A Principled Technologies report: Hands-on testing. Real-world results.



Upgrading to Windows Server 2019 on Dell EMC PowerEdge servers: A simple process that can dramatically reduce your storage footprint

Using Dell EMC PowerEdge R740xd servers with Intel Xeon Scalable processors, we upgraded from Windows Server 2016 and saw data compression ratios of up to 9.8:1 thanks to new Storage Spaces Direct features

Some IT admins who manage Dell EMC[™] PowerEdge[™] R740xd servers with Intel[®] Xeon[®] Scalable processors in a Microsoft[®] Storage Spaces Direct environment are considering upgrading to the Microsoft Windows Server[®] 2019 operating system. The potential space savings from storage deduplication could lead to consolidation and cost savings.

In the Principled Technologies data center, we performed hands-on testing to measure the benefit of performing this upgrade—a reduced storage footprint resulting from the deduplication features in the Windows Server 2019 version of Storage Spaces Direct. To quantify the amount of work required to get this benefit, we also noted the time and steps necessary to carry out the upgrade.

In this combination test report and migration guide, we show what we learned: The new OS let the server store data in dramatically less space, and the upgrade process was simple and quick. Together, these findings suggest that upgrading to Windows Server 2019 would yield proven results.



Save by storing data in less space

Deduplication enabled compression ratios up to

- 9.8:1 in a virtual desktop infrastructure environment
- 2.4:1 on a file server



Upgrading is a simple process

- Only 25 steps to upgrade
- Took less than 3 hours

Our test environment

The figure below illustrates the components of the test environment we used to explore the data storage space savings that Windows Server 2019 makes possible on the Dell EMC PowerEdge R740xd in an Storage Spaces Direct environment.



Upgrading to Windows Server 2019 improved storage utilization through deduplication

Like any data center resource, storage capacity is something you strive to use efficiently. Deduplication technologies work by identifying files—or parts of files—that occur multiple times across your company's environment. Once they find these duplicate chunks of data, they store a single copy of each. By eliminating unnecessary copies, these technologies let you store the equivalent of a much larger volume of data on your hardware. The effective cost per GB of data decreases, and you can save by delaying future storage investments even as your company grows.

Windows Server 2019 supports deduplication on Storage Spaces Direct ReFS volumes. When enabling deduplication for your volume, you can choose from three built-in modes that reflect the types of data that are typically prime candidates for deduplication:

- General purpose
- Virtual desktop infrastructure (VDI)
- Virtualized backup

The general purpose mode is suited well to file servers, which frequently contain multiple copies of the same chunks of data. Deduplicating these files is an easy way to save space. Similarly, VDI environments typically host many VMs that are nearly identical. When it comes to daily backups, changes from the previous day are often minimal. Rather than storing a completely new version each time you make a change, deduplication is a way to essentially save only the changes.

To measure the potential benefits of the deduplication capabilities of Storage Spaces Direct, we conducted hands-on testing of all three modes. If you're unsure which mode is best for your workload, Microsoft recommends sticking with the default general-purpose mode.² Note that when you enable deduplication, you also enable compression, which would also contribute to space savings.

Microsoft Storage Spaces Direct, now part of Microsoft Azure Stack HCI

According to Microsoft, "Azure Stack HCI is a hyper-converged Windows Server 2019 cluster that uses validated hardware to run virtualized workloads on-premises."¹ Azure Stack HCI includes the following technologies: Hyper-V, Storage Spaces Direct, Software Defined Networking, and Failover Clustering. Learn more at https:// docs.microsoft.com/en-us/azure-stack/ operator/azure-stack-hci-overview.

About Dell EMC PowerEdge R740xd servers

The 2U Dell EMC PowerEdge R740xd is powered by Intel® Xeon® Scalable processors. It includes the iDRAC9 management tool, SupportAssist for proactive customer support, and an out-of-band management architecture. Learn more at https://www.dell.com/en-us/ work/shop/povw/poweredge-r740xd.

General purpose mode for file servers

For this test, we set up virtual machines and populated them two ways: first with ISO image files and then with a mix of Microsoft Office files—Word, Excel, and PowerPoint. We set the server to run deduplication using the general-purpose mode. As we illustrate below, in both scenarios, deduplication caused storage requirements to shrink dramatically. The ISO image files used less than half the space and the Microsoft Office files used just over half the space.

ISO image files



Size before deduplication: **764 GB** Size after deduplication: **312 GB**

Microsoft Office files



Size before deduplication: **304 GB** Size after deduplication: **158 GB** Deduplication ratio: **2.4:1** Storage requirements decreased by **59.2%**

Deduplication ratio: **1.9:1** Storage requirements decreased by **48.2%**

About the Intel Xeon Scalable processor family

The Dell EMC PowerEdge R740xd features the Intel Xeon Scalable processor platform, which provide high per-core performance, up to 48 lanes of PCIe 3.0 bandwidth, and Intel Ultra Path Interconnect (Intel UPO) channels to increase scalability. In this study, we tested the Intel Xeon Gold 6130 processor, which offers 16 cores, 32 threads, and 22MB L3 cache. To learn more, visit: https://www.intel.com/content/dam/ www/public/us/en/documents/product-briefs/ xeon-scalable-platform-brief.pdf.

About Dell EMC Microsoft Storage Spaces Direct Ready Nodes

Dell EMC has another offering that can further simplify your Microsoft Storage Spaces Direct environment. According to Dell EMC, Microsoft Storage Spaces Direct Ready Nodes are preconfigured to provide the storage density and compute power necessary to meet the demands of a dynamic enterprise environment.³

Virtual desktop infrastructure

For this test, we used the Vdbench storage benchmarking tool, which allows you to create a data set that is compressible to a specific compression/deduplication ratio. We experimented with different block sizes and compression/deduplication ratios. We include complete results in the science behind the report, but below we show the test conditions that yielded the highest compression ratio. The deduplication capabilities you'd get by upgrading to the new OS would let you store your virtual desktop data using less than one-eighth the amount of your server's capacity. It's easy to see how this would be beneficial—you could add many new VDI users before needing to invest in more gear.



Virtualized backup

For this test, we again used the Vdbench test tool, but instead of a VDI use case, we used a scenario that simulates the kind of backups that many companies regularly perform. As in the VDI scenario, we experimented with different block sizes and compression/deduplication ratios and show the combination that produced the highest compression ratio.

As we see, deduplication would allow a company that upgraded to Windows Server 2019 to store their backup data using less than one-ninth the amount of storage space.



Upgrading from Windows Server 2016 to Windows Server 2019: A straightforward process

In this section, we provide the steps we took to perform an in-place upgrade while VMs were running. We include some screenshots to give you a sense of the graphical user interface. In the science behind the report, we provide all screenshots.

Note: It took our technician 2 hours and 46 minutes to perform this process.

- 1. Check that the servers are running version 14393.2828 or newer of Windows Server 2016.
- 2. If you're using a SET software-defined networking switch, run the following command in an elevated PowerShell session:

```
Get-ClusterResourceType -Cluster {clusterName} -Name "Virtual Machine" |
Set-ClusterParameter -Create SkipMigrationDestinationCheck -Value 1
```

- 3. Use Hyper-V VM live migration to move the running VM from the server:
 - a. Right-click the VM you wish to migrate, and select Move.



b. At the splash screen, click Next.

c. Select Move the virtual machine, and click Next.

Move "vdbench" Wizard		×
Choose Move	е Туре	
Before You Begin	What type of move do you want to perform?	
Choose Move Type	Move the virtual machine	
Specify Destination	Move the virtual machine and, optionally, its storage to another computer running Hyper-V.	
Choose Move Options	O Move the virtual machine's storage	
Summary	Move only the virtual machine's storage to another location, either on this server or on shared storage.	
	< Previous Next > Finish Cancel	

d. Specify a name for the destination server, and click Next.

Move "vdbench" Wizard		×
Specify Destin	nation Computer	
Before You Begin	Specify the name of the destination computer.	
Choose Move Type	Name: WS16-S2D-Node02	Browse
Specify Destination		
Choose Move Options		
Summary		
Contract y		
	< Previous Next > Finish	Cancel

e. Select Move only the virtual machine, and click Next.

Move "vdbench" Wizard	×
Choose Mo	ve Options
Before You Begin Choose Move Type Specify Destination Choose Move Options Summary	 What do you want to do with the virtual machine's items? Move the virtual machine's data to a single location. This option allows you to specify one location for all of the virtual machine's items. Move the virtual machine's data by selecting where to move the items. This option allows you to select the location of each item to be moved. Move only the virtual machine This option allows you to move the virtual machine without moving its virtual hard disks. The virtual machine's virtual hard disks must be on shared storage.
	< Previous Next > Finish Cancel

f. Review the move details, and click Finish.

Move "vdbench" Wizard		×
	Move Wizard	
Before You Begin Choose Move Type Specify Destination Choose Move Options Summary	You are about to perform the following operation. Description: Virtual machine: vdbench Move type: Virtual Machine Destination computer: WS16-S2D-Node02 Move method: SMB	
	< Previous Next > Finish Cancel	

4. Pause the cluster service by running the following PowerShell command: Suspend-ClusterNode -Drain

- 5. Place the server in storage maintenance mode by running the following PowerShell command: Get-StorageFaultDomain -type StorageScaleUnit | Where FriendlyName -Eq <ServerName> | Enable-StorageMaintenanceMode
- 6. To make sure all of the disks are in maintenance mode, run the following command: Get-PhysicalDisk
- 7. Double-click a Windows Server 2019 ISO to mount the image.
- 8. Change directories to the Windows Server 2019 mounted volume.
- 9. Run setup.exe.
- 10. On the Windows Server 2019 Setup screen, select Download updates, drivers and optional features (recommended), and click Next.
- 11. Enter the product key, and click Next.
- 12. Select Windows Server 2019 Datacenter (Desktop Experience), and click Next.
- 13. On the EULA screen, click Accept.
- 14. Select Keep personal files and apps, and click Next.
- 15. Click Install.
- 16. After the install has finished, log into the host.
- 17. Open an elevated PowerShell session.
- 18. To remove the node from storage maintenance mode, run the following command:

```
Get-StorageFaultDomain -type StorageScaleUnit | Where FriendlyName -Eq
<ServerName> | Disable-StorageMaintenanceMode
```

19. To resume the cluster service, run the following PowerShell command:

Resume-ClusterNode

- 20. Wait for the storage jobs to finish before moving to the next server in the cluster.
- 21. To check the state of the storage repair, run the following commands:

```
Get-StorageJob
Get-VirtualDisk
```

- 22. Once the storage job is complete and all virtual disks are returned to a healthy state, repeat steps 3 through 21 on the remaining nodes in the cluster.
- 23. To update the cluster functional level, run the following PowerShell command: Update-ClusterFunctionalLevel
- 24. To update the storage pool, run the following PowerShell command:

Get-StoragePool -FriendlyName S2D* | Update-StoragePool

25. To set the live migration check back, run the following PowerShell command:

```
Get-ClusterResourceType -Cluster {clusterName} -Name "Virtual Machine" |
Set-ClusterParameter SkipMigrationDestinationCheck -Value 0
```

Live migrating a VM to the newly created volume

In this section, we provide the steps we took to live migrate a VM to the newly created volume. We include some screenshots to give you a sense of the graphical user interface. In the science behind the report, we provide all screenshots.

Note: It took our technician 1 hour and 34 minutes to perform this process.

- 1. Open the Hyper-V Manager GUI.
- 2. Right-click the VM, and select Move.

Hyper-V Manager							- 1	x c		
File Action View Help										
🗢 🏟 🖄 🗊 🚺 🖬										
Hyper-V Manager	Virtual Machiner						Actions			
S2D-NODE01	Alarma A	Charles .	CDUUM		Unting	Chatan	S2D-NODE01	· ^		
S2D-NODE02	Name	State	CPU Usage	e Assigned Memory	00.00.27	Status	New	•		
S2D-NODE04	vdbench05	Connect		32768 MB	00:06:34		强 Import Virtual Machine			
		Settings				Hyper-V Settings				
		Turn Off					Virtual Switch Manager			
		Shut Down					🔜 Virtual SAN Manager			
		Save					Edit Disk			
	<	Pause				>	Inspect Disk			
	Checkpoints	Reset				۲	Stop Service			
		Checkpoint	Im	achine has no checkpoints			X Remove Server			
		Спескроппс					C) Refresh			
		Move					View			
		Export					Help			
		Kename					- Hep			
		Enable Replication					vdbench01	•		
		Help					Connect			
	vdbench01						Settings			
	af the same same						Turn Off			
		Created: 7/4	4/2019 10:11	1:10 PM C	ustered: No		Shut Down			
		Configuration Version: 8.0		н	eartbeat: OK (No	Application Data)	O Save			
		Generation: 2 Notes: No					II Pause			
		10000					IÞ Reset			
				B Checkpoint						
	A Marrie	Networking Declarities					- Move			
	Summary Memory	Networking Replication					Export	~		
Move a virtual machine or its stora	ige.									

3. Click Next.

Hyper-V Manager									
File Action View Help									
🗢 🤿 🙍 📰 🚺 📷									
Hyper-V Manager							Actions		
S2D-NODE01	Virtual Machines	1			La la		S2D-NODE01		^
S2D-NODE02	Name	State	CPU Usage	Assigned Memory	Uptime	Status	N	•	
S2D-NODE04	vdbench01 Mov	e "vdbench01" Wi	zard				×	hine	
		Before Yo	ou Begin					ager	
								jer	
	Before Y	ou Begin	This wizar	d helps you move a virtu	I machine to a diff	erent computer, or n	ove virtual machine storage		
	Choose M	Choose Move Type from one location to another location.							
	Checkpoints Specify D	estination							
	Choose M	love Options							
	Summary								
									•
									-
	vdbench01								
		Do not show this page again							
								-	
					< Previous	Next >	Finish Cancel		
	Summary Memory retwo	nong nepicauon					B Ernert	_	~
	1						I toport		•

4. Select Move the virtual machine's storage, and click Next.

Hyper-V Manager							12	
File Action View Help								
Prove V Manager Prove V Manager Stan NODER1 Stan NODER2 Stan NODER3 Stan NODER3	Virtual Machines Name Stat vdench05 vdench05 Checkpoints vdbench01	e CPU Usage ch01" Wizard coose Move Type what typ move move store	Assigned Memory e of move do you want to the virtual machine and, the virtual machine's stor only the virtual machine's pe,	Uptime perform? optionally, its storage spe storage to another ic	Status to another computer in sociation, either on this s	Actions S2D-NODE01 M	hine	•
	C			< Previous	Next > Fine	Cancel		
	Summary memory networking n	Children I				Export		~

5. Select Move all of the virtual machine's data to a single location, and click Next.

Itual Machines Iame volench01 volench05 heckpoints dbench01		er-Y Manager Ction View Help 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---	--	--

6. Browse to the location of the newly created volume, and click Next.

Hyper-V Manager							- 0	×	
File Action View Help									
🗢 🔿 🖄 📷 🖬									
Hyper-V Manager S2D-NODE01	Virtual Machines	Actions S2D-NODE01							
S2D-NODE03	vdbench01 Move	Status Choose > neur location fax victual machine							
						ler.			
	< Checkpoints Checkpoints Summary vdbench01	J Begin Specific ove Type New Sve Options Fol Drive Curn Sat	y a location for the virtual ma location er: style test able space: 4,97 T8 ent location : 1.02 T8	ext 2	Browse		,		
	Summary Memory recovery	ing mepication							
						Export		~	

7. Review the move summary, and click Finish.

Hyper-V Manager								_	
File Action View Help									
🗢 🤿 🙇 📰 📓 🛅									
Hyper-V Manager							Actions		
S2D-NODE01	Virtual Machines	1.4	1	Taran dar		1.0	S2D-NODE01		<u>^</u>
S2D-NODE02	Name	State	CPU Usage	Assigned Memory	Uptime	Status	New		•
S2D-NODE04	vdbench01	Move "vdbench01" W	lizard					× hine	
		Complet	ing Move Wiza	rd				ager	
								jer	
	Befo	re You Begin	You are a	out to perform the followi	no operation.				
	< Choi	ose Move Type	Descriptio	n:					
	Checkpoints Chor	ose Move Options	Victual m	arhina:	udh	ench01			
	Virtu	ial Machine	Move ty	pe:	Virt	ual Machine Storage			
	Sum	mary	Item to a	nove:	New Orker	v location	Nich al Hard Dieke		
			Attache	d virtual hard disk SCSI Co	ntroller C: K	ClusterStorage \Volume	Virtual Hard Disks		•
			Current	configuration	C:K	ClusterStorage \Volume	91		
		Smart Paging C: (ClusterStorage (Volume9)							
	vdbench01		To comple						
								-	
					< Previous	Next >	Finish Cancel		
	Summary Memory IV	etworking mepiication					Export		~
							1.44		

Even though it's very easy to upgrade, help is available!

Customers who prefer not to do their own upgrades have the option of using the Dell Technologies Windows Server 2019 Custom Upgrade Service. According to Dell Technologies, "For Dell EMC customers who are interested in upgrading their S2D Ready Nodes from Windows Server 2016 datacenter edition to 2019 datacenter edition and looking for assistance, Dell EMC is proud to offer the industry's first tested, validated, and globally available Upgrade Service. This service will be a custom offering as there are many variable details which must be considered when planning and executing a successful upgrade."⁴

Learn more at https://downloads.dell.com/manuals/common/microsoft-storage-ready-node-r640_ referenceguide_en-us.pdf.

Conclusion

Dell EMC Power R740xd servers with Intel Xeon Scalable processors and Microsoft Storage Spaces Direct offer customers an optimized platform that can lower costs with software-defined storage. We upgraded to Windows Server 2019 to evaluate the gains in storage savings using deduplication and compression. Our tests show data duplication and compression ratios ranging from 1.9:1 to 9.8:1, which for many customers could lead to the following benefits:

- Being able to store more data on existing storage
- Being able to delay the investment in additional storage

Upgrading to Windows Server 2019, was a quick and simple process that we were able to execute in less than 3 hours. Between the space savings made possible by deduplication and the simplicity of performing the upgrade, customers have much to gain by moving their Storage Spaces Direct environments to the new OS.

Learn more about Dell EMC PowerEdge R740xd servers at https://www.dell.com/en-us/work/shop/povw/ poweredge-r740xd.

- 1 "Azure Stack HCI overview," accessed July 23, 2019, https://docs.microsoft.com/en-us/azure-stack/operator/azure-stack-hci-overview
- 2 "Creating volumes in Storage Spaces Direct," accessed July 25, 2019, https://docs.microsoft.com/en-us/windows-server/ storage/storage-spaces/create-volumes
- 3 "Dell EMC Microsoft Storage Spaces Direct Ready Nodes Solution overview," accessed August 6, 2019, https://www. dell.com/learn/us/en/04/shared-content~data-sheets~en/documents~microsoft-storage-spaces-direct-ready-nodessolution-overview-en.pdf.
- 4 "Storage Spaces Direct Ready Nodes Upgrade Guidance from Windows Server 2016 to 2019," accessed July 23, 2019, https://downloads.dell.com/manuals/ common/microsoft-storage-ready-node-r640_ referenceguide_en-us.pdf

Read the science behind this report at http://facts.pt/u6gzkdr ►





Principled Technologies is a registered trademark of Principled Technologies, Inc. All other product names are the trademarks of their respective owners. For additional information, review the science behind this report.

This project was commissioned by Dell Technologies.