This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report Upgrading to Windows Server 2019 on Dell EMC PowerEdge servers: A simple process that can dramatically reduce your storage footprint.

We concluded our hands-on testing on July 9, 2019. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on July 7, 2019 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.
Our results

Deduplication testing

<table>
<thead>
<tr>
<th>Vdbench generation settings</th>
<th>Space used before deduplication (GB)</th>
<th>Space used after deduplication (GB)</th>
<th>Compression ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compression/deduplication ratio</td>
<td>Block size</td>
<td></td>
</tr>
<tr>
<td>File server 1 (ISO files)</td>
<td>N/A</td>
<td>N/A</td>
<td>764</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>312</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.4:1</td>
</tr>
<tr>
<td>File server 2 (Microsoft Office files)</td>
<td>N/A</td>
<td>N/A</td>
<td>304</td>
</tr>
<tr>
<td>VDI 1</td>
<td>2:1</td>
<td>8</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>273</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.8:1</td>
</tr>
<tr>
<td>VDI 2</td>
<td>4:1</td>
<td>16</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>121</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.6:1</td>
</tr>
<tr>
<td>Virtualized backup 1</td>
<td>4:1</td>
<td>4</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>119</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.8:1</td>
</tr>
<tr>
<td>Virtualized backup 2</td>
<td>2:1</td>
<td>4</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.5:1</td>
</tr>
<tr>
<td>Virtualized backup 3</td>
<td>4:1</td>
<td>64</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.8:1</td>
</tr>
<tr>
<td>Virtualized backup 4</td>
<td>2:1</td>
<td>64</td>
<td>1,044</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>279</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.7:1</td>
</tr>
</tbody>
</table>

Upgrade and live migration processes

<table>
<thead>
<tr>
<th>Number of steps</th>
<th>Time to complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrading from Microsoft® Windows Server® 2016 to Windows Server 2019</td>
<td>25</td>
</tr>
<tr>
<td>Live migrating a VM to the newly created volume</td>
<td>7</td>
</tr>
</tbody>
</table>
System configuration information

The table below presents detailed information on the systems we tested.

<table>
<thead>
<tr>
<th>Server configuration information</th>
<th>Dell EMC™ PowerEdge™ R740xd</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS name and version</td>
<td>Dell 2.1.7</td>
</tr>
<tr>
<td>Operating system 1</td>
<td></td>
</tr>
<tr>
<td>Operating system name and version/build number</td>
<td>Windows Server 2016</td>
</tr>
<tr>
<td>Date of last OS updates/patches applied</td>
<td>6/29/2019</td>
</tr>
<tr>
<td>Power management policy</td>
<td>Custom</td>
</tr>
<tr>
<td>Operating system 2</td>
<td></td>
</tr>
<tr>
<td>Operating system name and version/build number</td>
<td>Windows Server 2019</td>
</tr>
<tr>
<td>Date of last OS updates/patches applied</td>
<td>7/5/2019</td>
</tr>
<tr>
<td>Power management policy</td>
<td>Custom</td>
</tr>
<tr>
<td>Processor</td>
<td></td>
</tr>
<tr>
<td>Number of processors</td>
<td>2</td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Intel® Xeon® Gold 6130</td>
</tr>
<tr>
<td>Core count (per processor)</td>
<td>16</td>
</tr>
<tr>
<td>Core frequency (GHz)</td>
<td>2.10</td>
</tr>
<tr>
<td>Stepping</td>
<td>4</td>
</tr>
<tr>
<td>Memory module(s)</td>
<td></td>
</tr>
<tr>
<td>Total memory in system (GB)</td>
<td>192</td>
</tr>
<tr>
<td>Number of memory modules</td>
<td>12</td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Hynix® HMA82GR7AFR8N-VK</td>
</tr>
<tr>
<td>Size (GB)</td>
<td>16</td>
</tr>
<tr>
<td>Type</td>
<td>PC4-2666</td>
</tr>
<tr>
<td>Speed (MHz)</td>
<td>2,666</td>
</tr>
<tr>
<td>Speed running in the server (MHz)</td>
<td>2,666</td>
</tr>
<tr>
<td>Storage controller</td>
<td></td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Dell HBA 330 Mini</td>
</tr>
<tr>
<td>Cache size (GB)</td>
<td>0 MB</td>
</tr>
<tr>
<td>Firmware version</td>
<td>16.17.00.03</td>
</tr>
<tr>
<td>Local storage 1</td>
<td></td>
</tr>
<tr>
<td>Number of drives</td>
<td>2</td>
</tr>
<tr>
<td>Drive vendor and model</td>
<td>Intel SSDSCKJB240G7R</td>
</tr>
<tr>
<td>Drive size (GB)</td>
<td>240</td>
</tr>
<tr>
<td>Drive information</td>
<td>m.2 SSD</td>
</tr>
<tr>
<td>Server configuration information</td>
<td>Dell EMC™ PowerEdge™ R740xd</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>Local storage 2</strong></td>
<td></td>
</tr>
<tr>
<td>Number of drives</td>
<td>4</td>
</tr>
<tr>
<td>Drive vendor and model</td>
<td>Toshiba® THNSF8800CCSE</td>
</tr>
<tr>
<td>Drive size (GB)</td>
<td>800</td>
</tr>
<tr>
<td>Drive information (speed, interface, type)</td>
<td>6 Gb/s, SATA, SSD</td>
</tr>
<tr>
<td><strong>Local storage 3</strong></td>
<td></td>
</tr>
<tr>
<td>Number of drives</td>
<td>8</td>
</tr>
<tr>
<td>Drive vendor and model</td>
<td>Toshiba MG04ACA4</td>
</tr>
<tr>
<td>Drive size (GB)</td>
<td>4,096</td>
</tr>
<tr>
<td>Drive information (speed, interface, type)</td>
<td>6 Gb/s, 7.2K SATA, HDD</td>
</tr>
<tr>
<td><strong>Network adapter</strong></td>
<td></td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Mellanox ConnectX-4 LX 25GbE SFP</td>
</tr>
<tr>
<td>Number and type of ports</td>
<td>2 x 25GbE</td>
</tr>
<tr>
<td>Driver version</td>
<td>14.24.80.00</td>
</tr>
<tr>
<td><strong>Cooling fans</strong></td>
<td></td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Delta PFR0612DHE-C</td>
</tr>
<tr>
<td>Number of cooling fans</td>
<td>6</td>
</tr>
<tr>
<td><strong>Power supplies</strong></td>
<td></td>
</tr>
<tr>
<td>Vendor and model</td>
<td>Dell 05RHVVA00</td>
</tr>
<tr>
<td>Number of power supplies</td>
<td>2</td>
</tr>
<tr>
<td>Wattage of each (W)</td>
<td>750</td>
</tr>
</tbody>
</table>
How we tested

Setting up the Microsoft Windows Server 2016 Storage Spaces Direct (S2D) cluster

Configuring the out-of-band management switch
We used a Dell S3048 1GbE switch for our out-of-band management of the S2D cluster. We configured four ports with the appropriate VLAN for our S2D iDRAC connections. We also configured one port for our Microsoft Active Directory (AD) and S2D management VMs, and another port to connect our OOB switch to the TOR switch. See our switch configuration in the Vdbench configuration files section.

Configuring the top-of-rack switch
We used a Dell S5048 25GbE switch for our cluster networking traffic. We placed all cluster-facing ports into hybrid mode, enabled Data-Center-Bridging, and enabled Priority Flow Control on all ports. See our switch configuration in the Vdbench configuration files section.

Configuring the infrastructure VM
We used Windows Server 2016 VM as our Active Directory and DNS server. On this VM, we added the Active Directory Domain Service and the DNS Server roles, and created a new domain for our test cluster.

Configuring the S2D cluster nodes
We used four Dell EMC PowerEdge R740xd servers for our test cluster. We configured the iDRAC and BIOS on each server to match the pre-deployment checklist provided by Dell EMC in the Ready Node deployment guide. We first installed Windows Server 2016 Datacenter Edition onto a 240GB virtual disk, consisting of two m.2 SSDs in a RAID 1 pair, separate from the drives designated for cluster storage. We then created a SET switch, configured the network adapters with IP addresses, and joined each server to the domain. Finally, we ran the network and storage commands to enable RDMA and Storage Spaces Direct. We chose the manual deployment method, and performed the following steps for each server:

Installing Windows Server 2016
1. Boot the server to the Windows Server 2016 installation media. We used the BMC console virtual media to mount the ISO image and install remotely.
2. At the prompt, press any key to boot from the CD/DVD location.
3. Click Next.
4. Click Install Now.
5. Select Windows Server 2016 Datacenter Edition (Desktop Experience), and click Next.
6. Check I accept the license terms, and click Next.
7. Select the 240GB OS drive, and click Next.
8. After installation, enter a password for Administrator, and click Finish.

Installing server roles and features
1. Open a PowerShell window as the domain administrator and run the following command to install the required roles and features for Storage Spaces Direct:
   Install-WindowsFeature -Name "Data-Center-Bridging","Failover-Clustering","Hyper-V","RSAT-Clustering-PowerShell","Hyper-V-PowerShell","FS-FileServer"

Changing the host name
1. In the open PowerShell window, run the following command to change the hostname and restart the server.
   Rename-Computer -NewName S2D-Node01 -Restart

Configuring the VM switch and adapters
1. Open a PowerShell window as the domain administrator and run the following commands to create and configure the VM switch and adapters:
   New-VMSwitch -Name S2DSwitch -AllowManagementOS $true -NetAdapterName 'SLOT 4 PORT 1','SLOT 4 PORT 2' -MinimumBandwidthMode Weight -Verbose
   Add-VMNetworkAdapter -ManagementOS -Name 'Management' -SwitchName S2DSwitch -Passthru | Set-VMNetworkAdapterVlan -Access -VlanID 100 -Verbose
   Add-VMNetworkAdapter -ManagementOS -Name 'Storage1' -SwitchName S2DSwitch -Passthru | Set-VMNetworkAdapterVlan -Access -VlanID 101 -Verbose
Joining the Active Directory domain

1. Open a PowerShell window as the domain administrator and run the following command to join the Active Directory domain:

   ```powershell
   $credential = Get-Credential
   Add-Computer -DomainName test.local -Credential $credential -Restart
   ```

Configuring the network adapters for RDMA

1. Open a PowerShell window as the domain administrator.
2. To enable RDMA on the virtual adapters, run the following command:

   ```powershell
   Enable-NetAdapterRDMA -Name Storage1, Storage2
   ```

3. To map the virtual adapters to the physical ports, run the following commands:

   ```powershell
   Set-VMNetworkAdapterTeamMapping -VMNetworkAdapterName "Storage1" -ManagementOS -PhysicalNetAdapterName "SLOT 4 PORT 1"
   Set-VMNetworkAdapterTeamMapping -VMNetworkAdapterName "Storage2" -ManagementOS -PhysicalNetAdapterName "SLOT 4 PORT 2"
   ```

4. To enable RDMA for Live Migration Traffic, run the following command:

   ```powershell
   Set-VMHost -VirtualMachineMigrationPerformanceOption SMB
   ```

5. To set a network QoS policy, run the following commands:

   ```powershell
   New-NetQosPolicy "Cluster" -Cluster -PriorityValue8021Action 7
   New-NetQosTrafficClass "Cluster" -Priority 7 -BandwidthPercentage 1 -Algorithm ETS
   New-NetQosPolicy -Name 'SMB' -NetDirectPortMatchCondition 445 -PriorityValue8021Action 3
   New-NetQosTrafficClass -Name 'SMB' -Priority 3 -BandwidthPercentage 50 -Algorithm ETS
   New-NetQosPolicy -Name "Default" -Default -PriorityValue8021Action 0
   Enable-NetQosFlowControl -Priority 3
   Disable-NetQosFlowControl -Priority 0,1,2,4,5,6,7
   Enable-NetAdapterQos -InterfaceAlias 'SLOT 4 PORT 1','SLOT 4 PORT 2'
   Set-NetQosDcbxSetting -Willing $false
   ```

Running the cluster validation tool

1. Open a PowerShell window as the domain administrator.
2. To validate the cluster configuration, run the following command:

   ```powershell
   Test-Cluster -Node S2D-Node01, S2D-Node02, S2D-Node03, S2D-Node04 -Include 'Storage Spaces Direct', 'Inventory', 'Network', 'System Configuration'
   ```

3. Open the cluster validation report, and ensure there are no failures. If there are warnings in the report, verify that they are negligible, or correct the warnings before deployment.
Deploying the S2D cluster
1. Open a PowerShell window as the domain administrator.
2. Run the following command to create a new Storage Spaces Direct cluster without storage (we will add storage later):
   ```powershell
   New-Cluster -Name S2DSystem -Node S2D-Node01, S2D-Node02, S2D-Node03, S2D-Node04 -StaticAddress 192.168.100.6/24 -NoStorage -IgnoreNetwork 192.168.101.0/24, 192.168.102.0/24 -Verbose
   ```

Enabling the S2D cluster
1. Open a PowerShell window as the domain administrator and run the following command:
   ```powershell
   Enable-ClusterStorageSpacesDirect
   ```

Removing the host management network from Live Migration
1. Open a PowerShell window as the domain administrator and run the following commands:
   ```powershell
   $clusterResourceType = Get-ClusterResourceType -Name 'Virtual Machine'
   $hostNetworkID = Get-ClusterNetwork | Where-Object { $_.Address -eq '192.168.100.0' } | Select -ExpandProperty ID
   Set-ClusterParameter -InputObject $clusterResourceType -Name MigrationExcludeNetworks -Value $hostNetworkID
   ```

Updating Hardware timeout for Spaces port
1. Open a PowerShell window as the domain administrator and run the following commands:
   ```powershell
   Set-ItemProperty -Path HKLM:\SYSTEM\CURRENTCONTROLSET\SERVICES\spaceport\Parameters -Name HwTimeout -Value 0x00002710 -Verbose
   ```

Updating the firmware, driver, and OS
1. Open a PowerShell window as the domain administrator and run the following commands to see what driver and firmware versions you have:
   ```powershell
   Get-PnpDevice | Select-Object Name, @{l='DriverVersion' ;e={(Get-PnpDeviceProperty -InstanceID $_.InstanceID -KeyName 'DEVPKEY_Device_DriverVersion').Data}} -Unique
   ```
   2. Go to support.dell.com and download the latest drivers and firmware, making sure that it’s at least the minimum supported in the matrix.
   3. Open a PowerShell window as the domain administrator and run the following command on the first node:
   ```powershell
   Suspend-Node -Drain
   ```
   4. Run the following command to check and make sure the node is paused:
   ```powershell
   Get-ClusterNode
   ```
   5. Update the node and restart.
   6. Repeat steps 3 through 5 on the remaining three nodes.
Testing procedure

After the initial cluster setup, we started by creating eight CSVS_ReFS Mirror-Accelerated Parity (MAP) volumes on our Windows Server 2016 Storage Spaces Direct cluster. We then created eight VMs for our testing, and put one VM on each S2D MAP volume.

For our VMs, we created six with CentOS 7 and used Vdbench to generate datasets that the system could compress and deduplicate. For each of the six VMs we used a different block size, compression ratio, and deduplication ratio to generate these data sets. We also created two VMs with Windows Server 2016 to represent general purpose file servers. We copied ~744 GB of ISO files onto the first file server, and ~284 GB of Microsoft Office files, PDF files, executables, and other common files to the second file server.

Windows Server 2016 does not have the deduplication feature available for Storage Spaces Direct, so that formed our baseline storage usage. After we upgraded the Storage Spaces Direct cluster to Windows Server 2019, we recreated the same eight CSVS_ReFS volumes and migrated each VM over to the newly created volumes. We then enabled deduplication on each volume and let the background deduplication process run.

Creating the MAP volumes

1. Open a PowerShell window on any of the nodes and run the following command:

```
New-Volume -FriendlyName "Volume" -FileSystem CSVFS_ReFS -StorageTierFriendlyNames Performance,
Capacity -StorageTierSizes 1TB, 4TB
```

2. Repeat step 1 for each VM. We used eight MAP volumes in our testing, one for each VM.

Creating the Vdbench and fileserver VMs

1. Run the following command in PowerShell to create a new VM:

```
New-VM -Name <vmname> -Path <Path-to-folder> -NoVHD -Generation 2 -MemoryStartupBytes 32GB
-SwitchName S2DSwitch
```

2. Open the Hyper-V Manager GUI.
3. On the newly created VM, right-click, and select Settings...
4. We configured our VM with the following settings:
   a. 8 vCPUs
   b. 32GB RAM
   c. New Hard Disk: 50GB Fixed VHDX (OS)
   d. New Hard Disk: 1TB Fixed VHDX (Data)
   e. DVD Drive
5. In the DVD Drive tab, click Image file, and navigate to the location of the CentOS 7 ISO for Vdbench VMs, or Windows Server 2016 ISO for fileserver VMs.
6. Change the boot order to boot from the newly added ISO.
7. Click Apply.
8. Click OK.

Installing CentOS 7 on the Vdbench VMs

1. Boot the VM from the CentOS 7 ISO.
2. Select English, and click Next.
3. Select automatic partitioning for the disk.
4. Choose Minimal Install.
5. Disable kdump.
6. Enable the first active network port and configure it. For example, assign static IP address of 192.168.100.1/16 with gateway of 192.168.0.1, and DNS server of 192.168.0.10.1
7. Set the hostname.
8. Set the time zone to Eastern/US; enable NTP to sync from your time server if applicable.
9. Click Install.
10. Set the root password.
11. Reboot when the install has finished.

Installing Windows Server 2016 on the fileserver VMs

1. Power on the VM.
2. At the prompt, press any key to boot from the CD/DVD location.
3. Click Next.
4. Click Install Now.
6. Check I accept the license terms, and click Next.
7. Select the OS VHD, and click Next.
8. After installation, enter a password for Administrator, and click Finish.
9. Run Windows Updates, and reboot when prompted.

Producing the Vdbench dataset
1. Log on to the CentOS VM as root.
2. Set SELINUX to disabled in the following config file:
   ```
   vi /etc/selinux/config
   ```
3. Disable the firewall:
   ```
   systemctl disable firewalld
   systemctl stop firewalld
   ```
4. Install Java:
   ```
   yum install java
   ```
5. Download and copy vdbench 5.04.07 zip to the home folder.
6. Unzip vdbench.
7. Update the OS:
   ```
   yum update -y
   ```
8. Reboot.
9. Log on as root.
11. Run the Vdbench job to create the dataset:
    ```
    ./vdbench -f <config_filename>.cfg -o <config_filename>_out
    ```
Upgrading from Windows Server 2016 to Windows Server 2019

1. Check that the servers are running version 14393.2828 or newer of Windows Server 2016.

2. If you’re using a software-defined networking switch with SET, run the following command in an elevated PowerShell session:
   ```powershell
   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.

d. Specify a name for the destination server, and click Next.
e. Select Move only the virtual machine, and click Next.

f. Review the move details, and click Finish.
4. Pause the cluster service by running the following PowerShell command:
   ```powershell
   Suspend-ClusterNode -Drain
   ```

5. Place the server in storage maintenance mode by running the following PowerShell command:
   ```powershell
   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`

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:

```powershell
Get-StorageFaultDomain -type StorageScaleUnit | Where FriendlyName -Eq <ServerName> | Disable-StorageMaintenanceMode
```
19. To resume the cluster service, run the following PowerShell command:

   ```powershell
   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:

   ```powershell
   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:
   ```powershell
   Update-ClusterFunctionalLevel
   ```

24. To update the storage pool, run the following PowerShell command:
   ```powershell
   Get-StoragePool -FriendlyName S2D* | Update-StoragePool
   ```

25. To set the live migration check back, run the following PowerShell command:
   ```powershell
   Get-ClusterResourceType -Cluster (clusterName) -Name "Virtual Machine" | Set-ClusterParameter SkipMigrationDestinationCheck -Value 0
   ```

Live migrating a VM to the newly created volume

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

3. Click Next.
4. Select Move the virtual machine’s storage, and click Next.

5. Select Move all of the virtual machine’s data to a single location, and click Next.
6. Browse to the location of the newly created volume, and click Next.

7. Review the move summary, and click Finish.
Vdbench configuration files

vdbench01_build.cfg
messagescan=no
compratio=4
dedupratio=4
dedupunit=4k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h

vdbench02_build.cfg
messagescan=no
compratio=2
dedupratio=2
dedupunit=4k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h

vdbench03_build.cfg
messagescan=no
compratio=4
dedupratio=4
dedupunit=64k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h

vdbench04_build.cfg
messagescan=no
compratio=2
dedupratio=2
dedupunit=64k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h

vdbench05_build.cfg
messagescan=no
compratio=2
dedupratio=2
dedupunit=8k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h

vdbench06_build.cfg
messagescan=no
compratio=4
dedupratio=4
dedupunit=16k

sd=sd1,lun=/dev/sdb,openflags=o_direct,thread=1
wd=Prefill,sd=(sd1),xfersize=256k,rdpct=0,seekpct=EOF
rd=Prefill,wd=Prefill,iorate=max,elapsed=100h
This project was commissioned by Dell Technologies.

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

DISCLAIMER OF WARRANTIES; LIMITATION OF LIABILITY:
Principled Technologies, Inc. has made reasonable efforts to ensure the accuracy and validity of its testing, however, Principled Technologies, Inc. specifically disclaims any warranty, expressed or implied, relating to the test results and analysis, their accuracy, completeness or quality, including any implied warranty of fitness for any particular purpose. All persons or entities relying on the results of any testing do so at their own risk, and agree that Principled Technologies, Inc., its employees and its subcontractors shall have no liability whatsoever from any claim of loss or damage on account of any alleged error or defect in any testing procedure or result.

In no event shall Principled Technologies, Inc. be liable for indirect, special, incidental, or consequential damages in connection with its testing, even if advised of the possibility of such damages. In no event shall Principled Technologies, Inc.’s liability, including for direct damages, exceed the amounts paid in connection with Principled Technologies, Inc.’s testing. Customer’s sole and exclusive remedies are as set forth herein.

Read the report at http://facts.pt/syujn3d