



Windows Server 2016 Storage Spaces Direct Cluster

Marc Grote

Wer bin ich?

- Marc Grote
- Seit 1989 hauptberuflich ITler / Seit 1995 Selbststaendig
- Microsoft MVP fuer Hyper-V 2014, seit 2015 MVP Cloud and Datacenter (MVP Forefront von 2004-2014)
- Microsoft MCT/MCSE Messaging/Security/Server/MCLC /MCITP*/MCTS*/MCSA*/MC*
MCSE Private Cloud, Productivity, Cloud Platform and Infrastructure, Server Infrastructure, Exchange
MCS Server Virtualization Hyper-V / System Center/ Azure
MCITP Virtualization Administrator
- Buchautor und Autor fuer Fachzeitschriften
- Schwerpunkte:
 - Windows Server Clustering/Virtualisierung/PKI
 - System Center SCVMM/SCEP/DPM
 - Exchange Server seit Version 5.0
 - von *.Forefront reden wir nicht mehr ☹

Agenda

- Failover Cluster Neuerungen in Windows Server 2016
- Storage Spaces Direct Architektur
- Einrichtung eines S2D-Clusters
- Administration eines S2D-Clusters
- Storage-Erweiterung des S2D-Cluster
- S2D Troubleshooting

Failover Cluster Neuerungen in Windows Server 2016

- Virtual Machine Cluster Resiliency
 - Quarantine (Kein Cluster Join fuer 2 Stunden, VM Drain, nicht mehr als 20% Hosts)
 - Isolated (Node kein Active Member, VMs werden weiter gehostet)
 - Konfiguration per PS (Get-Cluster)
- Cluster Rolling Upgrade
- Host Resource Protection in VM
- Cloud Witness in Microsoft Azure

Failover Cluster Neuerungen in Windows Server 2016

- Host Guardian Service (VM Isolation fuer Tenants)
- Start Order Prioritaet fuer VM im Cluster
- Site Aware Cluster
 - Failover Affinity, Storage Affinity, Cross-Site Heartbeating
- Verbessertes Cluster Log
 - TimeZone, VerboseDiagnostic EventViewer
- Active Memory Dump

Demo

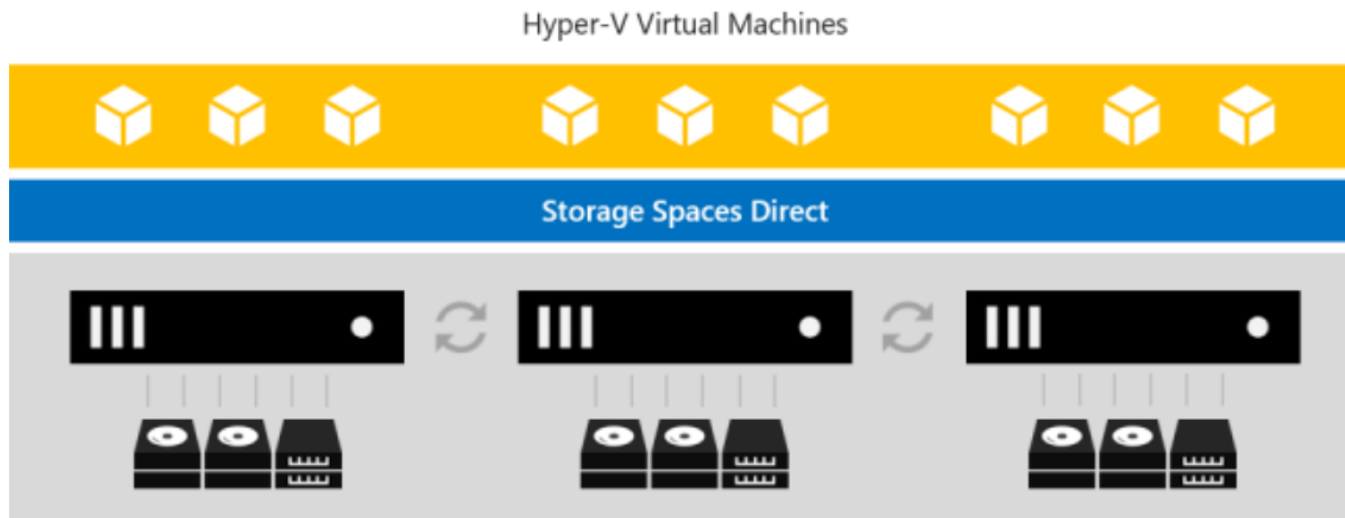
Storage Spaces Direct (S2D)

- Lokal angeschlossenen Festplattenspeicher von mehreren Servern werden zu einem gemeinsamen Speicher gebündelt
- Verschiedene Ebenen der Fehlertoleranz möglich
- Austausch der Paritäts-Informationen erfolgt über das Server Message Block-Protokoll (SMB 3.1.1)
- Speicher wird per Storages Spaces und Storage Pools zu Speicherung von virtuellen Maschinen in einem CSV ueber ReFS bereitgestellt.
- Windows Server 2016 Datacenter Lizenz notwendig

Storage Spaces Direct (S2D)

Hyper-Converged

One cluster for compute and storage. The hyper-converged deployment option runs Hyper-V virtual machines or SQL Server databases directly on the servers providing the storage, storing their files on the local volumes. This eliminates the need to configure file server access and permissions, and reduces hardware costs for small-to-medium business or remote office/branch office deployments. See [Hyper-converged solution using Storage Spaces Direct](#).

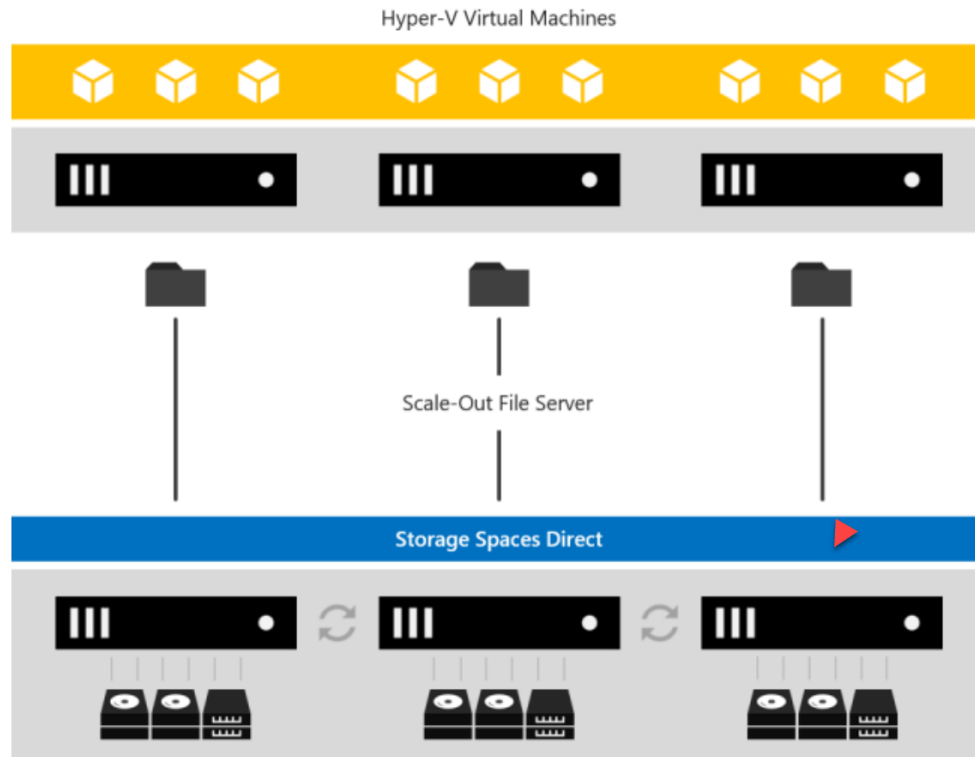


Quelle: <https://technet.microsoft.com/en-us/windows-server-docs/storage/storage-spaces/storage-spaces-direct-overview>

Storage Spaces Direct (S2D)

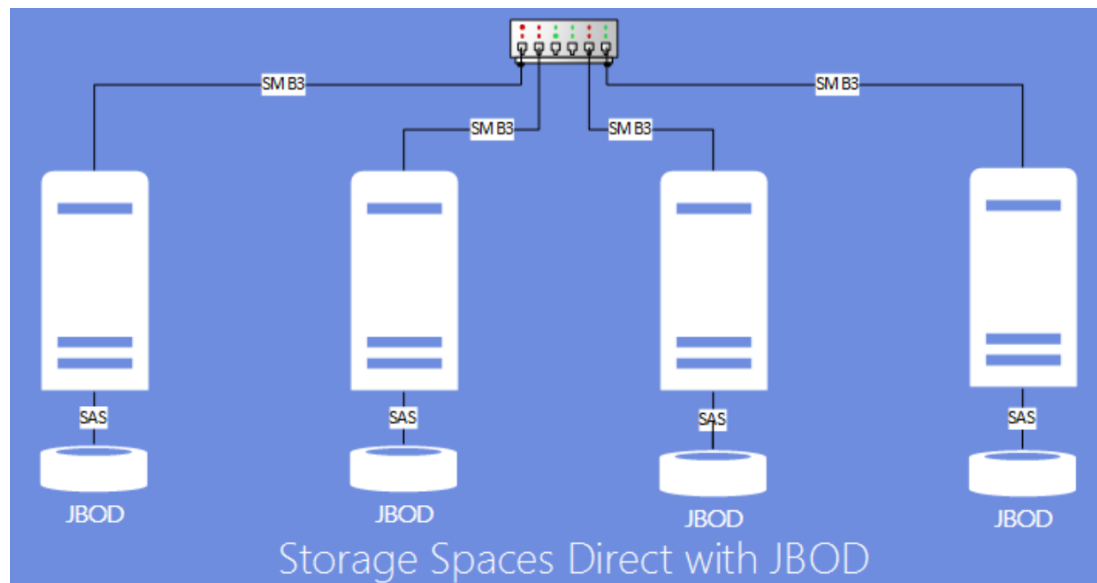
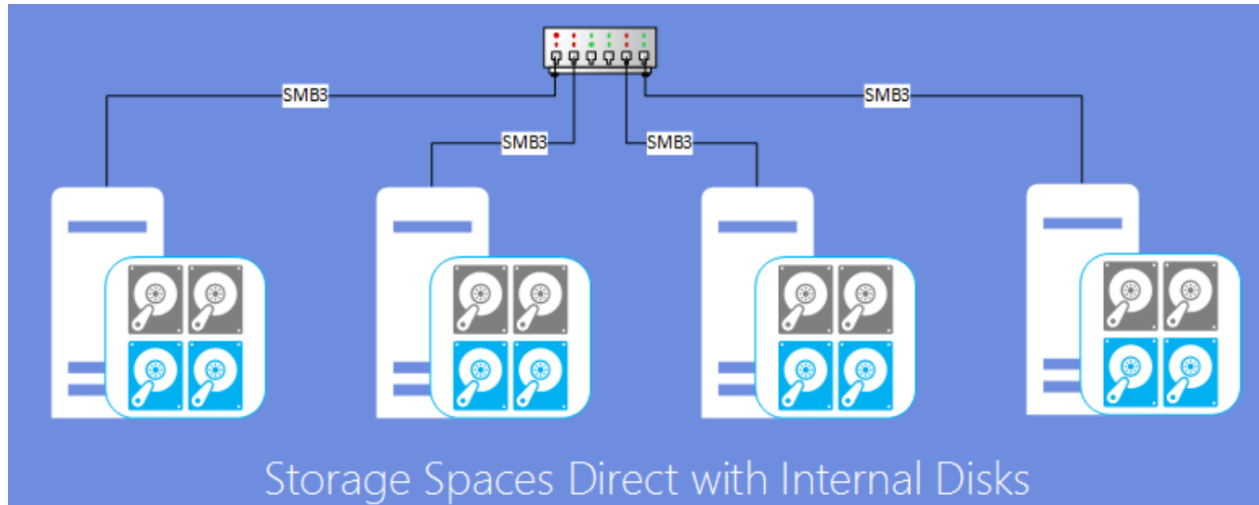
Converged

Storage and compute in separate clusters. The converged deployment option, also known as 'disaggregated', layers a Scale-out File Server (SoFS) atop Storage Spaces Direct to provide network-attached storage over SMB3 file shares. This allows for scaling compute/workload independently from the storage cluster, essential for larger-scale deployments such as Hyper-V IaaS (Infrastructure as a Service) for service providers and enterprises.



Quelle: <https://technet.microsoft.com/en-us/windows-server-docs/storage/storage-spaces/storage-spaces-direct-overview>

Storage Spaces Direct



S2D Systemanforderungen

- 2-16 Server (ideal) vom gleichen Modell und Hersteller
- Intel Nehalem Prozessor oder aktueller
- 4 GB RAM fuer 1 TB Diskspeicher als Cache
- 10 Gbit/s NIC fuer Cluster Kommunikation
- NIC Teaming empfohlen
- RDMA, iWARP oder RoCE faehig
- Alle Server gleiche HD (Typen, Groesse, Firmware)
- Maximum 1 PB RAW Kapazitaet pro Storage Pool
- SAS HBA (SAS/SATA), SES (SAS/SATA)

S2D Ausfallsicherheit

Two-way mirror

Two-way mirroring writes two copies of everything. Its storage efficiency is 50% – to write 1 TB of data, you need at least 2 TB of physical storage capacity. Likewise, you need at least two [hardware 'fault domains'](#) – with Storage Spaces Direct, that means two servers.



⚡ Warning

If you have more than two servers, we recommend using three-way mirroring instead.

Demo

S2D Ausfallsicherheit

Three-way mirror

Three-way mirroring writes three copies of everything. Its storage efficiency is 33.3% – to write 1 TB of data, you need at least 3 TB of physical storage capacity. Likewise, you need at least three hardware fault domains – with Storage Spaces Direct, that means three servers.

Three-way mirroring can safely tolerate at least [two hardware problems \(drive or server\) at a time](#). For example, if you're rebooting one server when suddenly another drive or server fails, all data remains safe and continuously accessible.



S2D Ausfallsicherheit

Single parity

Single parity keeps only one bitwise parity symbol, which provides fault tolerance against only one failure at a time. It most closely resembles RAID-5. To use single parity, you need at least three hardware fault domains – with Storage Spaces Direct, that means three servers. Because three-way mirroring provides more fault tolerance at the same scale, we discourage using single parity. But, it's there if you insist on using it, and it is fully supported.

Warning

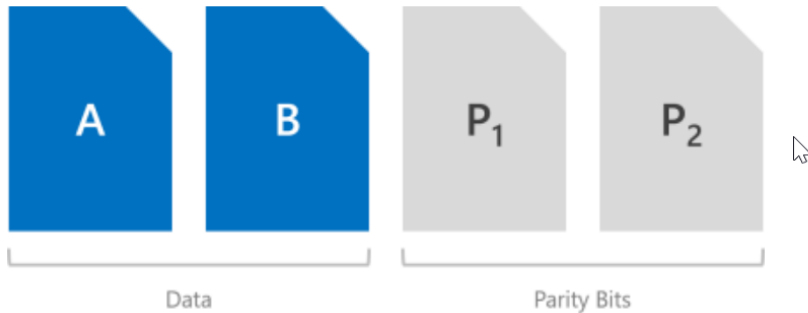
We discourage using single parity because it can only safely tolerate one hardware failure at a time: if you're rebooting one server when suddenly another drive or server fails, you will experience downtime. If you only have three servers, we recommend using three-way mirroring. If you have four or more, see the next section.



S2D Ausfallsicherheit

Dual parity

Dual parity implements Reed-Solomon error-correcting codes to keep two bitwise parity symbols, thereby providing the same fault tolerance as three-way mirroring (i.e. up to two failures at once), but with better storage efficiency. It most closely resembles RAID-6. To use dual parity, you need at least four hardware fault domains – with Storage Spaces Direct, that means four servers. At that scale, the storage efficiency is 50% – to store 2 TB of data, you need 4 TB of physical storage capacity.



The storage efficiency of dual parity increases the more hardware fault domains you have, from 50% up to 80%. For example, at seven (with Storage Spaces Direct, that means seven servers) the efficiency jumps to 66.7% – to store 4 TB of data, you need just 6 TB of physical storage capacity.



S2D Ausfallsicherheit

Resiliency types

Resiliency	Failure tolerance	Storage efficiency
Two-way mirror	1	50.0%
Three-way mirror	2	33.3%
Dual parity	2	50.0% - 80.0%
Mixed	2	33.3% - 80.0%

Minimum scale requirements

Resiliency	Minimum required fault domains
Two-way mirror	2
Three-way mirror	3
Dual parity	4
Mixed	4

Storages Spaces Direct Einrichtung

- Test-Cluster -Node S2D-NODE1.DOMAIN.TLD, S2D-NODE1.DOMAIN.TLD -Include "Storage Spaces Direct", Inventar, netzwerk, "Systemkonfiguration"
- New-Cluster -Name S2D-Netzweise -Node S2D-NODE1.DOMAIN.TLD, S2D-NODE2.DOMAIN.TLD - NoStorage -StaticAddress 192.168.16.100
- Set-ClusterQuorum -NodeAndFileShareMajority "\\FS1.DOMAIN.TLD\S2D-Witness"

Storage Spaces Direct Einrichtung

- S2D aktivieren ohne Autokonfiguration (in VM!)
- `Enable-ClusterStorageSpacesDirect -PoolFriendlyName S2D-Netzweise -CacheState Disabled -SkipEligibilityChecks -Autoconfig:0`
- `New-StoragePool -StorageSubSystemFriendlyName *Cluster* -FriendlyName S2D-Netzweise -ProvisioningTypeDefault Fixed -PhysicalDisk (Get-PhysicalDisk | ? CanPool -eq $true)`
- `Get-StorageSubsystem *cluster* | Get-PhysicalDisk | Where MediaType -eq "Unspecified" | Set-PhysicalDisk -MediaType HDD`
- `Get-PhysicalDisk | where {$_.size -lt 100000000000} | Set-PhysicalDisk -MediaType SSD`

Storage Spaces Direct Einrichtung

- `New-StorageTier -StoragePoolFriendlyName S2D-Netzweise -MediaType SSD -FriendlyName Performance -Verbose`
- `New-StorageTier -StoragePoolFriendlyName S2D-Netzweise -MediaType HDD -FriendlyName Capacity -Verbose`
- `1..3 | foreach {New-Volume -Size 40GB -FriendlyName "Volume $_" -FileSystem CSVFS_ReFS -StoragePoolFriendlyName S2D-Netzweise}`
- `Get-PhysicalDisk -HealthStatus <Healthy,Warning,Unhealthy,Unknown> | Get-PhysicalDiskStorageNodeView | ft disknumber, storagenodeobj*`

Storages Spaces Direct mit VMM

- VMM kann einen neuen S2D Cluster erstellen oder bestehende S2D Cluster verwalten
- Windows Server 2016 Datacenter erforderlich
- OS und Netzwerke konfigurieren
- Hosts unter VMM-Verwaltung bringen (Hyper-V Rolle und VMM-Agent werden installiert)
- S2D auf mit Baremetal Deployment erstellten Hosts und Nano Server (derzeit) nicht möglich
- Zuweisung von nur einer Storage-Klassifizierung zum Storagepool

Storage Spaces Direct mit VMM

- Dateiserver Rolle und Failover Clustering Feature werden installiert
- Storage Replica und Data Deduplication wird aktiviert
- Cluster Validierung wird durchgeführt
- Storage Spaces Direct werden aktiviert und ein Storage Pool angelegt
- Virtual Disk und Cluster Shared Volume (CSV) muss anschliessend angelegt werden
- Für ein PoC in einer Nested Virtualization sind zusätzliche Schritte erforderlich bzw. Nacharbeiten

Demo

Administration eines S2D Clusters

- Festplatten hinzufuegen
- Ggfs. Festplatten Konfiguration festlegen
- Storage Pool erstellen
- CSV erstellen
- S2D-Verwaltung mit Failover Cluster
Konsole, PowerShell und Server Manager

Demo

Storage-Erweiterung des S2D Cluster

- <http://cosmosdarwin.com/Show-PrettyVolume.ps1>
- Festplatten hinzufuegen
- `Get-StorageSubsystem *Cluster* | get-StorageHealthReport`
- Festplatten werden automatisch zum Pool hinzugefuegt, wenn nur ein Pool existiert
- Bei mehreren Pools PowerShell – `AddPhysicalDisk` verwenden

Storage-Erweiterung des S2D Cluster

- `Get-StorageTierSupportedSize -FriendlyName CSV-01_Capacity -ResiliencySettingName Mirror |ft @{{L="Tiersizemax(GB)";e={$_.tiersizemax/1GB}}}`
- `Get-VirtualDisk -Friendlyname "csv-01" | Get-StorageTier | FT Friendlyname, @{{Name="Size in GB";Expression={($_.AllocatedSize/1gb)}}}`
- `Get-VirtualDisk "CSV-01" | Get-StorageTier | ? Friendlyname -eq "CSV-01_Capacity" | Resize-StorageTier -Size 10GB`

Demo

S2D Troubleshooting

- Datentraeger pruefen
 - <http://cosmosdarwin.com/Show-PrettyVolume.ps1>
 - Server Manager
 - Failover Cluster Verwaltungskonsole
- Failover Cluster Verwaltungskonsole
- Failover Cluster Validation Test
- Failover Cluster Ereignisanzeige

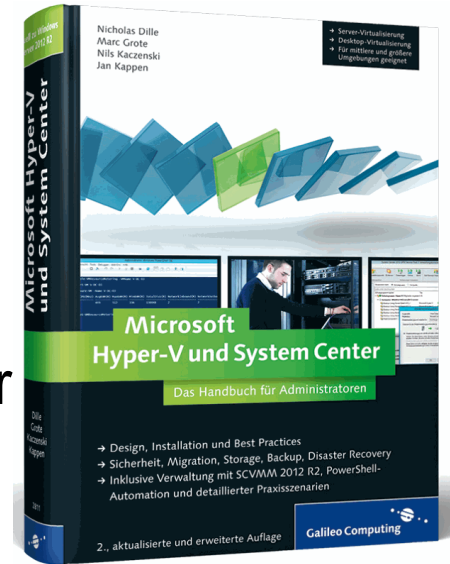
Demo

Fragen?

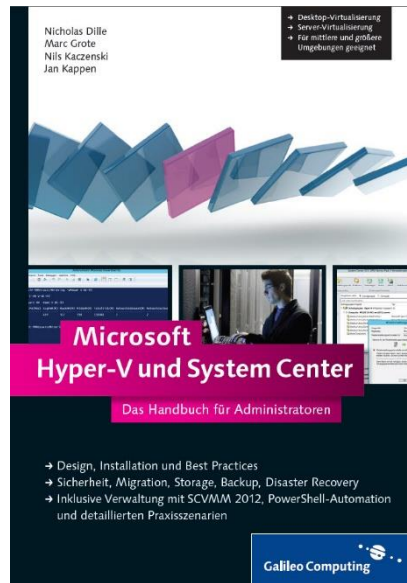
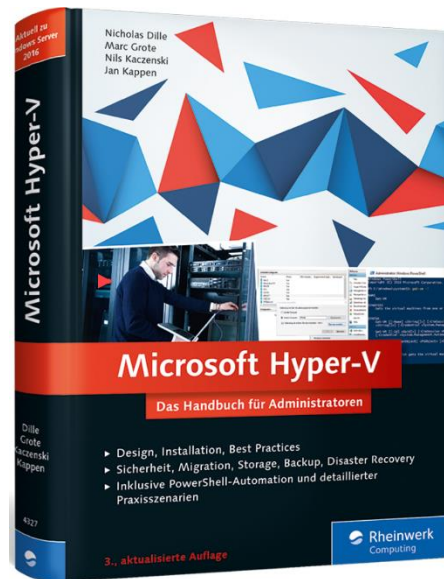
The image features the word "Fragen?" in a bold, sans-serif font. The word "Fragen" is rendered in a bright orange color, while the question mark is a medium blue. To the right of the text, there is a large, stylized blue question mark icon. This icon is composed of several overlapping, semi-transparent shapes in different shades of blue, creating a layered, 3D effect. The entire graphic is set against a plain white background.

Die Buecher

Hyper-V und System Center 2012 R2



Hyper-V 2016



Hyper-V und System Center 2012

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