

# Azure SQL Server VMs

## Optionen für höhere Verfügbarkeit

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# SQL Server on Azure Virtual Machines

- Full version of Microsoft SQL Server installed on a Azure VM
- Full list of SQL Server versions still under MSFT support are usable
- Running on a Hyper-V Host Server
- Using Remote Storage for OS / Data Disk (Software-defined Storage, similar to SAN)
- Could have local SSD temp disk (!)

# Running single instance VMs

- By default, each Azure VM is a single-instance VM
- It does not run on any Cluster or such
- SLA is granted, when Managed Disks are used
- SLA is on a per-month basis
- SLA depends on disk type of ALL attached disks:
  - Standard HDD                      95%
  - Standard SSD                      99,5%
  - Premium SSD                      99,9%

SLA	Per Month	Per Week	Per Day
95%	1.5 days	8.4 hours	1.2 hours
99%	7.2 hours	1.68 hours	14.4 minutes
99.5%	3.6 hours	50.4 minutes	7.20 minutes
99.9%	43.2 minutes	10.1 minutes	1.44 minutes
99.95%	21.6 minutes	5.04 minutes	43.2 seconds
99.99%	4.32 minutes	60.5 seconds	8.64 seconds

# Running single instance VMs

- Running SQL Server on a single instance VM is mostly a bad idea
- Single instance VMs will easily fail
- They will be affected by any of these:
  - Planned Maintenance
  - Unplanned Maintenance
  - Hardware failure
  - Power failure
  - Local Datacenter failure
  - Azure Region failure
- Sometimes, Live Migration will solve the issue without interruption
- Mostly, Autohealing will restart the VM on a new, unaffected Host (dirty shutdown)

# Business as usual?

- First things that might come into ones mind:
  - Always On Failover Cluster Instance (Failover Cluster)
  - Always On Availability Group (Replication)
  - Combination of both
- But: Just setting things up like on-premises might not be a good idea!
- You need to consider:
  - VM Deployment options
  - Storage
  - Network
  - Quorum

# What if?

- If you would just deploy 2 or more Azure VMs
- And have SQL Server installed on them
- They could both run on the same Hyper-V Host, in the same Rack or within the same Datacenter
- So both could fail at the same time for the same reason
- Nothing would be won on that way

# What are my options now?

- First and foremost: User Azure SQL Database or Azure SQL Managed Instance!

## SQL on Azure – Current Options and Names

- Azure SQL
  - Combination of all SQL Server database engine products available on Azure (all further products)
- Azure SQL Database
  - Single SQL Database or Elastic Pool (PaaS)
- Azure SQL Managed Instance
  - Own product within Azure SQL Family, not just a deployment option
- SQL Server on Azure VM
  - Full installation of Microsoft SQL Server on a Windows (or Linux) VM

- But this might not be suitable for your usecase!



# What else could we do?

- If you are still looking to run AlwaysOn FCI or AlwaysOn AG, use either one of these:
  - Azure Availability Set
  - Azure Availability Zone
- They will increase SLA and provide higher availability
  - Availability Set: 99,95%
  - Availability Zone: 99,99%

# Availability what?

- An Availability Set is basically just telling Microsoft Azure that a group of VMs are serving the same purpose
- Azure then gets the ability to consider this and provide better redundancy and availability
- Each VM in an Availability Set is assigned into an Update Domain (UD) and on Fault Domain (FD)
- Each Availability Set can have up to 3 FDs and up to 20 UD's but numbers higher than the amount of VMs in the Set are useless

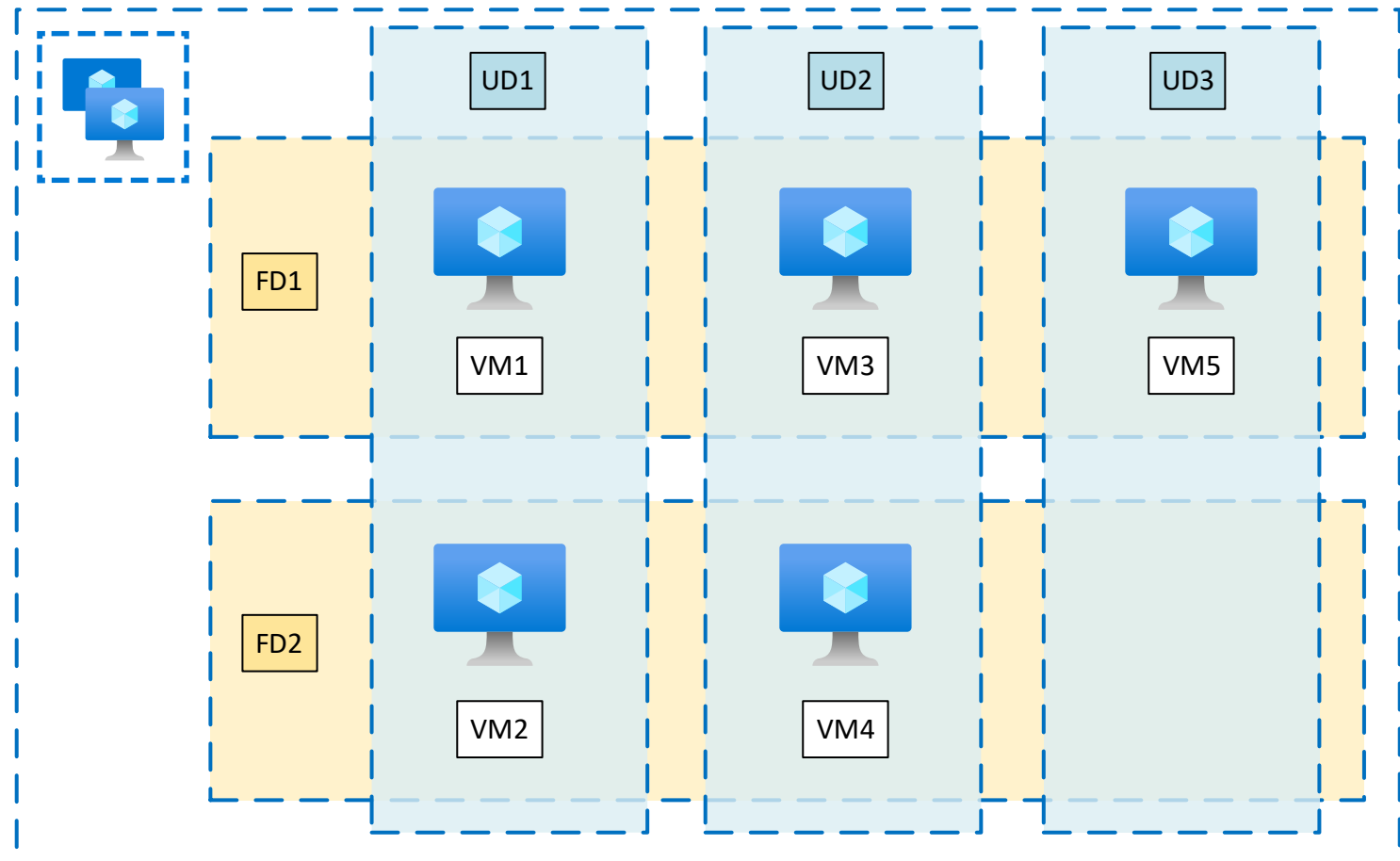
# How about these domains your are speaking about?

- Fault Domains (FD) share a common power source and network switch, so VMs in different FDs wont suffer from the same host, power or network failure
- Just think about FDs as if they where server racks
- Update Domains indicate groups of VMs and underlying physical H/W, that can be rebooted at the same time for maintenace
- A rebooted update domain is given 30 minutes to recover before maintenace is initiated on a different update domain

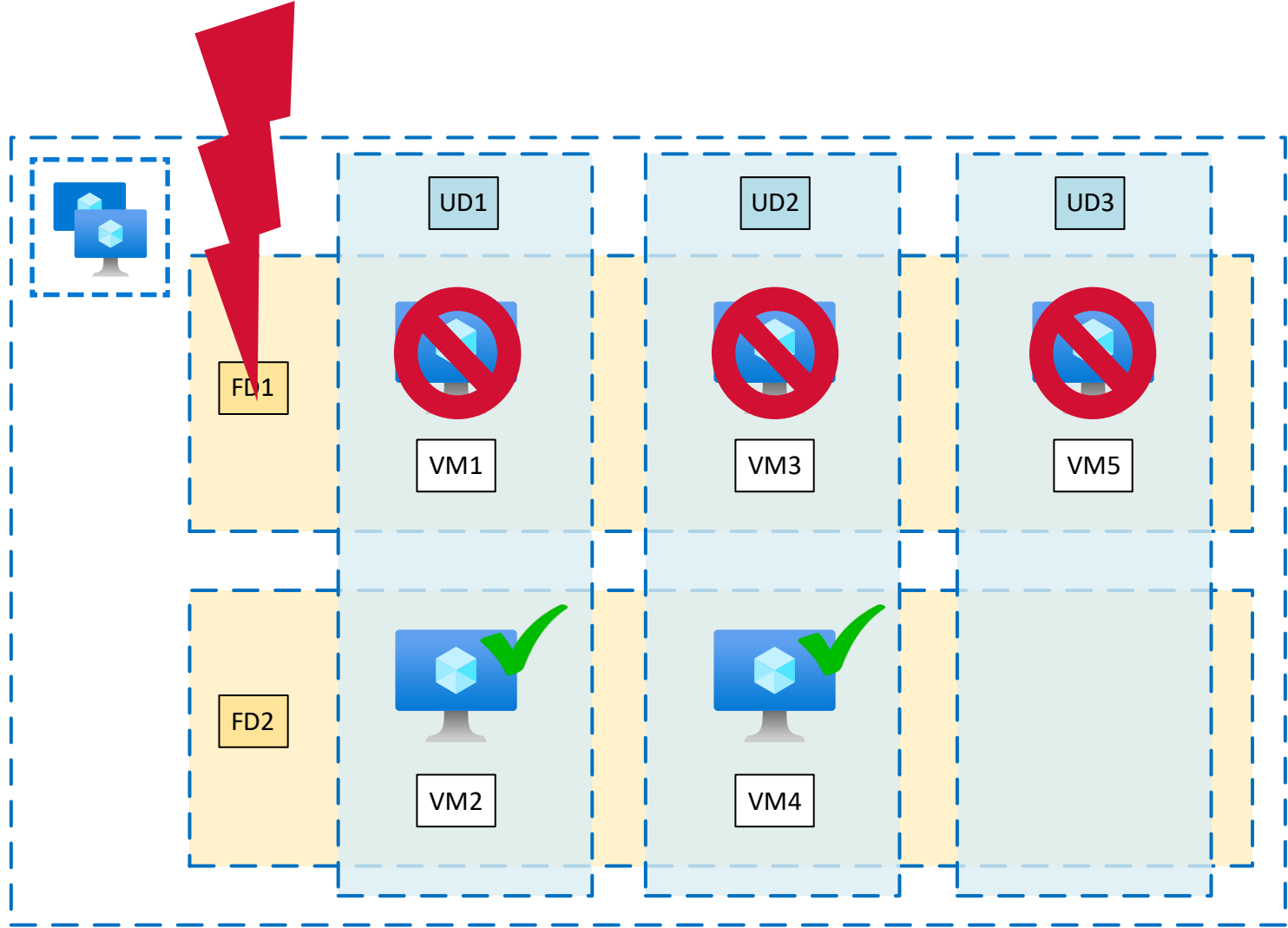
# But how does it work?

- Lets think about an Availability Set with 2 Fault Domains and 3 Update Domains
- And lets put 5 VMs with SQL Server into this Set
- Now it would look like this:

(this is a little bit simplified!)



# But how does it work?



## But be aware...

- Just having a single VM within an Availability Set does not improve availability, also does not grant an SLA!
- VMs cannot „be joined“ into an Availability Set after they were created
- Different types of VMs should never use the same Availability Set
- Availability Sets do not provide any replication – VMs need to be able to replace the other ones on their own
- You might need to use further services such as Load Balancers
- Availability Sets do not protect against datacenter- or region-level outages
- Availability Sets could also use Proximity Placement Group



# Short Demo

# This is not sufficient for me!

- So how about Availability Zones?
- They are available in more and more regions, but not all
- When deploying a VM, you can chose to put it in any of the three availability zones the regions is offering
- An availability zone is a set of datacenters within a region that share power, cooling and networking
- Zones are independent of the other ones
- They are connected through a high-performance network with round-trip latency of 2ms or less





# As well, be aware...

- You cannot define or change Availability Zones after the VM got created
- There will be traffic costs starting 1st Jul 2022 for inter-zone traffic
- You need to have two or more instances within an Availability Zone to gain SLA and higher availability
- There is still no replication or such
- To get the high availability, you need to put the VMs into DIFFERENT Zones!
- You cannot mix Availability Zones and Availability Sets (so having i.e. 6 VM Instances within the 3 zones could lead to 2 VMs being impacted at the same time)
- Use of Availability Zones will protect against outage within a single datacenter or failure of the whole DC – regional outage would still have an impact!

# Just one more thing about SLA

- Availability Set: 99,95%
- Availability Zone: 99,99%
- These values are given on the availability of ONE VM within the Set / Zone
- You need to have two or more instances to get the SLA
- There is no SLA on services running WITHIN the VMs!
- In case of any SLA violation, you will only get some refund for the charges of the affected services!

# So Availability Zone is better?

- As always: It depends!
- Availability Zone might offer the better SLA, but could have an impact on performance (i.e. when using AlwaysOn AG with synchronous replication) or could even lead to data loss (when primary node fails before data is replicated)
- VMs within an Availability Set can be placed into proximity placement groups
- This ensures they are kept close to each other, minimizing network latency (but could increase risk of simultaneous failure!)

# No more options?

- When application-level replication is not an option, you could use Zone-Redundant Storage (ZRS) Managed Disks (i.e. for older SQL Server versions that don't support synchronous replication)
- ZRS disks will provide improved availability via storage-level replication
- If one zones goes down, the ZRS disk will continue to work
- If the VM in the affected zone is affected as well, you could use a VM in another zone and attache the same ZRS disk
- ZRS disks could also be used for shared disks for SQL Failover Cluster Instance

# Further things to consider

- When using Azure VMs within failover cluster, just use one NIC per server / node within a single subnet for all nodes
- Cluster Validation Report will issue a warning that could be ignored (<https://docs.microsoft.com/en-us/azure/azure-sql/virtual-machines/windows/availability-group-overview#network-configuration>)
- When using failover cluster feature, always use a quorum resource (otherwise, there is no production support)
  - If there is no quorum, even a 3 node cluster can only safely survive a single node failure)
- Use a Cloud Witness where possible, unless you use Azure Shared Disks (then, you need to use Disk Witness). Fileshare Witness always is the last choice.

# Further things to consider

- Change the cluster heartbeat and threshold settings to relaxed values to avoid failures due to increased latency compared to on-prem (<https://docs.microsoft.com/en-us/azure/azure-sql/virtual-machines/windows/hadr-cluster-best-practices?tabs=windows2012#heartbeat-and-threshold>)
- Be aware of some other specific things that might be different in the cloud – see <https://docs.microsoft.com/en-us/azure/azure-sql/virtual-machines/windows/hadr-cluster-best-practices>



# Thank you!

# Any questions?



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