTO requirements

# SAP HANA in Azure VM Backup

Azure VM running SAP HANA Server



No Infrastructure



Plugin-Model



Easy Restores – System  
Copy

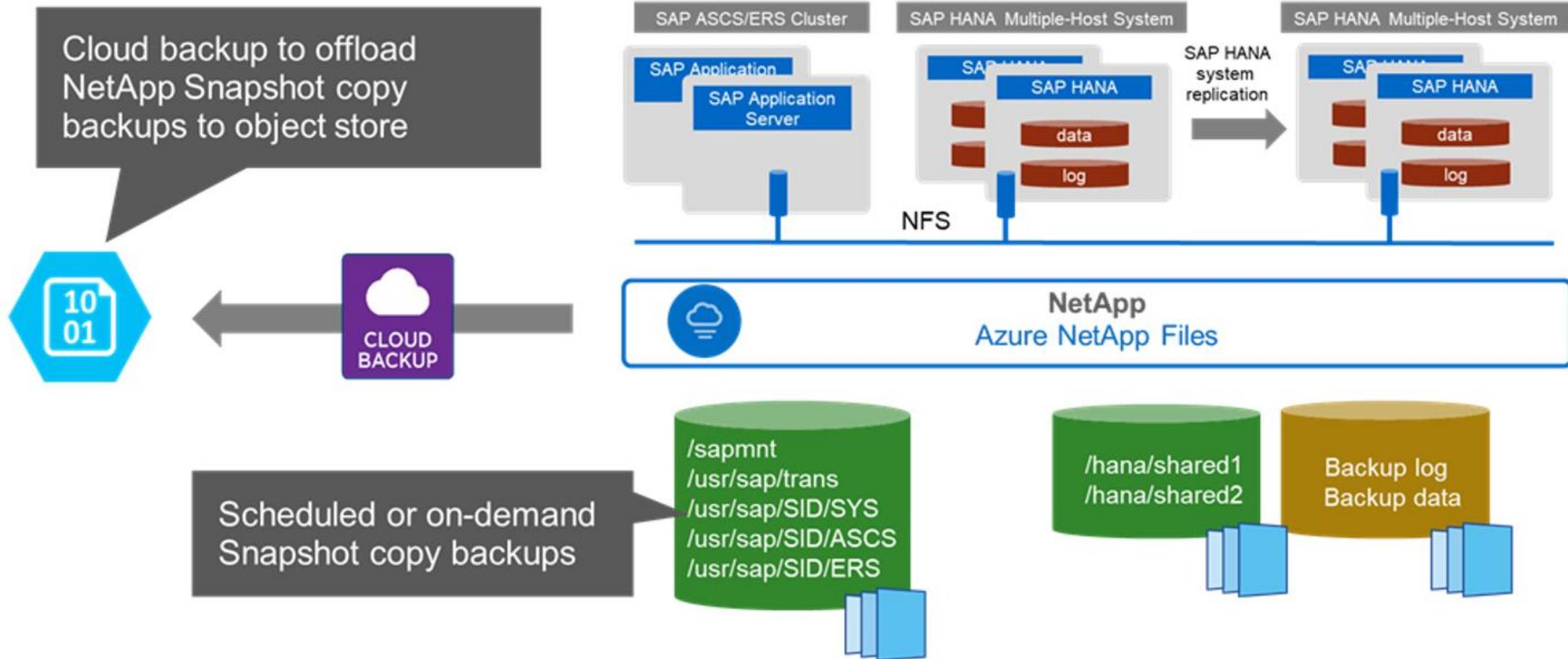


BackInt certified



Monitoring using LA

# ANF Snapshot backup (Preview)



# Azure HLI for SAP HANA Storage Snapshots

- Storage snapshot triggers SAP HANA snapshot
- Deletes SAP HANA snapshot after storage snapshot completes
- For restore, create a Microsoft Azure support request or self-service restore is also possible
- Apply transaction logs for a point in time recovery

# Azure HLI Storage Snapshots considerations

- A specific storage snapshot (at the point in time it is taken) consumes very little storage
- As data content changes and the content in SAP HANA data files change on the storage volume, the snapshot needs to store the original block content
- As such, the storage snapshot increases in size.
- The longer the snapshot is around, the larger the storage snapshot becomes
- The more changes made to the SAP HANA database volume over the lifetime of a storage snapshot, the larger the space consumption of the storage snapshot

# Azure LI Backup & Restore

- Database & log backup
  - Do-it-yourself or use 3<sup>rd</sup> party tools
- File/dir level backups
  - Copy files to an NFS fileserver with storage backed by Azure standard or cold storage

# SAP-Certified 3rd party backup solutions (backint)

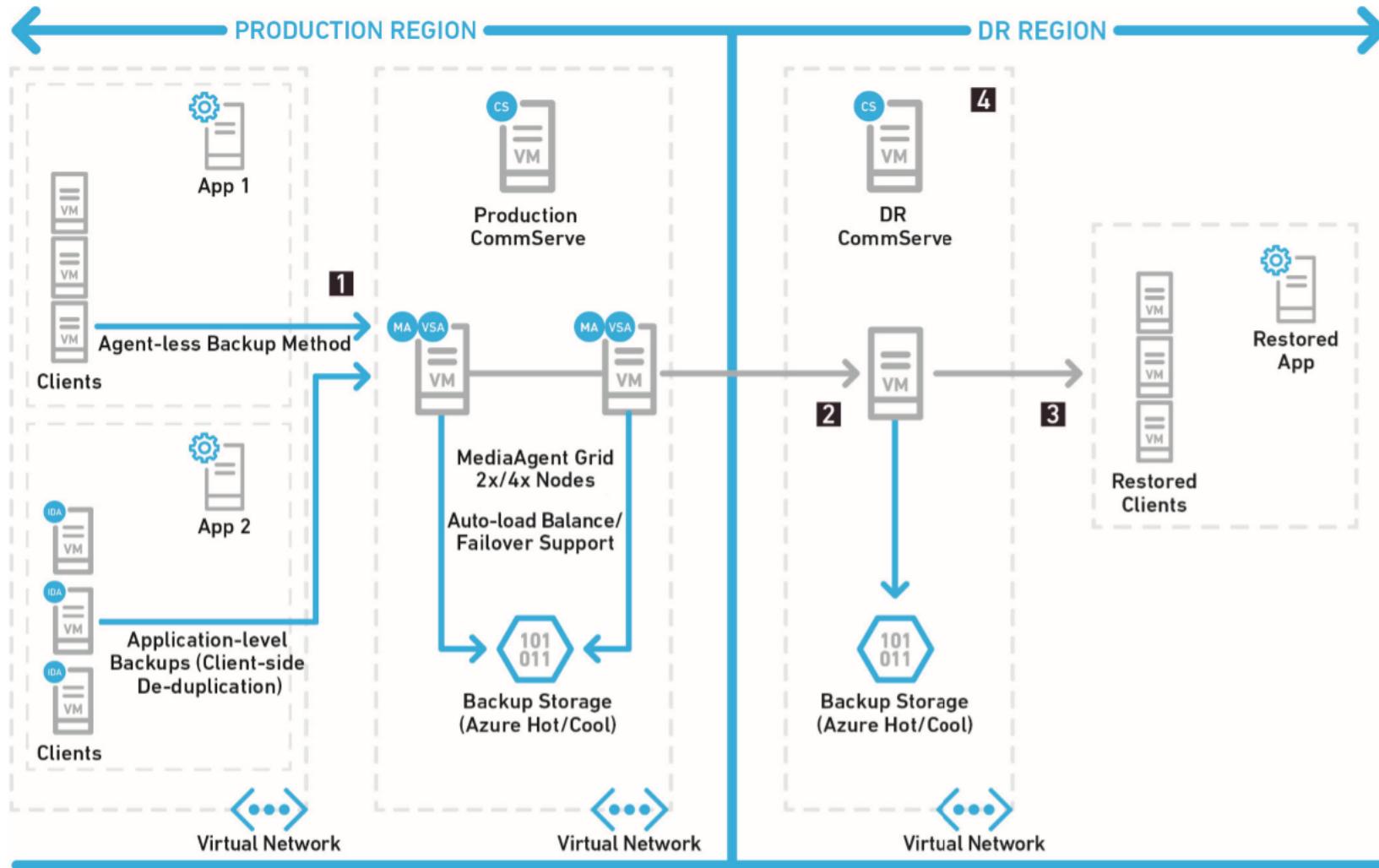


NetBackup 8.0

Legato Networker  
CloudBoost  
Data Domain Virtual Edition (DDVE)

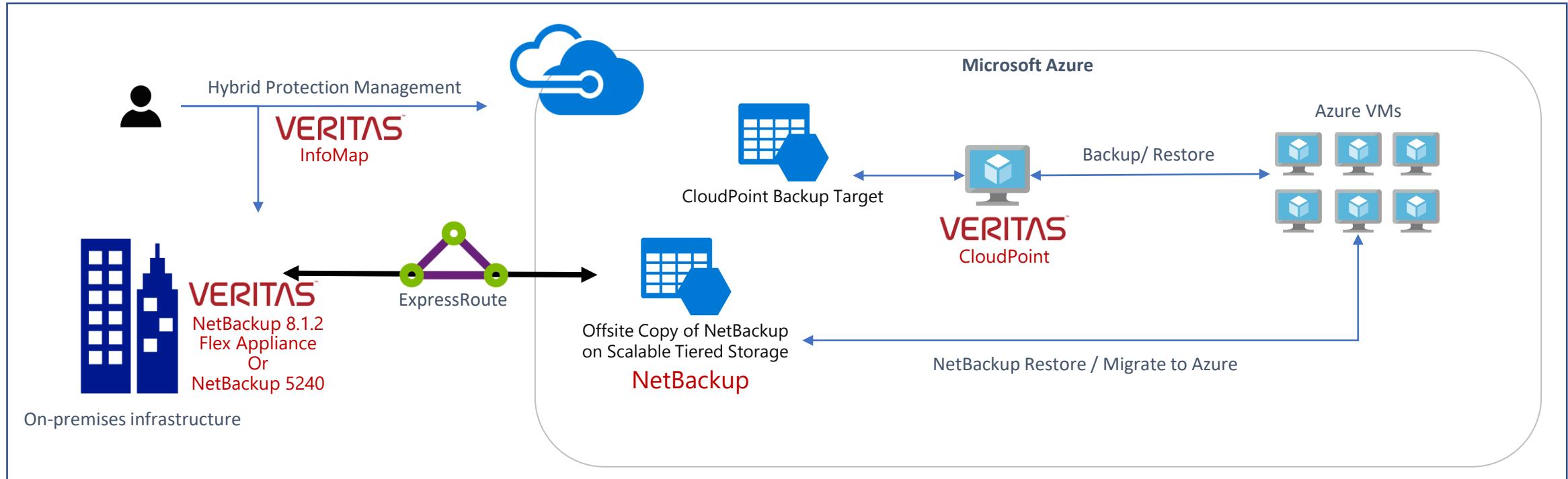
# Commvault

## BACKUP IN AZURE



# Veritas Reference Architecture

Modern infrastructure for Company XYZ



Common Management of on-premises and Azure infrastructure  
Simple integration with existing solutions  
Seamless and secure network extension  
Leverage existing investments and skills

Easily leverage your existing data and virtual machines  
Maintain common network and VM security  
Implement new technologies with no hardware procurement  
Hybrid Cloud made real!

# SAP on Azure Backup Solutions Summary

	Standard DB backup (e.g. SQL, Oracle, HANA)	Azure Backup Server (=SCDPM on Azure)	3 <sup>rd</sup> party solutions (e.g. Commvault, NetBackup)	Azure IaaS VM Backup	HANA on Azure Large Instances Storage Snapshot	HANA Backup using BackInt (in Preview)
Backup type	Database	Network/Agent	Network/Agent	Snapshot	Storage level snapshot	Network/Agent
Backup target	DBs within Azure VMs	SQL Server DBs, Files and OS States (Windows) within Azure VMs ( <a href="#">link</a> )	SQL Server/Oracle/HANA, Files and OS States (Windows, Linux) within Azure VMs	Azure VMs (Windows, Linux) running SQL Server ( <a href="#">link</a> )	HANA database volume, HANA log volume, boot volume ( <a href="#">link</a> )	HANA DBs ( <a href="#">link</a> )
Linux (Guest OS) support	-	No	Yes	Yes	Yes	Yes
SQL Server database backup capability	Transaction log (every minute), differential, full	Differential every 15 minutes and full (express)	Yes	Up to 3 times per day	-	HANA database backup (log backups for every 15 mins. Support for Full, differential. Support for incremental coming soon). For SQL backup, look here
Oracle database backup	No	No	Yes	File consistent backup with RMAN	-	No
Compression	Supported	Supported (storage sizing : <a href="#">link</a> )	Supported	None	-	None
Backup servers running on	DB Server	Microsoft Azure Backup Server (on VM) (installation kits downloadable from Azure Portal) (VM sizing : <a href="#">link</a> )	Backup Server (on VM)	None (Backup as a Service)	-	None (Backup as a Service)
Agent software required	No	Agent in backup target VMs and Azure Backup Agent in Azure Backup Server VMs	Yes	No (* Only Azure VM Agent)	No	No (* Only Azure VM Agent)
Network bandwidth required	Yes but controllable			None	None	Yes
Short term retention	Yes (on local storage)			None	Yes (on local NFS storage)	None
Long term retention	Possible				Up to 255 snapshots per volume (or transfer to Blob Storage)	Possible
Point-in-time recovery	Possible					
Recovery speed	Depend on I/O speed of underneath Blob storage or Backup Vault				Fast	Depend on I/O speed of underneath Blob storage or Backup Vault
Monitoring/alerting console	Database console	Azure Backup Server Console	Backup Server Console	Azure Management Portal	Script	Azure Management Portal
Reporting	Database console	System Center Service Manager	Backup Server Reporting	None	Script	
Licensing	Built-in	Pay-per-use on Azure ( <a href="#">link</a> )	Check vendor	Pay-per-use on Azure ( <a href="#">link</a> )	Built-in	Price model being built

# Agenda

1. SAP Certification for Azure (Any DB)
2. Key Design Aspects
3. Reference Architecture
4. Backups
5. Migration to Azure

# Customer Example : Current State of SAP and Benefits of Azure Migration

## Current State

**1** Contoso SAP is ECC on Windows/SQL 2008 R2 – EOS coming soon

**2** Fixed size of hardware - underutilized /oversized

**3** Largest server 8-core, 32GB RAM, 15K SAPS, 1TB DB

**4** HANA infrastructure for future migration costly

**5** Still concerned about Cloud/HANA migration

**6** No BI/Analytics/UX solution identified



**1** Contoso SAP is fully certified for Azure –OS/DB upgradable

**2** Your SAP can scale any time and any way in Azure

**3** 8-core Azure VM is \$0.4/hour - largest VM is 128-core, 4TB RAM, 134k SAPS

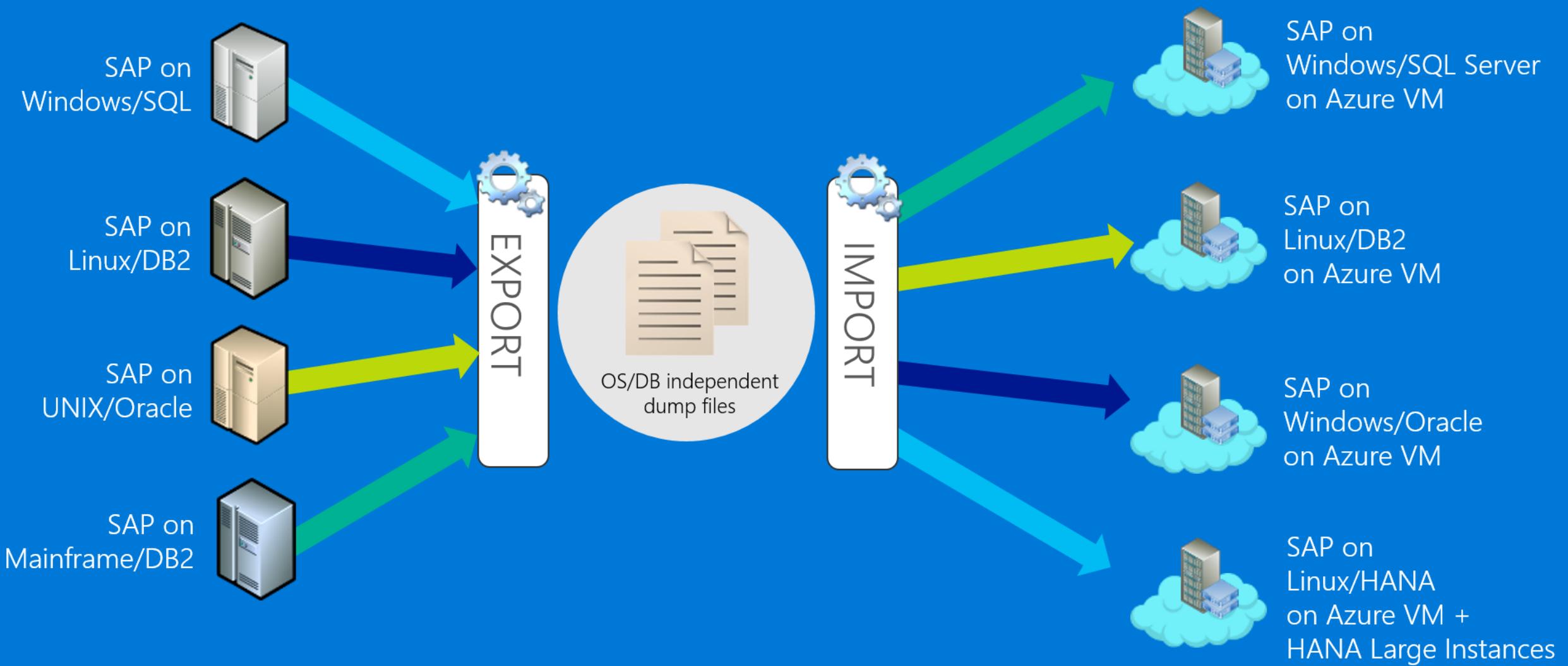
**4** SAP certified HANA infrastructure available from 192GB to 24TB on Azure

**5** All SAP system copy/HANA migration tools are supported on Azure

**6** Power BI & a variety of BI/Analytics/UX solutions available in Azure

## Benefits of Microsoft Cloud Platform

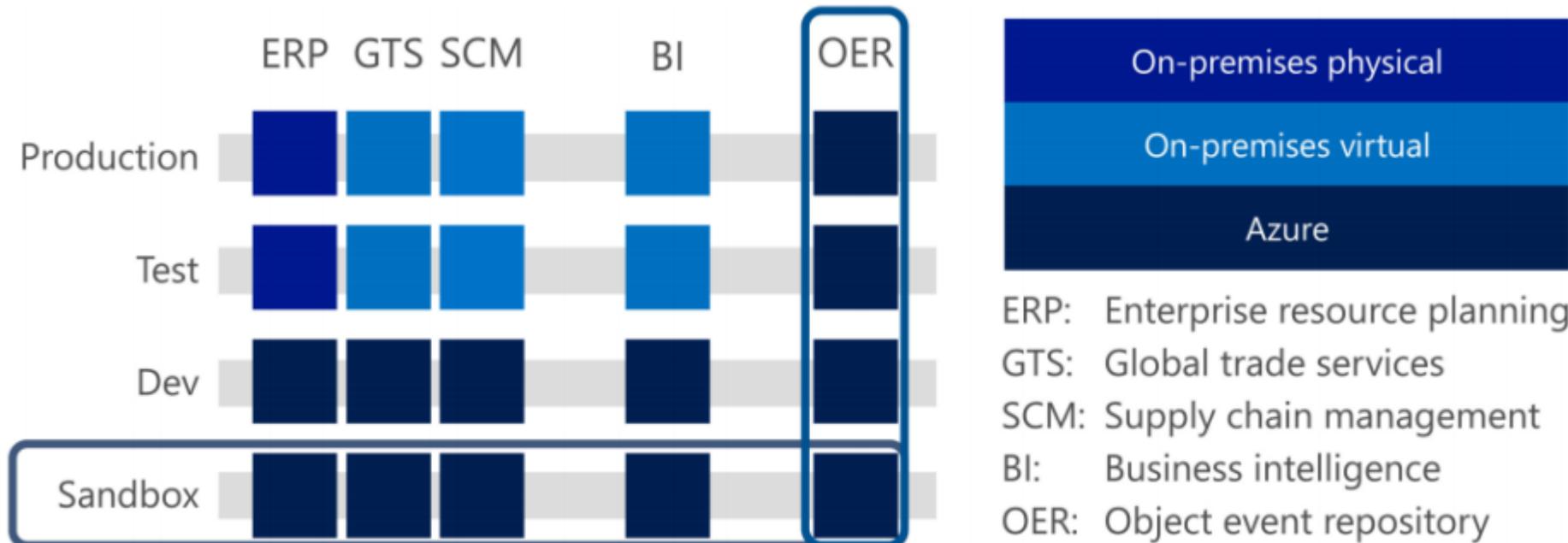
# Modernizing SAP platform on Microsoft Cloud OS



# Migration Methodology

## Horizontal vs Vertical Migration Methodology

- Horizontal Migration is moving the entire Tier starting with the non-prod tiers.
- Vertical Strategy is to move a product in all Tiers.
- Within Microsoft's own journey we took a combined strategy. Using Horizontal starting with Sandbox, but also Vertical with non-business critical systems to gain confidence in migrating to Production.



# Migration Methodology - 15 Lessons Learnt



## Assess your SAP environment:

- Prepare for migration.**  
Understand the complexity of your SAP workloads, underlying infrastructures, sizes of each workload and related databases (velocity, volume, and variety), and requirements for seasonal elasticity.
- Remove clutter.**  
While it didn't matter how much unused stuff was kept on the old, on-premises server; the cost of carrying around dead weight on the cloud adds up fast.
- Account for virtual machines.**  
Failure to allocate enough resources can result in weekly system increases.
- Determine an Azure region strategy.**  
Azure regions have global reach; verify resources are hosted in an Azure region or regions that provide the best connectivity.

# Migration Methodology - 15 Lessons Learnt



## Migrating SAP to the cloud:

- Consider a vertical strategy for moving low-risk systems to Azure.**  
Low-risk, end-to-end systems provide an opportunity to test your strategy and gain experience with a production environment in Azure.
- Benefit from building low-business impact systems in Azure.**  
When building new systems, consider building low-business impact systems in Azure from the start. This might save you money and help you learn about production environments in Azure.
- Determine which migration strategies can be best applied to your environment.**  
Understanding what to move and when to move it is essential for migrating SAP to Azure. Practical, business-friendly guidance can be found in [Strategies for migrating SAP systems to Microsoft Azure](#).
- Avoid moving systems when they're highly critical.**  
Schedule around big events like product releases, quarterly financial reporting, and projects that go live in the production environment.

# Migration Methodology - 15 Lessons Learnt



## Optimizing SAP in the cloud:

- Azure technology and available virtual machines are always advancing.**  
Achieve the best possible benefits for your business by staying up-to-date with new capabilities.
- Avoid wasting migration time on unneeded systems or data.**  
Confirm that retired systems aren't migrated, that your SAP infrastructure inventory is accurate, and that your disaster recovery plan is tested and in place.
- Design for high availability in your production systems.**  
Utilize Windows Server Failover Clustering, SQL Server Always On, and SAP features like logon groups, remote function call groups, and batch server groups
- Take advantage of the cloud.**  
Lower costs by limiting Azure usage to times when teams are out of the office on nights and weekends.

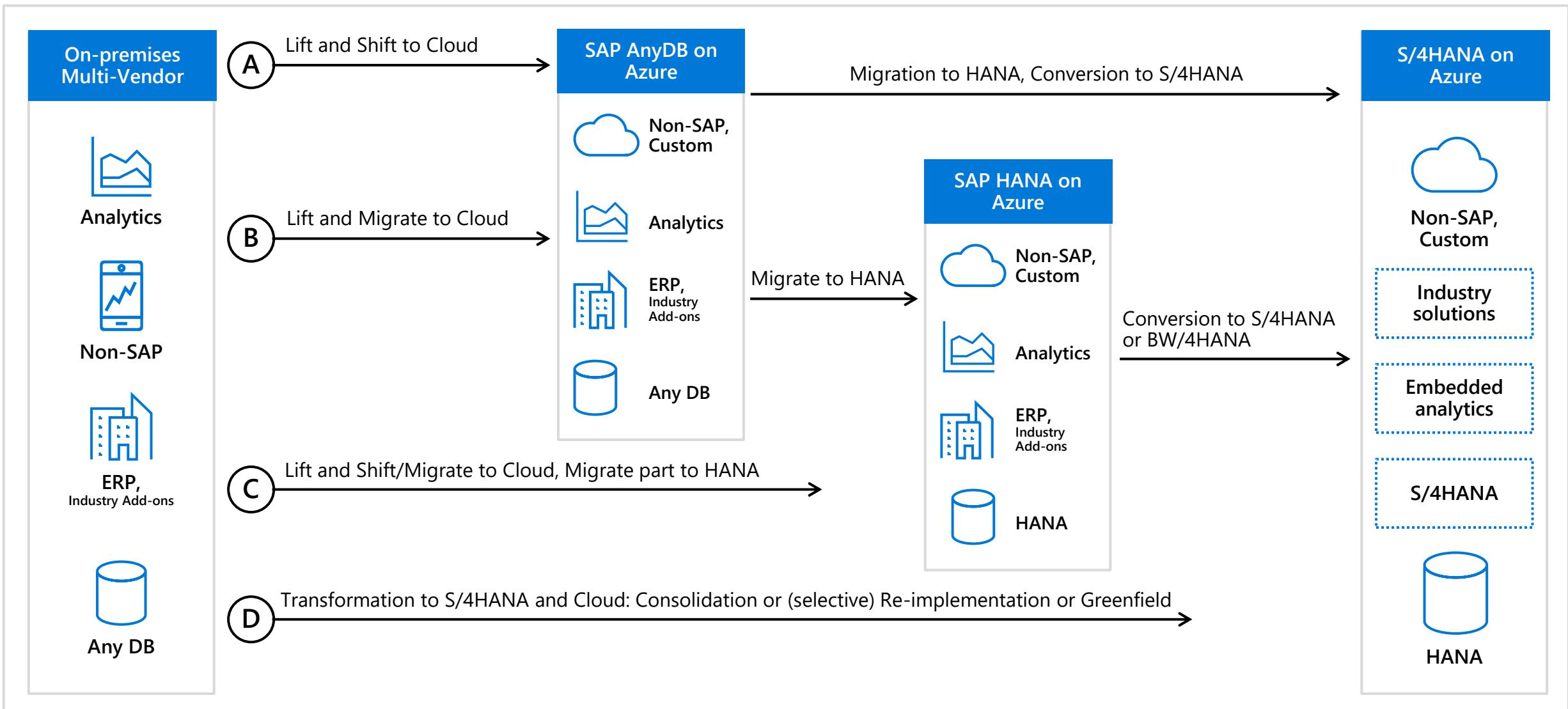
# Migration Methodology - 15 Lessons Learnt



## Securing and managing SAP in the cloud:

- Protecting business data is a top priority.**  
Consider all of the compliance and data security aspects of hosting data in the public cloud.
- Balance security needs with troubleshooting.**  
In a cluster installation, best practice is to open only the needed ports. A somewhat open environment can help with troubleshooting, but don't leave it too open.
- Plan to capture all legal requirements from the start.**  
Data safety and security can be complicated; work with the stakeholders and data owners for each application to capture all corporate and legal compliance needs.

# Journey to SAP on Azure



# SAP on Azure Migration Tools and Methodologies Overview

## Migration Tools and Methodologies:

1. **Backup, Transfer, Restore** – Commonly using Azure Storage options.
2. **Database Replication Technology** – Replicating the On Prem DB Node to the cloud
3. **SAP System Copy – Heterogeneous** - SAP Software Provisioning Manager includes tools to export/import the SAP system while changing the OS and/or DB.
4. **SAP System Copy – Homogeneous** - SAP Software Provisioning Manager includes tools to export/import the SAP system while keeping the OS/DB combination the same.
5. **SAP Database Migration Option (DMO)** – Migrate and Upgrade the solution in the same process.

**It is common for migration to use a combination of these tools and methodologies.**

# SAP on Azure Migration Tools and Methodologies

## **Backup, Transfer, Restore:**

Easiest method is to use a DB native tools such HANA Studio backup / SQL backup:

1. Perform a backup of the On-Premise source SAP system.
2. Copy backup into Azure.
3. Restore in Azure VM that runs your DBMS instance.
4. Optional: Set up log-shipping so that the changes applied in the meantime can be moved into the Azure hosted instances and applied there.
5. Stop the on-premise SAP instance. Take a last transaction log backup. Make sure the last transaction log backup gets copied to the Azure hosted instance and applied.
6. Start SAP system that you installed in Azure against the Azure hosted DBMS instance.
7. Perform post-system copy tasks.

# SAP on Azure Migration Tools and Methodologies

## **Database Replication Technology:**

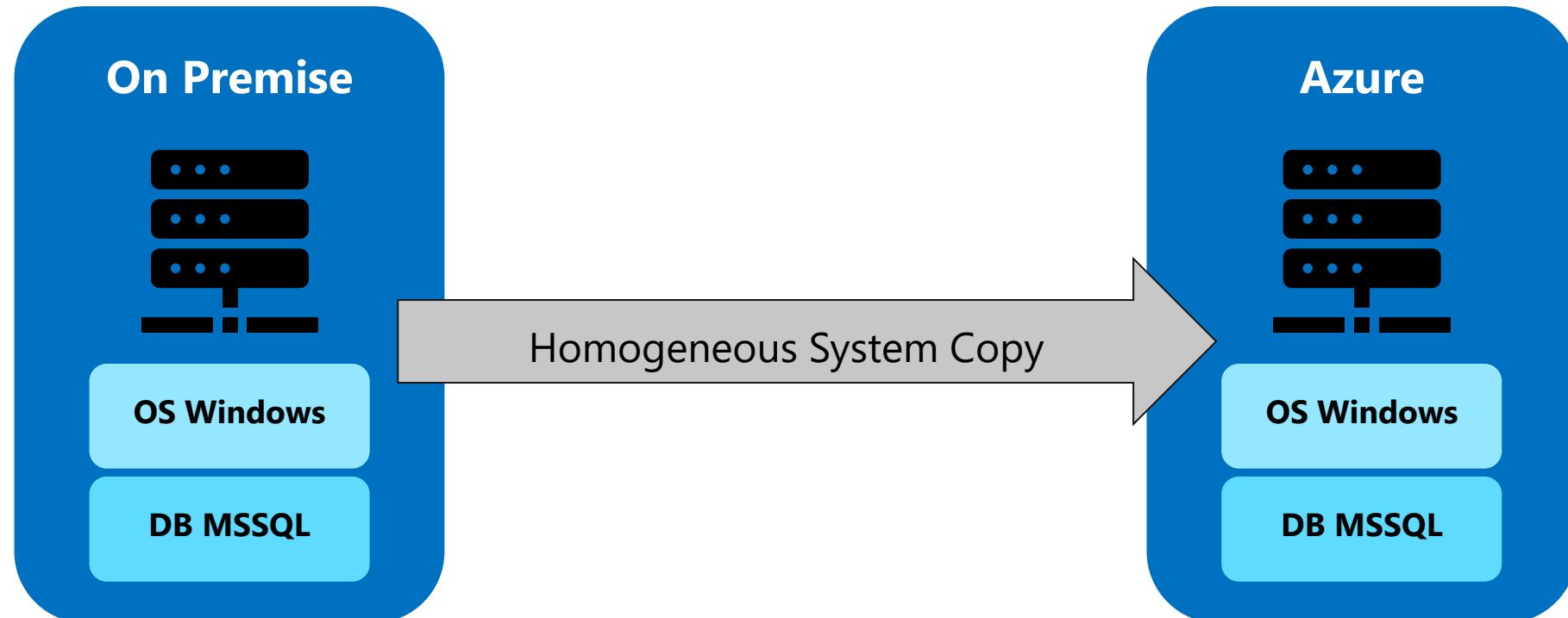
This could be HANA System Replication or SQL Server Always On:

1. Establish your connection to Azure. (Express Route / Site to Site VPN)
2. Setup the initial Sync (For large DB's recommend Backup/Restore method first)
3. Make sure the nodes are in Sync. Stop the on-premise SAP instance.
4. Either migrate the Application VM's or reinstall in Azure.
5. Start SAP system that you installed in Azure against the Azure hosted DBMS instance.
6. Perform post-system copy tasks.

# SAP on Azure Migration Tools and Methodologies

## SAP System Copy:

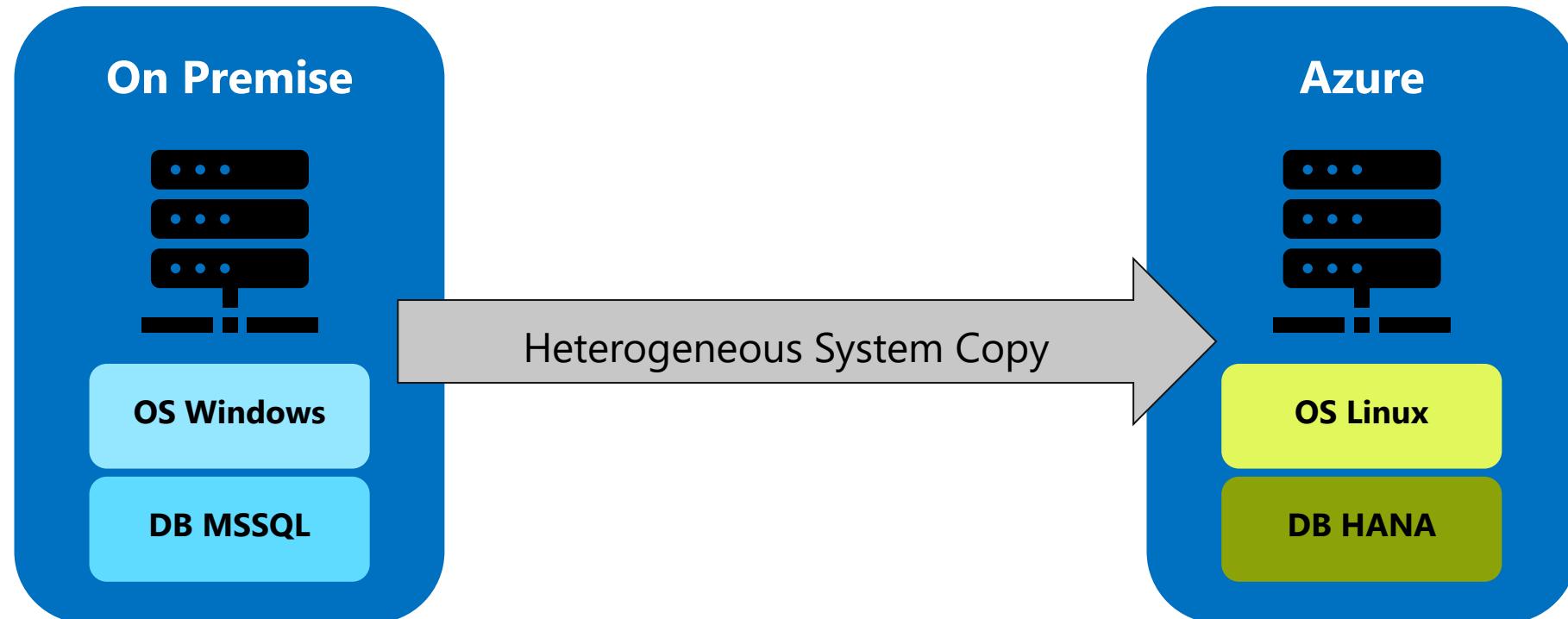
**Homogeneous System Copy** – Essentially keeping the same target OS/DB combination as what is running On-Premise. The DB is typically either flat file copied or backed up/restored into the cloud. The System Copy procedure will use SAP Software Provisioning Manager and will build the entire stack including the Application Servers, ASCS etc.



# SAP on Azure Migration Tools and Methodologies

## SAP System Copy:

**Heterogeneous System Copy** – In this example the Target OS, DB or Both will change from what is running On-Premise. The DB is exported to a bunch of OS/DB independent files and the SAP Software Provisioning Manager will import them into the new OS/DB combination on Azure.



# SAP on Azure Migration Tools and Methodologies

## **SAP Database Migration Option (DMO) :**

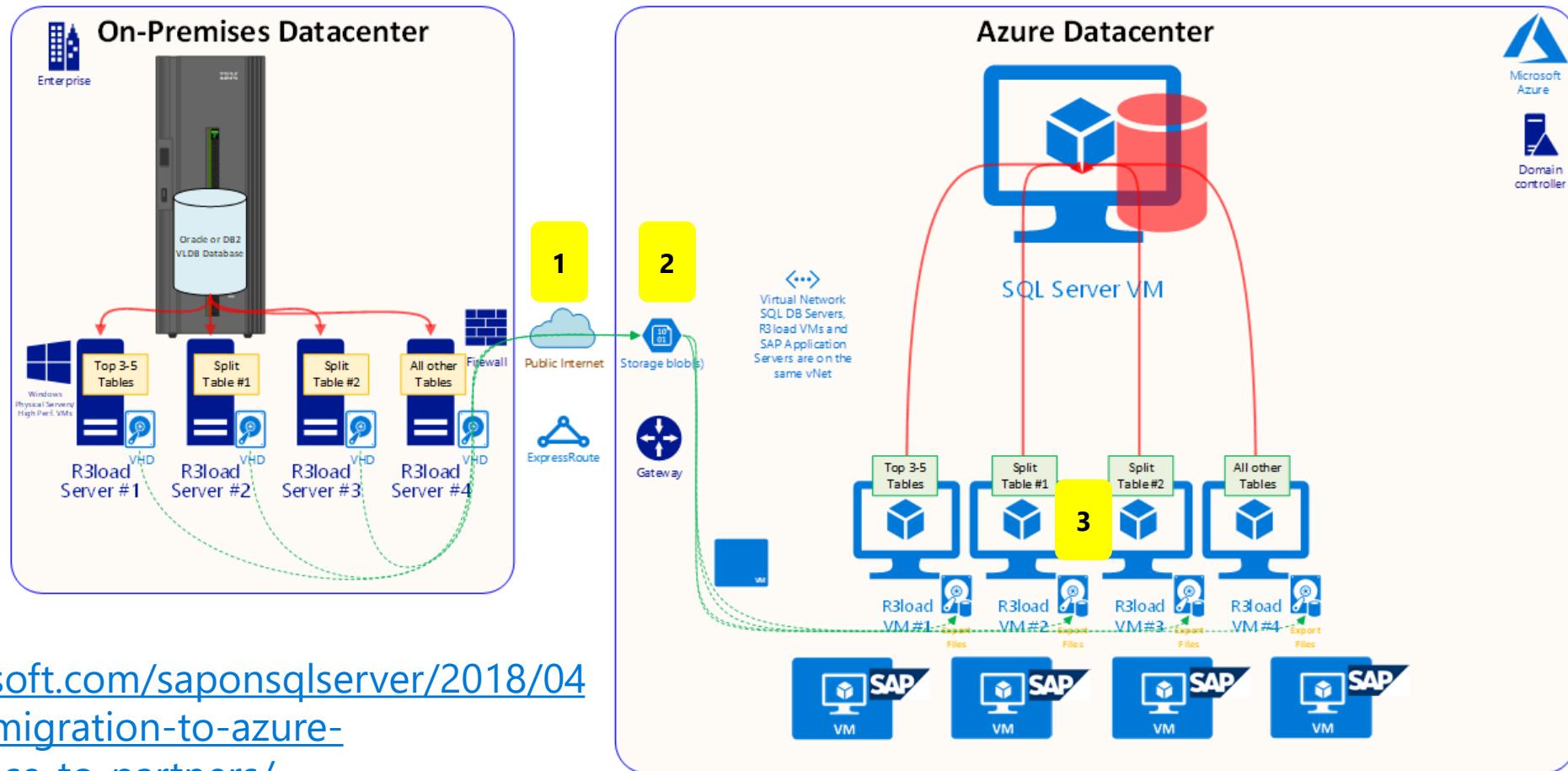
This scenario involves migrating any SAP Application from on-premises to Azure while you switch your database from AnyDB to HANA

1. Install a new SAP application server and HANA Database on Azure. This can be done through predefined Azure ARM templates.
2. Run export using the SAP Data Migration Options (DMO) system move tool for the on-premise SAP server
3. There are 2 ways of uploading the finished export files to Azure through ExpressRoute from the on premise SAPserver. One is sequential mode and the other is Parallel mode. Parallel mode is used to minimize downtime.
4. Run import using SAP DMO System Move option in Azure.
5. Run all post-migration steps for the Azure SAP App server.

# SAP on Azure Migration Tools and Methodologies

## Large DB Example:

- 1 ExpressRoute Connectivity
- 2 Blob Storage for export target.
- 3 Multiple VMs in azure to process the DB export files into the new target.



# SAP on Azure Migration Tools and Methodologies

## Important Points to consider:

1. ExpressRoute Connectivity – Ensure you have the bandwidth for the migration. Can you uplift the bandwidth for the migration? Ensure no unnecessary Network Virtual Appliances in the migration path.
2. Make sure your disk is optimized with high IOPS.
3. Ensure you have the appropriate compute to handle the load. This is especially important for when running in parallel mode. Setup extra Azure VM's temporarily for the migration.
4. Run plenty of mock runs on a copy of production to bed down the process.
5. Ensure you have SAP Router setup in the target location in advance so SAP can do post migration checks and help if any support needs are required post migration.
6. For every migration always consult the SAP System Copy Guides and related SAP notes.
7. Always use the latest versions of the SAP System Copy Tools. They update frequently.

# SAP on Azure Migration Tools and Methodologies

## Important Points to consider:

8. Certified OS/DB Migration Consultant is required.
9. SAP OS/DB Migration Check
10. At least 1 test migration of production.
11. Don't burn your source systems. Always have a fallback.

SAP Migration Requirements: SAP Note 82478

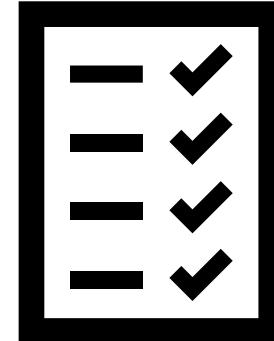
<https://launchpad.support.sap.com/#/notes/82478>

# SAP on Azure Migration Tools and Methodologies

## **Post Migration:**

Before handing over the system:

- Smoke Test the landscape.
- Catchup the Batch Jobs including Housekeeping jobs.
- Backup the system.
- Functional Test critical business processes.
- Confirm High Availability is in place.
- Check Disaster Recovery nodes are in sync.
- Confirm system and application monitoring is working.

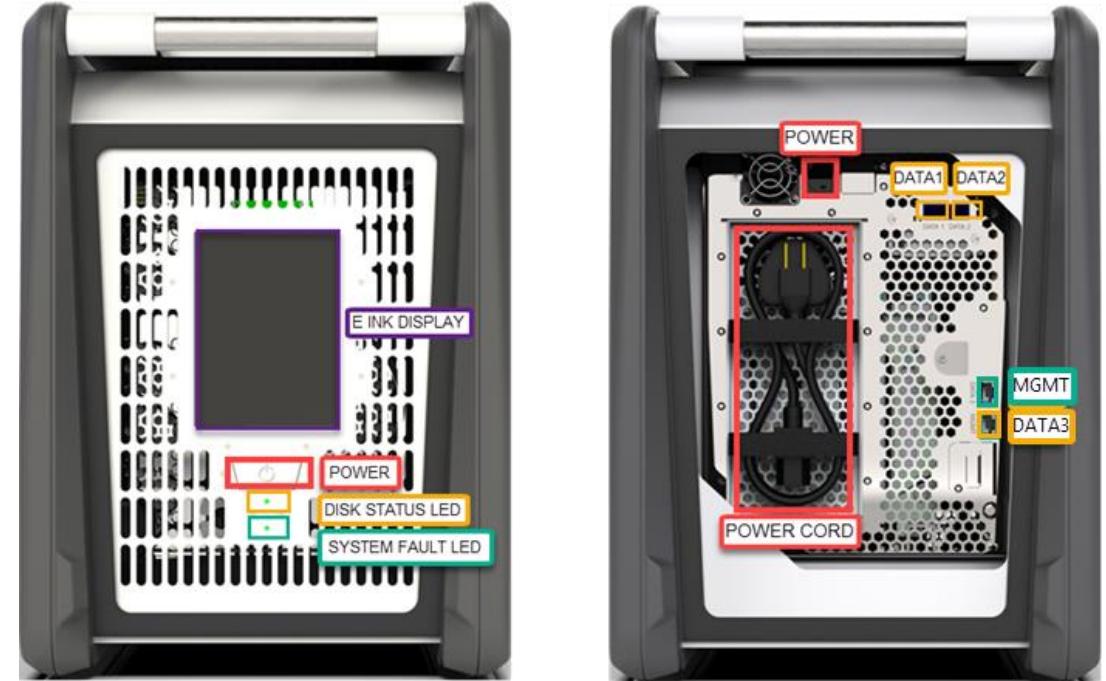


# SAP on Azure Migration Tools and Methodologies

## Azure Data Box:

Data Box is ideally suited to transfer data sizes larger than 40 TBs in scenarios with no or limited network connectivity. The data movement can be one-time, periodic, or an initial bulk data transfer followed by periodic transfers.

- 80TB Storage
- Has an Inbuilt Local UI and integrated into the Azure Portal via a Data Box Service.
- Availability - <https://azure.microsoft.com/en-us/global-infrastructure/services/?products=databox&regions=all>
- More Information - <https://docs.microsoft.com/en-us/azure/databox/data-box-overview>

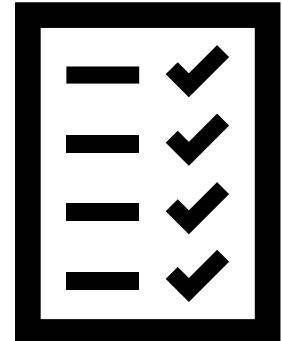


Data Box front view (left) and back view (right)

# SAP on Azure Migration Tools and Methodologies

## Resources:

- Very large database migration to azure recommendations guidance to partners -  
<https://docs.microsoft.com/en-us/archive/blogs/saponsqlserver/very-large-database-migration-to-azure-recommendations-guidance-to-partners>
- DMO Technical Procedure - <https://blogs.sap.com/2014/03/10/dmo-technical-procedure/>
- SCN FAQ System Copy and Migration –  
<https://wiki.scn.sap.com/wiki/display/SL/FAQ++System+Copy+and+Migration>
- SAP OS/DB Migration Certification –  
[https://training.sap.com/certification/c\\_tadm70\\_19-sap-certified-technology-associate---osdb-migration-for-sap-netweaver-752-g/](https://training.sap.com/certification/c_tadm70_19-sap-certified-technology-associate---osdb-migration-for-sap-netweaver-752-g/)



# Azure NetApp Files Migration Options



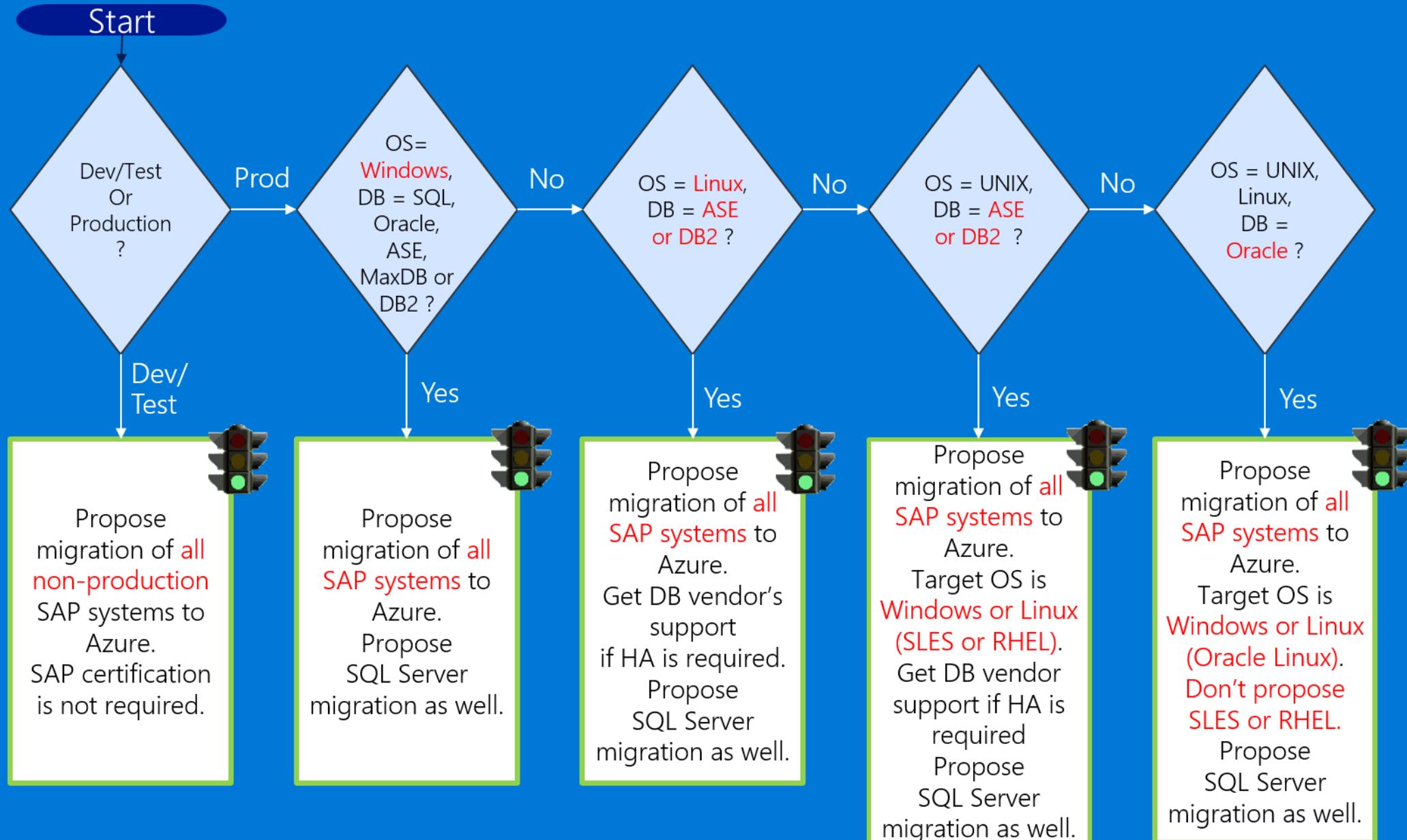
## Migrating from OnPrem to ANF

- If running NetApp OnPrem then using the NetApp Snap Mirror is an option.
- Alternatively you can mount the volumes over Express Route and use a replication tool (robocopy/rsync etc) that also replicates folder permissions.
- HANA System Replication also an option.
- Azure Data Box is currently not support for ANF.

## Migrating from Azure VM NFS to ANF NFS

- SAP documentation on the migration steps available here: [Link](#)
- **Migration in a nutshell:**
  - Create ANF Account, Capacity Pool and Volumes
  - Mount to your servers
  - Stop SAP
  - Copy data from old NFS to ANF
  - Drop NFS Mounts and alter ANF Mounts to use the same file UNC.
  - Start SAP
  - Test!

# Qualifying SAP on Azure Opportunities (Any DB)



# Q&A

Reach out to the team  
[sap-on-azure-pe-apac@microsoft.com](mailto:sap-on-azure-pe-apac@microsoft.com)

# Feedback

Your feedback is very important  
for us.

Your responses are Anonymous

<https://aka.ms/SAPAPAC-POE-FEEDBACK>





# SAP on Azure Enablement

Next Session – Architecting  
Netweaver on Azure

Tuesday, Oct 13, 2020, 10am SGT

Reach out to the team  
[sap-on-azure-pe-apac@microsoft.com](mailto:sap-on-azure-pe-apac@microsoft.com)

